Towards eliminating malaria in high endemic countries: the roles of community health workers and related cadres and their challenges in integrated community case management for malaria: a systematic review

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Abstract

**Background:** Human resource for health crisis has impaired global efforts against malaria in highly endemic countries. To address this, the World Health Organization (WHO) recommended scaling-up of community health workers (CHWs) and related cadres owing to their documented success in malaria and other disease prevention and management. Evidence is inconsistent on the roles and challenges they encounter in malaria interventions. This systematic review aims to summarize evidence on roles and challenges of CHWs and related cadres in integrated community case management for malaria (iCCM).

**Methods:** This systematic review retrieved evidence from PubMed, CINAHL, ISI Web of Knowledge, and WHO regional databases. Terms extracted from the Boolean phrase used for PubMed were also used in other databases. The review included studies with Randomized Control Trial, Quasi-experimental, Pre-post interventional, Longitudinal and cohort, Cross-sectional, Case study, and Secondary data analysis. Because of heterogeneity, only narrative synthesis was conducted for this review.

**Results:** A total of 66 articles were eligible for analysis out of 1380 studies retrieved. CHWs and related cadre roles in malaria interventions included: malaria case management, prevention including health surveillance and health promotion specific to malaria. Despite their documented success, CHWs and related cadres succumb to health system challenges. These are poor and unsustainable finance for iCCM, workforce related challenges, lack of and unsustainable supply of medicines and diagnostics, lack of information and research, service delivery and leadership challenges.

**Conclusions:** Community health workers and related cadres had important preventive, case management and promotive roles in malaria interventions. To enable their effective integration into the health systems, the identified challenges should be addressed. They include: introducing sustainable financing on iCCM programmes, tailoring their training to address the identified gaps, improving sustainable supply chain management of malaria drugs and diagnostics, and addressing regulatory challenges in the local contexts.

**Keywords:** Community health workers, Malaria, Community case management, Malaria endemicity

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Background
Mortality among children under 5 years old has fallen by more than 50% in the last decade [1]. However, the global burden of diseases and years of life lost are still high in low and middle-income countries owing to infectious diseases, including malaria [1]. Malaria burden remains high despite the knowledge of effective interventions [2]. Such interventions include community-based approaches for prevention and treatment of common illnesses responsible for high mortality and morbidity, such as malaria [3–5].

Community-based interventions call for individuals available in and originated from the respective communities to implement them. Community health workers (CHWs) have been effective in improving access to preventative, promotive and curative interventions in the communities they serve [6]. In malaria interventions, CHWs and related cadres have improved outcomes in disease control by tailoring interventions to local needs and regulations. The World Health Organization (WHO) has endorsed CHW-led interventions and encouraged its member states to embrace integrated community case management (iCCM) approaches and policies to address child mortality [7].

The iCCM approach using CHWs and related cadres has been effective in managing and preventing child deaths due to malaria in various contexts [6, 8]. Their use is cost-effective [9]. However, more than half a million children still die of malaria every year [1]. Drug resistance and mutation of the malaria parasite have presented significant hurdles in decreasing the persistently high mortality rates of malaria in children, particularly in highly endemic regions. Such complex factors in disease transmission and treatment present particularly difficult challenges for the iCCM approach, which relies on less-trained CHWs and related cadres who may have elementary skills and knowledge in malaria. They may not be able to manage more complex cases present to them.

Implementation of iCCM interventions has encountered various challenges. They have included shortages of drugs and supplies, poor quality of care, and lack of CHW incentives, training and supervision [8]. Such challenges continue to risk stalling positive outcomes obtained through iCCM interventions. In particular, they risk the establishment, scale-up and sustainability of iCCM interventions in reducing child mortality. In some settings, CHWs in iCCM programmes have been tasked with roles beyond what they are trained to do [7, 10]. Lack of health workers has influenced task-shifting from qualified medical personnel to CHWs for malaria case management as the only alternative. In other areas, where CHWs are the only personnel available, they have been used to deliver effective life-saving interventions [4].

Success of iCCM using CHWs and related cadres has been well documented. However, evidence of challenges and differing roles of CHWs and other lay health workers in various endemic regions has not been systematically examined. Challenges learnt from such varied implementation locations may help the process of adaptation of iCCM interventions in areas with similar characteristics. This systematic review was conducted to examine and summarize evidence on different roles of CHWs and related cadres in malaria prevention, case management and health promotion in malaria-endemic regions. This review also aimed to examine the challenges encountered by such health cadres in the implementation of iCCM.

Methods
This systematic review aimed to address two Population Intervention Comparator Outcome (PICO) questions: What is the role of CHWs and related cadres in malaria prevention, case management and health promotion in highly malaria-endemic regions? and, What are the challenges encountered while implementing iCCM for malaria using CHWs and related cadres?

In this review, the population of interest included CHWs and related cadres, such as village health volunteers and other lay health workers: home care providers and community medicine distributors. Qualified health cadres or those who had more formal and qualified training were excluded from this study. This also included mid-level providers and other official health workers employed to provide care in health facilities. Interventions of interest included iCCM, community case management of malaria (CCMn), seasonal malaria chemoprevention (SMC), and home-based management of fever. This review did not include a comparison group because of the nature of the two PICO questions.

The outcome of interest for this review was the roles and challenges faced by CHWs and related cadres. Challenges of CHWs and the related cadres were defined in line with the health system building blocks put forth by WHO [11]. They were grouped into financing, workforce, medical products, information and research, service delivery, and stewardship.

The developed protocol was registered in the PROSPERO database for systematic reviews (Registration number CRD42015027878). The current review is set to answer two of the four research objectives in the registered protocol. These are examining roles and challenges encountered by CHWs working in malaria interventions in malaria-endemic regions. Evidence search was conducted in PubMed, CINAHL, ISI Web of Knowledge, and WHO regional databases. A Boolean phrase was prepared and used for evidence search in PubMed, while search terms were used in other databases. Studies with
the following designs were included: randomized control trial; quasi-experimental; pre-post intervention; longitudinal and cohort; cross-sectional; case study; and, secondary data analysis. Evidence in form of opinion papers, reviews, editorials, and reports was excluded in this review.

A total of 1394 articles were retrieved. Of them, 617 articles were identified from PubMed and 777 articles from all other databases (Fig. 1). A total of 1380 were screened after removal of 14 articles as duplicates. Of the remaining, 1245 articles were further excluded based on their titles and abstracts. Only 139 articles were eligible for full text assessment based on inclusion and exclusion criteria. On the full text assessment, a total of 72 articles were further excluded based on differences in objectives (n = 33), study design (n = 15), participants (n = 2), interventions (n = 6), outcomes (n = 5), and lack of the defined intervention (n = 11). Finally, a total of 68 articles were eligible for analysis. Excel spreadsheet was used to report the extracted data. Only a narrative synthesis on the included studies was conducted because of the differences in study designs and measurements of outcome variables.

**Results**

**Description of the selected studies**

This review retrieved studies conducted in regions with high malaria endemicity (Table 1). These included Southeast Asia and sub-Saharan Africa regions. In the retrieved studies, CHWs were the commonest health cadre in 38 studies. Others included community health volunteers, village malaria workers, community medicine distributors, village health workers, home care providers, accredited social health activists, volunteer community-directed
| No | Citation | Country       | Study design               | Intervention                                                                 | Cadre                                  |
|----|----------|---------------|----------------------------|------------------------------------------------------------------------------|----------------------------------------|
| 1  | Rodriguez et al. [20] | Malawi        | Case study                 | iCCM                                                                         | CHWs surveillance assistants           |
| 2  | Chilundo et al. [21] | Mozambique    | Qualitative study          | iCCM                                                                         | CHWs                                   |
| 3  | Yansaneh et al. [33] | Sierra Leone  | Mixed methods, household survey, in-depth interviews, focus group discussions | Free healthcare initiative and iCCM | CHWs                                   |
| 4  | Witek-McManus et al. [34] | Malawi       | Pre-post interventional study | Training programme for school teachers                                         | CHWs                                   |
| 5  | Nanyonjo et al. [30] | Uganda        | Cross-sectional study      | iCCM                                                                         | CHWs                                   |
| 6  | Heidkamp et al. [26] | Malawi        | Cross-sectional study      | iCCM                                                                         | CHWs, called health surveillance assistants |
| 7  | Linn et al. [19]    | Senegal       | Quasi-experimental study   | ProAct model (iCCM in which CHWs proactively search for cases)                | HCPs                                   |
| 8  | Druetz et al. [35]  | Burkina Faso  | Cross-sectional study      | Community case management of malaria                                          | CHWs                                   |
| 9  | Das et al. [36]     | India         | Pre-post interventional study | a. Supportive supervision of ASHA plus community mobilization               | ASHA                                   |
|    |                       |               |                            | b. Community mobilization only                                                |                                        |
| 10 | Yansaneh et al. [12] | Sierra Leone  | Pre-post interventional study | Health for the poorest quintile, focussing on 3 diseases: diarrhoea, malaria, pneumonia. | CHWs                                   |
| 11 | Banek et al. [13]   | Uganda        | Mixed methods: cross-sectional, qualitative design | Home-base management of fever                                                 | CMDs                                   |
| 12 | Hamainza et al. [22] | Zambia       | Longitudinal study         | CHWs providing passive and active visits to households                        | CHWs                                   |
| 13 | Abbey et al. [24]   | Ghana         | Mixed method: cross-sectional, qualitative design | Community-based health intervention                                             | CHWs                                   |
| 14 | Lwin et al. [37]    | Myanmar       | Community-base intervention study | Sun primary health community-based intervention                              | CHWs                                   |
| 15 | Tine et al. [14]    | Senegal       | Randomized controlled trial | CCMm and seasonal malaria chemoprevention                                   | CHWs                                   |
| 16 | Tine et al. [29]    | Senegal       | Randomized controlled trial | Home-based management of malaria using RDT, ACT, rectal artesunate seasonal malaria chemoprevention delivered by CHWs | CHWs                                   |
| 17 | Nanyonjo et al. [18] | Uganda       | Cross-sectional study      | iCCM                                                                         | CHWs: Primary health facility workers (PFHFWs) |
| 18 | Siekmans et al. [38] | Kenya         | Cross-sectional study      | iCCM                                                                         | CHWs                                   |
| 19 | Ndiaye et al. [39]  | Senegal       | Secondary data analysis    | CCMm                                                                         | CHWs                                   |
| 20 | Blanas et al. [28]  | Senegal       | Mixed-methods design       | CCMm                                                                         | CHWs                                   |
| 21 | Ohnmar et al. [40]  | Myanmar       | Randomized controlled trial | Training unpaid village volunteers in provision of RDT, ACT and supervision  | Village volunteers                     |
| 22 | Lim et al. [41]     | Cambodia      | Cross-sectional study      | VMW vs health facility health worker intervention                             | VMW                                    |
| 23 | Kisia et al. [42]   | Kenya         | Cross-sectional study      | CCMm                                                                         | CHWs                                   |
| 24 | Counihan et al. [25] | Zambia       | Longitudinal study         | CHW intervention                                                             | CHWs                                   |
Table 1 continued

| No | Citation             | Country    | Study design                  | Intervention                                                                 | Cadre                      |
|----|----------------------|------------|-------------------------------|------------------------------------------------------------------------------|----------------------------|
| 25 | Rutta et al. [43]    | Tanzania   | Pre-post intervention study   | CORPs to provide early diagnosis and treatment of malaria                     | CORPs                      |
| 26 | Ratsimbasoa et al. [44] | Madagascar | Mixed methods design          | RDTs conducted by CHWs, compared to PCR and microscopy                         | CHWs                       |
| 27 | Brenner et al. [23]  | Uganda     | Pre-post intervention study   | Volunteer community health worker intervention                                | Community health volunteers |
| 28 | Mukanga et al. [45]  | Uganda     | Qualitative study             | Integrated malaria and pneumonia community case management                     | CHWs                       |
| 29 | Thiam et al. [46]    | Senegal    | Secondary data analysis       | Home-based management of malaria                                               | HCPs                       |
| 30 | Okeibunor et al. [15] | Nigeria    | Pre-post intervention study   | VCDDs intervention                                                             | VCDD                       |
| 31 | Lemma et al. [47]    | Ethiopia   | Pre-post intervention study   | Training of CHWs                                                               | CHWs                       |
| 32 | Patouillard et al. [16] | Ghana      | Randomized controlled trial   | Intermittent preventive treatment of malaria in children (IPTc)               | Community health volunteers |
| 33 | Chanda et al. [48]   | Zambia     | Cross-sectional study         | HMM                                                                           | CHWs                       |
| 34 | Chanda et al. [49]   | Zambia     | Prospective study             | CHWs intervention                                                             | CHWs                       |
| 35 | Ngasala et al. [50]  | Tanzania   | Prospective study             | Delivery of artemether–lumefantrine by community health workers               | CHWs                       |
| 36 | Phommanivong et al. [51] | Lao PDR   | Prospective study             | Training of village health volunteers                                         | Village health workers     |
| 37 | Yeboah-Antwi et al. [52] | Zambia    | Cluster randomized controlled trial | CHW intervention                                                            | CHWs                       |
| 38 | Mukanga et al. [53]  | Uganda     | Qualitative study             | CHW intervention                                                              | CMDs                       |
| 39 | Yasuooka et al. [17] | Cambodia   | Cross-sectional study         | VMW intervention                                                              | VMW                        |
| 40 | Hawkes et al. [54]   | Democratic Republic of Congo | Prospective cohort study     | Training of CHWs                                                              | CHWs                       |
| 41 | Eke et al. [55]      | Nigeria    | Prospective cohort study      | CHW intervention                                                              | CHWs                       |
| 42 | Awor et al. [56]     | Uganda     | Quasi-experimental study      | iCCM                                                                          | Drug shop attendants       |
| 43 | Cox et al. [57]      | Cambodia   | Mixed methods study           | Community-based surveillance systems                                          | VMW                        |
| 44 | Hamainza et al. [22] | Zambia     | Cross-sectional study         | Mobile phone SMS vs register book                                             | CHWs                       |
| 45 | Ndiaye et al. [58]   | Senegal    | Prospective cohort study      | Paediatric kit containing quinine, purified water, syringe                    | CHWs                       |
| 46 | Das et al. [59]      | India      | Longitudinal study            | Community-based presumptive chloroquine treatment                              | Volunteers                 |
| 47 | Mbonye et al. [60]   | Uganda     | Intervention study            | Community-based IPTp                                                           | Drug shop vendors, traditional birth attendants, community reproductive health worker, adolescent peer mobilizer |
| 48 | Vaneik et al. [61]   | Tanzania   | Cross-sectional study         | Community-based surveillance                                                  | CORPs                      |
| 49 | Cho-Min-Naing et al. [62] | Myanmar | Cross-sectional study         | Rapid on-site immunochromatographic test                                      | Volunteer health workers   |
| 50 | Kelly et al. [63]    | Kenya      | Cross-sectional study         | Community initiatives for child survival                                       | CHWs                       |
| 51 | Ruebush et al. [64]  | Guatemala  | Intervention study            | Community-based malaria case detection system—Volunteer collaboration network (VCN) | Volunteer collaborators     |
Table 1 continued

| No  | Citation               | Country       | Study design                      | Intervention                                      | Cadre               |
|-----|------------------------|---------------|-----------------------------------|--------------------------------------------------|---------------------|
| 52. | Aung et al. [65]       | Myanmar       | Pre-post intervention study       | Training of CHWs                                 | CHWs                |
| 53. | Gidebo et al. [66]     | Ethiopia      | Mixed-methods study               | Health extension programme                       | CHWs                |
| 54. | Kalyango et al. [67]   | Uganda        | Mixed methods study               | iCCM of childhood illnesses                      | CHWs                |
| 55. | Hamer et al. [68]      | Zambia        | Cluster randomized controlled trial| Training of CHWs                                 | CHWs                |
| 56. | Mubi et al. [10]       | Tanzania      | Randomized cross-over trial       | Training of CHWs                                 | CHWs                |
| 57. | Harvey et al. [69]     | Zambia        | Quasi-experimental study          | Training of CHWs                                 | CHWs                |
| 58. | Delacollette et al. [70]| Zaire         | Prospective cohort study          | Training of CHWs                                 | CHWs                |
| 59. | Eriksen et al. [71]    | Tanzania      | Randomized controlled trial       | Training of community women leaders              | Women leaders       |
| 60. | Kouyaté et al. [72]    | Burkina Faso  | Randomized controlled trial       | Training of women group leaders by health workers | Lay community women leaders |
| 61. | Onwujekwe et al. [73]  | Nigeria       | Prospective study                 | Training of CHWs                                 | CHWs                |
| 62. | Mayxay et al. [74]     | Laos PDR      | Longitudinal study                | Training of VHVs                                  | VHVs                |
| 63. | Hii et al. [75]        | Malaysia      | Cross-sectional study             | Community participation health programme (Suka-relawan Penjagaan Kesihatan Primer (SPKPI)) | VHVs                |
| 64. | Spencer et al. [76]    | Kenya         | Cross-sectional study             | Community-based malaria control programme         | Volunteer community health workers |
| 65. | Ajayi et al. [77]      | Nigeria       | Pre-post intervention study       | Training of mother trainers                      | CHWs                |
| 66. | Kweku et al. [78]      | Ghana         | Randomized controlled trial       | IPTc                                              | Community volunteers vs health workers in health facilities |

iCCM integrated community case management, CHWs community health workers, ASHA accredited social health activist, HCPs home care providers, CMDs community medicine distributors, VMWs village malaria workers, CORPs community-owned resource persons, CCDD volunteer community-directed distributor, VHVs village health volunteers, CHVs community health volunteers.
distributors, health surveillance assistants, village volunteers, community-owned resource persons, drug shop attendants, drug shop vendors, traditional birth attendants, community reproductive health workers, adolescent peer mobilizers, volunteer health workers, volunteer collaborators, women leaders, and mothers. In sub-Saharan Africa, the commonest cadre was CHW, while in Asia it was village malaria worker.

Role of CHWs and related cadres in malaria interventions

Table 2 shows the different roles of CHWs and related cadres on malaria interventions. This review classified their roles into three main categories: malaria case management, prevention including health surveillance and health promotion specific to malaria. Such roles were reported in a total of 40 articles.

In malaria case management, CHWs and related cadres were involved in the diagnosis of malaria using rapid diagnostic tests (RDT). They were also involved in management of fever and the treatment of malaria using artemisinin combination therapy (ACT). In some studies, CHWs and related cadres were involved in prescription of anti-malarial drugs, delivery of anti-malarial drugs for home-based care and treatment or referral of complicated cases to the health facilities. In some cases they were the vital person in the community to accompany community members to seek care [12], or to provide home-based visitations for follow-up [13, 14] (Table 2).

Community health workers and related cadres were also involved in malaria preventive roles as shown in a few selected studies. Such roles included provision of intermittent preventive treatment for pregnant women (IPTp) [15] and for children (IPTc) [16]. CHWs and related cadres were also involved in distribution of insecticide-treated bed nets as one of the malaria prevention strategies [15].

The reviewed evidence also suggested that CHWs and the related cadres took part in a number of health promotion activities for malaria in various contexts [14, 15, 17–19]. Examples of such roles included counselling for malaria prevention, early treatment and improving health-seeking behaviour. They provided health education about malaria and related complications, prevention and treatment.

Challenges of CHWs and related cadres in malaria interventions

Table 3 enumerates challenges and barriers CHWs and related cadres faced while implementing iCCM interventions. CHWs and related cadres faced health care financing challenges while implementing their roles in malaria interventions. This primarily included lack of sustainable sources of funds [20, 21]. As a result, CHWs and related cadres often suffered from poor or no remuneration [12, 22] and lack of incentives. Because the majority work on a voluntary basis, there has been no accountability when they are absent from the workplace [23].

Community health workers and related cadres have been facing similar health workforce challenges to other cadres working in malaria-related interventions. There has been a widespread lack of in-service training and other forms of continuous professional development [20]. Other related challenges include high turnover due to high attrition rates, especially for those working in hard-to-reach or remote areas [24], lack of incentives [23] and lack of motivation to continue with their work [12, 21].

Stewardship challenges also affected the role of CHWs and related cadres in malaria interventions. For example, in Malawi, abbreviated CHW training did not meet medical regulation standards for prescription resulting in CHWs not being allowed to prescribe anti-malarials [20]. Lack of supervision from qualified health workers and poor coordination from the existing health infrastructure affected implementation of CHWs’ role in iCCM [20, 21, 25, 26].

Lack of necessary medical supplies and medicine affected CHWs role in iCCM. Most studies mentioned stock-outs of ACT and other anti-malarials [21, 26, 27], test kits for malaria [13, 14, 25, 28] and gloves, among others [29].

Service delivery by CHWs working in malaria was impaired by a number of factors. First, CHWs and related cadres were not trusted to have adequate knowledge to care and treat malaria cases in some communities [21, 22, 27]. As a result, people who had symptoms of malaria still had to travel long distances to seek similar care in health facilities [27]. Second, distances from where they were stationed to households in need affected their service delivery [13], and the referral of their patients [30]. Third, lack of transport and poor roads caused delays in service delivery in some studies [13, 28].

Some of the iCCM and roles of CHWs and related cadres have not been evaluated [21]. This poses a challenge in scaling up this intervention to wider areas. Information and research are needed for understanding the challenges, lessons and areas for improvement when scaling up.

Discussion

The current study is the first systematic review that summarizes evidence on the roles and challenges of CHWs and related cadres working on malaria interventions. In this review, CHWs and related cadres were already tasked with different roles in malaria interventions. They included prevention, malaria case management and health promotion related to malaria.
| SN | Citation | Cadre | Roles |
|----|----------|-------|-------|
| 1. | Rodriguez et al. [20] | Health surveillance assistants | Treatment with ACT  
Disease surveillance  
Health promotion |
| 2. | Chilundo et al. [21] | CHWs:  
*Agentes Polivalentes Elementares* (APEs) | Prescription of anti-malarial  
Management of malaria cases |
| 3. | Yansaneh et al. [33] | Community health volunteers | Malaria treatment  
Health promotion  
Referral of critical patients or those with danger signs  
Accompanies malaria-sick patients to health facilities |
| 4. | Witek-McManus et al. [34] | CHWs | Diagnosis using RDT  
Treatment using ACT |
| 5. | Nanyonjo et al. [30] | CHWs | Diagnosis  
Patients’ referral |
| 6. | Linn et al. [19] | HCPs | Home visitation and health promotion |
| 7. | Druetz et al. [35] | CHWs | Patients consultations  
Prescription and treatment |
| 8. | Das et al. [36] | ASHA | Patients consultations  
Prescription and treatment |
| 9. | Yansaneh et al. [12] | Community health volunteers | Malaria treatment  
Disease prevention |
| 10. | Banek et al. [13] | (CMDs) | Home-based treatment of malaria |
| 11. | Hamainza et al. [22] | CHWs | Malaria treatment  
Diagnosis using RDT |
| 12. | Abbey et al. [24] | CHWs | Health promotion |
| 13. | Tine et al. [14] | CHWs | Malaria treatment  
Health promotion |
| 14. | Tine et al. [29] | CHWs | Home-based treatment and diagnosis |
| 15. | Nanyonjo et al. [18] | Primary health facility workers (PFHWs) | Facility treatment  
Health promotion and prevention |
| 16. | Siekmans et al. [38] | CHWs | Home-based treatment and diagnosis |
| 17. | Ndiaye et al. [39] | CHWs | Consultations  
Treatment using ACT  
Patients’ referrals  
Diagnosis using RDT |
| 18. | Blanas et al. [28] | CHWs | Treatment and prescription of ACT  
Diagnosis with RDT  
Selling anti-malarials at government prices |
| 19. | Ohnmar et al. [40] | Village volunteers | Treatment and prescription of ACT  
Diagnosis with RDT |
| 20. | Lim et al. [41] | Village malaria workers | Diagnosis |
| 21. | Kisia et al. [42] | CHWs | Treatment and prescription of ACT  
Diagnosis using RDT |
| 22. | Counihan et al. [25] | CHWs | Diagnosis using RDT |
| 23. | Rutta et al. [43] | CORPs | Diagnosis using RDT  
Treatment using ACT  
Referral of malaria cases |
| 24. | Ratsimbasoa et al. [44] | CHWs | Diagnosis using RDT |
| 25. | Brenner et al. [23] | Community health volunteers | Diagnosis using RDT  
Treatment using ACT |
| 26. | Mukanga et al. [45] | CHWs | Patients’ consultation: taking history  
Diagnosis with RDT  
Patient’s classification |
| 27. | Thiam et al. [46] | HCPs | Patients’ consultation: taking history  
Diagnosis with RDT  
Treatment |
| 28. | Okeibunor et al. [15] | CDDs | Distribution of ITNs  
Provision of IPTp drugs  
Counselling services on prevention among pregnant women |
Table 2 continued

| SN | Citation | Cadre | Roles |
|----|----------|-------|-------|
| 29. | Lemma et al. [47] | CHWs | Diagnosis using RDT  
Treatment of malaria |
| 30. | Patouillard et al. [16] | Community health volunteers | Intermittent preventive treatment in children (IPTc) |
| 31. | Chanda et al. [48] | CHWs | Diagnosis |
| 32. | Chanda et al. [49] | CHWs | Treatment using anti-malarials |
| 33. | Ngasala et al. [50] | CHWs | Treatment using anti-malarials (ACT) |
| 34. | Phommanivong et al. [51] | Village health workers | Diagnosis using RDT  
Treatment of malaria |
| 35. | Yeboah-Antwi et al. [52] | CHWs | Diagnosis using RDT  
Treatment using ACT |
| 36. | Mukanga et al. [53] | CMDs | Diagnosis using RDT |
| 37. | Yasuoka et al. [17] | Village malaria workers | Diagnosis with RDTs  
Prescribing anti-malarials  
Active detection  
Explanations about compliance  
Follow-up of patients |
| 38. | Hawkes et al. [54] | CHWs | Diagnosis using RDT  
Treatment of febrile conditions/malaria |
| 39. | Eke et al. [55] | CHWs | Diagnosis using RDT |
| 40. | Tjipke et al. | Volunteer community health workers | Treatment using modern medicine |
| 41. | Awor et al. [56] | Drug shop attendants | Malaria testing with RDT  
Malaria treatment with ACT |
| 42. | Cox et al. [57] | Village malaria workers | Surveillance of day 3-positive Plasmodium falciparum cases |
| 43. | Hamainza et al. [22] | CHWs | Diagnosis using RDT |
| 44. | Ndiaye et al. [58] | CHWs | Use of paediatric kit containing quinine, purified water, syringe |
| 45. | Das et al. [59] | Volunteers | Cases of fever treated during the 3-year period |
| 46. | Mbonye et al. [60] | Drug shop vendors, traditional birth attendants, community reproductive health worker, adolescent peer mobilizer | Delivery of SP doses to pregnant women |
| 47. | Vanek et al. [61] | CORPs | Number of malaria vector larval habitats |
| 48. | Cho-Min-Naing et al. [62] | Volunteer health workers | Sensitivities of malaria parasites tests |
| 49. | Kelly et al. [63] | CHWs | Treatment |
| 50. | Ruebush et al. [64] | Volunteer collaborators | Number of patients treated |
| 51. | Aung et al. [65] | CHWs | Diagnosis and treatment of paediatric malaria |
| 52. | Gidebo et al. [66] | CHWs | Diagnosis and treatment |
| 53. | Kalyango et al. [67] | CHWs | Treatment |
| 54. | Hamer et al. [68] | CHWs | Use of RDT |
| 55. | Mubi et al. [10] | CHWs | Provision of ACT |
| 56. | Harvey et al. [69] | CHWs | Use of RDT |
| 57. | Delacollette et al. [70] | CHWs | Treatment |
| 58. | Phommanivong et al. [51] | Village health volunteers | Use of RDT  
Provision of ACT |
| 59. | Eriksen et al. [71] | Women leaders | Role of women leaders in recognizing symptoms and providing first-line treatment for uncomplicated malaria |
| 60. | Kouyaté et al. [72] | Lay community women leaders | Malaria case management |
| 61. | Onwujekwe et al. [73] | CHWs | Malaria treatment |
| 62. | Mayxay et al. [74] | Village health volunteers | Use of RDT |
| 63. | Hii et al. [75] | Village health volunteers | Treatment |
| 64. | Spencer et al. [76] | Volunteer community health workers | Treatment with chloroquine |
| 65. | Ajayi et al. [77] | CHWs | Health promotion  
Treatment of malaria |
| 66. | Kweku et al. [78] | Community volunteers vs health workers in health facilities | Administration of amodiaquine plus SP |

*CHWs* community health workers, *ASHA* accredited social health activist, *HCPs* home care providers, *CMDs* community medicine distributors, *VMWs* village malaria workers, *CORPs* community-owned resource persons, *CCDD* volunteer community-directed distributor, *VHVs* village health volunteers
Table 3  Challenges of CHWs, VMWs and lay personnel working on malaria

| SN | Citation          | Cadre       | Challenges                                                                                                                                 |
|----|------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | Rodriguez et al. [20] | Health surveillance assistants | Short training not in-keeping with medical regulation standards for prescription  
Lack of resources to lengthen training  
Poor supervision and overburden with patients  
Most are found in remote and hard-to-reach areas where frequent supervision is not routine  
Job description keeps changing with more introduction of community interventions  
Financial instability and poor sustainability because of donor dependence and other unreliable sources |
| 2. | Chilundo et al. [21] | CHWs        | Policy conflicts on prescription. Authority does not allow personnel with short-term training to prescribe  
Stock out of supplies especially anti-malarials  
Poor supervision especially in the hard to reach areas  
Funding instability. The programme is donor funded and subjected to delays in funding disbursement  
Lack of community involvement and ownership  
No evidence yet on impact and no evaluation strategy  
APEs are not paid |
| 3. | Yansaneh et al. [33] | CHVs        | CHVs are not remunerated and have to do other income generating activities  
Not available when needed as they are not paid for their service |
| 4. | Nanyonjo et al. [30] | CHWs        | Patients may not complete referrals |
| 5. | Heidkamp et al. [26] | CHWs        | Stock-out of essential supplies  
Poor supervision from higher cadres |
| 6. | Druetz et al. [35] | CHWs        | Community preference on qualified health workers  
CHWs not known to people  
Medicine stock-out  
Long distance to CHWs |
| 7. | Banek et al. [13] | CMDs        | Patients overload  
Lack of supervision  
Limited malaria knowledge  
Tensions with community members  
Lack of remuneration from the government |
| 8. | Hamainza et al. [22] | CHWs        | Lack of remuneration  
Negative attitudes to care given by CHWs  
Weak social responsibilities |
| 9. | Abbey et al. [24] | CHWs        | High attrition rate of CHWs especially in hard-to-reach areas |
| 10. | Tine et al. [14] | CHWs        | Medicine and RDT stock-out |
| 11. | Ndiaye et al. [39] | CHWs        | Medicine and supply RDT stock-out (ACT, RDT, gloves, case files, patients forms) |
| 12. | Blanas et al. [28] | CHWs        | ACT and other medical supply stock-outs  
Expired medicines or unavailable in villages  
Scepticism from villages  
Transport problems, poor infrastructure and long distances for referrals |
| 13. | Counihan et al. [25] | CHWs        | RDT and other medical supply stock-outs after initial supplies finished  
Lack of supervision  
Sustainability |
| 14. | Brenner et al. [23] | CHVs        | Low turn-over of CHVs  
Low motivation  
Inconsistent supplies of medicine and supplies |
| 15. | Gidebo et al. [66] | CHWs        | Shortage of chloroquine,  
Patient pressure to take coartem |
| 16. | Delacollette et al. [70] | CHWs | CHWs' position remains ambiguous in the healthcare system.  
Non-comprehensive care may have negative effect on the sustainability of programme |
| 17. | Ajayi et al. [77] | CHWs        | *Challenges in their promotion/training activities*  
The community members were not in support of the project.  
Some community members felt trainers were wasting their time  
Trainers could not conduct training all the time because of their domestic needs |

CHWs community health workers, ASHA accredited social health activist, HCPs home care providers, CMDs community medicine distributors, VMWs village malaria workers, CORPs community-owned resource persons, CCDD volunteer community-directed distributor, VHVs village health volunteers
Community health workers and related cadres constitute the majority of potential health workforce for malaria and many other health-related interventions. Within the realm of malaria, understanding the breadth of their potential roles is an essential first step in order to best utilize the abundant pool of CHWs and related cadres. Their importance is augmented in the setting of human resource health crises, an overwhelming problem in most malaria-burdened countries due to their low-income country status [31]. The potential of utilizing CHWs and related cadres brings new hope in addressing both malaria and human resources for health challenges in such countries. This alternative resource can fill the gap if carefully tailored to suit the context [6] in order that efforts to control malaria and reduce morbidity and mortality can be achieved [7, 27].

Evidence presented shows a number of health system challenges [11] that CHWs and related cadres face. Such challenges have also been experienced in different settings with implementation of malaria interventions using other qualified cadres. The financial challenge is lack of stable funding to implement iCCM. In most settings of high malaria endemicity, malaria projects have been operating in donor-driven programmes that run vertically and were not integrated into the existing health system to ensure efficacy, timely delivery and to cut down bureaucracy. They have been expensive to run and lack sustainability beyond a project’s duration [32]. To ensure sustainability, CHWs and related cadres should be integrated into the health system infrastructure.

Short-term and focused training for CHWs and related cadres is a strength of iCCM. However, its cost effectiveness is a challenge in the implementation of malaria intervention, in particular, medical prescription and treatment [21]. It conflicts with other policies and regulations that require prescribers to have a minimum of training which is longer than that given to CHWs for iCCM [20, 32]. Short-term training reduces the community’s confidence in CHWs and related health cadres, which affects their utilization [22]. Tailor-made curricula for CHWs and related cadres should address conflicting policies and involve key stakeholders to ameliorate lack of confidence by the community.

Health workforce challenges are common among CHWs and related cadres. They include low or no remuneration, lack of recognition from some of the public health system, lack of incentives, and poor transport to remote areas. These are not uncommon causes of attrition, even among qualified medical and other health cadres. Addressing such challenges will help to deploy and retain CHWs and related cadres in hard-to-reach areas and solve the health workforce crisis in malaria-endemic areas.

Ensuring constant supply of anti-malarial and diagnostic tools, such as RDT and other supplies, is vital to implementation of iCCM. This review found that stockouts were a common challenge. In some studies, the first consignment given after training of CHWs was never replaced when it ran out. To ensure reliable supply, health systems should incorporate CHWs and related cadres in malaria interventions as part of its strategy.

The evidence presented should be interpreted carefully owing to the following two limitations. First, meta-analysis could not be conducted on the retrieved evidence owing to differences in study designs and differences in outcome measures. However, the narrative synthesis was more suitable to this study to take advantage of different experiences and challenges encountered. Second, all lay health workers were included and combined together. Such health workers’ levels of knowledge, training duration, and context differed from one region to another. However, evidence generated has consistently shown similar roles and challenges of these cadres in malaria interventions.

Conclusions
Community health workers and related cadres have been taking roles similar to those of more qualified health workers. They are important actors in malaria control and elimination but suffer from the health system challenges including financing, logistics, human resource management, and stewardship. To meet targets in sustainable development in health and to save countless lives and morbidity, CHWs and related cadres must be well resourced and sustained.

Authors’ contributions
BFs conceived the research questions, prepared and registered the review protocol, conducted the literature search, analysed the data, and prepared the first draft of the manuscript. LBM conducted the literature search, analysed the data, and prepared the first draft of the manuscript. RA conducted the literature search, and analysed the data. MJ conceived the research questions, supervised the research team on protocol development and registration, analyses and manuscript preparation. All authors read and approved the final manuscript.

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Competing interests
The authors declare that they have no competing interests.

Availability of data and materials
All the articles used for the analyses are listed in Tables 1 and 2.

Ethics approval and consent to participate
Efforts was made to ensure that all included article adhered to the ethical standards and obtained ethical approval beforehand.
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