ECONOMIC EVALUATION OF COMMUNITY BASED PRACTITIONERS IN LOW- AND MIDDLE-INCOME COUNTRIES

A literature review, country case studies and a generalized cost-effectiveness model

global health workforce alliance

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WHO Library Cataloguing-in-Publication Data

Economic evaluation of community based practitioners in low- and middle-income countries: a literature review, country case studies and a generalized cost-effectiveness model.

1.Community Medicine – organization and administration. 2.Community Medicine – economics. 3.Community Health Services – organization and administration. 4.Cost-Benefit Analysis. 5.Community Health Workers – economics. 6.Review. 7.Case Reports. 8.Developing Countries. I.World Health Organization.

ISBN 978 92 4 150933 6 (NLM classification: WA 546)

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MAJOR CONTRIBUTORS AND ACKNOWLEDGEMENTS

This study was carried out by the following institutes under the coordination of Giorgio Cometto, Global Health Workforce Alliance at the World Health Organization.

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The study was nested within REACHOUT, a research consortium funded by the European Commission's Seventh Framework Programme ([FP7/2007-2013] [FP7/2007-2011]) under grant agreement number 306090.

The support of the following individuals to the field work for this project is appreciated.

Ethiopia: Daniel Datiko and Tadesse Mamo from TB REACH; Shemels Wangoro, Mr Getnet and Mr Habtamu from the SNNPR Regional Health Bureau; HEP core process persons from Sidama Zonal Health Office; Mr Jonas from Shebedino District Health Office; Alemayehu Wajebo Chechiro from SNNPR TVET Bureau.

Kenya: Staff of the LVCT Nairobi, especially Dorothy Njeru, Marilyn Mireku and Lilian Otiso; Dr Mutari, Head, Division of Public Health, Ministry of Health; staff at Kasarani health centre.

Indonesia: Rukhsana Ahmed and Sudirman Nasir from Eijkman Institute; staff of the District Health Office, Southwest Sumba district, particularly Magdalena Koni, Head of Maternal and Neonatal Health Section; staff of the Palla subdistrict office, Southwest Sumba district; Balqis Nazaruddin who coordinated the local data collection in Takala district; staff of the District Health Office, Takala district, particularly Misma Silvana, SKM, Head of Maternal and Child Health Section; staff of the Patallassang subdistrict office, Takala district.

The following members of the research committee provided strategic guidance in conceptualization of the study and feedback on drafts of the report.

Neil Squires, United Kingdom Department for International Development

Taghreed Adam, Alliance for Health Policy and Systems Research, WHO

Franco Pagnoni, WHO

Chutima Suraratdecha, United States Agency for International Development.

This study was funded by the United Kingdom Department for International Development.

Muhammad Afzal (Global Health Workforce Alliance at the World Health Organization) led efforts to mobilize financial resources for this study.

ABBREVIATIONS

General

ANC	antenatal care
BCG	bacille Calmette-Guérin (vaccine)
CBD	community-based distributors
CBP	community-based practitioner
CEAC	cost-effectiveness acceptability curve
CEP	cost-effectiveness plane
CHW	community health worker
CTC	close to the community
DALY	disability-adjusted life year
DHO	district health office
DOT	directly observed therapy
EAC	equivalent annual cost
EPI	Expanded Programme on Immunization
GDP	gross domestic product
I$	international dollar
iCCM	Integrated Community Case Management
ICER	incremental cost-effectiveness ratio
LHW	lay health worker
LiST	Lives Saved Tool
LYG	life years gained
M&E	monitoring and evaluation
m-health	mobile health technologies
MCH	maternal and child health
MDG	Millennium Development Goal
MMR	maternal mortality ratio
MNC	maternal, newborn and child
MNCH	maternal, newborn and child health
NGO	nongovernmental organization
PNC	postnatal care
PPH	post-partum haemorrhage
SSA	sub-Saharan Africa
TB	tuberculosis
TBA	traditional birth attendant
TOT	trainer of trainees
UNICEF	United Nations Children's Fund
VMW	village midwife
WHO	World Health Organization

Ethiopia-specific abbreviations and terms

HDA	Health Development Army
HEP	Health Extension Programme
HEW	health extension worker
kebele	health subcentre
SNNPR	Southern Nations, Nationalities and People's Region
TTBA	trained traditional birth attendant
TVET	technical and vocational education and training

Indonesia-specific abbreviations and terms

bidan desa	village midwives (*bidan desa pedawai tidak tetap:* contracted midwives; *bidan desa pegawai negri sibil:* permanent government employees as formal civil servants)
IDHS	Indonesia Demographic Health Survey
polindes	village birthing hut
posyandu	integrated health post
pustu/ poskesdes	sub health post/clinic
VMP	Village Midwife Programme

Kenya-specific abbreviations

CHC	Community Health Committee
CHEW	community health extension worker
CHS	community health strategy
DHMT	District Health Management Committee
HHE	home health education

GLOSSARY

Costs: Resources, either expended or foregone, associated with implementing a health programme or treatment.

Cost-effectiveness: *One form of economic evaluation where both the costs and consequences of health programmes or treatments are examined* (Torrance & Drummond, 2005). In this document, consequences are considered as effectiveness and use as patient outcomes (change in health status and/or well-being) wherever possible. Where not available, measurable intermediate patient outcomes (for example, number of patients visited, number of visits conducted) and measurable CHW provider outcomes (for example, improved CHW productivity) are used.

Incremental cost-effectiveness ratio (ICER): ratio of the change in costs to the change in benefits (lives saved) of two alternative interventions. The equation for calculating the ICER is: (C1–C2) / (E1–E2), where C1 and E1 are the costs and number of lives saved/ life years gained (LYG) in one intervention group and C2 and E2 are the costs and number of lives saved/LYG in a second group (can be a control, intervention or no intervention group).

Sensitivity analysis: an economic modelling technique used to address uncertainty associated with cost-effectiveness analyses by identifying the key drivers of a model's results. One-way sensitivity analysis allows an assessment of the impact of a certain parameter on the model's conclusions. By varying assumptions on parameter values, economic evaluation modellers can consider a wide range of scenarios. Probabilistic sensitivity analyses enable the quantification of the level of confidence in the results of a cost-effectiveness analysis.

Lives saved: Projection of child and maternal survival with increasing coverage of child and maternal health interventions; generated by the Lives Saved Tool (LiST).

Disability-adjusted life year: a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

Life years gained: Number of additional life years saved multiplied by the remaining life expectancy at the time death was averted.

EXECUTIVE SUMMARY

Background

Community-based strategies play a significant role in many health systems in low- and middle-income countries, especially in light of critical shortages in the health workforce. The term community health worker has been used to refer to volunteers and salaried, professional or lay health workers with a wide range of training, experience, scope of practice and integration in health systems. In the context of this study, we use the term community-based practitioner (CBPs) to reflect the diverse nature of these cadres of health workers.

CBPs provide preventive, promotive, curative and palliative services across a range of areas, including reproductive, maternal, newborn and child health, HIV, tuberculosis, malaria, control of other endemic diseases, and noncommunicable diseases. Significant evidence has emerged over the past two decades on their effectiveness, which has triggered interest in the potential to use their services to expand access to care, in particular in rural and underserved areas where deployment and retention of more qualified health workers is problematic. Calls have been made to integrate CBP programmes in human resources and health strategies, and to scale up rapidly the extent and coverage of CBP initiatives.

There is, however, a dearth of evidence on whether investment in CBPs, from a system perspective, represents good value for money. This study was therefore commissioned in order to address the relative lack of information on their cost-effectiveness to meet health systems goals.

Objectives

The aim of this study was to develop a generalized cost-effectiveness model to conduct an economic evaluation of CBP programmes across three countries in which such initiatives had been implemented to scale, each of which differed in sociodemographic, epidemiological and health systems characteristics. The objectives were:

- to synthesize available evidence on costs and health benefits of CBPs across a range of disease areas, programme types and settings;
- to identify and categorize relevant 'design' features of CBP programmes that have been implemented to scale;
- to assess the cost-effectiveness of a set of CBP programmes sharing similar goals in health outcomes across the three countries;
- to assess whether current use of CBP-led interventions represents optimal use of resources in a variety of settings.

Methods

This was carried out in four steps, namely:

1. Review of the literature on cost and effectiveness of CBPs;
2. Mapping of CBP programme design features and context of implementation across six countries with national CBP programmes;
3. Selection of three of these countries for in-depth analysis of costs, results and cost-effectiveness;
4. Development of a generalized model to assess cost-effectiveness of CBP programmes in the three selected countries.

Results of the literature review

Available literature on cost effectiveness of CBPs was found to be surprisingly limited, given the large number of CBP programmes operating at scale globally: a structured search of the peer-reviewed literature yielded 25 studies and 4 reviews that met inclusion criteria. Existing evidence suggests that CBPs can be a cost-effective intervention, particularly for tuberculosis

(TB), but also – although the evidence is less strong – for malaria, maternal, newborn and child health and other programme areas.

Discussion of results of the literature review

A number of limitations should be considered in contextualizing the findings of the literature review.

The reviewed studies used very different methodologies; they compared CBPs to different cadres of health workers, and sometimes there was no comparator. Furthermore, the studies included and excluded different costs (e.g. training, supervision, recruitment and retention costs), and valued differently – or excluded – volunteer time.

Effectiveness of CBPs was also measured differently among the studies: the majority of articles reviewed focused on CBP involvement in TB or malaria. However, literature is lacking on evidence on the costs or cost-effectiveness of CBPs who take on responsibilities across a wider range of disease areas or conditions, as is the case in many settings.

Nearly half the studies in our review took a government perspective. However, by their very nature, CBPs are not necessarily an instrument of the government and in many health systems CBPs operate largely outside the formal health sector. Thus, the associated costs of CBPs to governments may be minimal, falling rather on the community.

Clear documentation of data sources and assumptions did not often feature in the studies included in this review. Many studies also failed to recognize the limitations of their data or question their quality.

Finally, the findings may be influenced by the fact that some areas have been evaluated less than others, rather than indicating an actual difference in cost-effectiveness in the various service delivery areas.

Selection of country case studies

Three countries – Ethiopia, Indonesia and Kenya – were selected for in-depth application of the tools and included in the model. The main inclusion criteria were that programmes should be national in scale, perform similar activities to allow for meaningful comparison, and have data available on effectiveness. While these criteria were also met in other countries, Ethiopia, Indonesia and Kenya were chosen on the basis of operational considerations that made an analysis more feasible – in relation to applicable time and resource constraints – for the research consortium.

Programmes were categorized according to the following features: the type of CBP involved; whether they were salaried; the focus of their work; their responsibilities; any supervisory roles; recruitment criteria; initial and follow-up training; how they were supervised; whether additional allowances were received; the catchment area covered; and the supplies they were given.

The cost-effectiveness model

The study estimated the incremental cost-effectiveness ratio (ICER) of three CBP programmes – health extension workers in Ethiopia, village midwives in Indonesia, and community health extension workers in Kenya. A costing tool was adapted from available models, as none of these adequately reflected the way that the CBP programmes were operating in the three settings examined.

Total cost inputs for each programme were obtained from a total of four districts in three countries: Shebedino district (Ethiopia), Southwest Sumba district (Indonesia), Takala district (Indonesia) and Kasarani district (Kenya). Cost data for the year 2012 (or from earlier years where applicable) were collected in each country's local currency between August and September 2013.

Total programme cost was estimated from a government perspective using 2012 prices expressed in international dollars (I$) and was based on the assumption that CBPs in each study country were a new cadre of health workers. Thus, programme costs in each country were considered an incremental cost against a status quo of no CBP programme. Where national programmes were undergoing change (such as

in Kenya and Ethiopia) the current status was costed. Start-up costs and recurrent costs were included, which covered both direct and indirect costs (for example, the cost of supervision). Cost data were collected from different administrative levels within the regions, from a variety of sources including expenses files, health workers payroll, budget files as well as through key informant interviews for programme operational processes. Cost estimates were based on actual findings on the ground rather than the theoretical cost corresponding to the full implementation of the relevant CBP policy or plan.

For Ethiopia and Kenya, intervention and control cohort coverage was obtained from empirical studies on the results of each country CBP programme: the Lives Saved Tool (LiST), an epidemiologic modelling tool, was used to calculate the impact – in terms of lives saved – of changes in coverage of a broad range of reproductive, maternal, newborn and child health (RMNCH) interventions.

Restricting the assessment of outcomes in the country case studies to RMNCH is an inherent limitation of this study, and ideally a broader assessment of the impact of CBP programmes would be desirable. The approach adopted was nevertheless deemed to be the most appropriate, considering that the scope of practice and coverage data available for CBP programmes in the three selected countries related predominantly to RMNCH. In addition, LiST is a well-established and widely recognized modelling tool.

Estimates of lives saved derived from LiST were converted into life years gained (LYG), which provides a more meaningful comparison across different population groups (for instance a child's life saved corresponds to a larger number of LYG than that of an adult, on the assumption of equal or very similar life expectancy). The option of assessing outcomes in terms of disability-adjusted life years or quality-adjusted life years was discarded since this would have required introducing additional untested assumptions in the model. Only interventions for which robust empirical evidence on CBP programme effect was available were entered into LiST modelling. For all three countries, ICERs were expressed as incremental cost per life saved and per LYG. One-way (univariate), scenario and probabilistic sensitivity analyses were performed to evaluate the degree of uncertainty in the estimation of the ICER.

Findings on costs

Cost inputs differed across the study countries, reflecting differences in the design and operational features of the CBP models in each country. For example, pre-service training costs were considerably higher for health extension workers (HEWs) in Ethiopia compared to initial training costs in Kenya, capturing differences in the length of pre-service training (one year in Ethiopia versus 10 days in Kenya). Annual salary costs for village midwives (VMWs) in Indonesia were considerably higher than that of HEWs in Ethiopia, reflecting differences in educational attainment between the two cadres of health workers, and local economic factors. In the Ethiopia programme, annual salary costs constitute the highest proportion at 38% of total cost, with supervision costs and the cost of constructing health posts accounting for 21% and 18% respectively. In Southwest Sumba (Indonesia), infrastructure costs relating to construction of health posts used by VMWs account for the highest proportion of total cost (51%), while financial incentives and allowances for VMWs account for the highest proportion of total costs in Takala district in Indonesia. In Kenya, the cost of stationery and registers represents the highest proportion at over 50% of total costs.

Findings on cost-effectiveness

Using country gross domestic product (GDP) per capita as the reference willingness-to-pay threshold value, all three programmes were found to be cost-effective; differences in incremental cost-effectiveness ratios found related in part to the way in which effects were measured and in part to the underlying difference in cost structure. Using the country GDP per capita (and multiples thereof) as this reference threshold is to a certain extent arbitrary, and other ways do exist to estimate willingness to pay. However, this approach has been widely adopted since it was proposed by the World Health Organization (WHO) Commission on Macroeconomics and Health in 2001, and is recommended by WHO as part of its flagship initiative

on assessment of cost-effectiveness (WHO-CHOICE). Incremental cost per LYG was estimated at I$ 82, I$ 999, I$ 2470 and I$ 3396 respectively in Kasarani (Kenya), Shebedino (Ethiopia), Takala (Indonesia) and Southwest Sumba (Indonesia) districts. Overall, the CBP programme in Takala district had the highest total costs and benefits while Southwest Sumba had the highest ICER. The lowest ICER was observed in Kasarani district.

The CBP programme in Shebedino district has a 100% probability of being considered cost-effective at three times GDP per capita, but virtually none at GDP per capita). In both Southwest Sumba and Takala districts, the CBP programme has a very high probability of being considered cost-effective (approximately 80% and 100%, respectively). Similar results are observed in Kasarani district where the CBP programme has a 100% probability of being cost-effective at threshold values well below the country's GDP per capita. However, if the annual salary of CBPs and additional costs (bicycles, motorbikes and air time allowances) are included in the analysis for Kasarani district, the CBP programme has a less than 10% chance of being cost-effective at a willingness-to-pay threshold equivalent to the country's GDP per capita. The probability of the programme being cost-effective rises steeply to 100% at a willingness-to-pay threshold of less than twice the country's GDP per capita.

Discussion of results of the cost-effectiveness model

A broader assessment of impacts – beyond RMNCH – might have captured the positive contribution of CBP programmes in other health services areas, potentially increasing their cost-effectiveness as measured and analysed through the model. It should also be highlighted that CBPs do not work or generate results alone, but are part of a team, working with community-based volunteers and supervised by district staff. Ideally, therefore, a community health care package should be assessed as a whole in terms of cost-effectiveness. However, this was beyond the scope of the present analysis on CBPs. The underlying community and health system support mechanisms and infrastructure are likely to influence the performance and results of CBP programmes. In reflecting on the generalizability of these findings, it is important to consider whether CBP programmes in other countries are similarly structured.

A further caveat relates to the fact that, by choosing programmes for which some effectiveness evidence was available, well-functioning programmes are likely to have been selected. However, the findings are consistent with the evidence base that exists.

A further challenge was that the existing evidence base does not provide empirical estimates assessing the influence of different design features (e.g. contents and duration of training, amount and type of supervision, level of remuneration). For the purpose of estimating the cost-effectiveness of different models, it was therefore necessary to rely on hypothetical changes in effectiveness, which limits the usefulness and value of the results of the scenario sensitivity analysis. Moreover, a scenario-sensitive analysis, which treats such system support features as binary variables (present or absent), simplifies effects that in reality are more nuanced in their influence; for example, policy decisions usually revolve around the amount, type and quality of supervision, rather than whether to supervise or not.

The generalized cost-effectiveness model based on the data of the country case studies in the three countries showed that the ICER was most sensitive to uncertainty in estimates of LYG and additional lives saved. Given that LYG and additional lives saved were the two parameters with the least estimated degree of certainty (i.e. indirectly through LiST from coverage data or obtained from suboptimal studies in the case of Kenya), there may be value in further research on the effectiveness of the impact of CBP programmes. This would in turn improve the reliability and level of confidence in cost-effectiveness estimates. It is important, however, to note that the social, political, and policy contexts within which the selected CBP programmes operate are evolving. Hence, an attempt to define the features of an 'ideal case scenario' is complex as the configuration of specific design features that work in one context may not work in another.

This analysis can therefore not answer a number of important and policy-relevant questions concerning

the design, use and scale-up of CBP initiatives: more research is needed – ideally using mixed methods - to assess fully the programmes within their community and health system context and to understand how CBP programmes are influenced by, and may affect the wider health system. Furthermore, the available data in the programmes examined through the three country case studies did not allow an assessment of the specific design features that make CBP programmes more or less cost-effective, of whether different health areas lend themselves to a cost-effective use of CBPs, and which broader societal costs and benefits they incur, beyond the perspective of the financier of the health system. More rigour in cost-effectiveness assessment and reporting is also called for.

Conclusions

The literature review, despite a number of limitations concerning the scope, quality and comparability of the studies identified, suggests that using CBPs is cost-effective in some settings. This is particularly the case for TB and, with less strong evidence but reasonable justification of cost-effectiveness in malaria and reproductive, maternal, newborn and child health.

The economic model developed based on the country case studies found that – under the assumptions made and notwithstanding important limitations inherent to availability of data and model design features – all three CBP programmes were cost-effective: incremental cost per life year gained was estimated to vary between US$ 82 and US$ 3 396. Using country GDP per capita as the WHO reference for the willingness-to-pay threshold value, the CBP programmes were found, through probabilistic sensitivity analysis, to have a high likelihood (80–100%) of being cost-effective or very cost-effective. The results were most sensitive to uncertainty in the estimation of life-years gained.

The main cost drivers of CBP programmes varied by setting, but the costs associated with salaries and incentives were typically a main element, followed by associated infrastructure and supervision costs. In developing or scaling up CBP programmes, more attention needs to be given to understanding costs (from both a government and societal perspective) and cost-effectiveness. The cost-effectiveness model developed can help policy-makers and planners to identify programme costs from a government perspective and provide a potential tool to adapt and apply costing methods to CBP programmes in other contexts.

Overall, the findings of the analysis represent an additional contribution to the wider (but limited) literature that suggests that CBP strategies tend to be lower cost (or cost saving) and improve coverage of essential services. In contexts where CBPs operate within an integrated team supported by the health system – as is the case in the three country case studies documented in this analysis – the CBP-led approach has a high likelihood, under the assumptions made, to be cost-effective in the delivery of some essential health interventions.

The integration of CBPs in health teams and health systems is critical to the generalizability of findings of this analysis: it should not be assumed that CBP initiatives disjointed from health system support and or with radically different design features than those described in this study are (equally) cost-effective. CBP programmes and initiatives should be adapted to local and health system contexts and needs. Scenario planning and using the modelling tool developed in the context of this study could help to maximize the impact and cost-effectiveness of CBP programmes.

1

INTRODUCTION

In recent years, there has been renewed attention to the potential use of community-based strategies to expand access to essential health-care services, especially in light of critical shortages in the health workforce (Singh & Sachs 2013). The term community health worker (CHW) has been used to refer to volunteers and salaried, professional or lay health workers with a wide range of training, experience, scope of practice and integration in health systems. In the context of this study, we use the term community-based practitioner (CBP) to reflect the diverse nature of these cadres of health workers.

Since the Declaration of Alma-Ata in 1978, CBPs have been a significant feature of primary health care systems and efforts to achieve universal health coverage. Reviews of national CBP programmes in the 1980s and 1990s suggested that the quality of care in large-scale programmes was often poor; however, the shortcomings of these programmes were attributed to the lack of ongoing training and supportive supervision rather than inherent flaws in the concept of the CBP (Christopher et al., 2011).

The design and implementation of CBP programmes vary enormously across continents, regions and countries: generalizations on the profile of CBPs globally are difficult. The roles and activities of CBPs diverge within and across countries and programmes: some CBPs perform a wide range of tasks that can be promotional, preventive, or curative and others are responsible for a more specific set of interventions. Despite the variety in profiles, a common premise is that CBPs – because they are 'close to the community' (CTC) providers – are more responsive to the health needs of local populations than clinic-based personnel and thus tend to be less expensive and have a role in promoting local participation and empowerment in health. CBPs are also commonly regarded as a means to improve the coverage of services as well as equity by reaching populations traditionally deemed 'hard to reach' (Lehman & Sanders, 2007). Recent evidence has confirmed the effectiveness of CBPs in delivering a range of preventive, promotive and curative services in low- and middle-income countries (Van Ginneken et al., 2013; Gilmore & McAuliffe, 2013; Perry & Zulliger, 2012; Glenton et al., 2011; Lewin et al., 2010).

It is often assumed that CBPs represent good value for money. For governments and funding agencies, the question of whether an intervention is more or less cost-effective compared with alternative interventions should be essential for decision-making. However, evidence in this area is lacking, and too often assumptions on effectiveness are based on findings from small-scale pilot studies rather than from national programmes. The need to cost sustainable training, supervision and quality assurance systems is often overlooked in such studies, which hampers decisions related to scale-up. At the same time, it must be recognized that local realities of programme implementation may vary considerably from policy documents. In low-resource settings, discussion on the expansion of the functions of CBPs is affected by a range of factors including funding, partnership arrangements and governance of CBP programmes, which in turn influence acceptability, motivation and performance of CBP in different ways. A successful cost-effectiveness model is one that bridges these differences, and recognizes that the assumptions might diverge from real-life costs of implementing programmes on the ground and from important contextual specificities of effectiveness.

Aim and objectives

The aim of this study was to develop a generalized cost-effectiveness model to assess the cost-effectiveness of CBP programmes across three countries where CBP initiatives were implemented to scale, but with different sociodemographic, epidemiological and health systems characteristics. The objectives of the study were:

1. to synthesize available evidence on costs and health benefits of CBPs across a range of disease areas, programme types and settings;
2. to identify and categorize relevant design features of CBP programmes that have been implemented to scale;
3. to assess the cost-effectiveness of a set of CBP programmes sharing similar goals and health outcomes across three countries;
4. to assess whether the current use of CBP-led interventions represents optimal use of resources in a variety of settings.

Methodological approach and context of study

To achieve these objectives, the following steps were undertaken:

1. A review of the literature on cost and effectiveness of CBPs;
2. Mapping of CBP programme design features in six countries with national CBP programmes;
3. Selection of three countries for inclusion in a cost-effectiveness model;
4. Development of a generalized cost-effectiveness model to assess cost-effectiveness of CBP programmes in the three selected countries.

2

LITERATURE REVIEW

The specific objectives of the literature review were:

a. to identify elements of costs and effectiveness that have been included/ excluded from CBP costing and cost-effectiveness studies to date;
b. to provide an overview of what is known about the costs and cost-effectiveness of CBPs globally;
c. to identify methodological and empirical gaps in the literature.

Methods

We used the search results from a larger, systematic review on factors influencing performance of close-to-community providers, which included searching the EMBASE, PUBMED, COCHRANE, CINAHL, POPLINE, and NHS-EED databases for the period January 2003 to April 2013 (Kok et al, 2014), as well as a manual search of reference lists. . This period was chosen primarily to limit the large amount of literature available on this topic; it was assumed that the systematic reviews included would cover findings prior to 2003. The search strategy of the Cochrane review of lay health worker (LHW) effectiveness (Lewin et al., 2010) was partly used; and a list of terms mentioned in the literature to describe LHW interventions was broadened to include CBPs and auxiliary staff. Reference lists of all papers and relevant reviews identified were manually searched. This broader review included quantitative, qualitative and mixed methods studies, all in English, about CBPs working in promotional, preventive or curative primary health care in LMICs. From that search we extracted costing studies, studies that assessed the costs and effects of a single CBP intervention and economic evaluations assessing the costs and benefits of at least two CBP interventions. An additional search was conducted in PubMed with a more specific search strategy on cost-effectiveness (see Annex 1).

Review approach

Three reviewers jointly developed two separate data extraction matrices. The first reviewed the study or model's overall methodological approach as well as specifics regarding how costs, effects and cost-effectiveness of the CBP programme were assessed. The overall methodological approach included study design, perspective, time horizon, discounting, year of costing and currency, intervention and comparator(s), setting, scenarios, sensitivity analysis and software. In terms of costs, the data extraction form captured programme (training, recurrent, capital and overhead/ indirect) and patient costs included, costs averted, how costs are reported and data sources. Both patient and provider outcomes were reviewed: thesewere defined as final patient outcomes (change in health status and/or well-being), measurable intermediate patient outcomes (for example, number of patients visited, number of visits conducted) and measurable CBP provider outcomes (for example, improved CBP productivity). Final outcomes, patient age or disability weighting, and data sources were assessed. The cost-effectiveness measure was also indicated. Systematic reviews were summarized in terms of main CBP-related findings. The review did not include an assessment of data or study quality.

The three reviewers jointly analyzed and discussed one article and discussed as a team questions that arose during data extraction. All papers were then read and abstracted by a single reviewer. Each reviewer completed the data extraction matrix separately and review results were compiled into a single matrix for analysis. Analysis was done by summarizing and discussing the data within the team, following the categories as presented above.

Search results

The search results yielded 42 potentially relevant papers, of which 17 were retrieved through a manual search. An additional article was retrieved from the secondary PubMed search, for a total of 43 articles on the costs and/or cost-effectiveness of CBPs. Of these, six were excluded based on a reading of abstracts by one reviewer. Full text copies of the remaining 37 articles that were identified as potentially relevant by the initial reviewer were retrieved. One additional review by Perry & Zulliger (2012) was known to be relevant by the study team, and the summary of their findings on cost-effectiveness of CBPs was used. After full text reading a further 10 articles were excluded because insufficient information was given about the type of CBP discussed, making it impossible to confirm relevance to the scope of this review, or because it

was determined that CBPs were not included. The 29 remaining papers included 25 individual studies and four reviews/discussion papers. The 25 papers on individual studies were fully reviewed using the data extraction form and the four reviews/ discussion papers (including Perry & Zulliger) were summarized (Annex 2). For a flow chart of the search strategy, see Annex 3.

Types of studies and general characteristics

The studies identified were heterogeneous in scope, methodology and choice of outcome measures.

This review included 13 articles that were economic evaluations comparing the costs and benefits of two alternative interventions or services, often comparing CBPs with facility-based practice. Three articles looked at the costs and benefits of a single intervention or programme, while eight were retained for the cost data they provided about a CBP programme. The studies assessed were from a provider perspective (n=10) as well as from wider societal perspectives (n=12) – the two approaches differ in the way they consider and include costs and benefits, i.e. the former focuses on the health-care system vis-à-vis the latter, which also focuses on its users and society at large. Two studies did not specify the perspective taken.

In terms of time horizons, only four studies included a time horizon greater than one year; the others either did not specify a time horizon or used one year. The modelling software was often not mentioned: two studies reported using Excel, two reported using STATA and one used Crystal Ball software for the sensitivity analysis. For an overview of the excluded papers, see Annex 4.

Thirteen studies in total performed a sensitivity analysis, the majority (n=10) using a one-way or univariate analysis. Variables used in the sensitivity analysis included unit costs and quantities of provider and patient cost items, assumptions about training (varying the intensity, excluding one type of training and varying the cost of the training), varying discount and exchange rates, administrative support, useful life of capital items and effectiveness data including life years saved and deaths averted.

Characteristics of CBPs in the studies

In terms of types of CBPs included, the assessed articles included a range of CBP types (and nomenclatures), including health extension workers (n=1), volunteers from the community or village health volunteers (n=6), CHWs (both paid and unpaid, n=7), traditional birth attendants (TBAs, n=1), guardians (n=1), monitors (n=2), community-based agents (n=1), peer supporters (n=1), women group facilitators (n=1) and other LHWs or health counsellors (n=3). Nine studies focused on CBPs in rural African settings. Four articles included CBPs working in urban settings. The other 11 articles either included multiple settings or did not specify whether the setting was urban or rural. Overall, 14 articles presented results from sub-Saharan Africa (SSA), 6 from Asia and 3 from Latin America. One article included various countries in SSA and one article did not specify the setting. The countries included in the review were Bangladesh (n=1), Brazil (n=1), Ethiopia (n=1), Ghana (n=3), Honduras (n=2), India (n=3), Malawi (n=2), Nepal (n=1), Nigeria (n=1), Pakistan (n=1), South Africa (n=2), Uganda (n=2) and Zambia (n=2).

Health priority areas included reproductive maternal, newborn and child health (RMNCH, n=10); tuberculosis (TB) and malaria(n=10); and other disease areas such as hypertension, diarrhoea, malnutrition, pneumonia and common mental disorders (n=4). The activities undertaken by CBPs varied by health priority area; the activities of CBPs working in RMNCH included basic curative activities, counselling and health promotion, referrals, prenatal care and support during home deliveries. CBPs involved in TB and malaria administered directly observed therapy (DOT) of TB medicines. CBPs working in other disease areas were involved in health education and promotion, screening, diagnosis and management of some conditions and referrals.

A number of different community settings were included in the reviewed articles: home (n=6), villages or general community (n=5), health facility or health centre (n=2) and workplace (n=1). One study reviewed the experience of CBPs and mobile health (m-health) technology. Several articles included CBPs operating in various settings (n=4), while six studies did not specify the exact setting.

Costs

In terms of programme costs, all but five of the studies included the value of the CBPs' time (either compensated or for volunteers, opportunity cost or supply price) and recurrent expenses such as materials and supplies, although the individual unit quantities and costs were rarely reported. Eleven studies included the value of capital items such as vehicles and equipment although the specifics were not mentioned. Overhead costs were included in 11 studies, for example for TB based on the proportion of total health facility visits or inpatient days attributable to TB. Two studies used a flat rate of 10% or 15%. Patient time costs were included in 9 of the 24 studies, including time for visits and hospitalization as well as transport, medicines, food and other expenses.

The studies relied on a wide range of data sources for the costing data, namely budget and expenditure files from health facilities, hospitals, districts, government price lists, patient questionnaires, literature, time sheets, payroll records, Ministry of Health and Finance and project accounts.

Since many of the studies did not estimate costs over a future time period, a discount rate was unnecessary. Three studies discounted costs at 3% and a fourth study discounted at 5%. The costing year ranged from 1996 to 2011 and all but one of the studies reported costs in US dollars (the other reported in international dollars). Studies reported costs in a number of different ways, including weighted mean costs, average programme costs, average costs, cost per activity, cost per patient managed or treated, cost per child, cost per inhabitant covered and total annual costs.

Outcomes

Final outcomes in terms of changes in health status or well-being included sputum smear results, cure rate, treatment completion rate and treatment success rate for TB-related studies. One malaria-specific article used reduced incidence of malaria and anaemia as the final outcome; the other three malaria-specific articles did not include a final outcome. The MNCH-related articles used neonatal mortality, disability-adjusted life years (DALYs) averted, weeks of exclusive breastfeeding, incidence of acute post-partum haemorrhaging (PPH), severe PPH cases and anaemia cases averted as outcome measures. The other studies measured final outcomes in terms of change in systolic blood pressure and presence/absence of depression or anxiety as measured by an internationally used score.

Four studies included measurable intermediate patient outcomes such as the number of patients who registered or received treatment, increased patient enrolment, number of patients counselled, number of visits made, proportion of patients with controlled blood pressure, proportion of cases appropriately diagnosed and treated, number of children scheduled to receive intermittent preventive treatment of malaria who received treatment (coverage) and the number of doses taken by the covered children (adherence).

Measurable CBP provider outcomes included professional health worker time gained and number of visits made by the CBP.

Two studies mentioned discounting future benefits, one at 3% and the other at 5% in the base case or standard analysis. Data sources for outcomes included randomized trials, monitoring and evaluation (M&E) systems, organizational and government offices, demographic surveillance systems and patient treatment registers. One study used assumptions about yearly incidence and disease progression.

Cost-effectiveness

Where this was assessed, the studies presented the cost-effectiveness of CBPs in terms of a wide range of different outcome measures: cost per visit, cost per patient or presumptive case successfully treated, cost per patient cured, cost per patient completing treatment, cost per DALY averted, cost per malaria case averted and cost per malaria case correctly diagnosed and treated, cost per caser recovered, and cost per life year saved. Results are summarized by the health priority areas of MNCH (n=10); TB and malaria (n=10); and other disease areas including diarrhoea, malnutrition, pneumonia and common mental disorders (n=4).

Limitations

A number of limitations should be considered in contextualizing the findings of the literature review, including the wide heterogeneity in methodologies and perspectives adopted, and in the choice of outcome measures. Additionally, documentation of data sources and their quality was often lacking. These and other limitations are described in greater depth in relevant sections of the report. With these caveats in mind, the results of the review by service area are summarized below.

Results of the review

Reproductive, maternal, newborn and child health

There is overall evidence to suggest that the use of CBPs in the field of RMNCH is cost-effective.

Maternal health

- Two articles by Sutherland et al. (2009 and 2010) looked at the prevention of PPH and anaemia in home births with misoprostol treatment or prevention delivered by village health workers. They conclude that this is more cost-effective than standard care (although standard care is not defined), and that treatment is more cost-effective than prevention (looking at cost per life saved only).

Newborn health

- Looking at neonatal deaths, Borghi et al. (2005) found that women's groups, facilitated by LHW, that developed strategies to improve maternal and neonatal health could provide a cost-effective way of reducing neonatal deaths with a cost per life year saved of US$ 211.
- The strategy of using *trained* TBAs to perform the neonatal resuscitation protocol and provide antibiotics with facilitated referral to a health centre to reduce neonatal mortality was found to be highly cost-effective in Zambia (Sabin et al., 2012). The cost per death avoided ranged from US$ 591 in the optimistic scenario to US$ 3 024 in the conservative scenario. Likewise, cost per DALY averted ranged from US$ 24 to US$ 120.
- For breastfeeding in Uganda, Chola et al. (2011) found that the use of local women trained as peer supporters to counsel women individually about exclusive breastfeeding could be implemented in sub-Saharan Africa at a "sustainable cost". The cost per mother counselled was US$ 139 and the cost per visit was US$ 26. The cost per week of exclusive breastfeeding was estimated to be US$ 15 at 12 weeks post-partum.

Child health

- With a cost per DALY averted of US$ 90.25–114.21, home management of under-5 fevers by trained, unpaid community volunteers through diagnosis and dispensing of antimalarials and/or antibiotics was found to be a cost-effective strategy for reducing under-5 mortality in rural Ghana (Nonvignon et al., 2012).
- Fiedler et al. (2003; 2008) reported on an intervention with CBPs in Honduras performing monthly visits to provide under-5 child growth monitoring, counselling, curative care and free-of-charge medicines. The most recent study revealed that the CBP programme cost 11% of the facility-based alternative while saving 203 000 outpatient visits a year and resulting in a potential cost saving of US$ 1.66 million.
- Two reviews focus on the use of lay and community health workers in vaccination programmes. In the United States of America and Ecuador, Corluka et al. (2009) found that LHWs were more cost-effective than the comparator, which did not include LHWs. However, there were insufficient data to allow conclusions to be drawn regarding the cost-effectiveness of LHW interventions to promote vaccination uptake. Pegurri et al. (2005) looked at five studies on strategies to bring services closer to the people with outreach teams, two studies on CBPs and three on peer training; all studies on immunization services in low- and middle-income countries were published on or before December 2001. This review included the same study from Ecuador in which the cost-effectiveness of outreach teams of CBPs and health staff respectively was compared in the Amazon areas. Outreach teams of CBPs dominated the evaluation, i.e. their cost was lower and their effectiveness higher. Outreach

teams were found to cost US$ 4–6 per dose and US$ 4–38 per fully vaccinated child. Peer training cost US$ 0.9 per fully vaccinated child. The strategies with the highest percentage increases in full coverage were CBPs and channelling (door-to-door visits by health workers and non-health workers to promote immunization).

TB and malaria

There is strong evidence that the use of CBPs during the non-hospitalized phase of TB treatment is a cost-effective alternative to facility-based treatment. Results come from various countries including Brazil (Prado et al., 2011), Ethiopia (Datiko & Lindtjørn, 2010), Malawi (Floyd et al., 2003), South Africa (Sinanovic et al., 2003; Clarke et al., 2006) and Uganda (Okello et al., 2003). CBPs were found to reduce the cost per patient successfully treated and cured anywhere from 40% (Sinanovic et al., 2003) to 74% (Clarke et al., 2006), compared with facility-based provision. Okello et al. (2003) point out the importance of proper training and supervision in achieving the documented success.

Evidence about the cost-effectiveness of CBPs for malaria control is less strong. This review included four studies that compared the costs and cost-effectiveness of CBP-delivered malaria programmes with regular care. Studies from Ghana by Patouillard et al. (2011) and Conteh et al. (2010) found that the delivery of intermittent preventive treatment of malaria for children by village health workers was less costly than delivery by nurses working at outpatient departments or EPI outreach. Chanda et al. (2011) found that home management of uncomplicated malaria by CBPs was 36% more cost-effective than the standard of care at health-facility level in rural areas in Zambia. Additionally, based on results from two villages, Onwujekwe et al. (2007) concluded that starting up a CBP programme for malaria control nationwide in Nigeria is potentially cost-effective. Looking at the use of pre-referral artesunate for the treatment of childhood malaria by CBPs in an unspecified country, Tozan et al. (2010) found a cost per DALY averted ranging from US$ 77 at full uptake and compliance to US$ 1173 at low intervention uptake and referral compliance. The authors conclude that it is a cost-effective, life-saving intervention with potential application in rural African settings where CBP programmes are already in place.

Other health priority areas

Findings related to the cost-effectiveness of CBPs for other disease areas are limited:

- Jafar et al. (2011) found the use of home health education (HHE) delivered by CBPs in Pakistan to be less cost-effective than a combined intervention of HHE plus training of general practitioners to control high blood pressure.
- Using LHWs/health counsellors in India for interpersonal therapy and case management of patients with mental disorders, Buttorff et al. (2012) found the LHW intervention resulted in cost savings from both a provider and patient perspective and achieved the same outcomes. This made it more cost-effective than standard care at public primary care facilities.
- Looking at an m-health intervention delivered by CBPs in Malawi on behalf of a rural hospital, Mahmud et al. (2010) found that its pilot use over a period of six months saved the hospital approximately 2048 hours of professional health worker time and US$ 2750.
- McCord et al. (2013) concluded that comprehensive CBP subsystems can be deployed across sub-Saharan Africa at a cost that is modest compared with projected costs of a primary health care system. The study did not look at outcomes.
- Walker & Jan (2005) did a non-systematic review of the evidence regarding the cost-effectiveness of CBPs in low- and middle-income countries in primary health care, vaccination services and TB control programmes. The limited number of studies available suggested that CBPs increase the coverage and equity of service delivery at low cost compared with alternative modes of service organization.

A study by Alam et al. (2012) on maternal health in Bangladesh presents a word of caution. As with other health-care cadres, retention of CBPs can be a challenge, and the high costs associated with CBP dropout make the programme less sustainable.

In a recent report on effectiveness of CBPs, Perry & Zulliger (2012) state that research on the cost-effectiveness of interventions provided by CBPs remains limited, and the cost-effectiveness of longer-term programmes providing a variety of interventions and other services is even more limited. Nonetheless, they conclude that CBPs can deliver highly cost-effective interventions of various types that improve the health of geographically defined populations. Such interventions range from promotion of healthier behaviours (such as exclusive breastfeeding for newborns) to provision of preventive services (such as vitamin A supplementation) to treatment (such as community-based diagnosis and treatment of childhood pneumonia or detection and treatment of patients with TB). They conclude that when the cost-effectiveness of CBP-provided interventions is compared with that of facility-based interventions, the former are, with rare exception, more cost-effective.

3

MAPPING OF CBP PROGRAMME DESIGN FEATURES AND CONTEXT OF IMPLEMENTATION

The main inclusion criteria for the mapping of CBP programme design features and for the development of the cost-effectiveness model were that programmes should be national in scale, perform similar activities, and have data on effectiveness. An initial desk review was undertaken to assess programmes within six countries – Bangladesh, Ethiopia, Indonesia, Kenya, Malawi and Mozambique – against predefined selection criteria. While the criteria mentioned above were also met in other countries, these six were chosen on the basis of operational considerations such as time and resource constraints that made the analysis more feasible for the research consortium that conducted this study.

The aim was to select three contexts with enough similarity to allow for meaningful comparison, enough diversity in features of CBP models to have implications for costs and effectiveness of the programmes (and thus, for cost-effectiveness) and finally, enough available data to allow collection in a short time frame.

Methods for initial assessment

A comprehensive assessment of relevant design features for each of the six country CBP programmes was conducted through consultation of relevant literature, data, and key individuals. Detailed matrices were produced to highlight features relevant to issues of cost-effectiveness. All CBPs, whether salaried or volunteers, were included. Information was collected on the focal areas covered, such as the disease areas and the balance of promotive, preventive and curative service offered. Programme design features assessed included:

- recruitment and selection;
- training;
- supervisory structures;
- incentives;
- supplies provided to CBPs;
- overall catchment area;
- coverage expected.

Information about districts or cadres that could be used as comparators was also sought. An in-country assessment of available grey literature, policy documents and results of initial key informant interviews also informed selection. Availability of data, the reporting systems and the type and number of variables collected as part of routine programme data were assessed; tools were reviewed from each context including registers and monthly summary sheets. A literature search was conducted for each context for published studies on CBP programme effectiveness.

Selection of three country case studies

There was a wide variation in CBP programmes and the cultural, political and funding contexts in which these were embedded. The following criteria were used, ordered by level of importance, to prioritize the choice of country case studies:

1. Existence of published studies on effectiveness: programmes that had been evaluated using rigorous peer reviewed methods with easily accessible data.
2. Programmes with effective M&E tools: this was important as data collected using M&E tools were used to supplement (or replace) published evidence on the effectiveness of CBP programmes.
3. Availability of disaggregated outcome data by cadre: this was required to allow identification of the effectiveness attributable to each cadre of health worker, including CBP and the control cadre.
4. Similar disease areas covered by CBPs to allow comparisons across countries where CBPs perform similar types of activities.
5. Similarities and differences in structure of CBP models (including CBPs and volunteers) with specific attention to recruitment, training, incentives, remuneration and supervision.
6. Existing ethical clearance for key informant interviews: this was felt to be important as it was anticipated that some information would be lacking from published documents, reports and routine data.

Results from initial assessment

Effectiveness: All countries except Mozambique have published studies on effectiveness.

M&E tools: Ethiopia, Indonesia, Kenya and Mozambique appear to have good in-country tools. Ethiopia, Indonesia, Kenya and Malawi focus on maternal health covered by CBPs, making cost comparisons of this area feasible. Since the CBP models of Ethiopia and Kenya

are similar to those of Malawi, and since Malawi did not have good M&E tools, this country was excluded.

Availability of disaggregated outcome data by cadre: Ethiopia and Kenya had data disaggregated by cadre, while Indonesia and Malawi do not collect data separately per cadre. There was insufficient information available for Mozambique to make a decision on this point.

Programme structure, scope and features: All countries had national CBP programmes. However, Mozambique's programme is comparatively young – revitalized in 2009 – and only partially rolled out, which may explain the paucity of published studies on the effectiveness of CBPs in the country. In addition, the disease areas covered by CBPs in Mozambique are not clearly defined, making it difficult for a comparison with the other countries.

In Kenya, volunteers are referred to as CHWs and supervisors are salaried and referred to as community health extension workers (CHEWs, described in later sections and relevant annexes). In Indonesia, although volunteers are used, the CBP model focuses entirely on the provision of maternal and child health (MCH) by salaried village midwives. The programme is well established and MCH outcomes are comparable with Ethiopia and Kenya. In addition, there is diversity in the Indonesia cost-effectiveness study because existing cadres of health workers are used (unlike the other countries where a new cadre of health workers is recruited and trained to carry out community-based programmes).

Ethical approval to conduct interviews: In Bangladesh, ethical approval had not been sought to interview and collect data from the national programme and so this country was not suitable for selection.

The next section describes the CBP programmes in the three country contexts (Ethiopia, Indonesia, Kenya) included in the cost-effectiveness model.

4

DESCRIPTION OF CBP PROGRAMMES IN ETHIOPIA, INDONESIA, AND KENYA[1]

1 Country-specific abbreviations are defined separately at the beginning of this report to avoid confusion.

The interpretation of the model relies on an in-depth understanding of the similarities and differences between the programmes (Table 1). In order to understand the additional costs of the programme, an overview of community health services at baseline (before the programmes were commenced) was required. Brief historical profiles of the programme in each context are provided in Annexes 5, 6 and 7. Finally, in order to understand better the influence of programme design features on potential outcomes, outputs and impacts (and therefore effectiveness), the national strategies and typology of CBPs are described; in this respect, specific attention is given to features such as responsibilities, recruitment, training, remuneration and allowances, supervision and overall coordination. Since two of the CBP programmes included are in a period of change (expansion in Ethiopia and expansion and restructuring in Kenya), the structures immediately relevant at the time cost data were collected are described.

Table 1: Key differences and similarities in CBP programme design features in the selected countries

Feature	Ethiopia	Indonesia	Kenya
Start, year	2004	1989	2006
Focus area	Maternal and child health (including antenatal, safe and clean delivery at the health post, immunization, growth monitoring and nutritional advice), family planning, immunization, adolescent reproductive health and nutrition	Maternal health: antenatal care, point of care tests e.g. malaria (in endemic regions) and HIV (only in Papua region), treatment such as for malaria, outreach care and providing safe delivery within a health facility and at home, postnatal checks, immunization	Maternal and child health prevention and promotion activities that link community members to the health system (registration, education, referral, follow-up)
Name of community-based practitioner	Health extension worker	Village midwives	Community health workers
Corresponding category in ILO's ISCO	3253 (community health workers)	3222 (midwifery associate professional)	3253 (community health workers)
Type of volunteers	Voluntary community health promoters	Community health volunteers and traditional birth attendants	None
Population catchment area	2 workers for 5000 people	1 worker per village of 500–1500 people	50 workers for 5000 people
Primary base of service delivery	A local health post but spend 70% of their time on house-to-house visits	Sub-health posts and village clinics	Community (home visits)
Initial training	1 year (government funded)	Nursing academy 3 years (self-funded)	10 days training (government funded)
One-off incentive kits	Backpacks	Motorbikes	Backpacks
Salary	Annual salary of approximately $ 2400	Annual salary of approximately $ 4250	Unpaid
Other financial incentives and allowances	None	Transport allowances; incentive per antenatal care, delivery assisted and postnatal care	None
Refresher training	On-job training in relation to local interventions	Refresher training offered (but none administered in the district in 2012)	Quarterly updates (but none administered in the district in 2012)
Supervision structure	Supervised by health centre and district health office personnel	Supervised by health centre and district health office personnel	Supervised by health centre personnel -community health extension workers at health centre level

5

DEVELOPMENT OF THE COST-EFFECTIVENESS MODEL

This section presents the cost-effectiveness model and the methodology adopted in estimating the incremental cost-effectiveness ratio of CBP programmes in the four case study districts – one each in Ethiopia and Kenya and two districts in Indonesia.

Programme costs were estimated from a government perspective, thus only costs relating to, for instance, training, salaries, medical supplies and health infrastructure were considered; costs of relevance from a societal perspective, e.g. travel expenses of patients, differences in opportunity costs of accessing CBP-provided care vis-a-vis health facility care, were not considered. The model also assumed that all costs incurred as part of the documented CBP initiatives were incremental costs of introducing a new programme, i.e. they would have not been incurred had the CBP programme not existed. In all four district case studies, total costs of starting (start-up costs such as initial training) and running (recurrent costs such as salaries, replenishment of medical consumables) the programme were estimated. The start-up cost was annuitized based on a useful programme life of 10 years and a 3% discount rate.

The number of lives saved and LYG were used as measures of effectiveness. Ideally, DALYs averted is the effectiveness measure of choice. However, it was not possible to estimate years lived with disability because 'disease-specific' disability weights were not available. The estimates of lives saved and LYG were derived indirectly using exclusively coverage of MNCH interventions for which data were available. The subsections below provide more details of the study methodology, model assumptions and effectiveness measures, as well as a description of total cost inputs. This is followed by an in-depth description of the costing methodology for each district case study, including the sources of the effectiveness measure. The results are presented and discussed in the final part of this section.

Methodological approach

While CBPs can be costed using a range of available tools (see Annex 8), some are not designed specifically for this purpose and therefore the unique features of CBPs may not be captured. For example, the Community Health Services costing tool (developed by Management Sciences for Health and then adapted for the One Million CBPs Campaign tool) includes CBPs as full-time, paid public servants, which is not the reality in many contexts. Moreover, the size and complexity of some tools makes them harder to adapt. We therefore adapted existing costing methodology to estimate programme costs. The costing tool used for this study borrows extensively from another tool developed by Management Sciences for Health – the Integrated Community Case Management (iCCM) Costing and Financing Tool – which is the most suitable to cost, from a government perspective, a wide range of elements of CBP programmes.

Costs

The total cost input for each programme was estimated for the districts of Shebedino (Ethiopia), Southwest Sumba and Takala (Indonesia), and Kasarani (Kenya). Total cost was estimated on the basis of 75 HEWs and 35 health posts in Shebedino; 76 VMWs, 1780 volunteers and 535 TBAs in Southwest Sumba; 182 VMWs, 2110 volunteers and 188 TBAs in Takala; and 50 CBPs in one community health unit in Kasarani district. Cost data for the year 2012 (or from earlier years where applicable) were collected in each country's local currency from August to September 2013. The total programme cost was estimated from a government perspective using 2012 prices expressed in international dollars. To allow for comparability across all three countries, costs estimated in the local currency of each country were converted to US dollars using purchasing power parity exchange rates (available at http://data.worldbank.org/indicator/PA.NUS.PPP).

In this study, the estimation of ICER was based on the assumption that CBPs in each study district were a new cadre of health workers. Programme costs in each district were considered an incremental cost compared to a status quo of no CBP programme. Therefore, only costs incurred by the programme were included in the cost-effectiveness analysis, whereas costs that were incurred both before and after the implementation of the programme were excluded. For example, in Shebedino district (Ethiopia) prior to the Health Extension Programme (HEP), community-based volunteers were trained to deliver periodic outreach programmes. Since these volunteers became

community health promoters (currently the HDA, Health Development Army) under the HEP, costs incurred in training them (and HDA workers) under the HEP were excluded. In Southwest Sumba and Takala districts (Indonesia), on the other hand, different types of health workers delivering MNCH services were included, including village midwives, volunteers and TBAs. In Kasarani district (Kenya), the focus was on CHWs and the support structure for CHWs in this setting.

Following previous studies (Johns et al., 2003; McCord et al., 2013; Jarrah et al., 2013), a costing protocol was developed to collect cost data on inputs classified under two broad categories: start-up costs and recurrent costs. Start-up costs include costs incurred prior to initiating service delivery and expected to be incurred only once over the useful life of the programme. Equivalent annual cost (EAC) was estimated by annuitizing the total start-up cost and to allow for comparison across all four study districts: a standardization of these parameters was achieved by estimating a useful life of 10 years and a 3% discount rate (Johns et al., 2003). Recurrent costs are those expected to be incurred annually throughout the life of the programme: these include both direct costs (for example CBP salaries and costs of medicines) and indirect costs (for example supervision). Estimated recurrent costs, based on the latest (2012) operational processes, were combined with total equivalent annual start-up costs to obtain an estimate of the total annual cost of the programme. Incremental cost of medicines and vaccines attributed to changes in coverage of reproductive, maternal, neonatal and child interventions were included for only the Ethiopian model but excluded from the Kenyan and Indonesian models due to unavailability of data. Following McCord et al. (2013), an overhead cost of 15% was added to total costs.

Effectiveness measure

The number of additional lives saved and life years gained were used as the measure of effectiveness.

Lives saved

In the absence of studies directly estimating the impact of CBP programmes on maternal, newborn and child (MNC) mortality, the Lives Saved Tool (LiST, version 4.632) was used to estimate indirectly the number of additional lives saved. LiST is a computer-based tool that models the impact of scaling up coverage of proven interventions on MNC mortality. It uses evidence-based effectiveness data, population projections as well as in-built baseline data on health status, mortality and coverage of MNCH interventions to make projections on the extent to which an increase in the such coverage will reduce MNC mortality (Winfrey et al., 2011). In-built country-specific baseline data on health status, mortality and coverage are drawn from various sources such as demographic health surveys and multiple indicator cluster surveys. On the other hand, in-built effectiveness data (data on the impact of each MNCH intervention on mortality) were obtained from expert reviews of studies on the effectiveness of various interventions on MNC morbidity and mortality (Walker et al., 2010; Jones et al., 2003).

The 75 RMNCH interventions incorporated into LiST cover both preventive (e.g. exclusive breastfeeding, full vaccination coverage, clean delivery, antimalarial preventive treatment in pregnancy) and curative (such as oral rehydration therapy and the use of antibiotics for pneumonia) interventions. The number of lives saved can be estimated by modelling the impact of changes on coverage. In this study, differences in coverage of selected

RMNCH interventions[2] in a control cohort (individuals not exposed to the CBP programme) and a treatment cohort (those exposed to the CBP programme) were compared with the target year (2012) coverage, and used to derive an estimate of the number of lives saved. This number was undiscounted because it was assumed that all benefits were incurred within one year.

For Ethiopia and Kenya, treatment and control cohort coverage data were obtained from empirical studies evaluating the impact of each country's CBP programme on various RMNCH interventions. CBPFor CBP Indonesia, actual data on the number of cases treated by CBPs, routinely reported in the health information system, were used to estimate treatment coverage, while control coverage was assumed to be zero for similar RMNCH interventions. Since LiST uses

2 Interventions were selected only when robust evidence of effectiveness was available.

in-built national level data, estimates of the additional number of lives saved are applicable to the number of lives that would have been saved at national level if RMNCH interventions were scaled-up nationally. This estimate was scaled down to estimate the number of additional lives saved in the study subpopulation by applying the proportion of study subpopulation to the national population.

Restricting the assessment of outcomes in the country case studies to RMNCH represents an inherent limitation of this study and, in theory, a broader assessment of the impact of CBP programmes would be desirable. The approach adopted was nevertheless deemed to be the most appropriate, considering that the scope of practice and coverage data available for the CBP programmes in the three selected countries relate predominantly to MNCH, and that LiST is a well-established and widely recognized modelling tool.

Life years gained

To estimate the total number of LYG, the number of lives saved was disaggregated into four categories: additional live births, additional lives saved in children < 1 month old, in children 1–59 months and in mothers. For each category, the number of LYG was calculated based on the remaining life expectancy at the time when death was averted.[3] Each category was discounted using a 3% discount rate (Johns et al., 2003) and totalled to estimate total LYG.

Cost-effectiveness ratio

For all four districts included in the study, the ICER was expressed as incremental cost per life saved and incremental cost per LYG. One-way (univariate) scenario and probabilistic sensitivity analyses were performed to evaluate the degree of uncertainty in the estimation of the ICER. The one-way sensitivity analysis shows the extent of the impact of the uncertainty of each parameter on the ICER and whether additional research is necessary to further improve estimates of the most influential parameters. Although this analysis provides useful information, it fails to capture overall uncertainty in all model parameters. Therefore a probabilistic sensitivity analysis was conducted to assess the impact of the joint uncertainty in model parameters.

In the one-way sensitivity analysis, the impact of each parameter on the ICER was examined by sequentially varying each parameter mean over a specified range (+/- 30%), while holding the others constant. In the probabilistic sensitivity analysis, an appropriate probability distribution was fitted around each parameter mean and varied within a bound defined as 10% below and above each parameter mean, respectively. All cost inputs were specified as gamma distributions, number of lives saved and LYG were specified as normal distributions and attrition rate and percentages (used in estimating overhead costs) were specified as beta distributions (Briggs, 2000). Parameter uncertainty was propagated through the model using 5000 Monte Carlo simulations and presented on a cost-effectiveness plane (CEP) and cost-effectiveness acceptability curve (CEAC).

Data collection methodology

This subsection outlines in detail the estimation of total costs for the CBP programmes as well as the source of effectiveness measures.

Costs

Ethiopia

In Ethiopia, cost data were collected from a variety of sources at different administrative levels within the Southern Nations, Nationalities and People's Region (SNNPR). Data sources included expenses files, health workers payroll, as well as key informant interviews for programme operational processes.[4] The following cost inputs were included in the estimation of total cost for the HEP.

Start-up costs

Start-up costs included initial training, one-off kits, incentives, construction of health posts and medical equipment.

3 Remaining life expectancies were obtained from life tables (http://apps.who.int/gho/data/node.main.692?lang=en, accessed 11 August 2014).

4 Ethical clearance for key informant interviews was obtained from the SNNPR Regional Health Bureau (reference number 026-19/17014) dated 18/10/2005 (Ethiopian calendar).

Pre-service training

HEWs are recruited and trained for one year in technical and vocational education and training (TVET) schools. This involves a nine-month theoretical classroom training followed by a three-month field-based internship. The initial training cost per HEW is collected from the regional TVET bureau and includes a trainer stipend (to cover cost of accommodation and meals), training materials, trainers annual salary, trainers per diem (paid to trainers during the three-month internship period) and a proportion of the institution's running cost. This was applied to the number of HEWs to estimate total cost of initial training. An attrition rate of approximately 1% was applied to the total number of HEWs to adjust for attrition during training.[5]

One-off kits/incentives

Following initial training and deployment into the community, each HEW is provided with a backpack. A unit cost was applied to the total number of HEWs to estimate the total cost of backpacks.

Other capital costs

HEWs are deployed into health posts from where they provide health-care services to the community. Health posts are constructed as part of the HEP either by the community or by the district health authority. The unit cost of constructing health posts was applied to the total number of health posts to estimate the total cost of buildings.

Under minimum standard guidelines (Federal Ministry of Health, 2011), each health post is equipped with at least one of the following types of basic medical equipment: stethoscope, sphygmomanometer, thermometer, kidney basin, delivery set, delivery coach, stretcher, autoclave, cold box, refrigerator, vaccine carrier, examination coach, adult weighing scale, child weighing scale and measuring tapes. It was assumed that all health posts within the district had at least one of each item. The unit cost of equipment, obtained from the UNICEF supply catalogue (2012), was applied to equipment quantity to estimate total costs of equipment.

5 Attrition was estimated as the average rate in the SNNPR over a 10-year period.

Recurrent costs

Recurrent costs included were HEW annual salary and the costs of medicines and supplies, while indirect costs included costs of refresher/ongoing training of HEWs as well as costs of supervisory visits and meetings.

Health extension worker salaries

Annual salary varies depending on the length of service. Average annual salary per HEW was estimated from health worker payroll records in the district health office.

Medicines, vaccines and supply costs

While costs of medical consumables are not specific to CBPs (medical supplies have the same unit cost irrespective of the type of health worker delivering them), it is necessary to include them in the costing model to estimate the total cost of the CBP programme.

The essential drug list, including vaccines and supplies for health posts, was obtained from an integrated treatment protocol for health posts. Due to difficulties in estimating actual resource use in each health post in Shebedino district,[6] quantities were estimated by applying changes in coverage of MNCH interventions attributable to the HEP to the demographic profile of the target population in the district (children under five and pregnant women). The impact of changes in coverage of MNCH interventions attributable to the HEP were obtained from two empirical studies.[7] Thus, only the cost of medicines, vaccines and supplies for which changes in coverage were available were included.[8] It was assumed that if an increase in coverage of an MNCH intervention can be attributed to the HEP, then the quantity of medicines, vaccines and supplies required to achieve that level of coverage can be attributed to the activities of HEWs. For example, if the coverage of Bacillus Calmette–Guérin (BCG) vaccines

6 Although two health posts (out of a total of 35) in Shebedino district were visited, data on resource use were not readily available. Resources used are also likely to vary depending on the disease profile of the different villages.

7 This is further discussed in the section on 'Effectiveness measures'.

8 Similarly only MNCH outcomes for which evidence on effectiveness is available are included in estimating the number of lives by the HEP. This is discussed further in the section on 'Effectiveness measures'

in children < 5 years increases by 20% following the introduction of the HEP, this can be applied to the same population group of children < 5 years to estimate the quantity of BCG vaccines required to achieve an additional 20% coverage. The total cost of medicines and vaccines was estimated by applying unit costs obtained from the UNICEF supply chain catalogue (UNICEF, 2012).

Medicines and vaccines included in the estimation of total costs are iron and folic acid supplements, tetanus toxoid vaccine, diphtheria-pertussis-tetanus (DPT) vaccine, oral polio vaccine (OPV), measles vaccine, BCG vaccine and ITNs. It is noted that this estimation of the cost of medicines, vaccines and supplies is likely to be underestimated, given that it does not capture the whole range of medicines and supplies relating to MNCH interventions provided to health posts under the HEP.

Refresher/ongoing training costs

HEWs receive an integrated 10-day refresher training once a year at the DHO, delivered by a qualified trainer. The trainers, who are either DHO process coordinators or health officers and nurses from the district health centres, are themselves trained for 10 days at the regional headquarters. Therefore, the ongoing training cost per HEW was estimated to include the costs of training HEW trainers (time attending training as a proportion of annual salary and per diem which covers transportation, meals and accommodation) and costs of training HEWs (cost of trainers as a proportion of annual salary, trainers per diem and HEWs per diem).

Supervision costs

Each health post has an assigned medical staff member from the health centre who provides supportive supervision and can be called on by HEWs at any time. Time spent by the assigned medical staff in supervising the health post ranges from 4–8 hours per day[9] depending on the health post need. In addition, health centre heads make weekly visits to health posts to supervise HEWs. Annual costs of health centre supervisory visits were estimated to account for the time of all staff involved in the direct supervision of HEWs. This includes a proportion of the annual salaries of assigned health centre medical staff (based on 6 hours/day per supervisor) and heads of health centres (based on 3 hours/week per supervisor).

At the district level, supervisory visits to all health posts are conducted quarterly. These visits span a period of 10 days alongside routine supervisory visits to all health centres and 10 households per sub-centre. Since supervisory visits were being conducted prior to the implementation of the HEP, only the costs of supervisory visits to health posts were estimated. The proportion of the total time spent supervising health posts (based on 3 hours per post) was applied to the annual salary and per diem of all DHO staff involved in quarterly supervisory visits to estimate annual district level supervisory visit costs.

Costs of supervisory visits from the zone and region were excluded because visits from the zone (quarterly visits) and region (biannual visits) are made to a very small proportion of health posts, thus making it difficult to estimate the unit cost of higher level supervision of health posts. However, the cost of supervision at the higher administrative level is accounted for in the overhead costs (McCord et al., 2013).

Supervisory meeting costs

Supervisory review meetings are conducted quarterly in the district health office (3 days per meeting) and monthly (one day per meeting) at the health centres to review the performance of HEWs. Prior to the HEP, review meetings were conducted as part of the district operational process; therefore only the annual per diem costs incurred by HEWs in attending DHO review meetings were included.[10] Since attending review meetings is part of the job description of HEWs, time cost is accounted for in their annual salaries. Costs and per diem of other participants including district health office and health centre staff were excluded.

9 Normal working hours for all staff are 8 hours/day and 2080 hours/year. Yearly hours were estimated on the basis of 251 days a year to account for national public holidays.

10 Meetings are attended by one HEW per health post; per diem is not paid to HEWs or other participants at review meetings at health centres.

Indonesia

Southwest Sumba district

Data were collected from the DHO and the midwife coordinator from Palla subdistrict. The primary informant at the DHO was the Head of the Maternal and Child Health section; other informants were the Secretary for Planning, and heads of the DHO, the Health Promotion section, Medical and Health Services and the Hospital section. When data were unavailable in Southwest Sumba district, data from Takala district were used instead. The following cost inputs were included in the estimation of total cost of the CBP programme.

Start-up costs

Start-up costs included were those for one-off kits/incentives and capital costs, including buildings (village midwife health posts) and equipment. Pre-service training costs of VMWs were excluded because their annual salaries were expected to reflect investment in training.

One-off kits/incentives

One-off kits/incentives include motorbikes. The total cost of motorbikes was estimated by multiplying the number of functioning motorbikes in 2012 (25) by an average purchase price (unit cost).

Other capital costs

VMW services are carried out at *polindes* (village birthing huts) and *pustus*/*poskesdes* (sub-health posts/clinics). The total cost of buildings was estimated by multiplying the number of facilities in 2012 (121) by an estimate of the purchase or construction price of the buildings.

Each VMW is provided with a midwife kit, the unit cost of which was multiplied by the number of VMWs to estimate total cost of the kits. The costs of other equipment were estimated from the list of standard equipment for the subvillage health posts/clinics and village birthing huts and purchase prices (unit costs) obtained from Takala district. These were a wooden cupboard, metal bed, baby scale, instrument tray with instruments, examination lamp, baby basket and other related equipment.

Recurrent costs

Recurrent costs included were transportation allowances, annual salaries and incentives as well as costs of medicines and supplies (i.e. direct costs). Other costs included were those for refresher/in-service training and supervisory visits and meetings (i.e. indirect costs).

Salaries and incentives

Annual salary per VMW was estimated as an average of the annual salaries of both civil service and temporary midwives. Civil service midwives receive an average monthly salary of Rp 2 500 000,[11] while contracted or temporary midwives receive an average monthly salary of Rp 925 000. In addition to their salary, VMWs receive a number of incentives, such as for deliveries performed, antenatal and postnatal care (PNC) visits, and a transport allowance for home visits. The value of this allowance depends on the distance travelled.[12] To estimate annual transportation allowance costs, an allowance of Rp 95 000 per integrated health post was used, to which each VMW is assumed to visit an average of four times per month. Antenatal care (ANC) incentives are Rp 20 000 per visit (up to four), PNC incentives are Rp 20 000 per visit (up to three) and delivery incentives are on average Rp 200 000 per delivery. Average incentives per midwife were estimated by multiplying the number of ANC visits, PNC visits and deliveries by the incentive amounts and dividing by the number of midwives receiving each incentive.

For assisting VMWs in integrated health posts, volunteers receive a quarterly incentive payment of Rp 50 000. Some villages offer additional incentives to volunteers with funding from the Ministry of Interior Affairs. However, data on these incentives were not readily available and were therefore excluded. TBAs also receive an incentive of Rp 20 000 per referral or delivery performed. Data on TBA incentives were

11 All amounts in Indonesian rupees were converted to international dollars using a purchasing power parity exchange rate of 6737.70.

12 Allowance was Rp 80 000 for distances less than 10 km and Rp 110 000 if the distance was more than 10 km.

obtained from one subdistrict. Total cost of TBA incentives was estimated based on an average of 0.17 referrals per TBA per year.

Supply costs

Due to unavailability of data, medicines and vaccines were excluded. Costs of supplies were estimated as the total cost of maternal health booklet registers (one per pregnancy) and stationery.

Refresher/in-service training costs

VMWs participate in several refresher/in-service trainings. These include a 10-day training on basic emergency maternal obstetrics and neonatal care (BEMONC) and a 5- day training on normal delivery management. The total cost for both training courses was obtained as an aggregate/total training expenditure for the district in 2012. VMWs also receive a 5-day training on child asphyxia, including a follow-up visit from trainers after three months. However, the cost of this training was unavailable and was therefore excluded.

Supervision costs

Supervisory visits are conducted primarily from the district to the subdistrict level. Twice a year a team of five supervisors (heads of the DHO, Family Health Secretariat, Public Health, and Maternal and Neonatal Health) conducts supervisory visits using a checklist. Costs include a proportion of supervisors' salary (data taken from Takala district) and transport allowance. VMWs directly supervise volunteers, but the time spent on this activity is accounted for in their salary. TBAs are largely unsupervised.

Supervisory meeting costs

Supervisory or coordination meetings are held three times a year at the district level (attended only by VMW coordinators) and once a month at the subdistrict level, attended by VMW coordinators and all VMWs within the subdistrict. A member of the district supervisory team also attends these monthly meetings. The total supervisory meeting cost was estimated as the sum of the proportion of the annual salaries of VMW coordinators and the district supervisory team member (salary data from Takala district). Time spent by VMWs attending meetings is already accounted for in their salaries.

Takala district

Data were collected from the DHO and one subdistrict community health centre (Patallassang). Key informants at the DHO included the head of the Maternal and Child Health department and a representative from the administration office. The key informant at Patallassang was the midwife coordinator. In cases where data were not available in Takala district, data from Southwest Sumba district were used. Data were collected in September 2013 by a public health researcher who received a 1.5-day orientation on the data collection protocol by the lead health economist during the data collection period in Southwest Sumba. Data were obtained for the year 2012 wherever possible, and substituted by earlier years when 2102 data were unavailable.

Start-up costs

Start-up costs include all one-off costs such as recruitment, initial staff orientation, costs of one-off kits/equipment and capital costs, including buildings (health posts) and medical equipment.

Pre-service training

Volunteers receive a 3-day training prior to initiating service delivery. In addition VMWs and TBAs receive a partnership training. The cost of pre-service training was estimated as the sum of volunteer training and VMW-TBA partnership training.

One-off kits/incentives

One-off kits/incentives include motorbikes. The total cost of motorbikes was estimated by multiplying the number of functioning motorbikes in 2012 (25) by an average purchase price (unit cost).

Other capital costs

VMW services are carried out at subvillage health posts/clinics and village birthing huts. An estimate for

the total cost of buildings was obtained by multiplying the number of facilities in 2012 (99) by an estimate of the purchase or construction price of the buildings.

Each VMW is provided with a midwife kit (volunteers and TBAs do not receive any capital supplies). The unit cost was applied to the number of VMWs to estimate the total cost of midwife kits. The costs of other equipment were estimated by applying purchase prices (unit costs) to the list of standard equipment for the subvillage health posts/clinics and village birthing huts. Each midwife kit includes a wooden cupboard, metal bed, baby scale, instrument tray with instruments, examination lamp, baby basket and other related equipment.

Recurrent costs

Recurrent costs included were annual salaries, incentives and costs of supplies (direct recurrent costs). Other costs included were for refresher/in-service training and supervisory visits and meetings (indirect recurrent costs).

Salaries and incentives

Civil service midwives receive an average salary of Rp 2 433 000, while that of contracted or temporary midwives is Rp 2 225 000. Volunteers and TBAs do not receive salaries. Several incentives may be received on top of the basic salary; for example, one civil servant VMW in this district receives a monthly incentive of Rp 600 000 for serving in a remote area. All midwives receive an average incentive of Rp 400 000 per delivery. For this study, an average 18 deliveries per month was assumed. For assisting at integrated health clinics for approximately two hours per month, volunteers receive an incentive of Rp 5 000 per month.

TBAs receive an incentive of Rp 50 000 per delivery (this can be for assisting a VMW with the delivery). Assuming an average of 18 deliveries per month per midwife, it was estimated that each TBA received per month the amount of the incentive (Rp 50 000) multiplied by the number of midwives (182), multiplied by the number of deliveries per midwife (18), all divided by the number of TBAs (182).

Supply costs

Due to the unavailability of data, medicines and vaccines were excluded, and the costs of supplies were estimated as the total cost of maternal health booklet registers (one per pregnancy), and stationery.

Refresher/in-service training costs

Usually, two midwives per subdistrict (including the midwife coordinator) participate in a regional training course each year, the cost of which was estimated at Rp 10 million per session.

Supervision costs

Three-hourly supervisory visits are conducted primarily from the district to the subdistrict level and are not VMW-specific. Each year, the DHO midwife coordinator and the head of the Maternal and Child Health section visit all 14 subdistrict community health centres and receive an incentive of Rp 150 000 and Rp 125 000 per centre respectively. The head of the DHO and staff from the Maternal and Child Health section visit seven centres per year for which they receive an incentive of Rp 250 000 and Rp 100 000 per centre respectively. Finally, midwife coordinators directly supervise the VMWs in their subdistrict, who in turn supervise the volunteers. TBAs are unsupervised. The midwife coordinator and VMW time related to this supervision is already included in their salaries.

Meeting costs

Meetings are held monthly to evaluate the VMW-TBA partnership and are attended by VMW and TBAs only. TBAs receive an incentive of Rp 50 000 for each meeting they attend, and the total cost of meetings was estimated based on 80% of TBAs attending 80% of the time.

Kenya

In Kenya, cost data were collected from the Division of Community Health Services which is part of the Department of Primary Health Services in the Ministry of Health and Sanitation. The Ministry of Health funds the core programme, although it is not directly involved

in training CHEWs, CHWs and CHCs; this role is carried out mostly by local partners supported by the Global Fund to Fight HIV, Tuberculosis and Malaria, and the GAVI Alliance. Cost data relating to the involvement of CHEWs, CBPs and CHCs are therefore generated by the implementing partners, who share the data with Ministry of Health from where the cost data for this study were obtained.

Health facilities in Kenya are categorized into three levels: community health units (level 1); health centres (level 2) and district/divisional health facilities (level 3). The cost estimates are a consolidation of data from 15 districts that had established community units. In addition to cost data provided by implementing partners, a level 2 facility located in the periurban location of Nairobi provided some estimates of cost data and duration of processes. The unit costs presented here were therefore estimated using both top–down and bottom–up analyses.

Start-up costs

Start-up costs included were the total cost of initial training (2 CHEWs, 50 CHWs and 9 CHC members) and one-off starter kits.

Pre-service training

Initial training of CHWs starts with training of trainers for District Health Management Committees (DHMTs). Two focal persons, usually the District Public Health Officer and District Public Health Nurse, are trained for three days. The DHMTs train two health cadres from level 2 or 3 health facilities as CHEWs for five days. The community health strategy stipulates that the two cadres should comprise a nurse and a public health technician. Finally, the DHMT, together with CHEWs, trains CBPs for 10 days. Costs related to initial training included per diem, transport, stationery and renting of venues.

One-off kits/incentives

Following initial training and deployment in the community, each CHW is provided with a bag containing household registers and notebooks for recording activities. The total cost of one-off kits was estimated by multiplying the unit cost per bag by the total number of CHWs.

Other capital costs

This includes the cost of white boards used by CHWs and CHEWs to summarize data on household health indicators within the community unit.

Recurrent costs

Recurrent costs included stationery (household registers and notebooks) and supervision at level 2 or 3 facilities. CHWs are supervised monthly by CHEWs (4 hours per month) at the health facility. The annual supervision cost was estimated as the total number of hours that CHEWs spent supervising CHWs per year multiplied by the hourly wage rate of CHEWs. There is no per diem involved during supervision.

Additional and ad hoc allowances

Within the Kenyan community health structure, each CHW is issued with a bicycle and each CHEW with a motorbike that should be fuelled and maintained by the health facility to which it is linked. In addition, a recent (2012) decree by the Ministry of Health states that partner NGOs or donors working with CHWs should give them a monthly allowance of 2000 Kenyan shillings. Some NGOs provide bikes and some also provide mobile phone air time for CHEWs and CHWs. Occasionally, NGOs or the Government during its campaigns (for example for polio) may pay a percentage of CHWs to take part for a one-week period. In practice, however, additional financial and non-financial incentives are rarely available. In-depth qualitative work with a range of CHWs and CHEWs in some districts in 2013 revealed that implementation of these recommendations is ad hoc and most often absent all together (personal communication, REACHOUT Principal Investigator, Kenya).

Given the relative importance of these additional financial and non-financial incentives in terms of their implications for both total cost and effectiveness (through their impact on CHW motivation) and thus for the cost-effectiveness of the programme, these cost inputs were included in a sensitivity analysis. In

this analysis, additional costs were added to base-case costs[13] to assess the extent to which they modify conclusions on the cost-effectiveness of the CBP programme. Additional cost inputs included were bicycles for CHWs, motorbikes for CHEWs (including maintenance, fuel and insurance costs), annual salary for CHW and airtime allowances for both CHWs and CHEWs. Bicycle and motorbike costs were included in the start-up cost category (annuitized based on a 10-year useful life of the programme and a 3% discount rate), while air time allowance, annual salary and motorbike maintenance costs were included in the recurrent cost category. Finally, motorbike and maintenance costs were based only on the proportion of time that CHEWs spent supervising CHWs (48 hours per annum).

Effectiveness measure

For Ethiopia, the MNCH interventions used to estimate the number of lives saved were obtained from two robust econometric, empirical studies that estimated the impact of the HEP on MNCH outcomes (Karim et al., 2013; Admassie et al., 2009). Coverage of ANC, iron supplementation, at least two doses of tetanus toxoid injections, PNC by HEWs and immediate breastfeeding after childbirth were obtained from Karim et al. Coverage of ITN use, regular use of latrines for the disposal of baby faeces, and vaccination (polio, BCG, DPT and measles) of children between 12–60 months were obtained from Admassie et al.

Karim et al. used two cross-sectional surveys of a representative sample of women with children aged 0–23 months from 117 communities in four regions of Ethiopia: Amhara, Oromia, SNNPR and Tigray. The first survey was conducted in 2008 and repeated within the same communities in 2010. The impact of HEP on coverage of a range of maternal and neonatal care practices was estimated using counterfactual analysis and community fixed effect models, which controlled for time trends as well as time varying individual, household and community characteristics.

13 Base-case total cost was estimated as described in the preceding subsection and is representative of the cost of the CHW programme in Kasarani district.

The second survey (Admassie et al.) used a random sample of women (15–49 years old) and children (< 5 years old) in 2007 from 128 health subcentres in three administrative regions (Amhara, Oromia and SNNPR). They applied propensity score matching and multiple regression analysis to estimate the impact of the HEP on coverage of MNCH interventions. In this study, changes in coverage were estimated from the counterfactual analysis. It is worth noting that the operational processes of the HEP have evolved since its inception in 2003 and, therefore, estimates of coverage change obtained from Admassie et al. may not completely reflect the impact of the current HEP on MNCH outcomes. However, in the absence of other recent robust studies, the estimates of coverage change they reported are assumed to be applicable to the current HEP.

In Indonesia, coverage of MNCH interventions was based on routine reports by VMWs to subdistricts on actual cases managed. In Southwest Sumba, MNCH interventions for which data were available at the district level included antenatal care visits (1st and 4th visits), health facility deliveries assisted by a VMW, postnatal care visits (1st, 2nd and 3rd) and iron supplementation (1st and 3rd doses). In Takala district, data were available for coverage of tetanus toxoid immunization, ANC visits (1st and 4th visits), health facility deliveries assisted by a VMW, PNC visits (1st, 2nd and 3rd) and iron supplementation (1st and 3rd doses).

In Kenya, data on the effectiveness of the CBP programme were obtained from an empirical study that evaluated the impact of the CHS on the coverage of various MNCH interventions. Wangalwa et al. (2012) used a sample of women with children < 23 months surveyed before and after implementation of the CHS in Busia County of Kenya. The study used a simple pre- and post-test estimation strategy to quantify the impact of the CHS on the coverage of ANC visits, deliveries with skilled birth attendants and exclusive breastfeeding. Although individual level characteristics were similar in the pre- and post-test sample, the robustness of the estimation strategy applied in the study was less convincing.

6

COST-EFFECTIVENESS ANALYSIS: RESULTS

Total cost was estimated for Shebedino district (Ethiopia), Southwest Sumba district (Indonesia), Takala district (Indonesia) and one community health unit in Kasarani district (Kenya). Table 2 displays resource-use items under each category included in the estimation of total costs. Tables 3a and 3b display cost estimates for each category. Differences in cost estimates across study districts reflect differences in the design and operational features of the CBP programmes. For example, pre-service training costs are significantly higher for HEWs compared with those of CHWs in Kasarani, capturing differences in the length of pre-service training (1 year for HEWs versus 10 days for CHWs). Annual salary costs for VMWs in Takala and Southwest Sumba are significantly higher than those for HEWs in Shebedino, reflecting differences in educational attainment between the two cadres of health workers.

Table 2: Description of each cost category and cost input included in the estimation of total costs

1. Start-up costs

Category	General definition	Ethiopia – Shebedino district	Indonesia – SW Sumba district	Indonesia – Takala district	Kenya – Kasarani district
Initial training cost	May include number of trainers and trainees, cost of hiring venue, length of training, salary/ per diem of trainer, per diem of trainees, cost of training materials	Trainer annual salary, stipend (accommodation and meals), training materials, and a proportion of institutions' total running cost	Not applicable	Training volunteers (3 days) and VMW-TBA partnership training	Training 2 DHMT members (3 days); 2 CHEWs (5 days) and CHWs (10 days). Costs include per diem, transport, stationery and venue
Incentives costs	One-off equipment or kits given to each CBP (mobile phone, backpack, etc.)	Backpacks	Motorbikes	Motorbikes	Backpacks
Other capital costs	Building health posts/village clinics, provision of bicycles, etc.	Health post construction and equipment	Construction and basic equipment of subvillage health posts/clinics and village birthing huts where VMW services are carried out	Construction and basic equipment of subvillage health posts/clinics and village birthing huts where VMW services are carried out	Chalkboard

2. Recurrent costs – direct

Medicines	Medicines used for delivering MNCH services	Iron and folic acid supplements, TT, DPT, oral polio, measles and BCG vaccines as well as ITNs	Excluded due to data unavailability	Excluded due to data unavailability	Not applicable
Supplies	Supplies used to deliver MNCH services	Excluded due to data unavailability	VMWs and volunteers: maternal health registers, stationery	VMWs and volunteers: maternal health registers, stationery	Household registers and notebooks
Annual salaries	Health workers	HEWs	VMWs	VMWs	Not applicable
Incentives	Financial and non-financial; may include performance and/or transport incentives	Not applicable	VMWs: transport, ANC, deliveries and PNC visits Volunteers: assisting with health posts TBAs: referrals	VMWs: remote posting (one VMW); delivery Volunteers: assisting with health posts TBAs: referrals	

3. Recurrent costs – indirect

Refresher training	Received during service	10-day refresher training per year for HEWs	10-day training on BEMONC and a 5- day training on normal delivery management for VMWs	Local regional training for VMWs	Not applicable
Supervision/ management	May include salaries and/or incentives related to supervision and management at different administrative levels	District level: proportion of salary and per diem of district health supervisory team. Health centre level: full salary (or proportion, where applicable) of health centre supervisors	District level: proportion of salary and full transport allowance of district health supervisory team	District level MWs: proportion of salary and district health supervisory team as well as other supervisory incentives Subdistrict level: proportion of VMW coordinators' annual salary	Health centre level: proportion of CHEWs annual salary
Meetings	May include venue rental, attendance incentives, per diems, etc.	Per diem for HEW attendance	Proportion of annual salaries of VMW coordinators and member of district supervisory team	Incentives for TBA attendance	Not applicable
Overheads		15% of total cost	15% of total cost	15% of total cost	15% of total cost

BCG = bacillus Calmette–Guérin; BEMONC = basic emergency maternal obstetrics and neonatal care; CHEW = community health extension worker; CHW = community health worker; CBP= community based practitioner; DHMT = District Health Management Committee; DPT = diphtheria-tetanus-pertussis; ITN = insecticide-treated nets; MW = midwife; TBA = traditional birth attendant; TT = tetanus toxoid; VMW = village midwife.

Table 3a: Total costs, 2012 (rounded to I$)

Cost categories	Shebedino	Southwest Sumba	Takala	Kasarani
START-UP COSTS (EAC)				
Pre-service training	8 848	NA	5 383	729
One-off incentives/starter kits	84	7 390	11 381	233
Construction of new health posts	83 806	817 593	668 940	NA
Equipment	15 437	5 213	12 284	25
Total start-up costs	**108 175**	**830 196**	**697 988**	**987**
RECURRENT COSTS – Direct				
Annual salary of CBPs	181 094	323 471	762 248	NA
In-service/refresher training	16 303	35 621	1 484	NA
Other monetary incentives & allowances	NA	254 398	2 334 921	NA
Medicines	13 413	NA	NA	NA
Supplies	NA	NA	NA	NA
Stationery (registers, books)	NA	38 579	38 579	1 552
Total direct recurrent costs	**210 810**	**652 069**	**3 137 232**	**1 552**
RECURRENT COSTS – Indirect				
Supervisory visits	97 409	5 964	3 460	186
Supervisory meetings	7 245	259	10 715	NA
Total indirect recurrent costs	**104 654**	**6 223**	**14 175**	**186**
OTHER COSTS				
Total volunteer costs	NA	21 646	310 521	NA
Overhead costs	47 320	101 991	519 289	261
TOTAL COSTS	**470 959**	**1 612 125**	**4 679 205**	**2 986**
Number of CBPs	**75**	**76**	**182**	**50**
Number of volunteers +TBAs	**NA**	**2315**	**2298**	**NA**

EAC = equivalent annual cost: total cost annuitized based on 10 years of useful life of programme and 3% discount rate; purchasing power parity (international dollar) exchange rates: 7.13 birr/I$ (Ethiopia); 6737.70 rupees/I$ (Indonesia); 45.1 shillings/I$ (Kenya); NA = not available/ applicable.

Table 3b: Full start-up costs, 2012 (rounded to I$)

Start-up cost inputs	Shebedino	Southwest Sumba	Takala	Kasarani
Pre-service training	77 740	NA	47 291	6 405
One-off incentives/starter kits				
Motorbike	NA	64 933	99 997	NA
Bicycles	NA	NA	NA	NA
Backpacks	736	NA	NA	2 051
Construction of health posts	736 325	7 183 460	5 877 377	NA
Equipment	135 628	45 803	107 931	222
Total start-up costs	**950 429**	**7 294 196**	**6 132 596**	**8 678**

NA = not available/ applicable.

Figures 1a–d display intradistrict comparisons of individual costs as a proportion of total costs. The highest proportion of total costs per district was annual salary in Shebedino (38%, Figure 1a); health post construction in Southwest Sumba (51%, Figure 1b); financial incentives and allowances for VMWs in Takala (50%, Figure 1c); and the cost of stationery and registers in Kasarani district (< 50% of total costs, Figure 1d).

Figure 1: Individual cost inputs as a proportion of total costs

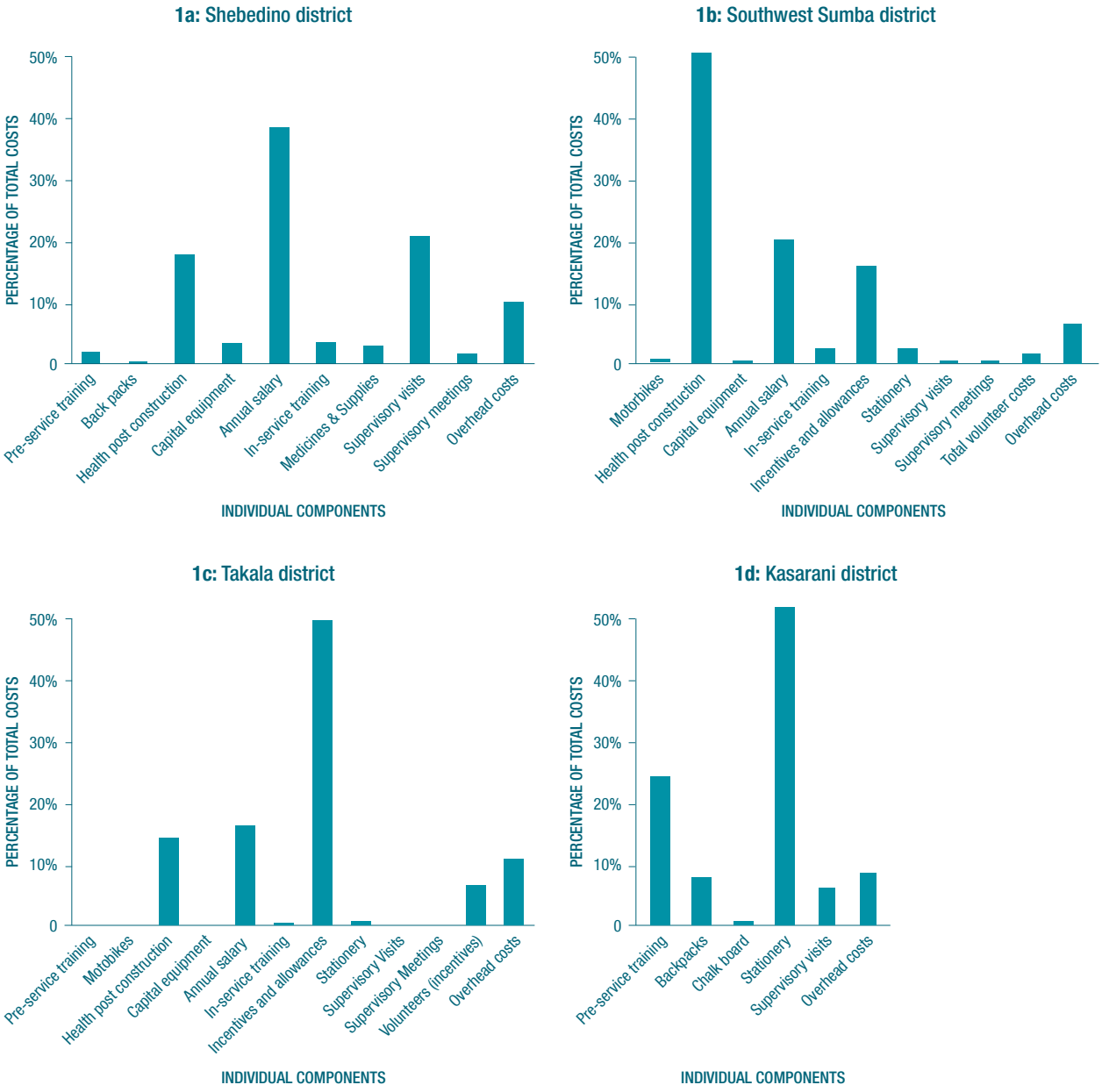


Table 4 summarizes the MNCH interventions and coverage estimates used to estimate additional lives saved and LYG. For Ethiopia, 11 interventions were used resulting in 5299 additional lives saved in the national population (0.061 lives per 1000 population). The number of lives saved, based on coverage data obtained from Southwest Sumba and Takala districts, was estimated at 13 930 and 58 471 in the national population of Indonesia (0.058 and 0.242 lives per 1000 population respectively). In Kenya, although only three interventions were used, the number of additional lives saved per 1000 population (0.263) was higher than estimates for Ethiopia and Indonesia.

Table 5 shows the number of lives saved and life years gained by population group. In Ethiopia, more lives were saved in the older cohort (1–59 months) than the younger cohort (infants < 1 month old). Conversely, in Indonesia and Kenya, more lives were saved in the younger rather than the older cohort. This may partly be explained by differences in the MNCH interventions used to estimate additional lives saved. In Indonesia and Kenya, data on the impact of the CBP programme were only available for interventions that targeted neonatal health while in Ethiopia, data on the impact of the HEP were available mostly for interventions such as immunization that target the health of older children (Table 4).

Table 4: MNCH interventions and programme effectiveness

MNCH interventions	Coverage change			
	Shebedino	SW Sumba	Takala	Kasarani
Pregnancy				
Antenatal care	8.9	45.2	96.0	23.0
Tetanus toxoid vaccination	7.0	NA	96.0	NA
Iron folate supplementation	7.4	88.6	98.0	NA
Childbirth				
Skilled birth attendance	NA	50.5	92.0	26.0
Breastfeeding				
Promotion of breastfeeding	8.4	NA	NA	32.0
Postnatal care				
Preventive postnatal care	11.2	65.9	100	NA
Others	NA	NA	NA	NA
Hygienic disposal of children's stools	1.1	NA	NA	NA
Household ownership of insecticide-treated nets	7.9	NA	NA	NA
Vaccines	NA	NA	NA	NA
BCG	9.3	NA	NA	NA
Polio	9.1	NA	NA	NA
DPT	11.6	NA	NA	NA
Measles	11.8	NA	NA	NA
Additional lives saved: national	**5 299**	**13 930**	**58 471**	**11 894**
study population	**17.0**	**16.0**	**65.0**	**1.3**
Life years gained in study population	**471.3**	**474.8**	**1 894.1**	**36.3**
Study population	**277 788**	**283 818**	**269 603**	**5 000**

NA= not available/ applicable

Table 5: Programme effectiveness by population group

District	Population group	Lives saved	Life years gained
Shebedino	0 day (stillbirth)	5	150.65
	< 1 month	4	117.48
	1–59 months	7	202.85
	Maternal	0	0.34
SW Sumba	0 day (stillbirth)	2.20	64.94
	< 1 month	12.80	372.50
	1-59 months	-0.04	-1.07
	Maternal	1.40	38.40
Takala	0 day (stillbirth)	24.7	721.68
	< 1 month	35.6	1037.58
	1–59 months	-0.2	-7.00
	Maternal	5.3	141.83
Kasarani	0 day (stillbirth)	0.40	11.41
	<1 month	0.70	20.67
	1–59 months	0.05	1.35
	Maternal	0.10	2.88

Table 6 shows estimates of incremental costs, benefits and the ICER for each study district. Overall, the CBP programme in Takala district had the highest total costs and benefits while Southwest Sumba had the highest ICER. The lowest ICER was observed in Kasarani district. This is unsurprising given the differences in the features of the CBP programme in Kasarani compared with the other study districts. For example, large cost inputs such as annual salaries, health post construction and financial incentives are not incurred in Kasarani, thus making this CBP programme appear most cost-effective.

In a sensitivity analysis, ICER was estimated when additional costs were included in the cost-effectiveness analysis for Kasarani district (monthly stipend or salary, bicycles and air time allowance for CBPs as well as motorbike costs and maintenance and air time allowances for CHEWs[14]). The results of this sensitivity analysis are shown in Table 7. ICER estimated following the inclusion of all six additional cost inputs is significantly higher than the base-case ICER – a difference of approximately I$ 930 per LYG. This difference is largely driven by the inclusion of an annual salary for CBPs while motorbikes, bicycles (both annuitized over the useful life of the programme) and air time allowances individually make lower contributions to the difference.

14 A proportion of motorbike and air time allowance costs was included by applying the proportion of time CHEWs spent supervising CHWs.

Table 6: Incremental cost-effectiveness ratio (ICER; rounded I$)

	Shebedino	SW Sumba	Takala	Kasarani
Incremental cost	470 958	1 612 125	4 679 205	2 986
Additional lives saved (LS)	17	16	65	1.3
Life years gained (LYG)	471	475	1 894	36
ICER (LS)	**28 022**	**98 359**	**71 600**	**2 269**
ICER (LYG)	**999**	**3 396**	**2 470**	**82**

Table 7: Additional costs (I$), Kasarani district

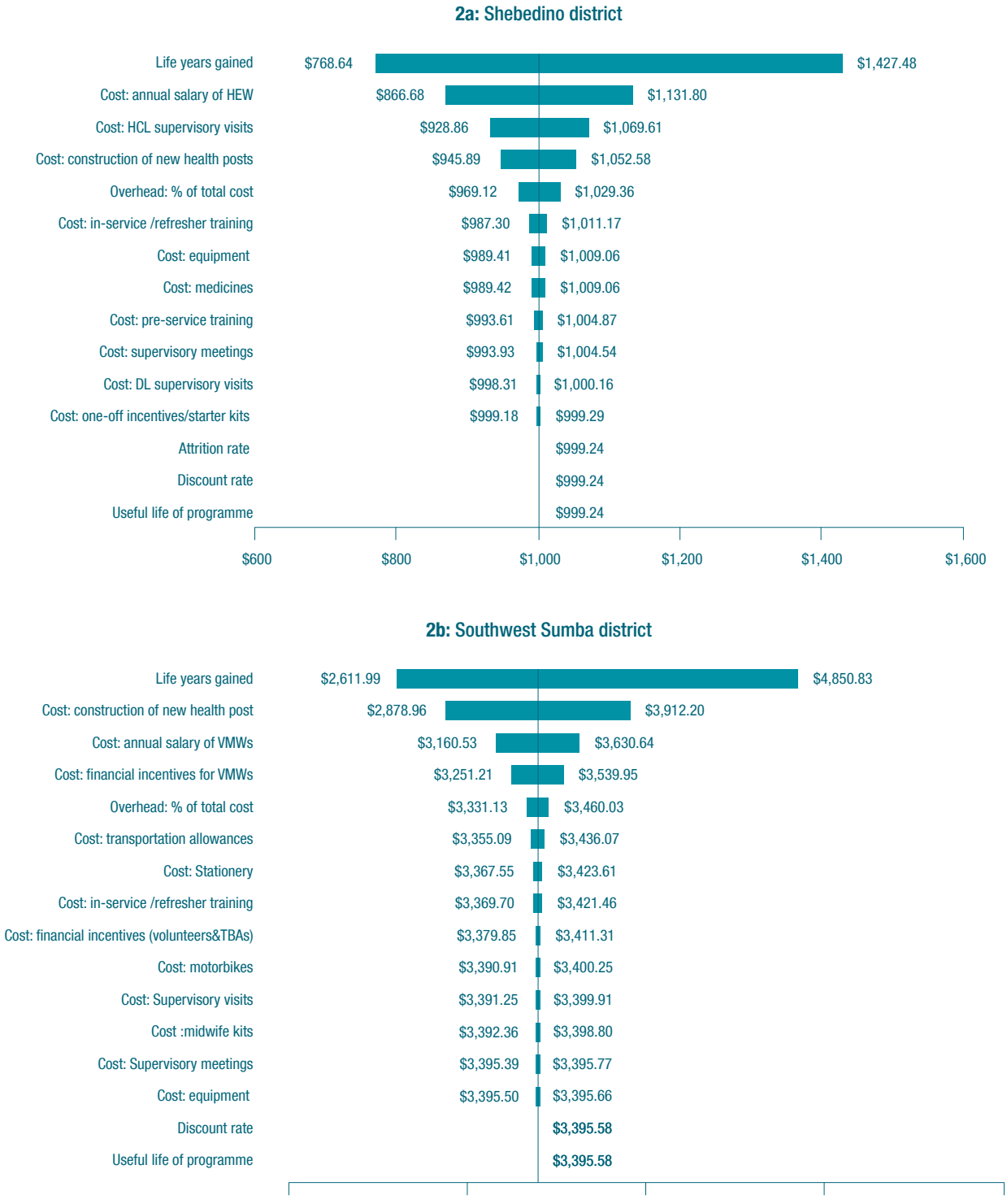
Additional Input	Individual cost	Total cost‡	ICER
Bicycles (EAC)	1,514.18	4,500.19	123.93
Annual Salary	26,607.54	33,584.67	924.89
CHW airtime allowance	1,330.38	4,515.94	124.36
Motorbikes(EAC) †	18.17	3004.18	82.73
CHEW airtime allowance†	12.77	3000.69	82.64
Motorbike maintenance†	136.23	3142.67	86.55
All Additional Inputs	29,619.27	36,818.31	1,013.94
Base-case*	**-**	**2 986.01**	**82.23**

EAC = equivalent annual cost; †Proportion of total cost of individual cost input; *Total base cost and ICER (see Table 3a, column 4); ‡Total costs if additional cost input is included. (Table 3a, column 4).

Sensitivity analysis

Figures 2a–d show the results of the one-way sensitivity analyses for Shebedino, Southwest Sumba, Takala and Kasarani districts respectively. The vertical axis in the middle of each graph represents the base-case ICER while the horizontal bars show ICERs attained by varying each parameter by +/- 30%. Parameters that have the greatest impact on the ICER are displayed from top to bottom of the graph. The graphs show that the ICER for all four study districts is most sensitive to uncertainties in the estimates of LYG. For example, in Shebedino district increasing LYG by 30% from the base-case estimate, while holding all other parameters constant, decreases base-case

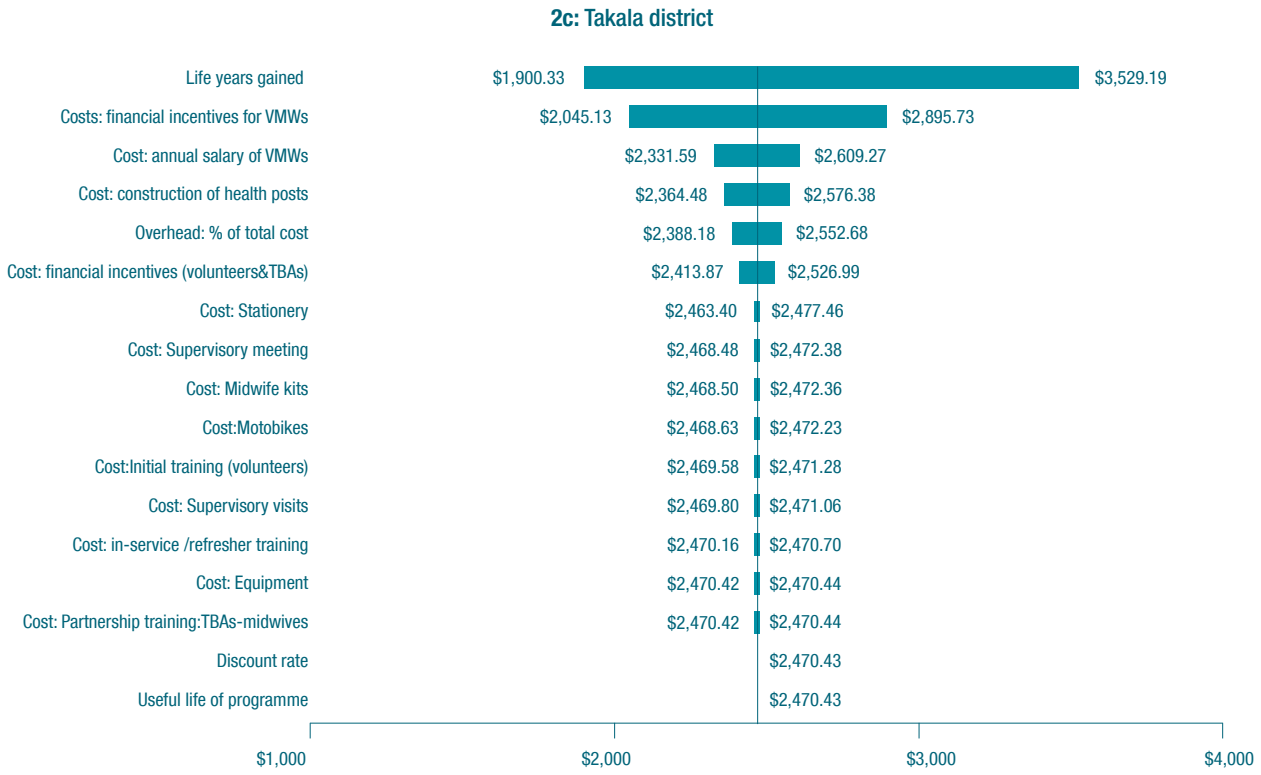
Figure 2: One-way sensitivity analysis (I$)

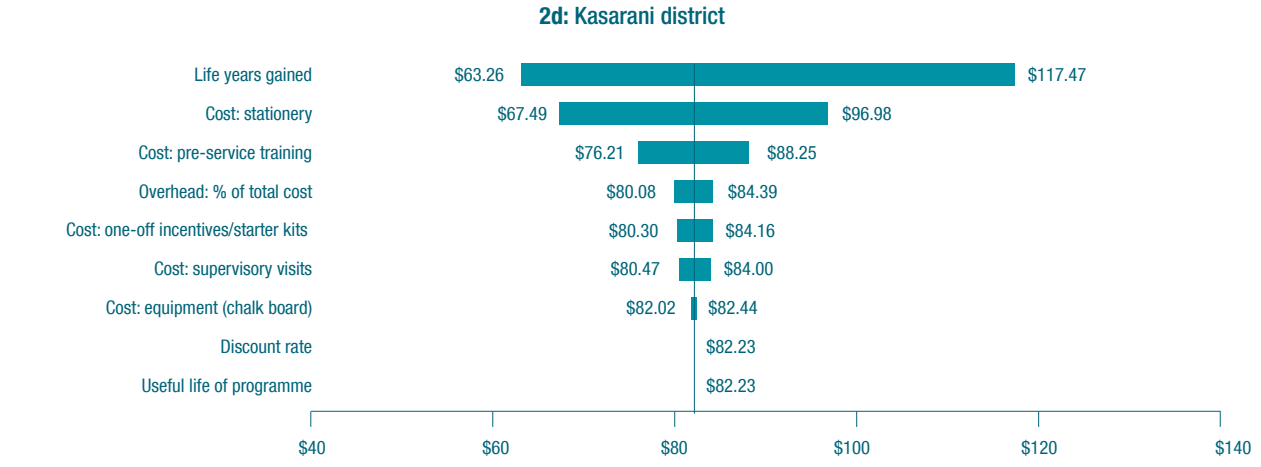


ICER by 23%. Decreasing LYG by 30% increases ICER by as much as 43%. Similar results are observed using incremental cost per additional life saved, where the ICER is more sensitive to uncertainty.[15]

Other parameters to which ICERs are sensitive (but to a lesser degree) include annual salary of HEWs (Shebedino district), cost of constructing health posts (Southwest Sumba), and financial incentives/ allowances for VMWs (Takala and Southwest Sumba districts).

15 Result shown in Annex 9.





DL = district level; HCL = health centre level ; HEW = health extension worker; TBA = traditional birth attendant; VMW = village midwife.

Figures 3–6 display the results of the probabilistic sensitivity analysis in a cost-effectiveness plane (CEP) and cost-effectiveness acceptability curve (CEAC). The CEP (Figures 3a-6a) shows that all 5000 iterations of the Monte Carlo simulation fall within the north-east quadrant, which means that CBP programmes are more costly and more effective than the comparator scenario of no intervention. The limited range of all possible costs and effects pairs in the Monte Carlo simulation is a reflection of the low variability of model parameters[16] (Briggs, 2000; Cohen & Reynolds, 2008).

Although all iterations fall within the north-east quadrant of the CEP, the decision on whether the programme is cost-effective depends on the willingness-to-pay threshold. The CEAC plots the

16 Model parameters were varied randomly within an upper and lower bound defined as 10% above and below each parameter mean.

proportion of costs and effects pairs that are cost-effective at different willingness-to-pay threshold values and is interpreted as the probability that the CBP programme will be cost-effective at a given willingness-to-pay threshold for an additional life year (Fenwick et al., 2006).

For this study, the country GDP per capita (and multiples thereof) was considered as the reference threshold of willingness to pay. While this approach is to a certain extent arbitrary, and other ways exist to estimate willingness to pay, this method has been widely adopted since its recommendation by the WHO Commission on Macroeconomics and Health (WHO, 2001), and is recommended by WHO as part of its flagship initiative on assessment of cost-effectiveness (WHO-CHOICE).

Using this reference threshold for value, the CBP programme in Shebedino district had a very low probability (around zero) of being considered cost-effective (at a GDP per capita of approximately I$ 470.22). However, as the threshold value increases to twice the GDP per capita, the probability that the CBP programme is cost-effective increases to approximately 20%, and at three times GDP per capita has a 100% probability of being cost-effective.

Figure 3a: Cost-effectiveness plane, Shebedino district

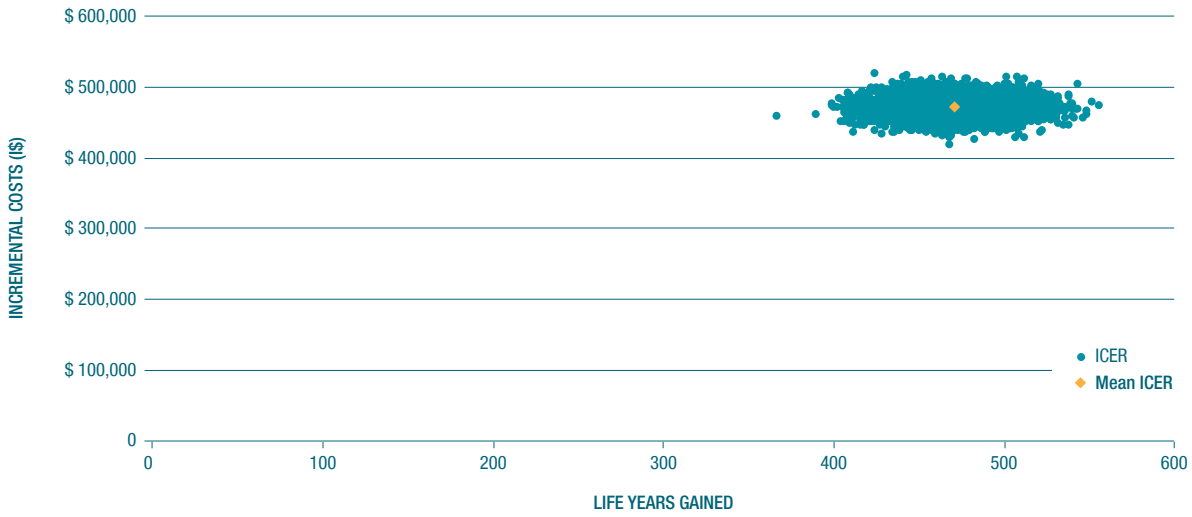


Figure 3b: Cost-effectiveness acceptability curve, Shebedino district

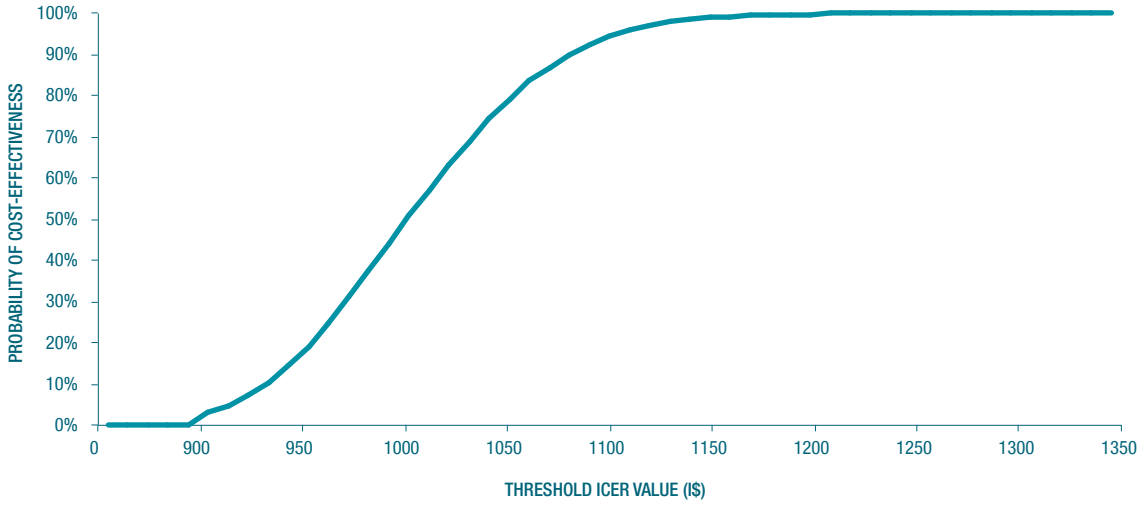


Figure 4a: Cost-effectiveness plane, Southwest Sumba district

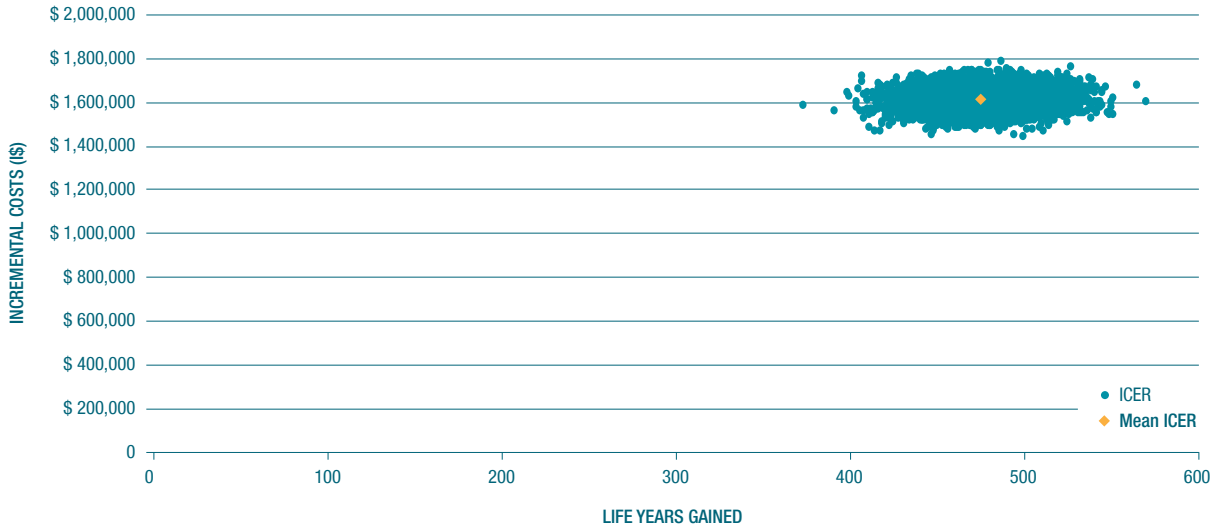


Figure 4b: Cost-effectiveness acceptability curve, Southwest Sumba district

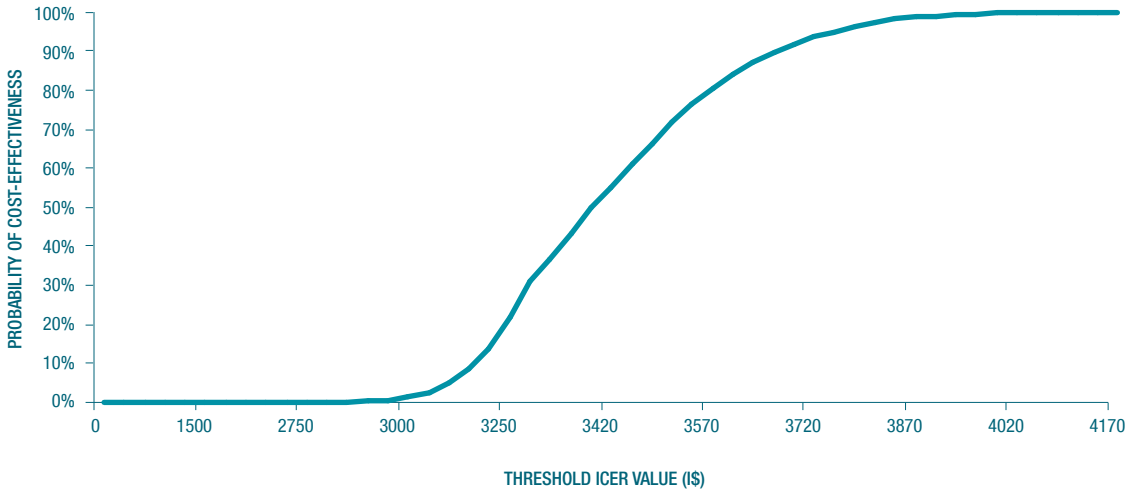


Figure 5a: Cost-effectiveness plane, Takala district

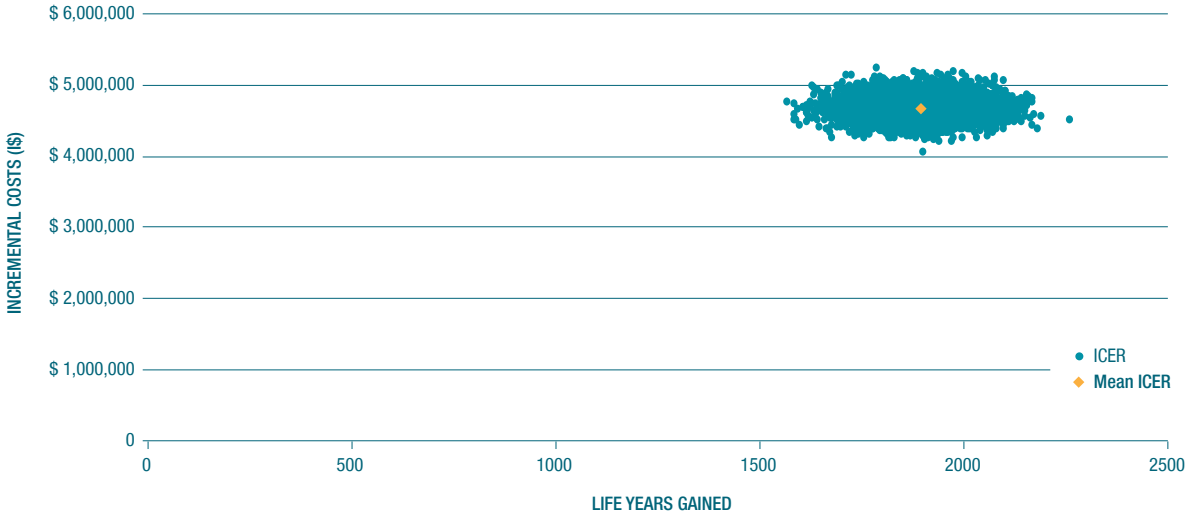


Figure 5b: Cost-effectiveness acceptability curve, Takala district

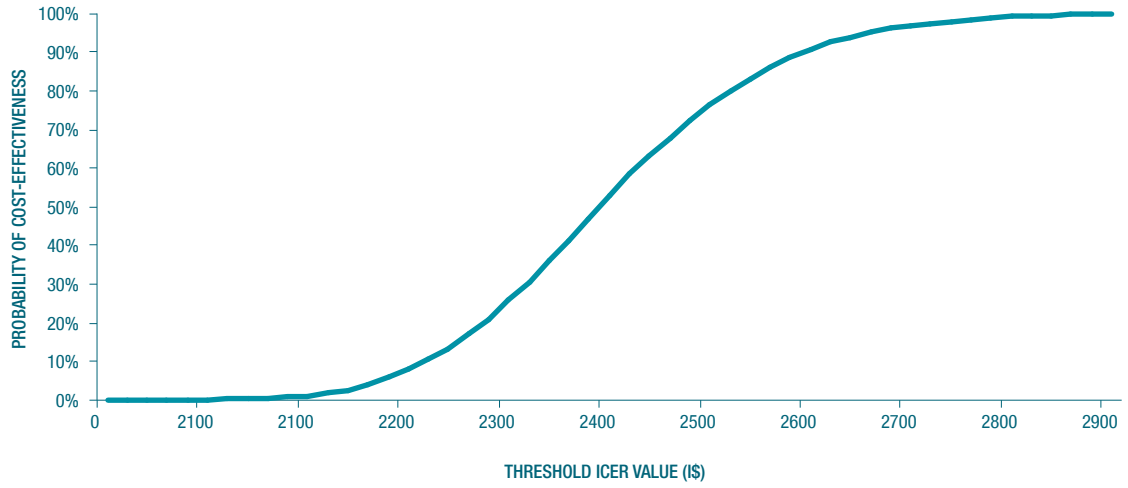
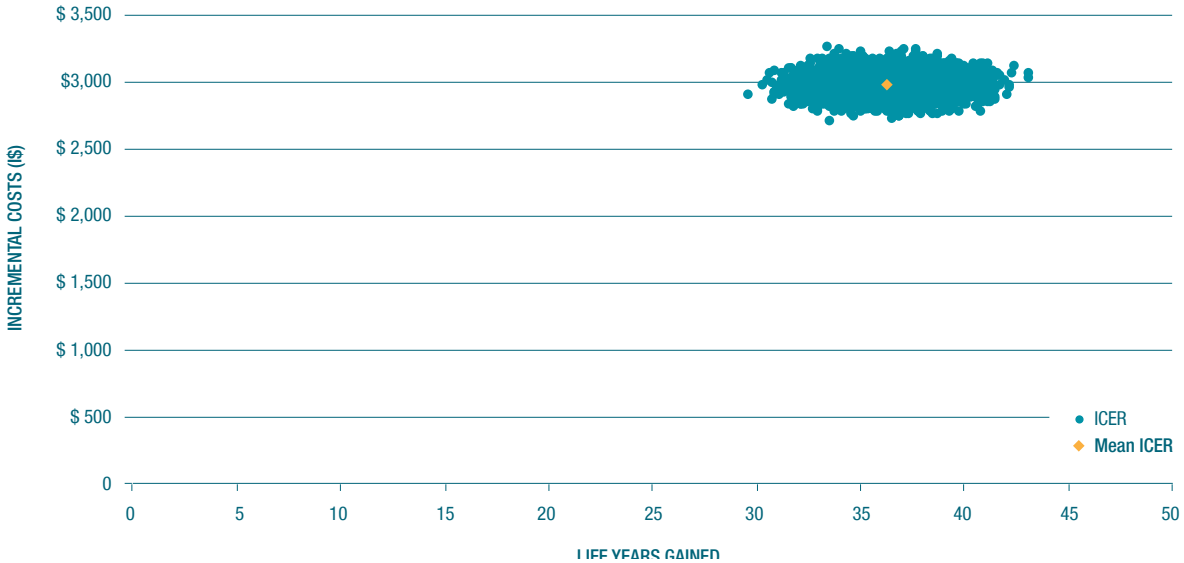


Figure 6a: Cost-effectiveness plane, Kasarani district



7

Figure 6b: Cost-effectiveness acceptability, Kasarani district

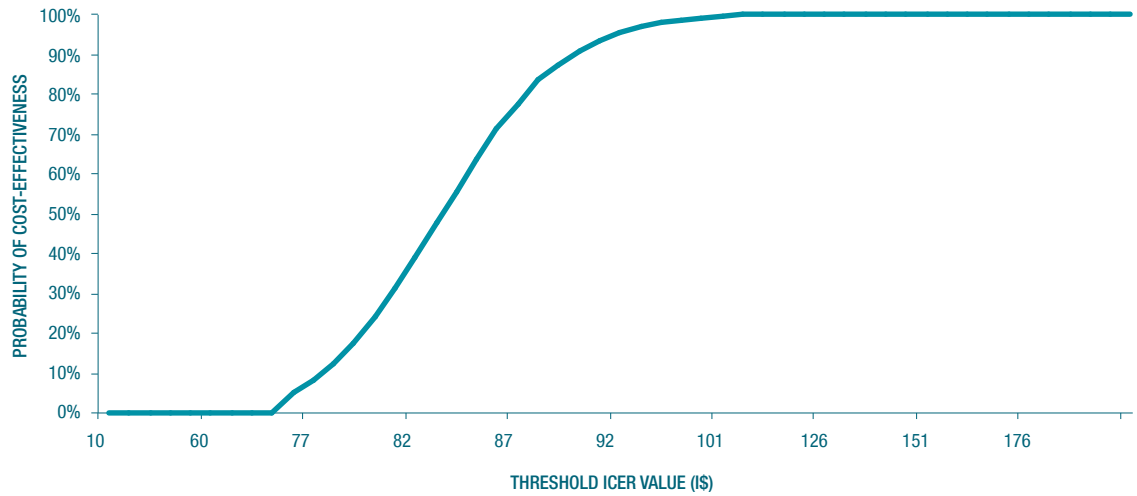
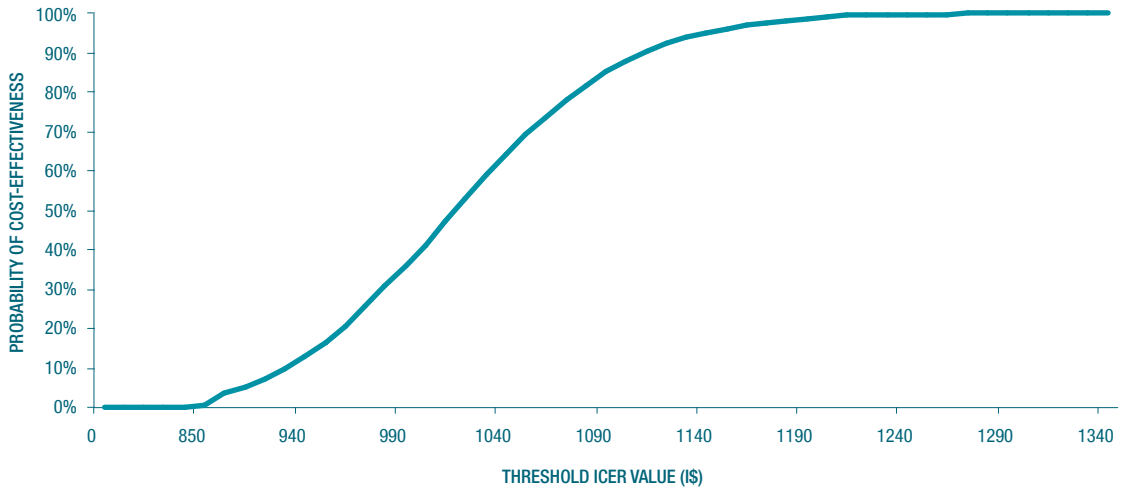


Figure 7: Cost-effectiveness acceptability curve including additional costs, Kasarani district



In both Southwest Sumba and Takala districts (Figures 4 and 5), at a GDP per capita of approximately I$ 3550, the CBP programme has a very high probability of being considered cost-effective (approximately 80% and 100%, respectively). Similar results are observed in Kasarani district (Figure 6), where the CBP programme has a 100% probability of being cost-effective at threshold values well below Kenya's GDP per capita. However, when annual salary of CHWs and other additional costs (bicycles, motorbikes and air time allowances) are included in the analysis, the CBP programme has a less than 10% chance of being cost-effective at the country's GDP per capita of approximately $860. As reflected by the narrow range of the simulation results in the CEP, the probability of the programme being cost-effective in the scenario when additional costs – including salaries – are considered rises steeply to 100% at a willingness-to-pay threshold of less than twice the country's GDP per capita (Figure 7).

Scenario sensitivity analysis

A scenario sensitivity analysis was performed to assess the cost-effectiveness of specific design features of the CBP programme. Multiple hypothetical scenarios were generated by excluding (alone and in combination) four design features of the CBP programme. Included programme design features affected both the motivation and performance of CBPs and as a result, the effectiveness of the programme (Glenton et al., 2013). These included training (pre-service and refresher), financial incentives and/or salary and supervision.

Regarding incremental costs under each scenario, an 'all or nothing' viewpoint was adopted where individual costs associated with a design feature were excluded from the estimation of the total cost of the programme. To estimate the incremental effect under each scenario, it was assumed that the elimination of a design feature would result in a decrease in the effectiveness (LYG) of the programme. That is, if CBPs receive no pre-service training and/ or refresher training, and/ or pay and/ or supervision, their effectiveness would decrease by a given proportion.

Given the dearth of evidence on the impact of each design feature on the effectiveness of a CBP programme in the literature, four hypothetical scenarios are described where LYG decreases by 20%, 40%, 60% and 80% following the exclusion of one or more design features. Reliance on hypothetical changes in effectiveness for the model estimates limits the usefulness and value of the results of the scenario sensitivity analysis. However, this can be useful to illustrate how such changes can be factored in the modelling; if and when empirical data are available, the application of scenario sensitivity analyses at national level can provide useful policy indications. The HEP in Shebedino district is used as the starting point for all modifications and each scenario is compared to the status quo, i.e. no CBP programme. The analysis is repeated using the CBP programme in Southwest

Table 8: Scenario analysis – ICER, Shebedino district (I$)

Design features	Life years gained decrease			
	20%	40%	60%	80%
None	304.34	405.78	608.67	1217.34
PST	327.80	437.07	655.60	1311.21
RT	354.06	472.08	708.12	1416.24
PST + RT	377.53	503.37	755.05	1510.10
Supervision	623.53	831.37	1247.05	2494.11
PST + supervision	646.99	862.66	1293.99	2587.97
RT+ supervision	673.25	897.67	1346.50	2693.00
PST + RT + supervision	696.72	928.95	1393.43	2786.86
Salary	856.67	1142.22	1713.33	3426.67
PST +salary	880.13	1173.51	1760.27	3520.53
Salary + RT	906.39	1208.52	1812.78	3625.56
PST + salary + RT	929.86	1239.81	1859.71	3719.43
Salary + supervision	1175.86	1567.81	2351.71	4703.43
PST + salary + supervision	1199.32	1599.10	2398.65	4797.29
Salary + RT + supervision	1225.58	1634.11	2451.16	4902.32
All	1249.05	1665.40	2498.09	4996.19

All shaded cells are considered as cost-effective options; PST = pre-service training; RT = refresher training.

Sumba to investigate the extent to which the results are generalizable across country settings.[17] The scenarios generated range from an optimistic scenario where all four design features are excluded and LYG decreases by only 20%, to a pessimistic scenario where all four design features are excluded and LYG decreases by 80%.

The results for Shebedino and Southwest Sumba districts (Tables 8 and 9) show, unsurprisingly, that the optimistic scenario is the most cost-effective option, while the pessimistic scenario is the least cost-effective option. Under each percentage decrease in LYG, the ICER follows a similar pattern for all design features excluded. The cost-effectiveness of each design feature largely depends on the extent to which LYG decreases following modifications to the programme. If LYG decreases by only 20%, all scenarios will be considered cost-effective in both Shebedino and Southwest Sumba. Conversely, if LYG decreases by as much as 80%, three scenarios (the pessimistic scenario, pre-service training alone and refresher training alone) will be considered cost-effective in the Shebedino district model and four (the pessimistic scenario, supervision alone, refresher training alone and supervision plus refresher training) will considered cost-effective in the Southwest Sumba district model.

The results can also be interpreted across percentage decreases in LYG. For example, in Shebedino district (Table 8), the option of pre-service plus refresher training (if LYG decreased by 60% following the exclusion of salaries and supervision) dominates refresher training plus supervision (if LYG decreased by 40% following the exclusion of pre-service training and salaries).

Finally, a scenario was generated by 'scaling-up' the CBP programme. The total cost of scaling-up the CBP programme in both districts was estimated by multiplying unit costs by an estimate of the national number of CBPs (approximately 35 000 in Ethiopia (2010/2011) and 79 000 (2006) in Indonesia). LYG were estimated by applying LiST estimates of the additional number of lives saved in the national population (Table 4) to remaining life expectancy at the time death was averted. ICERs for the national CBP programme in Ethiopia and Indonesia were estimated at approximately I$ 1400 and I$ 1700, respectively (Table 10).

17 The comparability of results in Shebedino and Southwest Sumba districts is limited by differences in the design features of the CHW programme in each setting – pre-service training is not a feature of the programme in Southwest Sumba while financial incentives and allowances is not a design feature of the HEP in Shebedino.

Table 9: Scenario analysis – ICER, Southwest Sumba district (I$)

Design features	Life years gained decrease			
	20%	40%	60%	80%
None	2 368.12	3 157.50	4 736.25	9 472.50
Supervision	2 386.97	3 182.62	4 773.94	9 547.87
RT	2 475.98	3 301.30	4 951.95	9 903.90
Supervision + RT	2 494.82	3 326.42	4 989.64	9 979.27
FI	3 138.39	4 184.51	6 276.77	12 553.54
FI + Supervision	3 157.23	4 209.64	6 314.46	12 628.91
RT + FI	3 246.24	4 328.31	6 492.47	12 984.94
FI + RT + Supervision	3 265.08	4 353.44	6 530.16	13 060.31
Salary	3 347.52	4 463.36	6 695.04	13 390.09
Supervision + Salary	3 366.36	4 488.49	6 732.73	13 465.46
Salary + RT	3 455.37	4 607.16	6 910.75	13 821.49
Supervision + Salary + RT	3 474.22	4 632.29	6 948.43	13 896.86
Salary + FI	4 117.78	5 490.38	8 235.56	16 471.13
Salary +Supervision + FI	4 136.63	5 515.50	8 273.25	16 546.50
Salary + RT + FI	4 225.63	5 634.18	8 451.27	16 902.53
ALL	4 244.48	5 659.30	8, 88.95	16 977.90

All shaded cells are considered as cost-effective options; PST-Pre-service training; RT- Refresher training; FI- financial incentives + allowances

Table 10: Scale-up scenario in Shebedino and Southwest Sumba districts (I$)

	Shebedino	Southwest Sumba
Total costs	219 780 500	1 675 761 465
Life years gained	148 604	948 513
Number of CBPcommunity health workers	35 000	79 000
ICER	$ 1,478.97	$ 1,766.72

7

LIMITATIONS IN THE EVIDENCE AND METHODOLOGICAL ISSUES

Evidence on cost-effectiveness of CBP arising from the literature review

This review included 24 studies from the period 2003–2013 about the costs and cost-effectiveness of CBPs in three main areas: MNCH; TB and malaria; and others. Despite the wide variation in types of CBPs, health areas covered, interventions and settings, the most conclusive findings supporting the cost-effective use of CBPs are found in the area of TB. Findings for RMNCH, malaria and other disease areas are less conclusive. However, even where there is evidence for the cost-effectiveness of CBPs compared with other forms of care, results should be interpreted with considerable caution. The reviewed studies used very different methodologies; they compared CBPs with different cadres of health workers, and sometimes there was no comparator. Furthermore, the studies in this review included and excluded different costs (e.g. training, supervision, recruitment and retention costs). Additionally, volunteer time was valued differently in different studies, and sometimes excluded altogether. Effectiveness of CBPs was also measured differently in different studies.

The majority of articles reviewed were about CBPs involvement in TB, malaria or RMNCH, reflecting the use of CBPs in some countries for specific health areas or conditions. However, literature is lacking on evidence about the costs or cost-effectiveness of CBPs who take on responsibilities across a wider range of disease areas or conditions, as is the case in many settings. Although the majority of studies focused on countries in SSA, the wide variation among these countries and the inclusion of studies from Asia and Latin America – each with unique contextual features – imposes an additional limitation on comparison.

Methodological issues arising from the literature review

The literature review revealed considerable heterogeneity of methodological approaches used to assess the costs and cost-effectiveness of CBPs in low and middle-income countries. The wide variety in methodologies limits both comparability and generalizability. Many articles, particularly earlier ones, did not provide sufficient details about how studies were conducted, under which methodological assumptions (e.g. time horizon), or their programmatic details such as the approach taken for supervision or training of CBPs. Hence, their usefulness as examples for similar models or studies is limited. This may affect the ongoing development of the field of health economics.

Nearly half the studies in the review took a government perspective. However, by their very nature CBPs are not always an instrument of the government, and thus often operate outside the formal health sector; associated government costs may thus be minimal. Costs may even become the responsibility of society, including individual service users and providers through out-of-pocket costs. If a government perspective is taken, these programmes will seem more cost-effective than they really are. Additionally, the government perspective fails to capture many of the social costs associated with CBPs identified by Walker & Jan (2005) such as social capital, volunteerism and trust, although these ideas are not well documented or fully understood. Indeed, methods used to date fail to capture many less tangible client benefits resulting from CBPs, such as close-to-community relationships with a care provider that the client personally knows and trusts. Hence, for CBPs, a societal costing perspective may be more appropriate, though methods to account properly for these "negative costs" and non-health benefits need further research.

Other important issues include quality of data and the need for qualitative research to accompany costing and cost-effectiveness studies. Quality of data was rarely discussed in the reviewed articles. Costing studies and economic evaluations rely on a large amount of data, usually taken from various sources and often on assumptions as not all data are readily available or clearly documented. Many studies also failed to recognize the limitations of their data or question their quality. Quality data are at the centre of accurate and effective calculations of costs and cost-effectiveness of CBP interventions. Qualitative data add contextual perspectives through exploring multiple relevant variables and highlighting differences between policy and the reality of implementation on the ground. A mixed methods approach to costing and cost-

effectiveness studies can greatly enhance the quality of findings by adding much-needed depth to a costing or cost-effectiveness study.

Finally, given the large number of CBP programmes around the world, many of which have been operating for decades, this review also reveals that many CBP programmes have not been assessed in terms of costs and/or cost-effectiveness. As CBPs grow in popularity and are incorporated in HRH policy in different countries, the need for well-designed and conducted costing and cost-effectiveness studies becomes particularly important.

Besides the limitations of the reviewed studies, limitations of this review itself should be taken into consideration. Publication bias is a potential issue and some relevant studies may have been missed if they were not identified by the larger search from which these results were taken (or published after April 2013 when that search was done) and since we did not consider grey literature. We have also not specifically evaluated the quality of the reviewed studies, though the review points out methodological shortcomings of the reviewed studies as a whole.

Limitations and assumptions in the cost-effectiveness model

This study attempted to address some of the identified gaps in the literature, by gathering evidence on costs and effectiveness of CBP programmes that deliver a range of RMNCH services in four different settings. However, certain limitations and assumptions have to be clearly acknowledged. These include the following:

- The effectiveness data used were drawn from secondary sources, and although care was taken to identify studies with robust methods, in some cases effectiveness data referred to different areas than the cost data. In Kenya, the study available to estimate effectiveness was not judged adequate to identify the effects of the programme.
- There was a mismatch in time periods from which cost and effectiveness data were obtained; evidence on effectiveness from 'historical' studies was used for the effectiveness of the CBP programme in Ethiopia and Kenya. However, given that the programmes in both countries are evolving, the historical studies may not have captured the impact of the current design of the CBP programme.
- Data on effectiveness was limited to RMNCH interventions for which there were available data/robust evidence on effectiveness. Therefore this study may not have captured the full impact of CBP programmes due to unavailability of data on other interventions that may have been positively affected by the programme.
- Costing was carried out in depth in 1–2 districts only per country programme studied (though in some cases broader programme costs were included from a wider range of areas), which raises questions about how typical that area was of the wider programme.
- While the model took into account a range of essential RMNCH interventions, it could not incorporate, due to data unavailability, all activities of the CBPs or indeed the more intangible societal aspects and non-health benefits, which were identified in the literature review as a gap.
- A government perspective was adopted in this study, so social costs/savings and benefits/disbenefits were not modelled. These would require a more sophisticated primary measurement of effectiveness which, while interesting, was not within the scope of this study. Both of these features probably mean that the impact of CBPs is underestimated here, while the failure to count non-government costs may still mean that the cost-effectiveness is overstated.
- For the costing, a number of assumptions had to be made due to the lack of empirical data. For example, medicines consumption related to the CBP programme was assumed to be proportionate to increase in coverage of key services, which is logical but not necessarily accurate; and operational costs beyond immediate supervision were assumed to be 15%, which was drawn from other studies. Direct evidence is clearly preferable for these variables if data and time permit.
- Certain cost elements were available in one site but not in another, which limited comparability across settings. For example, stationery costs were included in Kasarani and Southwest Sumba but not in Shebedino district due to unavailability of data.
- Similarly, for effects, the outcomes assessed in

the effectiveness study for Indonesia focussed on maternal health, whereas a broader RMNCH package was tracked in Kenya and Ethiopia. This points to some extent to the breadth of the role of the CBPs under study. However, as previously explained, VMWs in Indonesia carry out roles that extend beyond maternal health care, and their contribution may therefore be underestimated.

- Within the LiST model, assumptions are made about the effectiveness of interventions based on international evidence, which may or may not apply in specific settings.
- Cost-effectiveness scenarios relied on hypothetical changes in effectiveness, as the existing evidence base does not provide empirical estimates. The results of the scenario sensitivity analysis are therefore limited in usefulness and value, and should be considered primarily as an illustration of how such estimates can be derived if empirical data were available. Changes to effectiveness of programmes are sensitive to context and to interactive variables. Furthermore, treating them as binary variables (present or absent) greatly simplifies effects that in reality are more nuanced in their influence. For example, policy decisions usually revolve around the amount, type and, for example, the quality of supervision rather than whether to supervise or not.
- In the absence of empirical estimates of changes in the effectiveness of the programme under each scenario, the results of the scenario analysis reflect the relative costs of the features of a CBP programme, which will vary from place to place. For example, of the four features modified in the Shebedino district HEP, pre-service training costs contributed the least to the total cost of the programme, followed by refresher training costs. Similarly in Southwest Sumba, compared with financial incentives and salaries, supervision and refresher training costs contributed the least to total costs. It then follows that these two features (singly and in combination) emerge as the most cost-effective features. But it should be emphasized that the impact of either type of training on effectiveness is not known and that this must be viewed as illustrative rather than definitive.

8

DISCUSSION OF RESULTS

Typology of relevant design features of CBP programmes

Programmes in the three country settings were categorized according to the following features: the type of community agent involved; whether they were salaried; the focus of their work; their responsibilities; any supervisory roles played; recruitment criteria; initial and follow-up training; how they were supervised; whether they received additional allowances; the catchment area they covered; and the supplies they were given. The selected features were deemed to be the most relevant to understand and compare programmes; however, the categorization adopted in this study was difficult to apply as even the selected features were embedded in local contexts and the required information could only be found through accompanying qualitative work. There is undoubtedly a need for more precise terminology defining different types of CBPs in order to provide useful guidance for programme managers.

Despite differences in the broader context of implementation, there was sufficient similarity across the three countries included in this study to enable comparison. For example, all CBPs were salaried (although this policy did not appear to be fully implemented in one of the models under study), worked with and supervised community-based volunteers. All were mandated to provide a wide range of RMNCH services, although the Indonesian VMWs were more closely (but not exclusively) aligned with maternal health. Periods of initial training differed across the three countries, but all received periodic on-the-job training and were supervised by district staff. Population coverage was similar at 5000 per CBP, and all CBPs received, or were supposed to receive, a basic kit and allowances for air time and travel.

Cost-effectiveness of CBP programmes sharing similar goals in health outcomes

Cost-effectiveness was modelled using the LiST tool, which generates estimates of lives saved. These were converted into LYG, providing a more meaningful comparison across different population groups. Broader assessment of impacts – beyond MNCH - might have increased the effectiveness of the CBP programmes under study, by capturing their positive contribution in other health services areas. While the results indicated that all CBP programmes analysed were cost-effective, the caveats noted need to be reiterated, and further studies that incorporate a societal and a health systems perspective are required. Moreover, the results are sensitive to the estimates of effectiveness, which in our model were taken from secondary studies. Some of the differences in effects may therefore be driven by the study design.

The attributes of the programme that may contribute to cost-effectiveness are worth highlighting here. The fact that CBPs work as members of a broader team of community-based agents is likely to be a contributing factor to effectiveness. The cost structures are also interesting to examine. The proportion of salary costs for the CBPs in Indonesia and Ethiopia is around the expected level, but for Kenya the dominance of stationery costs in relation to total costs is somewhat unexpected, and can be interpreted in light of data limitations and the fact that CBPs are not currently paid. However, when potential additional costs (CBP salary, bicycles, motorbikes and air time allowances) are included in the analysis (currently under discussion in order to fully implement Government policies), the ICER for the Kenya CBP programme compares with that of the Shebedino CBP programme in Ethiopia. Again, this should be interpreted with caution as the cost-effectiveness analysis did not take into account the increase in service delivery (or effectiveness of the programme) that may occur when further incentives are provided to CBPs.

Are current CBP interventions an optimal use of resources in many settings?

Assessing optimal use of resources requires a comprehensive overview of the returns on other investments in health care and opportunity costs. Findings suggest that, given the goals of health systems and the challenges they face, the CBP-led approach has a high likelihood, under the assumptions made, to be a cost-effective approach to deliver selected essential health interventions.

This study shows that the ICER is most sensitive to uncertainty in the estimation of LYG and additional

lives saved. Given that these two parameters were estimated with the least degree of certainty (i.e. indirectly from coverage data, and sometimes obtained from suboptimal studies in the case of Kenya), there may be value in further research on the effectiveness of CBP programmes, which will in turn improve policy decisions on their cost-effectiveness.

Generalizability of findings

The model cannot offer definitive conclusions about the cost-effectiveness of CBP programmes in general or information on costs that may have been shifted to CBPs or clients, including the impact of this cost-shifting (the societal perspective). Neither does it include out-of-pocket costs for service users or for the CBPs themselves: many CBPs provide money, food or transport to households they visit or spend money to attend meetings, trainings and deliver reports. In addition, it is important to note that the social, political, and policy contexts within which CBP programmes operate are evolving and hence a definition of the features of an 'ideal case scenario' is complex: specific design features that work in one context may not work in another. Effectiveness is determined by the mix of CBP programme features and the context.

The contextual caveat relating to the integration of CBPs in health teams and health systems is critical in relation to the generalizability of findings of this analysis: it should not be assumed that CBP initiatives disjointed from health system support (and/or with radically different design features than those described in this study) are (equally) cost-effective.

Evidence gaps to inform a future research agenda

The literature review can answer only in part the cost-effectiveness question that many global and national organizations ask and on which scale-up is predicated. Further mixed methods research is needed to understand better why CBPs are sometimes cost-effective and sometimes not, and if there are fundamental aspects of different health areas that lend themselves to a cost-effective use of CBPs. Future research is also needed to understand reasons for shifting tasks to CBPs and the impact of this on efficiency, costs and cost-effectiveness of both the programme from which the tasks were shifted and the CBP programme. A fundamental challenge with comparing or generalizing CBP costing and cost-effectiveness findings is the varying nature of CBPs themselves. There is a wide typology of CBP models worldwide, with training and competence varying enormously. Studies should include more details about the type of CBP being assessed, and these differences should be taken into consideration when attempting to compare results.

9

CONCLUSIONS AND POLICY IMPLICATIONS

Supportive evidence on the effectiveness of CBPs has triggered global enthusiasm for their scale-up in order to meet targets of universal access to health care in an effective and equitable manner. In order to achieve these goals, policy-makers need to make decisions about features of CBP programmes that are best suited to the local context. They also need to design programmes within available resource envelopes and ensure that both start-up and recurrent costs are included in their planning. To take for granted that CBPs are an effective and inexpensive way to increase access to services, without asking key questions at the design phase, risks resulting in either a poor quality or ineffective programme, or the emergence of significant costs that had not been taken into consideration.

This study, commissioned in response to continued interest in the use of CBPs to meet health systems goals, aimed to address the relative lack of information on their cost-effectiveness.

Notwithstanding a number of methodological and data availability limitations which have been highlighted in earlier sections, the study has contributed to four main areas.

1. It has assessed the available evidence on CBP programme cost-effectiveness and how it has been measured.
2. It has provided a systematic basis for comparing the main features of CBP programmes in different settings.
3. It has adapted existing costing tools to provide a cost-effectiveness model that can be used for CBP programmes in other settings.
4. It has provided cost-effectiveness estimates for national CBP programmes in three countries and some hypothetical cost-effectiveness scenarios to illustrate the potential impact of changing certain core programme features.

The existing literature was found to be surprisingly limited, given the large number of CBP programmes operating at scale globally. Existing evidence suggests that CBPs can be a cost-effective intervention, particularly for TB, but also – although the evidence is less strong – for malaria, MNCH and other programme areas. These findings may relate to the fact that some areas have been evaluated less than others, rather than indicating an actual difference in cost-effectiveness in the various service delivery areas. More research is needed, which also embeds the programmes in their context and understands how CBPs may affect the wider health system and what broader social costs and benefits they may bring. More rigour in core cost-effectiveness assessment and reporting is also called for.

Although there is no absolute willingness-to-pay threshold value for what is or is not cost-effective, a recognized parameter is that interventions costing 1–3 times GDP per capita per DALY are cost-effective, while those that cost less than the average GDP per capita are highly cost-effective. Using this measure, the CBPs programmes under study were found to be cost-effective or very cost-effective: incremental cost per life year gained was estimated to vary between I$ 82 and I$ 3396. Through probabilistic sensitivity analysis and using the reference willingness-to-pay threshold value, the CBP programmes were found to have a high likelihood (80–100%) of being cost-effective or very cost-effective. The results were most sensitive to uncertainty in the estimation of life years gained.

The main cost drivers of CBP programmes varied by setting, but salaries and incentives were typically one of the major drivers, followed by costs related to infrastructure and supervision. In developing or scaling up CBP programmes, more attention needs to be given to understanding costs (from both a government and societal perspective) and cost-effectiveness. The cost-effectiveness model developed can help policy-makers and planners to identify programme costs from a government perspective and provides a potential tool to adapt and apply costing methods to CBP programmes in other contexts.

An assessment of the impact of CBP programmes beyond RMNCH may well have increased their effectiveness. It should also be highlighted that the CBPs did not generate their results alone, but were part of a coherently structured approach in which they operated as a team, working with community-based volunteers and supervised by district staff. While, therefore, a community health-care package should ideally be assessed as a whole in terms of

cost-effectiveness, this was beyond the scope of the current analysis, the focus of which was restricted to CBPs. The underlying community and health system support mechanisms and infrastructure are likely to influence the performance and results of CBP programmes, and thus, in reflecting on the generalizability of the findings, it is important to consider whether other national CBP programmes are similarly structured. It is also recognized that the programmes are in flux, particularly in Kenya. It is possible that by choosing programmes for which some effectiveness evidence was available, the study selected well-functioning programmes.

CBP programmes and initiatives should be adapted to local and health system contexts and needs. The cost-effectiveness model developed in the context of this study is a potential tool for policy-makers wishing to design, cost and evaluate current and future CBP programmes. Focusing on RMNCH outcomes, the model was developed and applied in a range of geographical settings and programme contexts to ensure that it is robust enough to provide results despite a wide diversity in design features of the CBP programmes. The model helps policy-makers to identify both initial and recurrent programme costs from a government perspective, and breaks these down into cost areas associated with training, salaries and incentives, medicines and supplies, supervision and other items. It links these costs to available information on programme effectiveness. The model provides a potential tool for policy-makers wishing to adapt and apply costing methods to CBP programmes in other contexts and settings. Scenario planning, using the modelling tool developed, could help to maximize the impact and cost-effectiveness of CBP programmes.

Overall, the findings of the analysis represent an additional contribution to the wider (but limited) literature that suggests that CBP strategies tend to be lower cost (or cost saving) and to improve coverage of essential services. In contexts where CBPs operate within an integrated team supported by the health system – as is the case in the country case studies documented in this analysis – the CBP-led approach has a high likelihood, under the assumptions made, to be a cost-effective approach to deliver some essential health interventions.

Scale-up of CBP programmes should take into account differences in settings and programmes. As indicated by Tulenko et al. (2013), the call for an expanded role of CBPs in the wake of renewed emphasis on universal health coverage must seek to integrate programmes within the health system, yet maintain enough flexibility for them to respond to local needs. Programmes should not be interpreted as being easy or simple to manage, as there is considerable resource input required in the form of time, management, financial and other. CBPs do not represent a cheap alternative to professional care, but should rather be seen as a complementary approach worth considering, especially in rural poor communities that have limited access to qualified health care professionals.

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Annex 1: Search details of the extra “check search”

PubMed 16 July 2013		**Results**
#1	“community health worker” OR “community health workers” OR “community health workers”[MeSH]	1 441
#2	“health economics” OR ”economics, medical”[MeSH] OR “economic evaluation” OR “health care costs” OR “health resource allocation” OR “health resource utilization” OR costs OR “costs and cost analysis”[MeSH] OR “cost analysis” OR “cost-benefit analysis”[MeSH] OR “cost effectiveness” OR “cost effective” OR “health care costs” OR “cost benefit analysis” OR “cost-benefit analysis”[MeSH] OR costly OR costing OR price OR prices OR expenditure OR “health expenditures”[MeSH] OR “value for money” OR budget OR budgets OR DALYs OR QALYs OR “quality-adjusted life years”[MeSH]	96 561
#1 AND #2		134

Annex 2: Summary of results of included studies

Study	Description	Costs	Effects (morbidity/mortality)	Cost-effectiveness
Maternal health				
Alam 2012	Maternal health intervention in Bangladesh. Each CHW oversees an average 200 households and visit 8–10 households/ day to disseminate health messages, identify pregnancies, bring pregnant women to birthing huts, accompany them during delivery and provide newborn care.	Average total cost of recommended retention strategies estimated at US$ 121.28 per CHW/year. This additional investment saves BRAC another US$ 60 per ad hoc CHW plus foregone services in the community.	NA	NA
Sutherland 2009	Simulation study on maternal health: prevention of PPH and anaemia (by village health workers).	Home delivery US$ 2; opportunity cost of provider training time US$ 2; 1-day training per provider: materials and teachers US$ 2; 600 ug misoprostol US$ 0.99; prenatal iron supplement per women/year US$ 0.87.	(Data taken from an RCT in India): 50% decrease in acute PPH cases and 80% reduction in severe PPH cases.	In the simulation, misoprostol use after delivery led to a 38% (95% confidence interval [CI], 5–73%) reduction in maternal deaths with an incremental cost per life saved of US$ 1401 (interquartile range [IQR], US$ 1008–1848). Prenatal iron supplementation resulted in a 5% (95% CI, 0–47%) decrease in maternal deaths compared with the standard care outcome with an incremental cost of US$ 2241 (IQR, no lives saved–US$ 3882) per life saved.

Study	Description	Costs	Effects (morbidity/mortality)	Cost-effectiveness
Sutherland 2010	Simulation study on maternal health: prevention of PPH (by village health workers).	Home delivery US$ 2; opportunity cost of provider training time US$ 2; 1-day training per provider: materials and teachers US$ 2; 600 ug misoprostol US$ 0.66; 800 ug misoprostol US$ 0.88; 2-hour 80 km trip by car from village to hospital.	(Data taken from an RCT in India): 50% decrease in acute PPH cases and 80% reduction in severe PPH cases. For a population of 10 000 women delivering at home, misoprostol treatment package saves 9.4 lives to standard management and prophylactic misoprostol saves an additional 1.4 (10.8 total) lives relative to standard management.	A decision to switch from standard management to misoprostol treatment would save an additional 216 DALYs and incur an additional US$ 1212. This implies an ICER of US$6 per DALY (US$1212/216). A decision to switch from misoprostol for treatment to prevention saves an additional 33.6 DALYs and incurs an additional cost of US$ 5721. This implies an ICER of US$ 170 per DALY (US$ 5721/33.6).
Neonatal health				
Borghi 2005	Maternal health intervention with women's groups in Nepal.	Average provider cost of the group intervention was US$ 0.75 per person/year (US$ 0.90 with health-service strengthening) in a population of 86 704. Average annual cost of facilitating a group was US$ 110. Supervision activities added an average annual US$ 203/group and administration costs added US$ 54.	A 29% reduction in neonatal mortality and a substantial reduction in maternal mortality during 33 months.	Incremental cost per life-year saved (LYS) was US$ 211, and expansion could rationalize on start-up costs and technical assistance, reducing the cost per LYS to US$ 138 (US$ 179).
Chola 2011	Breastfeeding intervention, local women trained as peer supporters in Uganda.	Annual programme costs US$ 56 308. Cost per mother counselled was US$ 139 and per visit US$ 26. Cost per week of EBF US$ 15 at 12 weeks post-partum. Scaling up modelled costs to district level public sector additional US$ 1 813 000.	EBF at 12 weeks: intervention 81.6% versus 43.9% control.	NA
Sabin 2012	Neonatal health, trained traditional birth attendants in Zambia.	Financial and economic costs US$ 118 574 and US$ 127 756/US$ 49 469 and US$ 53 550 per year. Ten years: discounted total and annual programme costs US$ 256 455 and US$ 26 834.	Neonatal mortality reduced by 45%; one death avoided for every 56 deliveries or 18 deaths reduced per 1000 live births.	Cost per death avoided US$ 1866, US$ 591 and US$ 3024 (base, optimistic, conservative). Cost per DALY averted US$ 74, US$ 24 and US$ 120.
Child health				

Study	Description	Costs	Effects (morbidity/mortality)	Cost-effectiveness
Fiedler 2003	Child health and nutrition in Honduras: growth monitoring of children < 2 by CHWs. The CHW treats and refers children < 5 to health services.	1) long-term annual recurrent cost per child < 2 participating in the programme: US$ 6.82 2) long-term annual incremental budget requirement per child < 2 participating in the programme: US$ 4.00 3) long-term annual recurrent cost per capita: US$ 0.44 4) AIN-C monthly growth monitoring and counselling session: 11% of a traditional, facility-based growth and development consultation per child.	NA	NA
Fiedler 2008	Child health and nutrition in Honduras: growth monitoring of children < 2 by CHWs. The CHW treats and refers children < 5 to health services.	1) annual recurrent cost per child < 2 participating in the programme: US$ 6.43 2) annual, incremental budget requirement per child < 2 participating in the programme: US$ 3.90 3) AIN-C monthly growth monitoring and counselling session: 11% of a traditional, facility-based growth and development consultation per child 4) effect of mothers substituting AIN-C monitoring for facility-based care 'saves' 203 000 outpatient visits a year, with a potential saving of US$ 1.66 million, equal to 60% of recurrent programme costs and equivalent to its annual incremental budget requirements.	NA	NA
Nonvignon 2012	CHW home management of malaria using two different drugs, by voluntary community-based agents in Ghana	US$ 204 395–260 932	Deaths averted: 79.1–79.9 DALYs averted: 2264.79–2284.57	Cost per anaemia case averted: US$ 150–228. Cost per death averted: US$ 2586–3272. Cost per DALY averted: US$ 90–114.

Study	Description	Costs	Effects (morbidity/mortality)	Cost-effectiveness
Tozan 2012	Community-based pre-referral treatment of children suspected of severe malaria in areas of rural Africa with poor access to formal health care: injection of rectal artesunate by a CHW with referral advice to caregivers.	Incremental costs: low scenario I$ 17 466; full scenario I$ 71 116.	At low intervention uptake and referral compliance of 25%, the intervention was estimated to avert 19 DALYs (95% CI 16–21). At full uptake and compliance, the intervention could avert 967 DALYs (95% CI 884–1050).	At low intervention uptake and referral compliance: I$ 1173 (95% CI 1050–1297) per DALY averted. Under the full uptake and compliance scenario, I$ 77 (95% CI 73–81) per DALY averted.
Tuberculosis				
Clarke 2006	TB treatment adherence and counselling by trained lay health workers on farms in South Africa.	Total marginal cost (private and public): US$ 21.80 per case for those screened in low season or self-referred in high season and US$ 22.03 for cases not self-referred during high season. Marginal time cost of an NSP TB case in non-intervention farms: US$ 19.80 when no recall needed and US$ 25.80 when recall was necessary.	Based on number of cases, intervention farms had a 42% better NSP TB case finding and 10% better cure rate than control farms. Intervention and control farms reached 83% and 65% successful treatment completion rate respectively.	Observed cost reduction was 74% per case detected and cured on the intervention farms compared to the control farms.
Datiko 2010	Health extension workers in Ethiopia administered DOT for 2 months during intensive phase at health post, and on monthly basis during continuation phase.	Cost of total, patient and caregiver community-based treatment lower than health facility DOT by 62.6%, 63.9% and 88.2% respectively.	Improved case detection rate (122% versus 69%) and treatment success rate (89% versus 83%) in community versus health-facility based DOT.	US$ 161.9 per successfully treated smear-positive patient in health facility versus US$ 60.7 via community approach.
Floyd 2003	Outpatient DOT at health facility (CHW) or community member guardian (only new smear-negative patients), delivering drugs in urban Malawi.	Cost per patient treated (smear+): old strategy US$ 456 / new strategy US $106; (smear-) old strategy US$ 67 / new strategy US$ 101.	Cure rate (new smear+ patients): old strategy 58% / new strategy 68%; (treatment completion) old strategy 33% / new strategy 50%.	Cost per patient cured (smear+): old strategy US$ 787 / new strategy US$ 296; cost per patient completing treatment similar in old/new strategy at US$ 200.
Okello 2003	DOT at community level by village-based volunteers in Uganda.	Cost per patient treated (new smear+): US$ 510 in conventional hospital and US$ 289 with community-based care.	Successful treatment rate (smear+ cases): 56% with conventional approach to care and 74% with new community-based care strategy.	Cost per smear+ patient successfully treated: US$ 911 for conventional approach versus US$ 391 through community-based care.
Prado 2011	TB care by guardians in urban Brazil.	Cost per patient treated: US$ 548 for CHW-supervised DOT versus US$ 389 for guardian-supervised DOT.	45 of 46 (98%) patients treated with guardian-supervised DOT versus 70 of 84 (83%) of CHW-supervised patients were cured or completed treatment.	NA

Study	Description	Costs	Effects (morbidity/mortality)	Cost-effectiveness
Sinanovic 2003	TB care by lay health workers in South Africa.	Estimated cost per patient managed (new smear+): US$ 495 in intervention group (choice between clinic- or community-based observation) versus US$ 769 in control group (clinic-based observation only). Corresponding costs for retreatment patients: US$ 823 (intervention) and US$ 1070 (control).	New smear+ patient success rate: 68% in intervention versus 64% in control group. Highest success rates were achieved using a lay-person treatment supporter (80%) and in workplace-based care (81%). Success rate was 58% in intervention and 52% in control group for retreatment patients; highest success rates were achieved using a lay-person treatment supporter (73%) and in workplace-based care (75%).	Estimated cost per patient successfully treated (new smear+): US$ 726 in intervention and US$ 1201 in control group. Corresponding costs for retreatment patients: US$ 1419 (intervention) and US$ 2058 (control).
Malaria				
Chanda 2011	CHWs using rapid diagnostic test in Zambia. Complicated malaria cases and non-malaria febrile cases were referred to nearest health facility. Uncomplicated cases were treated by CHWs using ACT (artemisinin-based combination therapy).	Average cost per case appropriately diagnosed and treated: US$ 4.22 for home-based management and US$ 6.61 at health facilities.	NA	Cost per case correctly diagnosed and treated: US$ 4.22 for home-based management and US$ 6.12 at facility level. ICER: US$ 4.18 per case appropriately diagnosed and treated.
Conteh 2010	Community-based volunteers in Ghana delivered 3 different IPTc drug regimens to children aged 3–59 months.	Cost per child receiving at least the first dose of each course of IPTc: US$ 8.19–14.70.	Compared to placebo, reduced malaria incidence 17–69% and anaemia 30–45%.	US$ 67.77–211.80 per malaria case averted based on intervention costs alone.
Onwujekwe 2007	Community members in Nigeria treat presumptive uncomplicated malaria in adults and children.	Ahani costs Total consumer: US$ 2548 Total provider: US$ 4515 Overall (approx): US$ 7062 Adu costs Total consumer: US$ 1585 Total provider: US$ 4302 Overall (approx): US$ 5886	NA	NA
Patouillard 2011	Village health workers in Ghana dispense IPTc during three consecutive scheduled days from a central point of each village.	Cost of dispensing IPTc: VHW US$ 1053 and 1494; health facility: US$ 1230 and 1696. Cost per child “fully covered”: US$ 4.58 when IPTc delivered by VHWs and US$ 5.27 when delivered by nurses, resulting in an incremental saving of US$ 0.69.	NA	NA

Study	Description	Costs	Effects (morbidity/mortality)	Cost-effectiveness
Other disease areas				
Buttorff 2012	Lay health workers/ counsellors in India, mental disorders.	Control arm: US$ 225 per year, intervention arm with lay health worker: US$ 179 per year.	Over 12 months follow-up, mean psychiatric symptom scores improved by 3.84 points (95% CI 3.29 to 4.38) more in the intervention than in the control arm.	The between-arm difference in QALYs gained appeared small (0.02), partly because it relates to a single year, but it represents a mean of 7.3 additional days free of depression and/or anxiety for each subject in the intervention arm. The mean health system cost per case recovered at the end of follow-up was US$ 128 (95% CI 105 to 157) in the intervention arm and US$ 149 (95% CI 131 to 169) in the control arm. The between-arm difference in total costs per case recovered was more striking, with costs in public and private facilities about US$ 120 and US$ 86 lower, respectively, in the intervention than in the control arm.
Jafar 2011	CHWs in Pakistan provide advice at 3-monthly intervals on the importance of physical activity, diet and smoking cessation.	HHE: US$ 3.34 per participant HHE/GP: US$ 3.99 GP only: US$ 0.65	Mean systolic blood pressure effect: HHE 5.6; HHE/GP 10.8; GP 5.6; no intervention 5.8.	ICER US$ 23 of HHE/GP combined; other ICERs dominated.
Mahmud 2010	Antiretroviral therapy, home-based care, TB treatment, and prevention of mother-to-child transmission by CHWs in Malawi.	Over six months, HBC nurse and TB coordinator reported approximately US$ 1000 and US$2000 in fuel savings, respectively. The 2945 SMS messages sent during the pilot cost approximately US$ 250. Given that no funds were invested in phone repair/ replacement, net savings for the hospital were around US$ 2750.	NA	NA
McCord 2013	Various (diarrhoea, malaria, malnutrition, TB screening, pneumonia, management of pregnancy and health promotion).	Average annual cost for all sub-Saharan Africa by 2015: US$ 2.6 billion (US$ 6.86 per inhabitant covered/US$ 2.72 per inhabitant). Annual cost to train, equip and support each CHW: US$ 3750.	NA	NA

AIN-C: Atencion Integral a la Ninez en la Comunidad [Integrated Community Child Health Program], Honduras; CHW: community health worker; CI: confidence interval; DALY: disability-adjusted life year; DOT: directly observed therapy; EBF: extended breastfeeding; GP: general practitioner; HHE: home health education; ICER: incremental cost-effectiveness ratio; IPTc: intermittent preventive treatment for malaria in children; NA: not available; NSP: new smear positive; PPH: postpartum haemorrhage; QALY: quality-adjusted life year; RCT: randomized controlled trial; TB: tuberculosis; VHW: village health worker.

Annex 3: Flow chart of search strategy

Annex 4: Overview of excluded studies

Study	Reason for exclusion
Bachman, 2009	No information on cost-effectiveness of CBPs
Brown, 2012	Not in low- or middle-income countries
Darmstadt, 2005	No information on cost-effectiveness of CBPs
Darmstadt, 2008	No information on cost-effectiveness of CBPs
Fiedler, 2008b	No information on cost-effectiveness of CBPs
Goldie, 2010	No information on cost-effectiveness of CBPs
Groeneveld, 2005	Not in low- or middle-income countries
Hawkes, 2009	No information on cost-effectiveness of CBPs
Hogan, 2005	No information on cost-effectiveness of CBPs
Hoque, 2011	This is a systematic review of economic analysis in Bangladesh. No information on CBPs
Jones, 2011	No focus on CBPs
Lewin, 2008	Review without concrete information on cost-effectiveness of CBPs
Vijayaraghavan, 2012	No focus on CBPs
Viswanathan, 2010	Review, not in low- or middle-income countries
Whitley, 2006	Not in low- or middle-income countries
Wilford, 2012	No information on cost-effectiveness of CBPs

Annex 5. Community health worker models and maternal health services in Ethiopia

Evolution of community health programmes in Ethiopia

For decades, Ethiopia has implemented community-based health activities using community based practitioners (CBPs). Different community members were involved in the community-based interventions under specific names such as traditional birth attendants (TBAs), community-based distributers (CBDs), community-based malaria agents and community health agents. Most of these groups received only short orientations about the health-related intervention in which they were involved. An additional group, the primary health care workers, were trained from three to six months to provide coordination to health-related activities during campaigns. They were paid per diem during the interventions, which usually lasted less than five days and took place five to eight times per year. None of the CBPs was on a government payroll.

The number of CBPs per community varied from 12 to 50 depending on the population and size of the community. There was no regular supportive supervision except during campaign periods. However, CBPs would organize immunization sessions, usually once per month per community, provide health education as per the activities expected from them, and submit reports on a monthly basis.

In 2004, Ethiopia launched its Health Extension Programme (HEP) as a national health policy priority (Federal Ministry of Health Ethiopia, 2007) and has expanded this flagship programme to cover the whole country. This strategy was adopted with a view to achieving universal coverage of primary health care for the rural population and has a clearly defined package of care, and supervisory and reporting structures, including maternal health. The HEP provides preventive and curative activities through 16 health packages (of which maternal health is one). It targets the household level, particularly women and children, and is designed to improve the health status of families, with their full participation, using local technologies and the community's skills and wisdom. It is delivered by health extension workers (HEW) with support of the household-level Health Development Army (see below).

The HEP is the main vehicle to bring key maternal, neonatal and child health interventions to the community. Antenatal care (ANC) coverage provided by HEWs showed some improvement over time, albeit from a very low baseline: from 0% in 2005 and 11% in 2007, ANC increased to 25% in 2010. However, HEW knowledge on ANC and danger signs of pregnancy for counselling purposes is reported to be poor (Araya et al., 2012).

Maternal health situation in Ethiopia

Ethiopia has high maternal mortality combined with low use of maternal health and other skilled birth attendance services. In 2012, the maternal mortality ratio (MMR) was estimated at between 210 and 630 deaths per 100 000 live births; the lifetime risk of maternal death is about 4% of women dying during pregnancy, during childbirth, or within two months of childbirth (Central Statistical Agency, 2012). Maternal health service use is low and significantly affected by sociodemographic factors, availability, accessibility and affordability of the service, women's status in the household and women's knowledge, attitude, beliefs and culture (Simkhada et al., 2007; Kkonde, 2010).

Various reasons have been identified for non-utilization of maternal health services. These include the unexpected occurrence of labour with short duration, the absence of illness during pregnancy, lack of awareness, preference of giving birth in the presence of relatives, trust in TBAs, cultural reasons and the belief that delivering in a health facility is not necessary and not customary (Bahilu et al., 2009; Central Statistical

Agency, 2012; Mesfin et al., 2004; Fikre & Demissie, 2012; Worku et al., 2013). Studies conducted in Jima and Ambo hospitals show that major causes of maternal deaths are haemorrhage, puerperal sepsis, hypertensive disorders in pregnancy, ruptured uterus and unsafe abortion (Asheber, 2000; Garomssa & Dwivedi, 2008). Most maternal deaths are from direct obstetric causes.

Overview of community health workers in Ethiopia

1. **Health extension workers** are selected by the community in which they work and reside. An all-female cadre, they are salaried and receive training for one year, after which they are deployed as employees by the government. Although HEWs work from local health posts, they devote 70% of their time to house-to-house visits. They are technically accountable to the nearest health centre within their district. The HEP is supervised by a team drawn from different disciplines at each level to direct and support HEWs to perform their duties effectively. HEWs are directly responsible to and evaluated by the *kebele* (health subcentre) administrator or chairperson who recruits them. Health centres in their catchment area and the district health office technically oversee health service delivery in the community. Until 2013, HEWs were formally supported by voluntary community health workers and community health promoters. However, the structure under which these two cadres operate has been dissolved and these volunteers are now incorporated in the Health Development Army. Maternal health care is provided by HEWs through the Family Health Package of the HEP, which comprises the following subpackages: maternal and child health (including ANC, 'safe and clean delivery' at the health post, immunization, growth monitoring and nutritional advice), family planning, adolescent reproductive health and nutrition.
2. **Community health promoters** were volunteers who reside within the community that selects them to conduct programme advocacy and sensitization at community level. They are selected based on their interest to provide health services to the community and their own previous use of the primary health service packages, which is an advantage for providing health education. They are responsible for 20 to 50 households depending on the size of the community.
3. **Traditional birth attendants** are 'close-to-the-community' (CTC) providers of choice to assist delivery for most rural women. They are not formally supported by the government nor do they have formal links to the health centre. However, as members of community, HEWs do have contact with TBAs and where possible will inform them about identifying high-risk pregnancies and referring women to health centres as appropriate.

Coverage, coordination and supervision

In Ethiopia, the regional states are divided into zones, each of which has districts with 5–7 health centres that provide services to 25 000–35 000 people per centre. These are divided into health subcentres, the smallest administrative unit, each of which normally has a health post with two HEWs covering a population of 5000 people on average. Health subcentres comprise a number of clusters that cover 20–50 households or 100–250 people each.

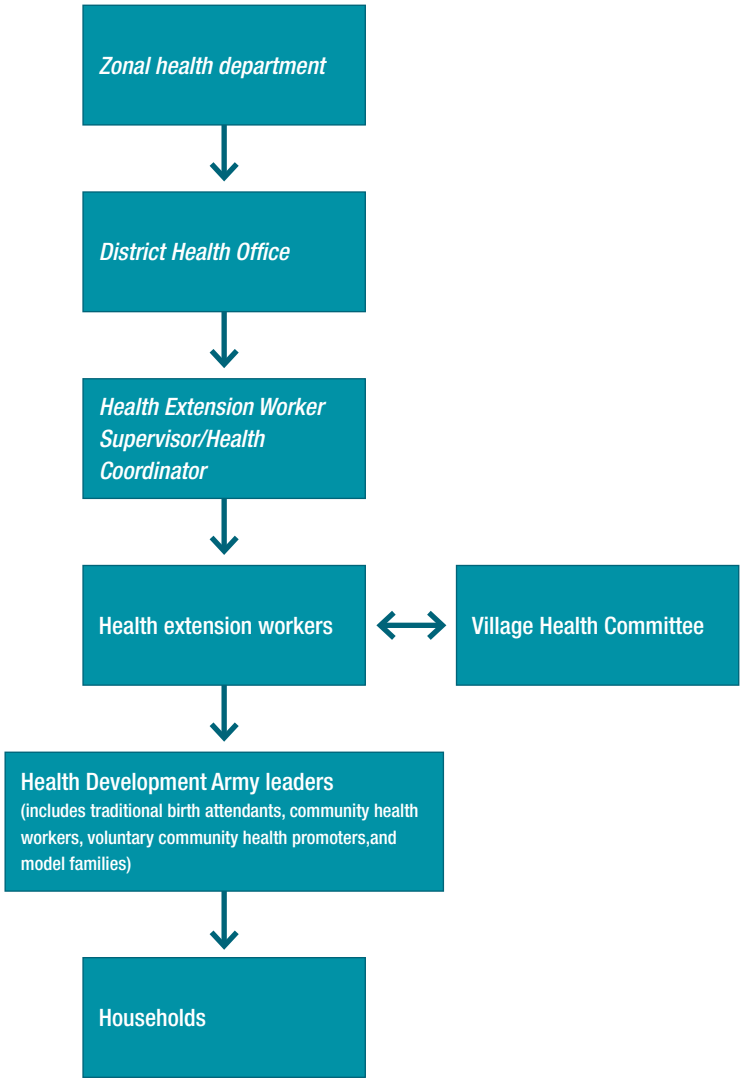
The **Health Development Army** (HDA) is a network of all families in rural Ethiopia, whereby groups of five households are led by one 'model family' who advises them on matters relating to public health. They are responsible to teach, follow and help the adoption of elements of the HEP (including maternal, newborn and child health) within the members of their 'one to five network'. HEWs are responsible for the training of the model families on the health extension packages and the families then pass their knowledge on to others in their network. To become a model family requires a 'graduation' to certify that basic training has been undertaken and health activities successfully promoted. In theory, all families will eventually become model families. A group of 25–30 households forms a development group, who evaluates the progress of the HEP implementation among the community. There is no published literature on this new health development army and its effectiveness to date.

HEWs and the HDA in Ethiopia are supported by the neighbourhood **village health committee**. The

committee is composed of non-salaried workers supporting the HEW and the community in health-related activities at cluster level (20–50 households of 100–250 people). Committee members must be accepted by their communities. They are trained at community level on how to apply the HEP within the home and to facilitate ongoing awareness-raising sessions for health interventions. Village health committee members are supervised by the HEW and health centre or by the district health office. They receive a per diem during campaigns; associated costs are calculated from payment sheets from health offices, although these may be incomplete.

HEW supervisors are salaried staff, responsible for supporting and supervising HEWs and their programme. They must hold a diploma in a health-related field and undergo a further two months training. They are supervised by the district health office and zonal health department, and are responsible for five to seven health subcentres (25 000–35 000 people). Figure A5.1 shows the supervision structure for CTC providers in Ethiopia.

Figure A5.1: Supervision structure for close to community providers in Ethiopia



Italic font represents paid staff; normal font represents voluntary staff.

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Annex 6. Community based practitioner models and maternal health services in Indonesia

Evolution of the programme

Maternal and child health (MCH) is a top priority area of community health programmes in Indonesia. In an effort to improve maternal health, several initiatives have been put in place since the late 1980s (World Bank, 2010). Most noteworthy of these were the Safe Motherhood Programme introduced in 1988 and the Village Midwife Programme (VMP) in 1989. The objective of the VMP was to place one trained midwife per village (particularly in the underserved and rural areas) to provide antenatal and postnatal care and assure childbirth by skilled health-care providers. The deployment of 60 000 village midwives in the 1980s within a well-structured community health service reaching the village level saw dramatic improvements in maternal health indicators. However, despite over two decades of concerted government effort, the maternal mortality crisis persisted and drawbacks of the VMP were evident (Heywood & Choi, 2010).

In 2001 Indonesia decentralized the health system, emphasizing self-reliance and empowerment in community health that focuses on MCH (Heywood & Choi, 2010). This was done in recognition of the fact that MCH is a major health priority in Indonesia and the health structures needed to be well developed to serve rural communities. The revisions took place within the "Minimum Service Standard" which included 1) practice of antenatal care, 2) treatment of obstetric complications, 3) delivery by skilled providers, 4) postnatal care, 5) family planning, and 6) coverage of costs for the poor. The guidelines for these measures were not clear and were not applied by many districts. Current maternal health activities stem from the WHO Making Pregnancy Safer programme and the government policy of Healthy Indonesia 2010 with a focus on community empowerment.

Although the health infrastructure is well laid out for MCH and the community strategy well described, many challenges persist. There is a lack of management skills and central data collection as well as interruptions in services at community health facilities. Since decentralization, the division of responsibilities has been unclear. Midwives and nurses are deployed to serve rural communities, but many lack the experience and skills needed to fulfil their roles (Titaley et al., 2011b). Together with the high workload of midwives and poor referral systems, this hampers the quality of care, resulting in a loss of confidence in the capabilities of young midwives. Incentives for village midwives need a more coordinated approach (Ensor et al., 2009).

Maternal health situation in Indonesia

The national midwife deployment programme is considered to have a considerable impact on maternal health indicators (Titaley et al., 2011a). The maternal mortality ratio (MMR) declined from 307 to 207 deaths per 100 000 live births between 2003–2004 and 2007 (Indonesia Demographic Health Survey (IDHS), 2007). While an MMR of 102 per 100 000 live births is one of the targets of the Millennium Development Goals (MDGs) set for 2015, the recent IDHS (2012) showed an increase of MMR to 359 deaths per 100 000 live births. The reason for this increase in maternal mortality is unclear, though it may be influenced by improved reporting or due to differences in the IDHS survey methods used in 2007 and 2012.

In the five years preceding the 2012 IDHS, coverage in several aspects of maternal health improved: out of every 25 pregnant women surveyed, 22 reported to have made four or more antenatal visits and 90% received ANC by a skilled health provider, defined as an obstetrician or gynaecologist, doctor, nurse or midwife. Births assisted by a skilled provider increased to 83% from 2007 to 2012 with nearly two thirds (63%) taking place in a health facility and 80% receiving postnatal care within two days of delivery. These are promising improvements from the figures found in

the 2007 IDHS survey. Nevertheless the high MMR suggests poor maternal health compared with other East Asian countries with similar GDP per capita. Action is therefore needed in order to attain the objectives of MDG5 and the Indonesian strategic health plans (Titaley et al., 2011).

Overview of community health cadres and their functions, particularly in relation to maternal health

There are several types of community based providers, with midwives being the main category. Midwives are engaged in multiple health-care tasks as well as obstetric work, and their services are carried out at subhealth posts (*pustus*) and village birthing huts (*polindes*). Integrated health posts (*posyandus*) are run with support from the community and involvement of other providers such as family planning and traditional birth attendants (TBA) volunteers: it is here that promotion of family planning, ANC and point-of-care testing, health education, growth monitoring, nutrition support, and immunization are carried out.

1. **Village midwives** are salaried health workers, responsible for providing services at village level. The village midwife's role involves carrying out ANC, point-of-care tests, e.g. for malaria (in endemic regions) and HIV (in Papua region), treatment, e.g. for malaria, outreach care and providing safe delivery within a health facility and at home, postnatal checks, immunization and other tasks assigned by the District Health Office (DHO). As village midwives may be the only health provider in a village, their roles expand to other tasks such as providing general medical care to adults and the elderly, visiting schools for public health programmes, visiting houses for environmental public health programmes and providing family planning.

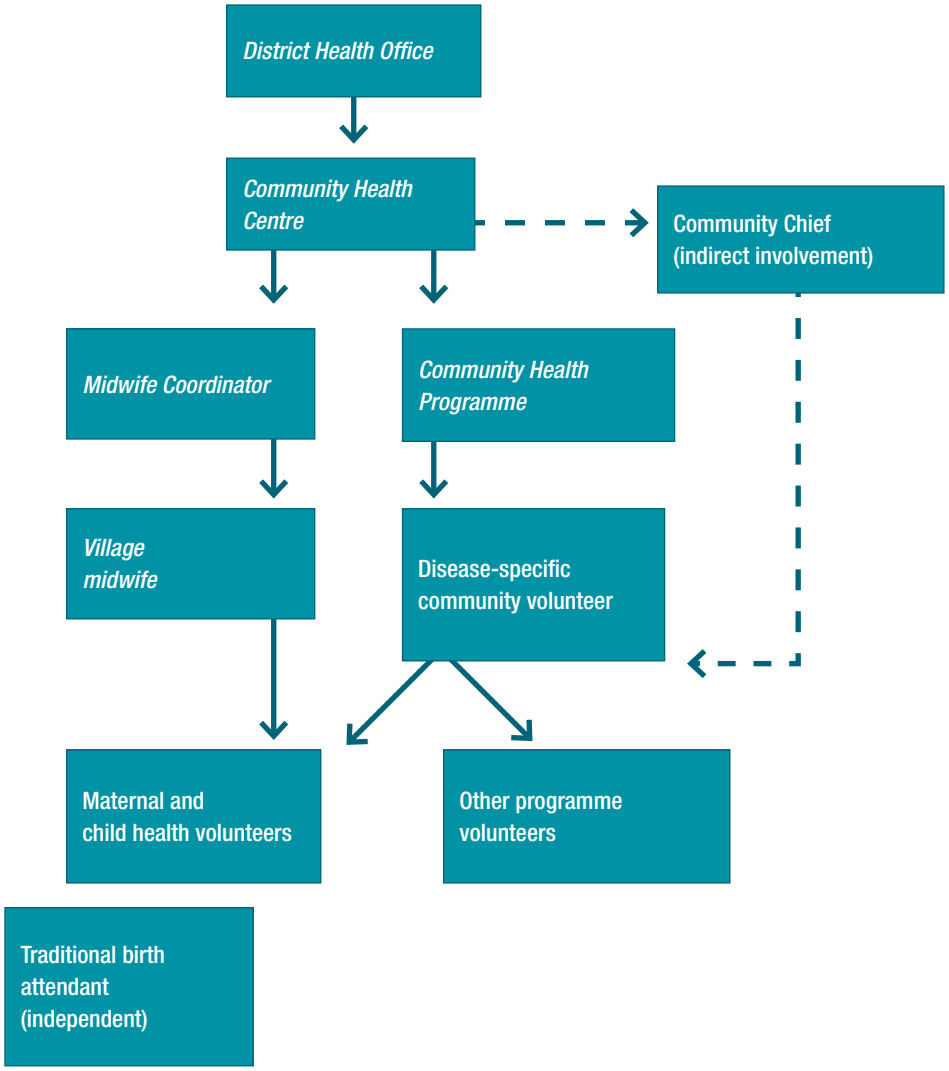
   Two grades of midwives exist at village and community health centre level. The first are permanent government employees, or formal civil servants, who mainly work in the community health centres and provide assistance to the health posts. These workers undergo formal training for three years at a nursing academy, and many districts offer additional training for recruited midwives. The second category relates mostly to midwives based at village level, employed on a contractual basis, and responsible for providing outreach care and home births. Trained in the 1980s through a one-year training, some are still in post today. There are also apprentice midwives, who are not paid. Unlike CBPs in other settings, village midwives are not expected to come from the community in which they work.
2. **Midwife coordinators** supervise village midwives at the community health centre. As with village midwives, their effectiveness is assessed based on minimal service standards. This includes at least four ANC visits, management of obstetric complications by a trained midwife, coverage of pregnant women assisted by a skilled attendant, coverage of three postpartum visits for each woman, and management of neonatal complications.
3. **Community health worker volunteers**, known locally as *kaders,* are non-salaried but work closely with the community health centre and under the direction of the midwife coordinator and village midwives with whom they work. They are responsible for covering a village with a population of 200–1500, although some villages have multiple volunteers. Their primary role is to assist the village midwives during the monthly health post activities. These are community-driven and attended by village midwives to provide MCH care, family planning, immunization, nutritional education and, in some areas, distribution of supplementary food to babies who are not gaining weight. Services for the elderly have recently been integrated into these activities. Volunteers receive limited on-the-job training and are required to register attending mothers, record babies' weight, fill in their health cards, and offer health education, particularly on family planning. They are also expected to identify and inform the health centre about pregnancies and malnourished children in their community.
4. **Traditional birth attendants** are informal workers with a recognized and important link to pregnant women. Their role and integration within public services vary according to geographical location and the extent of local traditional practices. They provide health education, partner with midwives to increase

skilled birth attendance coverage, and provide massage and psychological support for women who are pregnant and/or in labour. The role of a TBA is typically inherited, covers one village, and is based on community acceptance. Training of TBAs is variable, depending on the district programme. They receive no salary, but typically receive gifts in kind (such as rice/chicken) from the community. They receive incentives from the DHO when pregnant woman are referred or brought to deliver in a health facility.

Coverage, coordination and supervision of community health workers

A village midwife is responsible for 1–3 villages, assigned as needed. Her services are carried out at sub-health posts, village clinics and at integrated health posts.

Figure A6.1: Supervision structure for community based providers in Indonesia



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Annex 7. Community based provider models and maternal health services in Kenya

Evolution of the programme

Primary health care (PHC) programmes involving the community are not new in Kenya: they were launched as pilot programmes in the 1970s and involved the active participation of communities in decision-making concerning their priorities in health promotion and disease prevention. However, the broad-based programmes were abandoned as being costly in the face of a shrinking health budget in the late 1980s. They were replaced by vertical disease-specific interventions targeting reduction in child mortality, immunization campaigns, family planning, bednet distribution and home-based HIV testing, among others.

Local community volunteers were used for outreach and campaigns, trained briefly by vertical programme staff and given allowances during the time of the project or outreach, before being dropped and hopefully retained by the next vertical programme. The situation worsened at the introduction of user financing and cost recovery schemes at PHC centres and dispensaries. Concerns about the subsequent drop in the number of people using PHC services, as well as poor health indicators (particularly in maternal health), led to the adoption of new approaches, including the involvement of community health workers (CHWs) as part of an overarching community health strategy described below.

Maternal health situation in Kenya

Kenya's maternal health indicators have failed to improve significantly over the past five years and it is not on course to meet the Millennium Development Goal target on maternal mortality. Results from the Kenya Demographic Health Survey 2008–2009 showed that only about half (52%) of pregnant women received care before the sixth month of pregnancy. Importantly, Kenya's estimated maternal mortality ratio increased from 414 to 488 maternal deaths per 100 000 live births from 2003 to 2008–2009 respectively (Central Bureau of Statistics, 2004 and 2010). Home deliveries remained constant at 56% (Central Bureau of Statistics 2010). There are approximately 7700 maternal deaths annually in Kenya. A recent in-depth analysis of demographic health survey data revealed that infectious diseases, including malaria and HIV, play a large role in maternal mortality (Desai et al., 2013). The data suggest that improved access to and increased uptake of skilled obstetric care, as well as preventive measures against HIV/AIDS, malaria and tuberculosis (TB) among all women of childbearing age, at community level, may help to reduce pregnancy-related mortality.

The health services provided in the community are defined by the Kenya Essential Package of Health. This package defines six lifecycle cohorts, of which pregnancy and the newborn is one. Communities are expected to provide or initiate the following maternal health services:

- Family planning services
- Maternal and child health (MCH) services – antenatal and postnatal services for pregnant women
- Maternal/obstetric care – includes delivery and basic emergency obstetric services that can be provided at dispensary level
- Immunization, nutrition for mothers and babies
- Adolescent reproductive health.

Kenya's community strategy

Kenya's Community Strategy has been the vehicle to deliver the National Health Sector Strategic Plan. The objective of the strategy is to build the capacity of CHWs and community-based resource persons. The strategy includes a description of the proposed maternal health services at community level, outlines the types of CHWs, describes their functions, and summarizes how they are supervised and how the system is coordinated.

Overview of community health cadres and their functions, particularly in relation to maternal health

1. **Community health extension workers (CHEWs)** are salaried workers based in the health facility and must hold a certificate in a health-related field (enrolled community nurse, midwife or public health technician). An additional paid cadre acting in the community is that of lay counsellors for HIV. Many of these salaried staff from nongovernmental organizations are retraining as CHEWs and being absorbed into the community strategy. Since 2013, CHEWs follow a 16-day curriculum that provides them the skills to be primary caregivers at the community level: they may carry out HIV testing and counselling, immunization, basic treatments and midwifery among other tasks. In the new system proposed, the trained and salaried community midwives will assist mothers to deliver at home and refer complicated cases to the health facility in a timely manner. The community midwife and other CHEWs will also have family planning commodities to distribute to women in their households, as they conduct home visits where they will also assess children's immunization and nutrition status and provide them with the necessary vaccinations.
2. **Community health workers (CHWs)** are trained volunteers, although the Government of Kenya has proposed that CHWs receive performance-based incentives. CHWs should be mature, literate, hardworking and responsible male or female members of the community where they work. They are selected by the community at the chief's meeting. CHWs undergo a ten-day training course, with further refresher training every three to six months or as the need arises. They serve approximately 20 households and are tasked to carry out two home visits per week and attend monthly meetings where reports are collected. CHWs are provided with a kit bag, training manual, badge and bicycle.

   Their responsibilities in relation to curative services include referral to health facilities, community case management of common ailments and follow-up. Disease prevention activities include education on hygiene, sanitation and environmental health, condom promotion and distribution, supply of insecticide-treated nets (ITNs) for malaria prevention, and basic nutritional assessments.

   In relation to maternal health, the scope of CHW practice includes:
   a. identifying, during home visits, women of reproductive age, pregnant women and mothers, and ensuring they are entered in the village register and CHW diary;
   b. providing information and health education on reproductive health services including family planning, sexually transmitted infections, pregnancy and the services available in the health facility;
   c. referring the midwife to homes where services are required, e.g. family planning, antenatal care, delivery; and provide postnatal follow-up;
   d. accompanying household members to the facility to ensure linkage, especially for delivery;
   e. conducting follow-up visits.
   f. CHWs willing to volunteer for additional tasks and training may also take on roles such as community-based distributors (CBDs) of contraceptives or as TB ambassadors. CBDs educate and dispense contraceptives to women aged 15–49 years and TB ambassadors facilitate referrals of possible TB patients to a health facility and monitor adherence to treatment of TB patients.

3. **Traditional birth attendants (TBAs)** are the only community-based MCH specific workers involved in the community health strategy. According to community midwifery implementation guidelines, TBAs should be attached to skilled birth attendants such as trained community midwives or nurses at the health facility; furthermore, the role of the TBA is not to conduct deliveries but to provide information, advise and refer in a timely manner. However, they remain an option to conduct delivery at home for many women who do not deliver in health facilities; in these cases, they and are paid in cash or in kind.

Coverage, coordination and supervision of community health workers

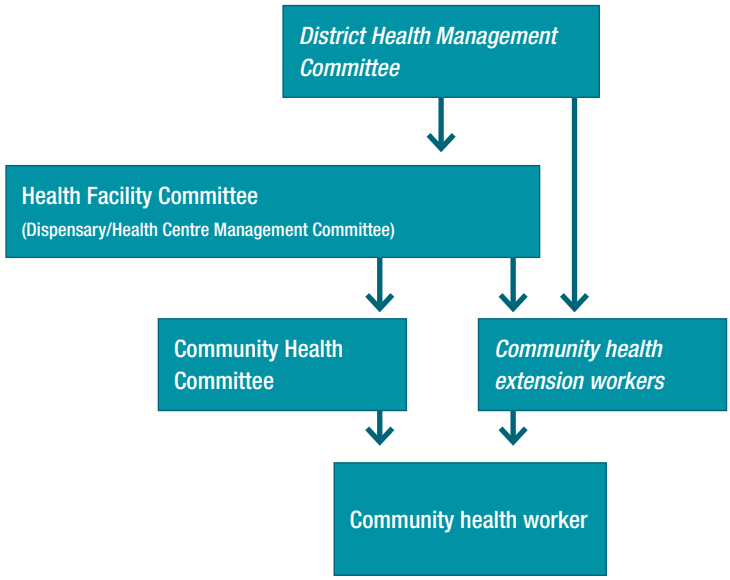
Within the Kenyan community health structure, CHEWs are the main health providers, who are

supported by CHWs at the household level. In practice, locations referred to as community *level one* units of approximately 5000 people are covered by 2 CHEWs and 50 CHWs, each responsible for 20 households. CHEWs supervise and provide support to CHWs, including progress assessments and assistance with problem-solving.

This model started to evolve in 2013/2014 with the goal of having 5 CHEWs, each supported by 2 CHWs, per unit of 5000 people. At least one of these CHEWs must be a community midwife. In total it is estimated that there will be 46 000 CHEWs and 92 000 CHWs in the country by 2017. For the purposes of costing, the existing rather than the intended model has been used.

The District Health Management Team (DHMT) coordinates the community health strategy activities at district level; a member of the DHMT is trained to be the Community Health Strategy (CHS) coordinator for the district. The CHS coordinator must hold a degree or higher diploma in a health-related field. Together with the District Public Health Nurse and District Public Health Officer, responsibilities are to supervise CHEWs, attend DHMT monthly meetings, and participate in the development and quarterly review of the district annual work plan. Community health committees (CHCs) provide a link between the community and the health facility through representation on health facility committees and participation in the selection and supervision of CHWs (Ministry of Health, 2006).

Figure A7.1: Supervision structure for selected CTC providers in Kenya



Italic font represents paid staff; normal font represents voluntary staff.

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Central Bureau of Statistics, Kenya (2004). Kenya Demographic and Health Survey 2003. Calverton (MD): Central Bureau of Statistics, Ministry of Health, Kenya and ORC Macro.

Desai M, Phillips-Howard PA, Odhiambo FO, Katana A, Ouma P, Hamel MJ, et al. (2013) An Analysis of Pregnancy-Related Mortality in the KEMRI/CDC Health and Demographic Surveillance System in Western Kenya. PLoS ONE 8(7): e68733.

Kenya National Bureau of Statistics, ICF Macro (2010). Kenya demographic and health survey 2008–2009. Calverton (MD): Kenya National Bureau of Statistics and ICF Macro.

Ministry of Health (2006). Taking the Kenya Essential Package for Health to the Community: A Strategy for the Delivery of Level One Services. Nairobi.

Annex 8: Overview of other CBP costing models

There are several costing models available that can be used for community based practitioners (CBPs):

- Community Health Services Costing Tool / One Million CHWs Campaign Tool
- Integrated Community Case Management Costing and Financing Tool
- OneHealth Tool
- Reproductive Health Costing Tool
- Other disease-specific tools

Community Health Services Costing Tool / One Million CHWs Campaign Tool

Management Sciences for Health (MSH) developed a Community Health Services Costing Tool that, following a pilot use in Liberia, formed the basis of a version for the One Million CHWs Campaign (personal correspondence, Zina Jarrah). The tool used data from the Millennium Villages Project (currently operating in more than 20 African countries) to estimate the costs of fully deploying CHW subsystems (with full-time, paid public sector CHWs) across the rural areas of nearly 50 countries in sub-Saharan Africa. Although the focus of the tool is on generalist CHWs, it allows for some of these to be trained to work closely with skilled birth attendants on maternal care. The application of this tool is further described by McCord et al.[18]

Integrated Community Case Management Costing and Financing Tool

MSH has also developed an Integrated Community Case Management (iCCM) Costing and Financing Tool that has been used in Malawi, Rwanda and Senegal. They define iCCM as "the delivery of timely and low-cost interventions at the community level by CHWs." The tool takes a programme perspective and includes the cost of iCCM provided by governments, nongovernmental organizations and other providers, although it should be able to be applied to government activities alone.

OneHealth Tool

The OneHealth Tool was developed by multiple United Nations agencies and is a comprehensive model to encompass the costing, budgeting, financing and development of national health-sector strategies. Although designed for a broad, national application, it also allows for programme-specific as well as health system component costing. Community health workers are an included category of staff.

Reproductive Health Costing Tool

The Reproductive Health Costing Tool of the United Nations Population Fund (UNFPA) can be used to estimate requirements and costs of providing an essential package of reproductive/maternal health interventions at country or state/provincial level. The main purpose of the tool is to help countries to cost and create budgets quickly for existing sector strategies and plans; this tool would be useful if a CBP programme can be considered in this context.

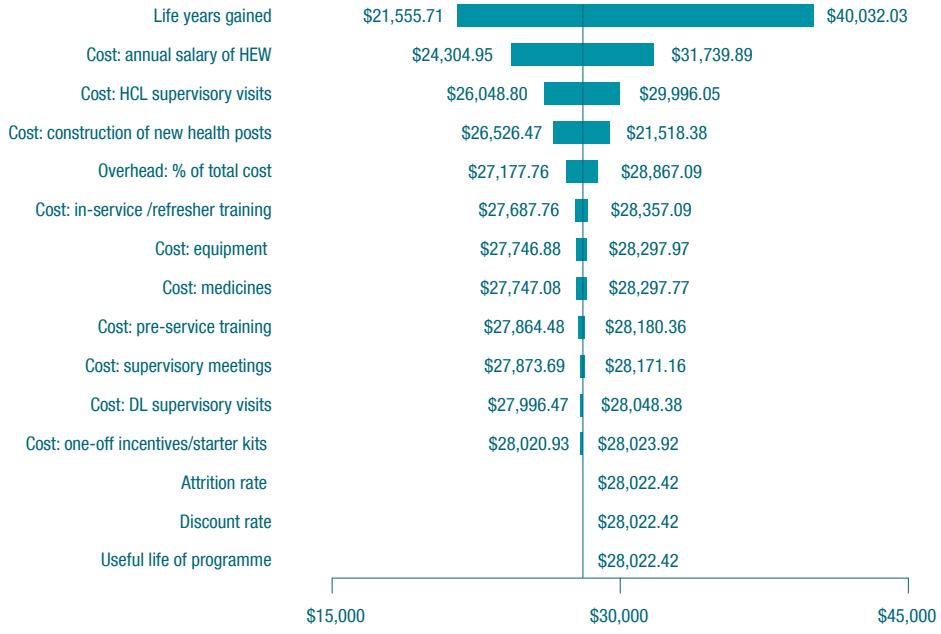
Other disease-specific costing tools

Other disease area-specific tools could be used for costing CBP-delivered interventions. For a full list and review of costing tools please see the Partnership for Maternal, Newborn and Child Health web site: http://www.who.int/pmnch/knowledge/publications/costing_tools/en/.

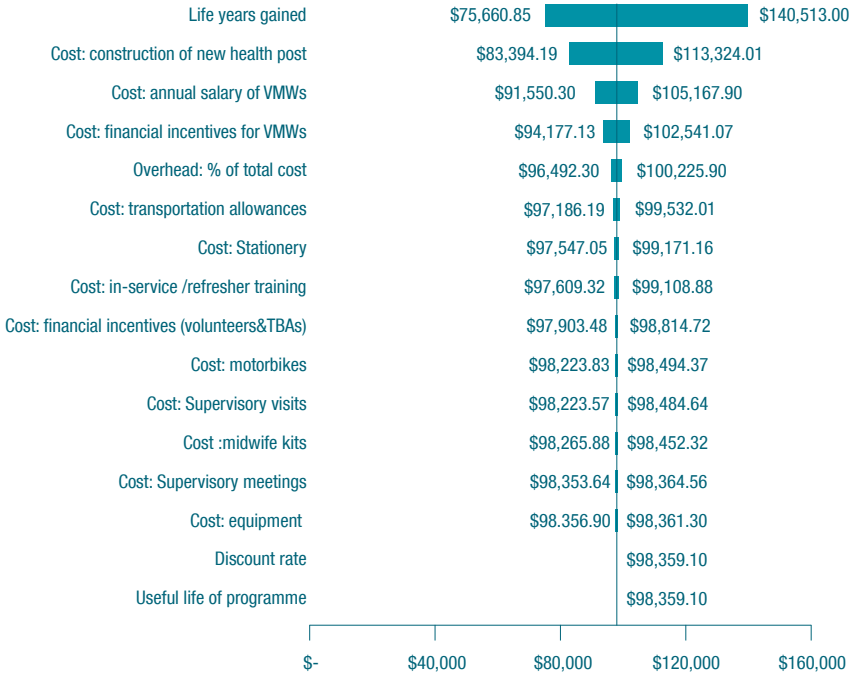
18 McCord GC, Liu A, Singh P. Deployment of community health workers across rural sub-Saharan Africa: financial considerations and operational assumptions. Bull World Health Organ 2013; 91:244–253B.

Annex 9: One-way sensitivity analysis (lives saved model)

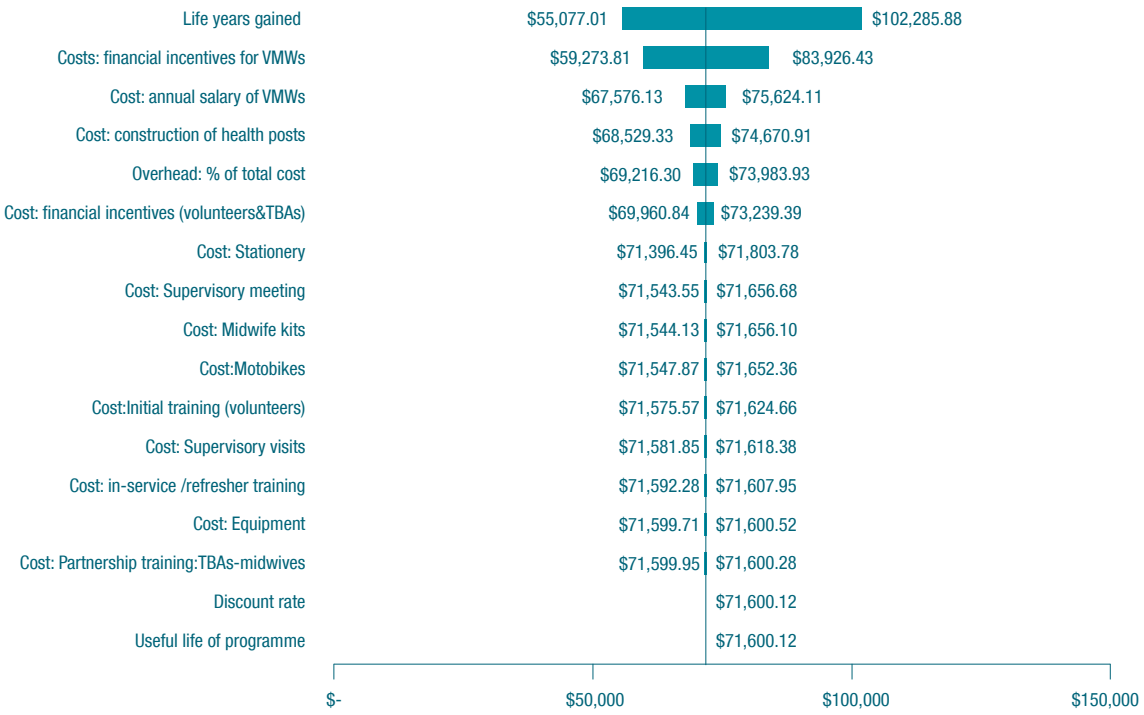
a: Shebedino district



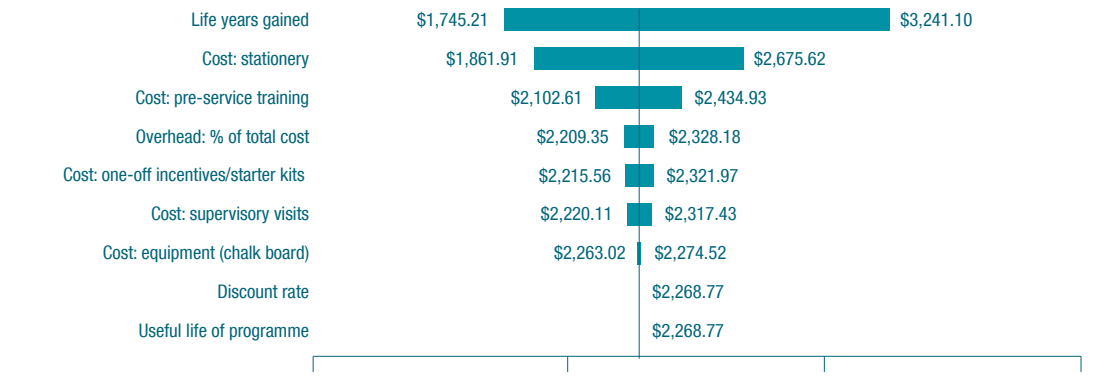
b: Southwest Sumba district



c: Takala district



d: Kasarani district



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