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Improving Newborn Survival in Southern Tanzania (INSIST) trial; community-based maternal and newborn care economic analysis

Fatuma Manzi,^{1,*} Emmanuelle Daviaud,² Joanna Schellenberg,³ Joy E Lawn,³ Theopista John,⁴ Georgina Msemo,⁵ Helen Owen,³ Diana Barger,⁶ Claudia Hanson³ and Josephine Borghi³

¹Ifakara Health Institute, Dar Es Salaam, P.O. Box 78 373, Tanzania, ²Medical Research Council, Francie van Zijl Drive, Parowvallei, Cape; PO Box 19070 7505 Tygerberg, Cape Town, South Africa, ³London School of Hygiene & Tropical Medicine, Keppel Street London WC1E 7HT, London, UK, ⁴World Health Organisation, Dar Es Salaam, United Republic of Tanzania, Tanzania, ⁵Ministry of Health and Social Welfare, Sokoine Drive, Dar Es Salaam, Tanzania and ⁶Save the Children, 899 North Capitol Street, Suite 900, Washington, DC 20002

*Corresponding author. Ifakara Health Institute, Plot 463, Kiko Avenue Mikochei, P.O. BOX 78373, Dar es Salaam, Tanzania. E-mail: fmanzi@ihi.or.tz

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Abstract

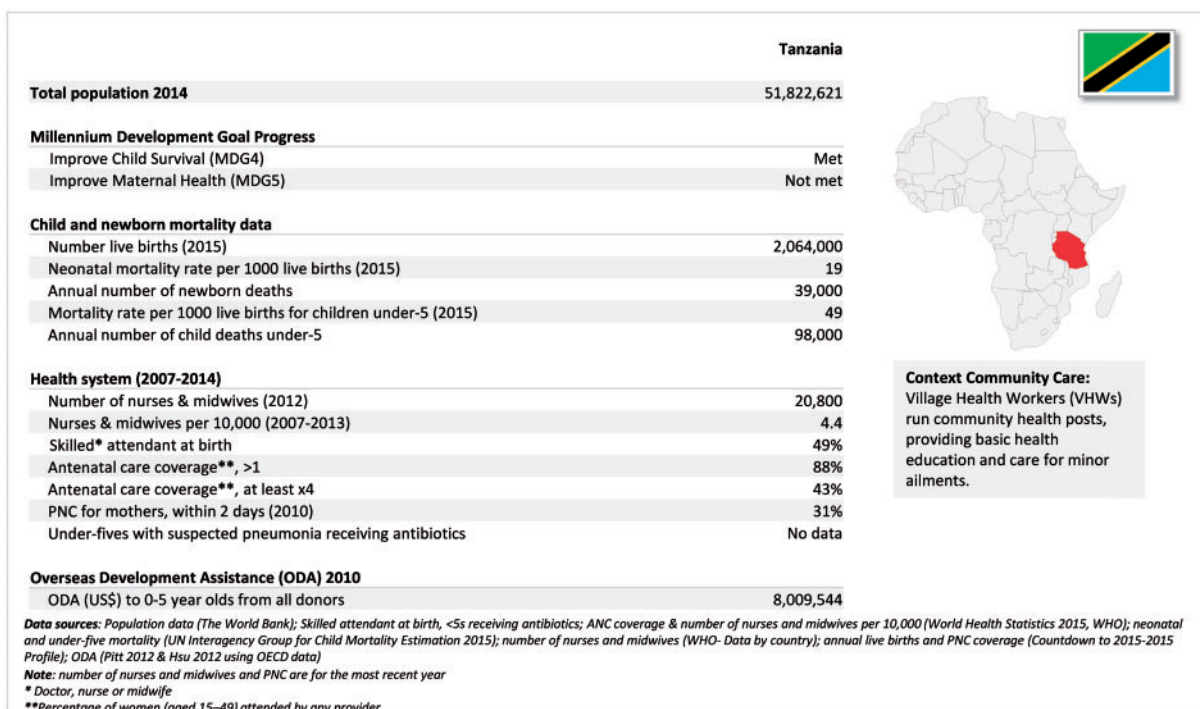
Despite health systems improvements in Tanzania, gaps in the continuum of care for maternal, newborn and child health persist. Recent improvements have largely benefited those over one month of age, leading to a greater proportion of under-five mortality in newborns. Community health workers providing home-based counselling have been championed as uniquely qualified to reach the poorest. We provide financial and economic costs of a volunteer home-based counselling programme in southern Tanzania. Financial costs of the programme were extracted from project accounts. Ministry of Health and Social Welfare costs associated with programme implementation were collected based on staff and project monthly activity plans. Household costs associated with facility-based delivery were also estimated based on exit interviews with post-natal women. Time spent on the programme by implementers was assessed by interviews conducted with volunteers and health staff. The programme involved substantial design and set-up costs. The main drivers of set-up costs were activities related to volunteer training. Total annualized costs (design, set-up and implementation) amounted to nearly US\$300 000 for financial costs and just over US\$400 000 for economic costs. Volunteers ($n=842$) spent just under 14 hours per month on programme-related activities. When volunteer time was valued under economic costs, this input amounted to just under half of the costs of implementation. The economic consequences of increased service use to households were estimated at US\$36 985. The intervention cost per mother–newborn pair visited was between US\$12.60 and US\$19.50, and the incremental cost per additional facility-based delivery ranged from US\$85.50 to US\$137.20 for financial and economic costs (with household costs). Three scale-up scenarios were considered, with the financial cost per home visit respectively varying from \$1.44 to \$3.21 across scenarios. Cost-effectiveness compares well with supply-side initiatives to increase coverage of facility-based deliveries, and the intervention would benefit from substantial economies of scale.

Keywords: Costs, cost-effectiveness, home-based counselling, maternal, newborn, Tanzania

Key Messages

- The home-based counselling intervention involved substantial design and set-up costs. The main cost drivers of set-up costs were community health worker (CHW) training and immediate post-training follow-up.
- Of the mothers in the intervention area of the home-based counselling programme, 80% (22 276) received at least one home visit from CHWs.
- The economic cost per mother–newborn pair for the home-based counselling intervention was US\$19.5.
- Moving from two CHWs per village to one CHW with the same study population and crude birth rate would translate into a decrease of 35% in the financial cost of the programme increasing the sustainability of the programme. The financial cost in a 100,000 population at 95% coverage was USD 6.9 per mother.

Box 1 Tanzania at a glance



Introduction

Health system improvements have been credited for Tanzania's rapid 24% reduction in child mortality between 1999 and 2004, including the doubling of public expenditure on health, decentralization and sector-wide basket funding and expanded coverage of child-survival interventions (Masanja *et al.*, 2008). Yet, improvements in child survival have primarily benefited infants older than one month, resulting in an ever-increasing concentration of mortality in the first month of life: the neonatal period (Lawn *et al.*, 2006, Liu *et al.*, 2012). Despite high-level government commitments, reaching newborns with effective interventions has proven difficult

as evidenced by the gaps in the continuum of care (Kerber *et al.*, 2007).

Although most women receive some antenatal care, less than half give birth with the help of a skilled attendant (49%) (Box 1). A mere 50% of mothers report exclusively breastfeeding during the first six months, and yet, over 90% of infants receive DPT3+ vaccinations (Lawn *et al.*, 2006, Manji, 2009). The challenge of overcoming these gaps in service delivery is compounded by, among other things, a severe shortage of trained health workers (Manzi *et al.*, 2012). As a result, most of the estimated annual 34 000 newborns' deaths occur at home, without any formal contact with the health system (Manji, 2009).

Taking stock of these challenges, there has been renewed interest in scaling-up home-based counselling and household care to improve newborn and child survival in the context of the health-related Millennium Development Goals (Bhutta *et al.*, 2010). Community Health Workers (CHWs) providing home-based counselling have been championed as uniquely qualified to reach the poorest and most remote, who are most at risk (Haines *et al.*, 2007; Bhutta *et al.*, 2008). Although there is promising evidence of home-based counselling-based packages involving home visits from CHWs, reducing neonatal mortality by as much as 50% in several Asian settings, there is little evidence on effectiveness and feasibility at scale, particularly in Africa (Kirkwood *et al.*, 2013). Evaluation of the costs and cost-effectiveness of these interventions should inform implementation at scale (Mangiattera *et al.*, 2006).

Improving Newborn Survival in Southern Tanzania (INSIST) was effectively started in 2009 and aimed to develop, implement and evaluate the effectiveness and cost of a scalable strategy of two interventions to improve neonatal survival:

1. A home-based counselling intervention.
2. A quality-improvement intervention at primary healthcare facilities that was implemented in one of the six home-based counselling intervention districts owing to resource constraints (costs not included in this article).

This article presents the estimation of the incremental financial and economic costs of the home-based counselling intervention, as well as the incremental cost per additional facility-based delivery. Scale-up costs at different levels of coverage and improved efficiency scenarios are modelled.

Methods

Description of a home-based counselling intervention

The home-based counselling intervention was developed in 2009. The intervention was branded *Mtunze Mtoto Mchanga*, which means ‘protect your newborn baby’ in Swahili. Four female volunteer CHWs from each village were trained for six days by government health staff to visit women and their families three times in pregnancy and twice in the first few days of life, with additional visits for low-birth-weight babies. At the end of the training, two volunteers from each village were selected to start the work, guided by the results of a written test, with the remaining two acting as reserves. In collaboration with national and local stakeholders, key counselling messages were selected on the basis of three aspects: the frequency of the behaviour, the extent to which change was felt to be feasible and the likely impact on survival. Key messages focused on hygiene during childbirth; early and exclusive breastfeeding; and extra care, including skin-to-skin care, for low-birth-weight babies (Penfold *et al.*, 2014). Because it was believed that both funding and maintenance of weighing scales were unlikely to be sustainable, a screening tool using newborn foot size as a proxy for birth weight was developed to allow volunteers to identify low-birth-weight or premature babies born at home (Marchant *et al.*, 2010). Supporting counselling messages included the importance of childbirth in health facilities, birth preparedness, warmth (immediate drying and wrapping, delayed bathing), cord cutting with a clean blade, tying with clean thread, dry cord care and danger signs for sick newborns (Borghi *et al.*, 2013). Volunteers supported counselling using a parent and baby counselling card, which was left with the family, and a locally made doll. They were given a job description, a training guide and work manual and a workbook to document

appointments, home visits and the place of delivery for each woman. They were also given a T-shirt and an umbrella as incentives.

The strategy was designed for large-scale implementation within existing government structures and the health system. From January to June 2010, more than 800 volunteers were selected after training, two for every village in half of all the wards of six districts in two regions: Mtwara and Lindi. The wards were selected randomly from all 132 wards (a ward comprises 4–6 villages). Supervision and support were provided monthly by village executive officers, who are local government leaders, and also by a member of staff from the local health facility (usually a nurse) (Mkumbo *et al.*, 2014). The health facility staff provided technical advice, whereas the village executive officer linked the volunteer CHW with the community and mediated if families were unwilling to be visited. Every three to four months, volunteers met with supervisors and district health staff at a ward-level review meeting, referred to as Quarterly Review Meetings (QRM). In all, 10 review meetings were held for each ward between June 2010 and July 2013.

The Council Health Management Teams, Regional Health Management Teams and a core group of key national-level stakeholders were involved in meetings during the design and set-up phases and provided ongoing advice during the implementation phase.

Approach to costing

We estimated the financial and economic costs from a provider perspective. Financial costs include all financial transactions incurred as a direct result of the project. Economic costs value all resources including those not paid for by the project, such as the time of routine health staff supporting home-based counselling intervention. Costs were estimated during the design and set-up phase, June 2009–July 2010, and during the first year of implementation, August 2010–July 2011. The programme was implemented over 3 years (mid-2010 to mid-2013); however, the annual costs were presented, as this is often preferred by policymakers. The costs of research activities were excluded, as these have no bearing on the effectiveness of the intervention. Project monitoring costs, however, were included, as these would be necessary even for routine implementation. We used the Cost of Integrated Newborn Care Tool User Manual, developed by Saving Newborn Lives (SNL) and the South African Medical Research Council, to guide our estimation of provider costs (Daviaud and Lawn, 2010) (Further details are provided in [Supplementary Annex](#) and Daviaud *et al.*, 2017a).

We also estimated the economic consequences to households of eventual changes in care-seeking for deliveries associated with the home-based counselling intervention using methods derived from (Manzi *et al.*, 2008).

Data sources

Financial costs for the home-based counselling intervention were extracted from the project accounts. We collected data on use of project staff time for economic costs from staff and project monthly activity plans and apportioned time spent on intervention activities. We collected CHW and CHW supervisors’ time allocated to the programme via a purposefully sampled (representing each district) survey of 66 volunteers and 31 supervisors. We interviewed CHWs about home visits, supervisory support and their daily schedule using a structured questionnaire. CHW supervisors were interviewed about their role and the time spent on the intervention, as were the ‘District Mentors’ supporting quality improvement. Volunteer time was valued using the minimum basic salary in Tanzania (\$41.3 per month for full-time work in 2015).

Table 1. Annualized financial and economic cost of the home-based counselling programme by phase of programme in 2015, in USD

Activity	Annualized financial cost	Share of total financial cost (%)	Annualized economic cost	Share of total economic cost (%)
Design costs				
High-level meetings	7095	20	10 920	21
Development of intervention	19 307	56	28 485	55
Material development and vehicle purchase	8274	24	12 369	24
Total design costs	34 677	100	51 774	100
Set-up costs				
Training of regional facilitator and district facilitators	3122	3	5353	3
Printing cards	6898	6	7605	5
Kits, T-shirts and umbrellas	4481	4	4856	3
Printing manuals and workbooks	1809	2	1941	1
Training CHWs	75 923	64	97 054	63
Training supervisors	10 035	8	12 828	8
Post-training follow-up	16 197	14	24 096	16
Total set-up costs	118 464	100	153 734	100
Implementation				
Quartely review meetings	62 685	49	26 436	13
Home visits	30 289	24	90 866	44
Management	34 044	27	89 510	43
Total annual implementation	127 018	100	206 811	100
Total	280 158		412 319	

We estimated household costs associated with increased attendances at facilities for deliveries and specific purchases for deliveries, through client exit interviews. In all, 151 women with a child under one attending child services (vaccinations) were purposefully sampled to represent all study districts. Interviews, using structured questionnaires, covered costs incurred by the household for services for the most recent facility-based delivery, including travelling to and from the facilities and purchases for supplies for the delivery (e.g. gloves and soap).

Classification of costs

Costs were classified by activities and inputs. The project activities for the home-based counselling intervention included material development, piloting and printing, training of volunteers and supervisors, kits, T-shirts and umbrellas for the CHWs, QRMs, home visits and management by project staff. We classified inputs as recurrent items such as staff, transport, supplies, utilities and capital items such as vehicle and equipment.

The costs were also categorized in terms of design and set-up costs and implementation costs (recurrent) measured for a period of 1 year. Design costs are one-off costs associated with design of the intervention and development of materials; these costs would not need to be replicated if the interventions were scaled up to new districts. Set-up costs (provision of kits, initial training and printing of material, would be repeated for the introduction of the intervention in a new district or region. Items with over one life year were categorized as capital items and annualized.

Analysis

For both design and set-up phases, costs were annualized over the lifetime of the intervention (3 years), including training costs, as refresher training was taking place as part of the QRMs. For the analysis of economic costs, we derived an annuitization factor for capital items and design and set-up costs using a discount rate of 3% per year (Walker and Kumaranayake, 2002). All costs were adjusted for inflation and converted into 2015 US dollars (US\$1 = Tsh1990) (* <http://www.oanda.com/lang/fr/currency/histor>

ical-rates/average March–August 2015). Financial costs are also expressed as proportion of public health expenditure (government funds + donor funds) per capita to assess sustainability.

Evaluation of effects

We measured project outputs including the number of women visited and the number of home visits carried out using the volunteer workbooks during the review meetings. We conducted a cluster-randomized trial to estimate the effects of the home-based, counselling-based intervention (ClinicalTrials.gov NCT01022788) (Penfold *et al.*, 2014) (Borghetti *et al.*, 2013). We undertook a representative survey of care practices and newborn mortality in 5000 households in 2011 and in 175 000 households in 2013. As there was no evidence of mortality impact, we reported the costs per additional facility-based delivery.

Evaluation of cost per output and cost-effectiveness

We estimated the incremental financial and economic cost per woman of reproductive age, per active CHW, per mother visited and per home visit and per additional facility-based delivery for the home-based counselling intervention.

Scale-up costs

To assess the implications for scale-up of the home-based counselling intervention in a routine system, we modelled the costs of the programme if implemented with local rather than expatriate salaries for management and support of the intervention. We also examined the impact on costs of variations in coverage, as this has the most significant effect on impact (Gogia *et al.*, 2011).

Scenario 1: Target coverage and target number of home visits.

We modelled the costs of the programme with local staff for 80% coverage of eligible households, as well as for target coverage of 95% of pregnant women being covered by the programme and the target number of visits per mother set at five in the protocol.

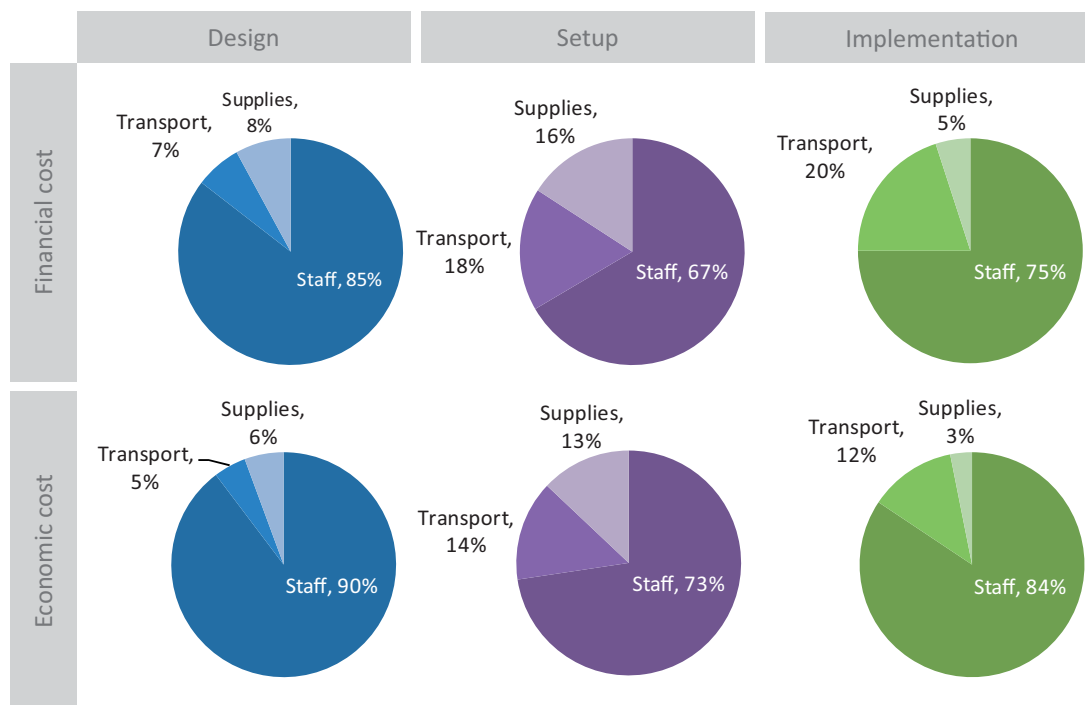


Figure 1. Resource inputs as a share of total financial and economic cost for the home-based counselling intervention by programme phase (USD 2015)

Scenario 2: Increased coverage, CHW workload and therefore efficiency. We modified Scenario 1 by applying various levels of population coverage (50%, 70% and 95%), setting at four the target number of visits, but combining with increased efficiency by assessing the possibility of decreasing the number of CHW per village from two to one, having set at 6 hours per week the maximum time a volunteer can be expected to spend on the programme.

Scenario 3: Standardization to a population of 100 000. We standardized the results of Scenario 2 by applying the model to a population of 100 000 total population, using the 2012 national crude birth rate of 39.7 per 1000 people (<http://data.worldbank.org/indicator/SP.DYN.CBRT.IN>).

Sensitivity analysis

One-way sensitivity analyses were done on economic costs and effects to assess the impact on results of variation in those variables that were most likely to change should the intervention be replicated in a different part of the country or over a different period. Variables affecting costs that were adjusted in sensitivity analyses included changes in salary level by ±4% and exclusion of design costs as part of the programme intervention, as this is a one-off cost. Finally, we varied the discount rate used to derive the annuitization factor from 3% in the base case to 0–6%. We estimated a best and a worst case scenario for costs. The best case scenario was estimated without design costs, with salary costs reduced by 4%, and no discount rate used for the annuitization factor. The worst case scenario was estimated with design costs, with salary costs increased by 4% and with a 6% discount rate. In the sensitivity analysis of the effects, we considered the lower and upper estimates of effect from the 95% confidence interval (5.6–9.3%). We estimated a best and a worst case scenario for cost-effectiveness by combining the two cost scenarios with the upper and lower limits of effects.

Table 2. Average household costs associated with facility-based delivery in 2015 USD (n=151)

Cost item	n	Mean in USD
Direct medical costs at the facility	123	6.30
Cost of supplies purchased	64	4.03
Travel costs	30	0.96
Total		11.29

Results

Intervention costs

The annualized financial cost of the design of the home-based counselling intervention was US\$34 677, and the economic cost of the design was US\$51 774 (Table 1). Staff costs accounted for 85–90% of the design costs for financial and economic costs (Figure 1). The cost of setting-up the home-based counselling programme was around three times more than designing the intervention, and was driven by the costs of training CHWs and their supervisors. (Table 1). The annual financial cost of implementation was slightly higher than the annualized set-up costs. The total annualized cost (design, set-up and implementation) amounted to just under US\$300 000 for financial costs and just over US\$400 000 for economic costs. Staff were the main drivers of costs of set-up and of implementation (Figure 1). The incremental financial cost of the intervention (annualized set-up and implementation) expressed as programme cost per capita total population represented 2.1% of public health expenditure per capita per year.

Volunteers and time use

CHWs made an average of 1.8 home visits a week, with a median time of 30 minutes per visit and 45 minutes in travel, a total of

Table 3. Cost per output and cost-effectiveness of the home-based counselling intervention, in 2015 USD

Cost, cost per output, cost-effectiveness	Financial cost	Economic cost	Economic with household costs
Annualized design+ set-up + implementation cost	280 158	412 319	449 304
Cost per woman of reproductive age	1.94	2.86	3.11
Cost per active CHW trained	340.00	500.39	545.27
Cost per home visit	3.83	5.64	6.14
Cost per mother + baby pair visited	12.58	17.82	19.48
Cost per additional facility-based delivery	85.52		137.15

2.25 hours per week spent on home visits. They spent around 2 hours with the facility supervisor each month and half an hour with the home-based counselling supervisor—the Village Executive Officer, and 1.5 hours a month on administration and preparation tasks. In total, CHWs spend 13.74 h per month on programme activities (which corresponds to about 8% of a full-time position). Additional details are presented in [Supplementary Annex Table C3](#). The monthly incentive stood at US\$3.06 per volunteer; however, the opportunity cost of their time was estimated at US\$9.19 per month, amounting to US\$30 289 in financial and US\$90 866 in economic costs directly related to home-based counselling, and representing 24% and 44% of total financial and economic costs of programme implementation, respectively.

Outputs and effects of the home-based counselling intervention

A total 824 active volunteers were trained as CHWs, and the same number of reserve CHWs and 420 supervisors were trained to support their work across the intervention area along with 82 health facility-based supervisors. Eighty percent (22 276) of the mothers in the intervention area received at least one home visit from CHWs. A total of 73 130 home visits were carried out. For the period August 2010–July 2011, mothers received an average of 3.3 home visits, which included 2.2 pregnancy visits and 1.1 post-natal visits. CHWs saw an average of 27 mothers each year, and made 1.8 home visits a week ([Supplementary Annex Table C1](#)).

The population of the intervention area was 1.2 million with an estimated 261 630 women of reproductive age. The crude birth rate was 39 per 1000 population ([DHS, 2010](#)). Hence, there were an estimated 46 800 live births among the intervention population per year. Of these, we assume 82% gave birth in a facility at endline, with a seven percentage point increase resulting from the intervention, resulting in an increase in facility-based deliveries from 38 376 to 41 652, or 3276 per year ([Hanson et al., 2015](#)). There was no effect of the programme on neonatal mortality ([Hanson et al., 2015](#)). An effectiveness threshold analysis calculating the reduction in the neonatal mortality rate required for the intervention to be cost-effective is presented ([Daviaud et al., 2017a](#)) for the countries involved in the multi-country study; for Tanzania, the annual neonatal mortality rate should decrease by 1%.

Household costs

The average household cost of a delivery at the facility was US\$11.29 ([Table 2](#)). The economic consequences of increased

service use to households (assuming zero costs were incurred for deliveries at home) is estimated at US\$36 985 ($=3276 \times 11.29$). Hence, the total annualized economic cost of the home-based counselling intervention inclusive of household costs is estimated at US\$433 955.

Cost per output and cost-effectiveness of the home-based counselling intervention

The intervention cost is between US\$1.94 and US\$3.11 per woman of reproductive age for financial and economic costing (inclusive of household costs) ([Table 3](#)). The cost per mother–newborn pair visited was between US\$12.58 and US\$19.48, and the incremental cost per additional facility-based delivery ranged from US\$85.52 to US\$137.15 for financial and economic costs (with household costs). In the sensitivity analysis, the financial cost per additional facility-based delivery ranged from US\$64.37 to US\$99.71; the economic cost (inclusive of household costs) ranged from US\$102.50 to US\$162.76.

Sensitivity analysis

Under sensitivity analyses, eliminating design costs decreased the annual economic cost of the home-based counselling intervention by 13% to US\$360 545. Variation in salary costs resulted in a $\pm 3\%$ change in the annual economic cost relative to the base case (between US\$399 529 and US\$425 621). When changing the discount rate used to derive the annuitization factor from 3% to 0–6%, the economic costs varied $\pm 3\%$ from US\$400 579 to US\$424 282. In the best and worst case scenarios, the annual economic costs varied from US\$341 011 to US\$437 954. In the sensitivity analysis of the effects, variation between the lower and upper estimates of effect from the 95% confidence interval (5.6–9.3%), resulted in an additional 2621–4352 facility-based births. Combining the best and worst case estimates of costs with the potential variation in effects, the economic cost per facility-based delivery inclusive of household costs varied from US\$90 to US\$178.

Modelling of financial costs of scale-up of the home-based counselling intervention

In Scenario 1, if the home-based counselling intervention was delivered as part of the routine health system, the annualized financial costs of set-up and implementation (excluding the one-off design costs) if delivered solely by local staff would amount to \$23 4864, a decrease of 4% on the actual study costs. The cost per mother visited would be \$10.54 and the cost per home visit at \$3.21. The programme would represent 2.0% of district public health expenditure (government + donors) per capita. If coverage of households reached increased from 80% to 95% and the number of visits per mother/baby pair increased from 3.5 to the target 5, the total financial cost of the programme would only increase marginally to US\$236 157, but with higher number of home visits, the cost per home visit would reduce to \$1.79 per home visit ([Table 4](#)).

In Scenario 2, with one CHW per village and four visits per mother, a CHW would make 5.4 home visits a week and spend 6.8 hours on the programme (13% over the set 6 hours maximum time per CHW per week) for 95% coverage (3.9 home visits and 5.4 hours for 70% coverage). The cost per mother visited would stand at \$5.77 and at \$1.44 per home visit.

In Scenario 3, standardizing to 100 000 population with the country crude birth rate in 2012 of 39.7 per 1000 population (lower than that observed in the study at 47.8 per 1000), the cost per mother visited would be US\$6.90 and at US\$1.73 per home visit for

Table 4. Assumptions and Costs for 3 scale-up scenarios in 2015 USD.

Description	Scenario 1: as per package design		Scenario 2: increased CHW workload and efficiency		Scenario 3: Standardization to 100 000 total population	
	Achieved (3.3 visits)	Target (5 visits)	Average 4 visits	Target (5 visits)	Average 4 visits	Variable
	Actual	Target	Variable	Target	Variable	Variable
Coverage Assumptions						
% of potential mothers visited	80	95	50	70	50	70
Total population per CHW	707		1413		1413	
Number of mothers visited	22 276	26 453	13 923	19 492	1985	2779
Number of visits/mother	3	5	4		4	
Total home visits	73 130	132 264	55 690	77 966	7940	11 116
Number of CHWs	824		412		71	
Number of mothers per CHW/year	27	32	34	47	28	39
Visits per CHW/week	1.8	3.3	2.8	3.9	2.3	3.3
CHW hours on programme/week	3.3	4.9	4.2	5.4	3.5	4.4
Cost per mother (\$)	10.54	8.93	10.68	7.72	12.84	6.90
Cost per home visit (\$)	3.21	1.79	2.67	1.93	3.21	1.73
Programme cost (\$)	234 864	236 157	148 656	150 381	25 490	25 736
Programme cost per capita total population (\$)	0.40	0.41	0.26	0.26	0.25	0.26
Programme cost as % public health expenditure per capita	2.0		1.3		1.3	
Crude birth rate per 1000 population	Study 2011 47.8	Country 2012 39.7				

95% coverage, and an average of four visits per mother. A volunteer CHW would spend an average of 5.5 hours a week on the programme.

In both Scenarios 2 and 3, increasing coverage from 50% to 95% with four visits per mother would increase programme cost by only 2%.

Discussion

In this article, we aimed to understand the main drivers of home-based counselling intervention costs and look at its replicability and sustainability in the context of Tanzania.

The home-based counselling intervention involved substantial design and set-up costs. The main cost drivers of set-up costs were the activities related to community health worker training and on-going support. The costs of implementation were slightly higher than the set-up costs. The main drivers of implementation costs were QRMs, management and volunteer time. Volunteers spend just under 14 hours per month on programme-related activities, with a total 824 volunteer CHWs used by the programme. The valuation of the time of volunteers is a further key variable affecting programme cost, with the current value of incentives paid representing only a third of the actual value of their time valued at its opportunity cost. When volunteers were valued in terms of the incentive payment made by the programme, this input amounted to a quarter of the costs of programme implementation. However, when valued at their true economic cost, in terms of income foregone owing to time spent on the programme, their input was just under half of total implementation costs. The importance of valuing volunteer time in economic evaluation has been recognized (Goodrich *et al.*, 2012), although there is still no consensus as to the best way to do this, with a variety of valuation options being possible. The approach used in this study, under economic costing, was a human capital approach, which valued time based on the minimum wage as a proxy for the likely revenue or value of activities carried out by the volunteers in the absence of the programme. However, this approach is seen by some to overestimate the value of lost time, which may be better estimated through stated preference measures, based on volunteers' required level of compensation to carry out specific activities (van den Berg *et al.*, 2005). The data collected on volunteer time were based on volunteer recall captured through interview, which could result in bias. However, observations of volunteer activity were not possible owing to resource constraints.

Increasing access to facility-based deliveries in the programme also resulted in additional household costs amounting to just under US\$37 000 across the intervention population. The incremental cost per facility-based delivery varied between US\$86 and US\$132 per additional facility-based delivery in the base case analysis, and between US\$64 and US\$165 in the sensitivity analysis. This is lower than that estimated for a supply-side programme designed to increase service uptake, payment for performance, implemented in another area of Tanzania (US\$479 per additional facility-based delivery) (Borghi *et al.*, 2015). However, the programme is less cost-effective, when considered in relation to this single outcome, than voucher schemes to increase access to maternal and child health services. The reported cost-effectiveness of these schemes varied from US\$33 per additional institutional delivery in Uganda (Alfonso *et al.*, 2015) to US\$91 in Bangladesh (Laurel H *et al.*, 2010). However, such comparisons should be handled with caution owing to differences in data sources, birth rates and the scope of costs included in the studies. Furthermore, home-based counselling addressed a wide

range of behaviours, and facility-based deliveries was just one among a range of other behaviours affected by the programme, such as antenatal coverage and hygiene during delivery and breastfeeding (Hanson *et al.*, 2015).

The programme effectively covered 80% of the target population, and greater coverage may conceivably be achieved over time as volunteers get used to the programme. In the perspective of scale-up and integration in a routine system, we modelled an efficiency scenario, reducing to one the number of CHW per village. Unpaid volunteers can only be expected to work a limited amount of hours a week, which we assumed to be 6 hours a week. In a scenario with 95% of mothers covered by the programme with four visits per mother, CHWs would spend an average of 6.8 hours a week on the programme, given the crude birth rate in the study area. If, however, the lower national crude birth rate was applied to a 100 000 total population, CHWs would spend an average of 5.5 hours a week on the programme for the same scenario.

To reflect the programme scale-up as part of the routine health system, we applied local salaries for management and support and focused on the annualized incremental financial costs of set-up and implementation moving from two CHWs per village to one CHW with the same study population and crude birth rate would translate into a decrease of 35% in the cost of the programme, increasing the sustainability of the programme and the improvement of neonatal health.

According to the ongoing local government and health sector reforms in Tanzania, districts are encouraged to allocate funds for intervention implementation according to the intervention-addressable burden of disease (Ministry of Health, 2001). The health funding contributed by donors, 'basket funding', enables districts to choose which interventions to adopt based on a minimum package of essential health interventions provided by the Ministry of Health and Social Welfare. As newborn-related problems are a major part of the overall burden of disease in Tanzania, it follows that knowledge on how much it costs to address newborn and child survival issues could inform district health managers fund allocation decisions.

Conclusion

Home-based counselling requires substantial set-up costs, and the costs of ongoing implementation vary in function of the estimated value of volunteer time. Cost-effectiveness compares well with supply-side initiatives to increase coverage of facility-based deliveries, and a substantial increase in scale and intensity of intervention coverage could be achieved at minimal additional cost.

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Supplementary data

Supplementary data are available at *HEAPOL* online.

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Note

1. Ministry of Health. Tanzania: National Health Accounts, 2001 [http://www.afro.who.int/dsd/nha/country-nha/tanzania-nha.pdf]

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