

Community-based intervention packages facilitated by NGOs demonstrate plausible evidence for child mortality impact

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Introduction Evidence exists that community-based intervention packages can have substantial child and newborn mortality impact, and may help more countries meet Millennium Development Goal 4 (MDG 4) targets. A non-governmental organization (NGO) project using such programming in Mozambique documented an annual decline in under-five mortality rate (U5MR) of 9.3% in a province in which Demographic and Health Survey (DHS) data showed a 4.2% U5MR decline during the same period. To test the generalizability of this finding, the same analysis was applied to a group of projects funded by the US Agency for International Development. Projects supported implementation of community-based intervention packages aimed at increasing use of health services while improving preventive and home-care practices for children under five.

Methods All projects collect baseline and endline population coverage data for key child health interventions. Twelve projects fitted the inclusion criteria. U5MR decline was estimated by modelling these coverage changes in the Lives Saved Tool (LiST) and comparing with concurrent measured DHS mortality data.

Results Average coverage changes for all interventions exceeded average concurrent trends. When population coverage changes were modelled in LiST, they were estimated to give a child mortality improvement in the project area that exceeded concurrent secular trend in the subnational DHS region in 11 of 12 cases. The average improvement in modelled U5MR (5.8%) was more than twice the concurrent directly measured average decline (2.5%).

Conclusions NGO projects implementing community-based intervention packages appear to be effective in reducing child mortality in diverse settings. There is plausible evidence that they raised coverage for a variety of high-impact interventions and improved U5MR by more than twice the concurrent secular trend. All projects used community-based strategies that achieved frequent interpersonal contact for health behaviour change. Further study of the effectiveness and scalability of similar packages should be part of the effort to accelerate progress towards MDG 4.

Keywords Child health, outcomes, non-governmental organizations, community mobilization, Millennium Development Goals

KEY MESSAGES

- A group of 12 non-governmental organization (NGO)-implemented maternal child health projects using community-based intervention packages in diverse settings was studied. The project areas experienced population coverage increases for all 17 indicators tracked by at least one project for which concurrent subnational Demographic and Health Survey (DHS) comparison data were available. Each project consistently simultaneously raised several population-based health outcomes faster than concurrent subnational secular trends, as measured by DHS, despite variations in project context and design. The average annual coverage change for the indicators was 2–59 times greater than the DHS comparison change.
- When the statistically significant population coverage changes in the project areas for key interventions or practices were modelled with the Lives Saved Tool—a technique validated for such projects in a previously published article—the estimated decline in under-five mortality rate (U5MR) was greater than concurrent subnational secular trend in 11 of 12 cases ($P=0.0032$). On average, the annual U5MR improvement was more than twice the concurrent trend (5.8 vs 2.5% per year).
- The projects used similar strategies to increase access to and quality of services, improve knowledge of preventive practices and curative services and increase community support for positive health practices. Most of the community-based strategies had the aim of achieving frequent interpersonal contact with mothers and other caregivers of children under five for health behaviour change. Ten of 12 of the projects reported achieving at least monthly contact with a majority of caregivers in the project area through outreach from facilities, community support meetings and household visits.
- There is a strong need for partnerships between governments, NGOs and academia to further study the effectiveness and scalability of similar community-based intervention packages to help accelerate progress towards Millennium Development Goal 4.

Introduction

Two-thirds of the world's 7.7 million annual child deaths could be averted through a set of evidence-based high-impact interventions, outlined in recent *Lancet* series (Bryce *et al.* 2003; Jones *et al.* 2003; Darmstadt *et al.* 2005; Black *et al.* 2008). Some evidence also suggests that community-based strategies can effectively deliver these interventions in high-mortality, resource-poor settings (Freeman *et al.* 2009; Bhutta and Lassi 2010). However, to achieve the Millennium Development Goals (MDGs), there is still a gap in the evidence base for effective implementation strategies for these interventions, particularly at the community level, especially under realistic field conditions (Rajaratnam *et al.* 2010). The US Agency for International Development's (USAID's) Child Survival and Health Grants Program (CSHGP) maintains a database of non-governmental organization (NGO) child survival projects. Since its inception in 1985, CSHGP has funded 420 Maternal, Newborn and Child Health (MNCH) projects, implemented by 55 US NGOs and their local partners in 62 countries. The projects all utilized community-based intervention packages (i.e. they delivered more than one intervention via common platforms and strategies) (Lassi *et al.* 2012) focused on increasing preventive practices and access to quality curative care services at community and facility levels and implemented under realistic field conditions in one or several districts in resource-poor settings. We use the term community-based to refer to health activities that take place in community settings and involve community members in their design and implementation. All projects used a variety of community-based strategies with the aim of achieving frequent interpersonal contact of caregivers and decisions makers for improvement of health behaviours.

Interpersonal communication and community mobilization were two commonly used strategies. Interpersonal communication employs face-to-face interactions between a health educator or community health worker and women/caregivers in one-on-one or group settings within the home or elsewhere in the community. Community mobilization refers to a capacity-building process to facilitate community individuals, groups or organizations to plan, carry out and evaluate activities on a participatory and sustained basis to improve their health and other needs (Howard-Grabman and Snetro 2003), and was implemented in varying degrees. In some projects, NGOs also supported government efforts to implement community case management programmes for diarrhoea, malaria and/or pneumonia. Projects developed the local capacity of health workers and community members (faith-based and community leaders and/or community health volunteers), and mobilized community groups (community support groups, women's groups, etc.). The technical interventions and strategies employed by these projects are explained in more detail elsewhere (MCHIP PVO/NGO Support n.d.).

Figure 1 shows the logic model for the implementation, documentation and analysis of these CSHGP projects. Each project measured health outcomes on a population basis, both the utilization of health services (e.g. antibiotics for pneumonia, etc.) and the practice of health behaviours (e.g. exclusive breastfeeding, use of an insecticide-treated bednet, etc.). Although the projects are not designed for research purposes and therefore do not have monitored comparison areas, they nevertheless are implemented in a standardized fashion and share common characteristics that enable before–after analyses, both in aggregate and across projects. Each project has baseline and endline population-level indicators for key MNCH

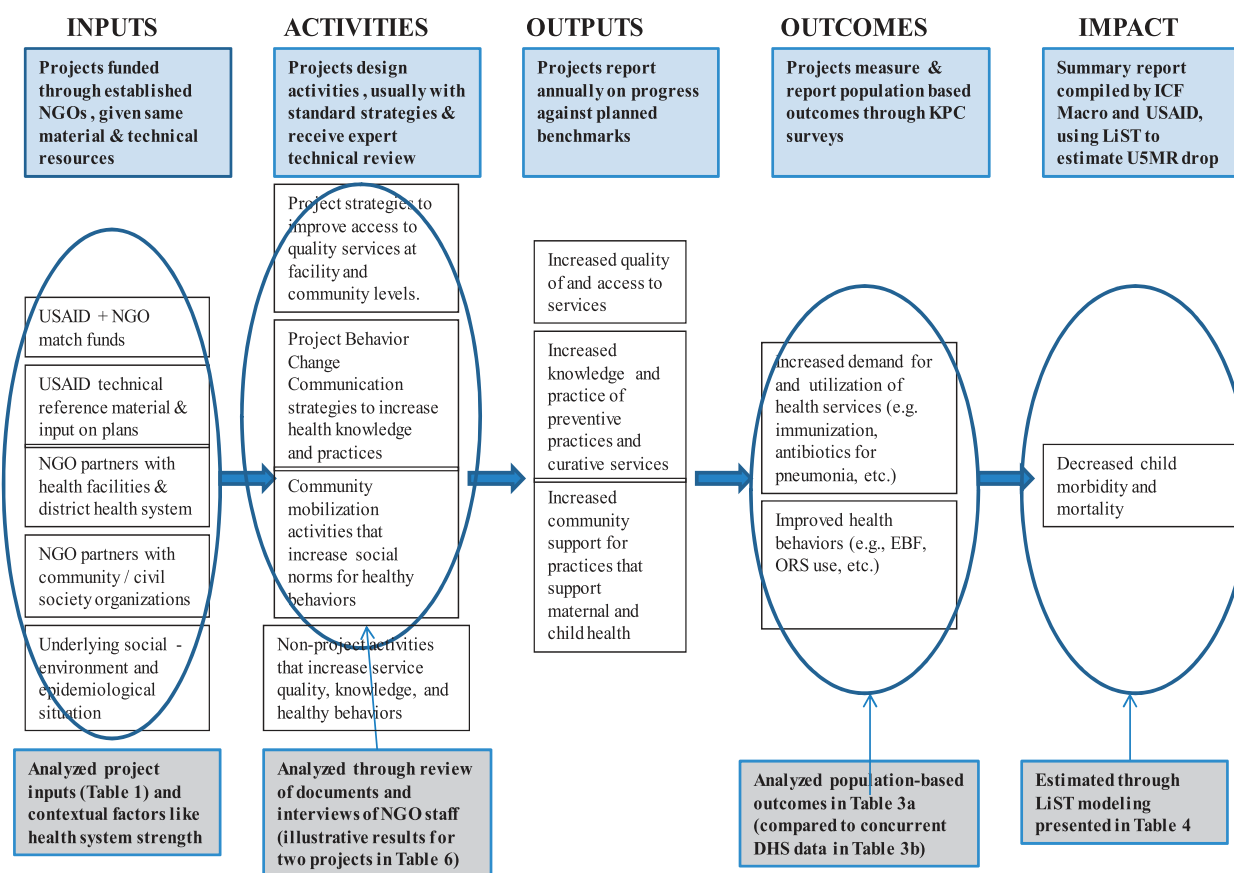


Figure 1 Logic model: project documentation (top), implementation (middle) and analyses (bottom).

outcomes consistent with concurrent Demographic and Health Survey (DHS) data, allowing comparisons with regional and national data sets. Thus, analyses can be done approximating quasi-experimental design. All projects implemented high impact evidence-based interventions with much overlap with the *Lancet* series on child survival (Jones *et al.* 2003), neonatal care (Darmstadt *et al.* 2005) and nutrition (Black *et al.* 2008). Each project used locally adapted strategies to deliver an integrated package of services consistent with best practices (e.g. Marsh *et al.* 2004; Edward *et al.* 2007; Shrestha 2009; Sarriot *et al.* 2010; Taylor 2010).

One of the most intensively studied of these CSHGP projects is World Relief’s Vurhonga project in Chokwe District, Gaza Province, Mozambique, implemented from 1999 to 2003. It had 20 000 children under five in its target area and documented coverage increases for eight child health indicators included in the Lives Saved Tool (LiST), a validated tool that can be used to estimate child mortality impact by modelling the effect of population coverage changes of evidence-based interventions. A published independent evaluation of the mortality experience in the project area estimated a 39% reduction in under five (U5) mortality during the 4-year project period (9.3% per year), agreeing well with the estimate of mortality decline derived from the project’s community-based vital registration system (Edward *et al.* 2007). During this same period, the DHS documented a 4.2% annual secular decline in U5 mortality in Gaza Province. When the project’s coverage data, supplemented with concurrent subnational DHS data, were modelled in LiST,

the modelled estimate of the U5 mortality rate (U5MR) decline agreed well with the measured change (Ricca *et al.* 2011). In other words, there was plausible evidence that the project area experienced a decline in child mortality more than twice as great as the concurrent secular trend in the surrounding area and that modelling in LiST accurately estimated this.

This study aimed at testing the generalizability of the published findings on the mortality experience in the Vurhonga project to the other projects in the CSHGP database. It reviewed 12 projects in the CSHGP database completed within the prior 12 months that had sufficient information for analyses of the coverage changes for evidence-based interventions for reducing U5 mortality. As none of these projects had independent direct U5MR estimates, project coverage data were modelled in LiST to estimate mortality effects. There have been several articles demonstrating the validity of LiST modelling of mortality from DHS coverage data used as the comparison in this study (Amouzou *et al.* 2010, 2012; Victora *et al.* 2011). An analysis was also done to elucidate the project strategies likely to have caused the apparently accelerated decline in U5MR.

Methods

Units of analysis and inclusion criteria

This study received approval from ICF’s institutional review board. Informed consent was obtained from all study participants, who were NGO project staff. Study personnel searched

the USAID CSHGP database for projects to include in this analysis, and agreed on the following three inclusion criteria: (1) the project was completed within 1 year of study initiation to facilitate interviews with NGO staff on project strategies ($n=30$); (2) there were complete baseline and endline coverage data for all indicators for project interventions with evidence for impact on child mortality included in LiST (three projects excluded); and (3) there were data from two DHS surveys, one within 3 years of project baseline and the other within 3 years of endline for comparison of coverage and mortality data (15 projects excluded); 12 projects in the database met the three inclusion criteria. Table 1 provides a description of the projects. Seven projects were in sub-Saharan Africa, four in South and Southeast Asia and one in the Caribbean. All projects were in rural areas, implemented from 2001 to 2007; lasted 4 or 5 years in one or several districts with a median total population of 184 000 and 39 800 children under five; and had budgets of ~\$2 million. They spent a median of \$2.23 per capita annually, representing a median of 38% of national governmental per capita health expenditure (range 17–95%) (WHO 2007).

Measurement of coverage changes at the population level

All projects obtained informed consent for their surveys. They all collected population-based coverage data at baseline and endline using a small-sample survey instrument known as the Knowledge, Practices and Coverage (KPC) survey, based on DHS questions (MCHIP PVO/NGO Support 2000). KPC surveys cover mothers/caregivers of children 0–23 months of age. Project interventions cover children 0–59 months of age. This is explained further elsewhere (Ricca *et al.* 2011). Sampling uses either 30×10 cluster sampling or Lot Quality Assurance sampling, designed to detect statistically significant baseline/endline differences of $\sim \pm 16\%$ ($\alpha = 0.05$, $\beta = 0.20$) for an indicator whose baseline value is 50%. All KPC results are reported to the USAID database and checked for accuracy by ICF staff. All project documents were reviewed by the study team (i.e. financial reports, detailed implementation plans, annual reports, midterm and final evaluations). Project managers were interviewed through a structured instrument to confirm the accuracy of project coverage data in the central database and gather in-depth information on project strategies.

DHS data for comparisons

DHS survey data were used for comparison of the same interventions used by the project (Demographic and Health Surveys 2009). The DHS data were from the subnational area in which the project was located. Two DHS surveys were used to calculate the change in coverage. The first DHS survey was done within 3 years of project baseline and the second DHS survey was done within 3 years of the endline. In all cases, the subnational sample was representative of the region and not a reanalysis of data.

LiST modelling

LiST is a cohort model of child survival from 0 to 59 months of age. Version 4.3 of the LiST tool, current in May 2011, was used for modelling and downloaded from the Johns Hopkins

Table 1 Basic information for the 12 projects that fitted inclusion criteria for analysis

Country	Region where project implemented	NGO	Project base-line and endline years	First and second DHS years	Target area total population	Target area children 0–59 months	Total project budget	Annual project expenditure per capita	Project expenditure as % government health expenditure per capita ^a
Benin	Borgou District	Medical Care Development Inc.	2002–7	2001–6	186 654	33 104	\$1 879 001	\$2.52	28.3%
Cambodia	Kampong Thom District	Adventist Development and Relief Agency	2001–6	2000–5	126 658	16 322	\$2 023 057	\$3.19	53.0%
Cambodia	Battambang District	Catholic Relief Services	2002–6	2000–5	154 147	33 726	\$1 891 059	\$2.45	27.4%
Cambodia	Kampong Cham District	World Relief	2002–7	2000–5	162 546	20 344	\$1 583 376	\$1.95	35.6%
Ethiopia	Amhara	CARE	2003–7	2000–5	205 826	35 993	\$1 758 080	\$2.14	95.1%
Guinea	Upper Guinea	Save the Children	2001–6	1999–2005	393 060	83 011	\$1 816 675	\$1.16	28.5%
Haiti	North-East Department	Project HOPE	2001–6	2001–5	56 778	10 381	\$2 600 000	\$8.67	44.6%
Malawi	Southern Region	International Eye Foundation	2002–6	2000–4	237 000	42 542	\$2 195 478	\$2.32	41.1%
Mali	Kayes	PLAN USA	2002–6	2001–6	315 520	67 457	\$1 733 333	\$1.10	16.5%
Nepal	Central Region	PLAN USA	2002–6	2001–6	525 799	78 870	\$1 509 964	\$0.57	17.5%
Rwanda	Butare Prefecture	Concern Worldwide	2002–6	2000–5	152 134	24 494	\$1 933 657	\$2.54	40.1%
Rwanda	Cyangugu Prefecture	World Relief	2001–6	2000–5	152 981	25 241	\$1 854 243	\$2.42	40.6%

^aReference: World Health Organization (2006).

Institute for International Programs website. The development of LiST, its structure and assumptions are described there (Johns Hopkins Bloomberg School of Public Health: Institute for International Programs, LiST home n.d.). In brief, the U5 mortality modelling in LiST is built on the Spectrum platform which models demographic trends, using national population structure and fertility data (Stover *et al.* 2010). LiST provides estimates of the cause-specific child mortality impact of 40 interventions with strong evidence of impact on child survival.

All available coverage data from the 12 projects were examined to determine which coverage indicators were appropriate to use for the coverage indicators available in LiST. The authors discussed the indicator definitions and corresponding coverage data that best fit the interventions in LiST. These project indicators were mapped to LiST interventions as shown in Table 2.

The values of changes in coverage for those interventions implemented by the project are shown in Table 3. These data were supplemented with non-project intervention data, preferentially from concurrent DHS data (see Supplementary Table S1). Where such data were not available, LiST trend file data from other sources were used [i.e. MICS (UNICEF n.d.) and The Joint Monitoring Programme (WHO and UNICEF n.d.)].

The effect sizes used for all interventions were those already included in LiST by the Child Health Epidemiology Reference Group (Walker *et al.* 2010). The cause of death profile used was that included in LiST based on national estimates. The U5, infant and neonatal mortality rates used were estimates of those specific to the project areas at baseline, as extrapolated from the subnational U5MR estimates from the DHS done within 3 years of project baseline, with the exception of Cambodia, Ethiopia and Guinea which only have national level mortality data for the baseline DHS years.

Contextual analyses

Data on several measures of health system strength were obtained from the *World Health Report 2000* (World Health Organization 2000) and data on six domains of governance were obtained from the World Bank's Governance Matters website (World Bank 2009).

Analysis of community-based strategies employed and interpersonal contacts achieved

Given the projects' emphasis on community-based strategies and previous internal LiST analyses showing that the majority of mortality effect of CSHGP projects is due to community-based activities, the team decided to analyse the projects' community strategies in more depth.

Study authors reviewed project documents, and assistants clarified questions by speaking with an informant at each of the NGOs knowledgeable about the project(s) implemented by their organization. Informants answered all questions by referring to written project documentation.

Illustrative in-depth descriptions of project strategies

The strategies employed by several NGO projects in this data set, including the Vurhonga project mentioned earlier, are

described in more detail elsewhere (e.g. Marsh *et al.* 2004; Edward *et al.* 2007; Shrestha 2009; Winch *et al.* 2005). To illustrate the types of strategies and results achieved, two projects typical of the group are described here.

CARE Ethiopia

CARE International implemented its child survival project in Farta Woreda, Ethiopia, with a rural population of 278 000. The project worked in partnership with 2400 villages (each with an average of 22 families) in 40 'kebeles' (peasant associations) and all 30 health posts, nine developing health centres, one health centre and one hospital in the area.

CARE used a variety of community-based strategies to improve preventive, home-care and care-seeking practices. CARE built the capacity of the 'woreda' and 'kebele' administrations, the Ethiopian Orthodox Church, model mothers, Health Extension Workers (HEWs) and volunteer community health workers to support women and caregivers one-on-one within the home and in community settings and to mobilize community health groups. CARE supported the community to select ~2400 'model' mothers. They facilitated bi-weekly or monthly Mother-to-Mother Support Groups (MTMSGs), each with 15–20 women, to discuss maternal and child health practices; made household visits and advocated for health at 'kebele' meetings. The project trained ~527 religious leaders and priests, at least three per church, who held health discussions after church, advocated for attendance at MTMSG meetings and performed household visits for pregnant and lactating women. When the government of Ethiopia instituted the new HEW cadre, the project trained them in counselling and child survival messages so they could support one to three previously trained Volunteer Health Workers per 'kebele'. Interpersonal communication and behaviour change activities reached nearly 100% of the population with frequent health messages which was supplemented with less intensive communication strategies including production and use of counselling cards, posters, videos and radio dramas.

CARE also built the capacity of local health facilities to improve quality of care through Integrated Management of Childhood Illness (IMCI) training, supportive supervision, essential drug revolving funds and provision of equipment and supplies. The project measured significant coverage changes in antenatal care (ANC) visits, exclusive breastfeeding, complementary feeding, measles and complete DPT3 immunization, handwashing and use of oral rehydration therapy (ORT) for diarrhoea and antibiotics for pneumonia (DT Whitson, unpublished data, p. 55).

PLAN Nepal

PLAN International implemented its integrated child survival project in the Bara District of the Narayani Zone of the Central Development Region of Nepal. The project worked in partnership with 98 village development committees (VDCs) serving a rural population of 600 000, the Child Health Division of the Ministry of Health, District health staff, Ministry of Health facilities, local NGOs and community-based organizations.

PLAN used a mix of interpersonal communication and community mobilization strategies to improve health practices. PLAN built the capacity of its local NGO partners to train and supervise 882 government Female Community Health

Table 2 Seventeen evidence-based interventions whose project-measured coverage changes were compared with concurrent DHS data and were modelled in LiST

Indicator abbreviation	Project indicator (and DHS indicator)	LiST indicator	LiST indicator description
ANC4	Antenatal care × 4	Antenatal care	Per cent distribution of live births in the 3 years preceding the survey by source of antenatal care during pregnancy
TT2	Tetanus toxoid vaccination × 2, previous pregnancy	Tetanus toxoid vaccination	Per cent of last live births in the last 3 years preceding the survey in which two or more tetanus toxoid injections were given to the mother during pregnancy
IFA	Iron folate 90+	Multiple micronutrient supplementation	Per cent of pregnant women receiving micronutrient supplementation for the duration of pregnancy
IPTp	Use of Intermittent Preventive Treatment by women during pregnancy	Use of Intermittent Preventive Treatment by women during pregnancy	Percentage of women aged 15–49 with a live birth in the 2 years preceding the survey who during the pregnancy took any antimalarial drug for prevention (two or more doses) and who received IPT
SBA	Skilled birth attendance	Skilled delivery assistance	Per cent distribution of live births in the last 3 years preceding the survey, by type of assistance during delivery (doctor or other health professional)
EBF	Exclusive breastfeeding (0–5 months)	Breastfeeding status (exclusive breastfeeding)	Per cent of children 0–5 months of age who are exclusively breastfed. Note: Breastfeeding status refers to 24 h preceding the survey. Children classified as breastfeeding and plain water only receive no other complementary foods or liquids
Comp Feed	Complementary feeding—breast-milk and complementary foods 6–9 months (no DHS indicator)	Complementary feeding—education only	Per cent of mothers intensively counselled on the importance of continued breastfeeding after 6 months and appropriate complementary feeding practices
PPV	Post-partum visit within 3 days	Preventive postnatal care	Percentage of infants delivering at home with a postnatal health contact/visit within 2 days of birth
Vit A	Vitamin A supplementation	Vitamin A supplementation	Percentage of children aged 6–59 months who received vitamin A supplements in the 6 months preceding the survey
ITN	ITN use last night by child	ITN used last night by child under five	Percentage of children under 5 years of age who slept under an ITN the night before the survey
Meas	Measles vaccination	Measles vaccination	Percentage of children 12–23 months of age who had received measles vaccine ‘by the time of the survey’ (according to the vaccination card or the mother’s report)
Full Vacc	Full vaccination with all EPI vaccines	DPT vaccine × 3	Proportion of infants having received three doses of diphtheria, tetanus and pertussis vaccine prior to the survey
Hand Wash	Handwashing by caretaker	Handwashing materials and facilities	Percentage of households with handwashing materials in dwelling/yard/plot
Latrine	Households with latrine	Flush toilet or pit latrine	Per cent of homes with access to an improved latrine or flush toilet
ORT	ORT use, last diarrhoeal episode	Treatment of diarrhoea with ORS or recommended home fluids (RHF)	Percentage of children under five with diarrhoea in the 2 weeks preceding the survey who received ORS or RHF
Abx Pneum	Antibiotics for last episode of pneumonia	Treatment of acute respiratory infection with antibiotics	Percentage of children under 3 years who were ill with a cough accompanied with rapid breathing and the percentage who were ill with fever during the 2 weeks preceding the survey ‘whose mothers sought treatment with antibiotics’
Mal Treat	Prompt antimalarial for fever (within 24 h)	Timing of antimalarial drugs taken by children with fever	Among children under age five with fever in the 2 weeks preceding the survey, the percentage who took antimalarial drugs and who took the drug the same or next day after developing fever

Volunteers (FCHVs) and traditional birth attendants in maternal and newborn care and child spacing. Project and MOH staff jointly trained, supervised and monitored FCHVs who treated children with diarrhoea and pneumonia using oral rehydration solution (ORS) and cotrimoxazole, respectively, provided contraceptives and education on birth spacing, and taught

maternal and newborn preventive care. PLAN supported FCHVs to organize and facilitate 430 pregnant women’s groups and 200 child groups. The pregnant women’s groups, each with 8–12 pregnant women, met monthly in each village. By the end of the project, 92% of the FCHVs had been involved in educating and mobilizing pregnant women’s groups to attend

Table 3 Per cent changes in coverage (baseline to final) measured in project areas for 17 evidence-based interventions (statistically non-significant changes shown in parentheses were not modelled in LiST)

Country	NGO	ANC4	TT2	IFA	IPTp	SBA	EBF	Comp Feed	PPV	VitA	ITN	Meas	Full vacc (DPT3)	Hand Wash	Latrine	ORT	Abx Pneum	Mal Treat
Benin	MCDI		26.0		29.0	(4.7)	17.3			83.0	68.0	(12.7)	28.0	11.0		29.0	(8.0)	46.0
Cambodia	ADRA	36.8	29.1			(2.0)	78.2	-21.7		43.7	(5.4)	23.2	32.2	(-4.2)				
Cambodia	CRS		(-8.4)			19.9	86.1				(3.6)	32.2	41.8	16.6		40.4	43.5	45.9
Cambodia	WR		74.0	90.3			87.0			49.7		64.0	67.0	76.2		67.9		59.4
Ethiopia	CARE	41.9	(13.7)			(7.0)	22.4	60.0		(7.1)		49.2	42.0	90.4	88.0	61.0	57.1	
Guinea	SC	23.0	(3.7)		(8.0)	23.9	33.5	19.0				23.0	22.0				28.0	
Haiti	PHOPE	(-4.6)	51.0			84.3	23.0		34.5	65.9		33.4		49.6		18.0		
Malawi	IEF		(2.1)		(11.0)	(10.0)	(3.0)			(-4.0)	52.6	(9.8)	17.0	(6.0)		18.0	30.0	
Mali	PLAN	56.3	59.7			(4.4)	50.8				94.1	32.5	26.2	(2.1)		(0.3)	40.0	24.6
Nepal	PLAN	33.0	50.4			(9.8)	38.3	23.0	52.0	(8.0)		61.7	57.0	72.7		44.0	(1.0)	
Rwanda	CWI	(-3.5)	(6.0)		41.0	36.0	23.5	-45.0	33.1	24.4	46.9	(4.4)		(-15.0)		21.3		45.0
Rwanda	WR		49.2			49.2	38.7			50.0	66.7	20.4	49.5	94.0				76.7

Where there is a blank cell, the project did not implement that intervention.

antenatal and postnatal visits and immunize children; providing support to outreach clinics at least eight times in the last 12 months and developing community maps, with which they tracked the services received by eligible women and children. PLAN leveraged its existing 200 child groups, primarily focused on child rights and school enrolment, to raise awareness and deliver messages focusing on MNCH practices to their schools, families and community. Multiple strategies were implemented to link communities with facilities to develop participatory solutions to health problems, including establishment of community drug management committees, health management committees, community health funds and advocating for financial support from VDCs for community level activities. The project reached 100% of the population with credible and effective interpersonal communication.

PLAN improved the quality of care at health facilities through IMCI training and monitoring, and assisted in ensuring all district facilities were adequately stocked with supplies and equipment. The project measured significant coverage changes in use of ANC services, TT2, exclusive breastfeeding, early post-partum visits, measles and complete DPT immunizations, handwashing and use of ORT for diarrhoea.

Results

Coverage changes for interventions with evidence of child mortality

These projects facilitated intervention on an average of 11 (range=9–13) of the evidence-based child health interventions contained in LiST, with statistically significant improvement on an average of 7.8 (range=4–9). Table 3 summarizes coverage changes measured in the project populations through the project baseline and endline surveys. When these coverage changes are compared with the concurrent DHS surveys (Table 4; Figure 2), the coverage improvements measured by the project are larger in 11 of 12 cases. The project areas showed coverage improvements better than concurrent trends in a majority of cases across all indicators examined, whether

they were home prevention/care activities (e.g. breastfeeding and ORT use) or activities indicating increased demand for and utilization of community-based services (e.g. community-based antibiotics for pneumonia) or facility-based services (e.g. skilled birth attendance).

LiST modelling

When statistically significant coverage changes were modelled in LiST, they gave the results shown in Table 5. For comparison, the first column of Table 5 shows the annual U5MR decrease in the subnational region, directly measured in the concurrent DHS surveys. Only national mortality data were available for comparison in the case of Cambodia. The next column in Table 5 shows the estimated decrease in U5MR when all coverage change data were modelled. That is, the project data were used for the interventions on which the project worked and therefore had coverage data; this was supplemented with coverage change data from other sources (mainly DHS) for non-project interventions to complete the information on the parameters needed for LiST modelling. In one of the 12 projects (Malawi), the estimated decrease in U5MR is not as great as the concurrent secular trend. In the 11 cases in which the estimated U5MR decrease in the project area was greater, the range of the ratio of project area decrease to national trend decrease is 2.2 times greater (Benin) to 3.5 times greater (Guinea). In one case (Rwanda/CWI), the concurrent trend in U5MR was deteriorating, while the modelled U5MR was improving. The average estimated annual decrease in U5MR was 5.8%, compared with 2.5% for the directly measured U5MR decrease from concurrent DHS subnational data. The probability that the comparison to DHS mortality trend favoured the project in at least 11 of 12 cases by chance is <1% ($P=0.0032$).

The last column in Table 5 shows the results of estimated mortality effect of only modelling the coverage changes from project interventions. This is a way of isolating the effect of the project itself. It is interesting to note that in 5 of the 12 cases, the estimated U5MR decline is greater when the project data are modelled without the added secular trends for non-project

Table 4 Concurrent per cent changes in coverage measured from DHS1 to DHS2 in comparison subnational area

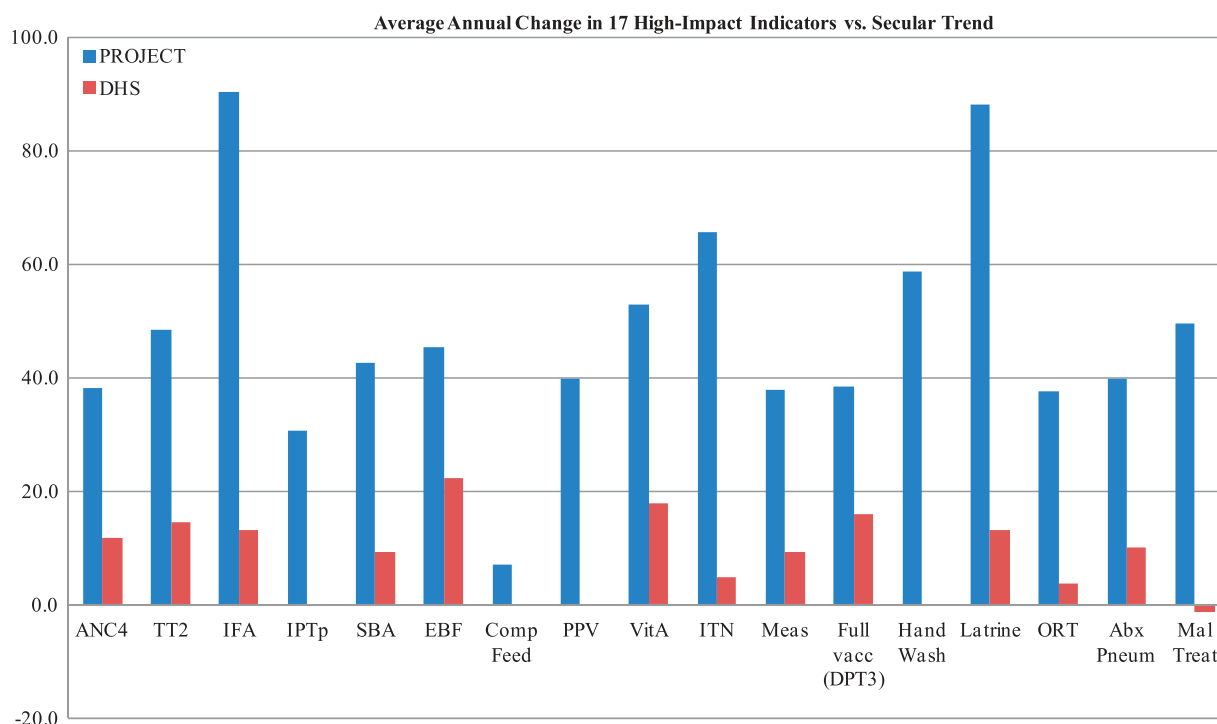
Country	NGO	ANC4	TT2	IFA	IPTp	SBA	EBF	Comp Feed	PPV	VitA	ITN	Meas	Full vacc (DPT3)	Hand Wash	Latrine	Water Connect in Home	ORT	Abx Pneum	Mal Treat
Benin	MCDI	-8.4	-5.0	13.6		-2.3	6.8			-4.7	-0.4	0	0		9.8	23.9	0	2.2	5.8
Cambodia	ADRA	38.0	34.9	7.8		16.2	58.3			48.0 ^a	0 ^b	6.1	40.4		4.3	6.3 ^c	14.4	4.2	0 ^b
Cambodia	CRS	43.2	27.6	25.6		14.6	58.3			48.0 ^a	0 ^b	22.6	24.7		0	6.3 ^c	-5.4	20.9	0 ^b
Cambodia	WR	35.3	32.8	7.0		35.8	58.3					38.5	59.2		7.4	7.7 ^c	42.3	33.3	0 ^b
Ethiopia	CARE	10.2	29.0 ^d							-19.7	0 ^b	11.6	15.5		36.3	12.5	11.5	4.1	0 ^b
Guinea	SC	20.2	4.7			3.6	18.9			93.0 ^a		-2.2	5.7		91.2	0.1	-7.0	4.0	0 ^b
Haiti	PHOPE	2.5	16.1	25.6		22.8	21.4			-20.1		10.1	13.4		-22.1	-20.5	-9.5	-9.2	
Malawi	IEF	0.6	5.4	8.6		3.6	13.2			-8.4		-8.8	-4.9		5.3	-9.6	19.7	8.0	-5.9 ^b
Mali	PLAN	-23.9	26.5	16.1		-17.0	12.4			47.0 ^a	25.0 ^b	15.6	28.3		4.0	-3.5	-20.7	20.6	-6.5 ^b
Nepal	PLAN	18.0	22.0	26.5		15.1	-15.3			7.9		16.2	19.4		22.5	7.4	-0.9	-0.2	
Rwanda	CWI	6	-18.8	1.2		8.2	6.0			4.2		5.6	-3.5		0.2	-11.6	-0.7	25.9	-3.4 ^b
Rwanda	WR	-0.1	-2.6	0.2		2.0	6.0			0.8		-4.9	-8.5		-0.5	-19.6	2.2	6.6	-3.1 ^b

^aData Source: www.childinfo.org; LiST.

^bData Source: Multiple Indicator Cluster Survey (MICS); LiST.

^cData Source: Joint Monitoring Programme; LiST.

^dData Source: WHO/UNICEF 'Protected at Birth'; LiST.

**Figure 2** Average annual change in high-impact indicators.

interventions. This is the result of the fact that the coverage for some non-project interventions was deteriorating in some comparison areas. The largest decrease in the estimated annual U5MR decline is 25% (Nepal), and the average change in the parameter was 0% (i.e. no change) when only project data were modelled, compared with modelling all LiST interventions.

Sensitivity analyses

The results of the sensitivity analyses are shown in Table 6. All key parameters used in the LiST model were varied by 10% in either direction. The largest changes in the modelled annual decrease in U5MR were caused by varying the baseline cause-attributable death rate for the most important cause of U5MR. In one case (Benin) when decreasing this parameter for

Table 5 Changes in U5MR directly measured by DHS and estimated for project area by modelling with LiST

Country	NGO	Measured annual decrease in U5MR (DHS)	Estimated annual decrease in U5MR, ALL interventions modelled in LiST	Estimated decrease in U5MR, ONLY PROJECT interventions modelled in LiST
Benin	Medical Care Development International	5.9	6.7	6.2
Cambodia	Adventist Development and Relief Agency	2.5 ^a	4.6	3.9
Cambodia	Catholic Relief Services	2.5 ^a	7.2	7.8
Cambodia	World Relief	2.5 ^a	7.0	6.7
Ethiopia	CARE	5.9	9.9	8.8
Guinea	Save the Children—USA	0.6	2.4	2.3
Haiti	Project HOPE	1.9	5.3	5.9
Malawi	International Eye Foundation	5.8	4.1	3.8
Mali	PLAN USA	4.3	6.2	6.4
Nepal	PLAN USA	7.8	9.0	8.6
Rwanda	Concern Worldwide	2.0	5.8	5.6
Rwanda	World Relief	-3.4	6.9	7.0

^aNational DHS mortality data.

Table 6 Results of sensitivity analysis: upper and lower bounds of modelled annual U5MR decrease are shown when key modelling parameters varied as indicated

Country	NGO	Estimated annual decrease in U5MR, ALL interventions modelled in LiST (%)	Baseline U5MR varied by 10% points	Baseline proportion of deaths from greatest cause of national U5 Mortality varied by 10%	Coverage change of intervention with largest estimated impact varied by 10% ^a
Upper and lower bounds of modelled annual U5MR decrease					
Benin	Medical Care Development International	6.7	6.7–6.8	5.6–7.6	6.6–7.0
Cambodia	Adventist Development and Relief Agency	4.6	4.2–5.0	4.1–5.1	4.3–4.8
Cambodia	Catholic Relief Services	7.2	7.0–7.6	7.2–8.2	7.0–7.3
Cambodia	World Relief	7.0	6.8–7.1	6.9–7.9	6.7–7.0
Ethiopia	CARE	9.9	9.7–9.9	8.4–11.2	9.6–10.0
Guinea	Save the Children—USA	2.4	2.4–2.5	2.2–2.4	2.2–2.6
Haiti	Project HOPE	5.3	5.1–5.5	5.0–6.0	5.2–5.5
Malawi	International Eye Foundation	4.1	4.1–4.2	3.8–4.6	3.8–4.5
Mali	PLAN	6.2	6.1–6.2	5.3–7.3	5.8–6.6
Nepal	PLAN	9.0	8.8–9.3	8.3–10.1	8.1–9.0
Rwanda	Concern Worldwide	5.8	5.7–5.9	5.7–6.0	5.6–5.9
Rwanda	World Relief	6.9	6.8–7.0	6.8–7.5	6.8–7.0

^aExcept when increasing coverage parameter by 10% would put final coverage at over 100%.

the most important cause of death, the difference disappeared in the estimated annual change in U5MR in the project area compared with concurrently measured DHS mortality trend. For all other projects, varying any of the three key parameters did not change the conclusion that the annual decline in U5MR in the project area was greater than the concurrent decline in the subnational DHS comparison area.

Community engagement and frequent interpersonal contact

Although all projects also supported improvement in access to and quality of care at health facilities, the majority (average

67%, range 46%–88%) of estimated lives saved in LiST modelling by project interventions was gained through community-based interventions. All projects used a variety of interpersonal communication and community mobilization strategies focused on building or strengthening partnerships with communities to improve health-related practices at the community and household level. The strategies varied to respond to the local context, but all aimed at frequent contact between caregivers of children under five and credible sources of health information. These sources included health personnel, community members, such as community health volunteers, trained faith-based leaders, trained community leaders and community support groups. All

projects had similar mechanisms for such frequent interpersonal contact, and 10 of 12 of them (all except Malawi and Haiti) documented data consistent with at least monthly contact with a majority of mothers and other caregivers of children under five throughout the project period. The health objectives of such contacts varied by project and potentially included behaviour change activities, community support aimed at improved home preventive practices (e.g. handwashing), home treatment (e.g. ORT use) and/or careseeking for community services (e.g. community case management of pneumonia) or facility-based services (e.g. skilled birth attendance).

Coverage levels significantly increased in spite of weak settings

All projects worked in rural settings in Africa, Asia and the Caribbean with moderate to high child mortality, and all were in countries prioritized on the Countdown to 2015 list (WHO and UNICEF 2010). The average U5MR in the project countries was 145.6, compared with 121.1 in all other Countdown countries. The projects also worked in areas with weak health systems. The average WHO 2000 ranking for health system strength was 155 of 190 for the project countries. This compares with an average ranking of 144 for all other Countdown countries. Governance was also weak, as measured by the World Bank's 2002 scoring for government effectiveness, regulatory quality, rule of law, corruption, civil society voice and stability.

Discussion

This analysis contributes preliminary evidence that NGO-facilitated projects utilizing community-based intervention packages can contribute to improving coverage for multiple high-impact interventions simultaneously at the scale of one or several districts. The results are similar to the results from a previously published analysis of a single NGO project from the same database. That is, the average estimated annual decrease in U5MR in this group of project areas is more than twice that measured directly by concurrent DHS data.

The study has limitations because each individual project did not collect data from a comparison area, and may have had confounding variables or other activities that improved coverage in the project area. Project personnel themselves collected the baseline and final population coverage data, which opens the possibility of bias; however, the data were reviewed by an outside field-based evaluator and are reported to a central database where it is also checked. A previous analysis of a project from this database (Ricca *et al.* 2011) with similarly collected coverage data and direct mortality estimate showed good agreement with LiST modelling estimates, giving some evidence that biases are likely to be small. There is some evidence of ongoing underreporting of early neonatal deaths in the DHS (Oestergaard *et al.* 2011); however, if this bias was constant over the study period, then the 'difference' in mortality rates measured here should not have been affected. Finally, the project itself was within the DHS region used for comparisons, and therefore contributed to the improvements in coverage and mortality measured there. This would have tended

to 'decrease' the improvements registered in the project area compared with the comparison area. The authors feel that these counterbalancing limitations taken together should not have biased the results significantly. The authors feel that this analysis provides plausible evidence that the community-based intervention packages employed were effective in improving coverage, especially given that coverage changes improved so consistently across project areas examined, even for interventions whose coverage was declining in the same subnational region at the same time.

While all projects packaged several interventions using various strategies, they focused their efforts on strategies to improve health-related behaviours of mothers and other caregivers of children, which were implemented by local Ministry of Health and civil society partners under realistic field conditions in the type of areas where progress needs to be made to reach worldwide MDG 4 targets, as opposed to being part of tightly controlled research projects. Some of the projects that performed best were implemented in the weakest contexts. For instance, the project in Mali was in an area with an U5MR of 250. The project in Ethiopia was working within a health system ranked 180 of 190 by WHO in 2000. The median project area had ~35 000 children. This is larger than the highly studied Matlab area which in 2005 had ~27 000 children under five (ICDDR,B 2010).

Evidence from both controlled trials and routine settings highlights the capacity of community-based strategies to improve health outcomes (Azad *et al.* 2010; Baqui *et al.* 2009; Manandahar *et al.* 2004; Morrison *et al.* 2005; Baqui *et al.* 2008a,b; Bhutta *et al.* 2008b, 2010; Kumar *et al.* 2008; Arifeen *et al.* 2009; Bryce 2010; Tripathy *et al.* 2010). However, recent evaluations of large scale child health programming found community components to be weak, with variable population coverage (Bryce *et al.* 2010).

These projects are typical of the even larger group of NGO projects funded by USAID over the last two decades. They were chosen for this analysis not because of their presumed successful outcomes, but because they represented the most recent group of projects with both project and concurrent DHS information necessary for the analyses. The fact that all 12 projects eligible for inclusion in the analysis raised coverage levels of key interventions and 11 of 12 were estimated to have reduced U5MR beyond secular trend suggests that success was due to overall effectiveness of the strategies these integrated and largely community-based projects employed, rather than to the effectiveness of a specific intervention. The technical interventions ranged from changing household behaviours with direct health effect (e.g. exclusive breastfeeding and handwashing), to household behaviours that also required a commodity [e.g. ORT use and insecticide-treated net (ITN) use], to increasing demand for and utilization of community-based services (e.g. immunization and community case management) or of facility-based services (e.g. ANC and skilled birth attendance). Projects also varied in their use of specific interpersonal communication and community mobilization strategies. For instance, PLAN mobilized local NGOs, World Relief employed mothers' groups and CARE focused on mobilizing religious leaders. What is likely to be the key determinant is that while each project's strategy was designed

to fit the context culturally and epidemiologically, it always achieved frequent interpersonal contact with a large fraction of the target population, with the aim of improving health behaviours of the caregivers of children. These projects were implemented in rural settings in a variety of countries, implying that these strategies can be implemented effectively in a variety of environments.

Other analyses have shown that community-based behaviour change strategies have produced results at moderate and larger scale (Kumar *et al.* 2008; Schaetzel 2008; Thompson and Hartyunyan 2009; McPherson 2010). At national scale, several countries also have had successful experiences with similar community-based strategies. For instance, there is the successful experience in Honduras with the AIN-C system for community-based growth promotion and behaviour change related to health and nutrition (Schaetzel *et al.* 2008) in which groups of mothers convene monthly community-based growth monitoring sessions. In Nepal, various community-based interventions have been delivered through the FCHV system, often coupled with Mothers' Group volunteers (McPherson *et al.* 2010). This latter example began simply as a means for mass distribution of vitamin A, but has since layered on several other interventions successfully, such as breastfeeding promotion and community case management of pneumonia. This national community-based strategy is now integrated in a similar way to this NGO-facilitated programming.

As concerted efforts are made to accelerate the achievement of MDG 4 by scaling up community-based strategies (Bhutta *et al.* 2011; Lozano *et al.* 2011; Barros *et al.* 2012; Bhutta 2012; Liu *et al.* 2012), particularly in underserved areas with weak health systems and low health facility coverage, NGOs can play important roles. NGOs can assist in capacity-building efforts with government and local civil society counterparts to improve the quality of the local health system; improve equitable access by effectively linking communities with the health system; increase community health-related knowledge and practices for both preventive and curative care; and increase community support and norms for positive health behaviours. These capacity-building services are critical as many governments are in search of effective strategies for task shifting of service delivery towards lower level health workers and into communities themselves.

This analysis conforms to many of the 'real world' analytical methods proposed recently by global evaluation experts (Victora *et al.* 2009), aimed at generating practical lessons that help the effort to revitalize a focus on primary health care, particularly at the district level (Sanders 2004), while also contributing to national and global evidence. There is an increased emphasis on the role of programme learning to strengthen effective implementation of national policies and strategies at scale (Walley *et al.* 2007; Countdown Coverage Writing Group 2008; Ghebreyesus 2010; Mangham and Hanson 2010; Peterson 2010; Zachariah *et al.* 2010; Victora *et al.* 2011). The larger group of projects, with their standardized metrics and documentation, from which this sample was drawn, provides a database for further study of effective community-based intervention packages. There is a strong need for partnership between NGOs, academia and governments to identify the characteristics of the most effective and scalable strategies to

help achieve MDG 4, especially those strategies that need to be standardized and those that should be tailored to local conditions. A shared research agenda with NGO implementers to build evidence for scaling up community-based intervention packages in routine settings is needed to help reduce child mortality in pursuit of MDG 4, especially in high-mortality settings.

Supplementary Data

Supplementary data are available at *HEAPOL* online.

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The information and views presented in this article are solely those of the authors and do not necessarily represent the views or the positions of the USAID or the US Government.

Author contributions

J.R. participated in the research design, implementation, data collection, data analysis and manuscript writing. K.L. and D.P. participated in the data analysis and manuscript writing.

N.K. and L.R. participated in manuscript writing. All authors have seen and approved the final version of the manuscript.

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Conflict of interest

None declared.

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