Pro-sustainability choices and child deaths averted: from project experience to investment strategy

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The pursuit of the Millennium Development Goals and advancing the 'global health agenda' demand the achievement of health impact at scale through efficient investments. We have previously offered that sustainability—a necessary condition for successful expansion of programmes—can be addressed in practical terms. Based on benchmarks from actual child survival projects, we assess the expected impact of translating pro-sustainability choices into investment strategies.

We review the experience of Save the Children US in Guinea in terms of investment, approach to sustainability and impact. It offers three benchmarks for impact: Entry project (21 lives saved of children under age five per US$100 000), Expansion project (37 LS/US$100k), and Continuation project (100 LS/US$100k).

Extrapolating this experience, we model the impact of a traditional investment scenario against a pro-sustainability scenario and compare the deaths averted per dollar spent over five project cycles.

The impact per dollar spent on a pro-sustainability strategy is 3.4 times that of a traditional one over the long run (range from 2.2 to 5.7 times in a sensitivity analysis).

This large efficiency differential between two investment approaches offers a testable hypothesis for large-scale/long-term studies. The 'bang for the buck' of health programmes could be greatly increased by following a pro-sustainability investment strategy.

Keywords Child health, community, developing countries, vulnerable populations, strategic planning, sustainability

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KEY MESSAGES

- We compare two scenarios for scaling up effective health interventions through the funding of project cycles, in order to emphasize critical principles and suggest improved investment practices: a traditional investment scenario and a pro-sustainability scenario.

- The impact per dollar spent on a pro-sustainability strategy is 3.4 times that of a traditional one over the long run.

- Our analysis creates an evidence-based hypothesis for the possible gains in impact to be made by designs allowing long-term, degressive and conditional funding.

- Consistency of purpose for both national and external stakeholders and practical pro-sustainability choices result in higher impact.

Introduction

Whether targeting great pandemics (such as HIV, AIDS, tuberculosis, malaria), the maternal and child health agenda, chronic illnesses of the epidemiological transition (diabetes, cardiovascular diseases, cancer) or new infectious diseases (avian and pandemic influenza), the tone for global health is clearly set, and rightly so, on making a difference in terms of achieving impact at scale within national systems (Garrett 2007).

A positive development has been a growing emphasis on national or local 'ownership' (OECD 2005), echoing past concerns about institutionalization (Goodman and Steckler 1993). This reflects an ongoing concern for sustainability, even though concerns about efficiency and affordability of programmes risk taking second stage while the money flows in the race to scale. Sustainability concerns will increase as financial crises and competing emergencies place increasing pressure on governments, non-profit organizations and donor countries' aid budgets.

While conceptual discussions about the place and definition of sustainability in the development context have a long history and are likely to endure (Bossert 1990; Shediac-Rizkallah and Bone 1998; Gruen 2008), we have offered a practical focus on the sustainability of health outcomes, based on a system approach and the development of key capacity areas among diverse stakeholders (Sarriot et al. 2004a). Among others (Olsen 1998; GFATM 2005), we have offered that building for sustainability is a sine qua non of long-term impact on a large scale (Sarriot et al. 2008).

In this paper, we compare two scenarios for scaling up effective health interventions through the funding of project cycles, in order to emphasize critical principles and suggest improved investment practices. Our analysis links practical questions of sustainability and scale. The findings should be relevant to international development agencies and donors, but also to developing countries' governing bodies (governmental or other). These institutions will continue to be charged with providing essential services and health benefits to their entire population, and one way or another they will have to do so by scaling up and institutionalizing interventions first implemented as individual 'field projects'.

We start our discussion with a review of Save the Children and partners' achievements during consecutive Child Survival projects in two districts of Guinea, where repeated evaluation findings initially stimulated the questions and analyses of this article.

Background: One experience in scaling up an effective Child Survival strategy

Save the Children operated two consecutive projects funded by the US Agency for International Development (USAID) Child Survival and Health Grants Program (Box 1) in Upper Guinea, over a 10-year period (1996–2006).

Save the Children worked consecutively in two districts in Upper Guinea, a savannah zone bordering Mali and the Ivory Coast. The two districts (Mandiana and Kouroussa) are sparsely populated and have a total population of 393 060 living in 527 villages (see Table 1). The local economy is based on agriculture, traditional mining of gold and small-scale commerce. The region experiences a period of low availability of food each year from July to September. In Upper Guinea, 87.3% of women have no schooling.[1] Women have key roles as caretakers of children and managers of food resources within the family. The maternal mortality rate was 528/100 000 live births in 1999 and the infant mortality rate (IMR) was 98/1000. The under-five mortality rate was 177/1000 nationally, and was estimated at 222/1000 for Upper Guinea.[2]

The two sequential phases of Save the Children's project were evaluated. At each stage, elements of sustainability were reviewed (Waltensperger 2002; Sarriot 2006).

Phase 1: The Mandiana model

Save the Children developed its model for community health in Upper Guinea first through a planning grant (1996–97) and then through a first child survival project (1998–2002; project CS-14).

The project's technical interventions addressed the most prevalent causes of infant and maternal mortality, and included nutrition/Vitamin A, immunization, maternal and newborn care.[3] The three main cross-cutting strategies for carrying out the technical interventions were: (1) community mobilization to improve demand for, access to and use of key health services; (2) behaviour change interventions at the household

Table 1 Total and beneficiary populations of the two districts

		Total population[a]	Children under five[b]
Phase 1	Mandiana	170 188	36 977
Phase 2	Mandiana	208 804	45 368
	Kouroussa	184 256	40 034
	Total	393 060	85 402

Sources: [a]1996 Census; [b]Estimates from 1996 Census.

Box 1 Child Survival and Health Grants Program (CSHGP) overview

Since 1985, CSHGP has channelled over US$500 million (two-thirds provided by USAID itself), through 420 projects implemented by 55 US-based NGOs in 61 countries. CSHGP grants are mid-size project grants (usually ranging from US$1.5–2 million over 3 to 5 years), and have provided critical child survival interventions, including nutrition, but also addressed maternal health, family planning, HIV/AIDS and tuberculosis. CSHGP grants are substantial enough to allow for serious evaluation design, notably through the systematic use of baseline and final population-based health surveys.

(Program statistics accessed at: http://www.childsurvival.com/projects/statistics.cfm, 21 February 2008.)

Box 2 Elements of sustainability in the 'Mandiana model'

Institutional sustainability was supported by building the capacity of partners, as well as strong communication and collaboration among the various stakeholders, including the prefectoral health directorate ('Direction Préfectorale de la Santé'—DPS), village health committees (VHC), and community health centre management committees ('Comité de Gestion et de Santé'—COGES). VHCs were established in all 73 main villages, and satellite VHCs (or relay-VHCs) were installed in an additional 60 villages. By the end of project, 86% of the VHCs were judged to be functioning, rated as 'strong' (70%) or 'satisfactory' (16%) according to performance criteria developed by the project team. Emergency revolving funds (ERF), supporting transport plans for obstetrical emergencies, were functioning in all 73 main villages and were fully supported by the VHCs, community leadership and traditional authorities, including traditional practitioners.

Along with cost recovery, which is built into the Guinean health care system, community-managed revolving funds contributed to the **financial sustainability** of the project strategies. The 2002 final household survey results indicated improved knowledge and practice in all of the technical intervention areas. Qualitative data collected during the final evaluation suggested changes in community norms for behaviours related to pregnancy and delivery, breastfeeding and complementary feeding, recognition of danger signs for childhood illness, and health seeking in general—all favouring **behavioural sustainability**.

The final and acid test for sustainability is that of the **sustainability of health outcomes**, supported by these elements, and creating the central variable of this study.

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level; and (3) capacity-building at all levels of service delivery (e.g. health centres, health posts, community).

The Mandiana Phase 1 project met or exceeded most of its population health objectives (details are presented in the findings). It earned high marks from the Ministry of Health at both the regional and national levels and was recognized as a model for community health in Guinea, helping to shape national policy in the area of traditional birth attendant training. It also provided a model for community-directed revolving funds and transport plans for obstetrical emergencies. The final evaluation concluded that the project's strong community mobilization, social engagement, and capacity-building approach had strengthened institutional, financial and behavioural sustainability, particularly at the community level (Box 2) (Waltensperger 2002).

Phase 2: Scaling up the Community Health Initiative in two districts

The Community Health Initiative (CHI) for the districts of Kouroussa and Mandiana (2002–06; project CS-18) built upon the 6 years of child survival and health experience in Mandiana, and extended the model to cover the entire Mandiana and entire neighbouring Kouroussa districts. The CHI approach was based on the development of institutional and inter-organizational capacities.

CHI introduced partnerships between Save the Children and two local non-governmental organizations (NGOs). These provided an invaluable link to communities for rapidly replicating the key elements of success of the initial project: the VHCs (village health committees). An added benefit of this approach included building the organizational capacity of both the NGOs and the Ministry of Health district offices. In this strengthened partnership approach, Save the Children relinquished the direct implementation role, which it had in the previous Mandiana model. It trained NGO animators and MOH health agents, and they in turn worked with communities to

develop VHCs, train them, supervise them and act as the Health Information System liaison.

The two CHI districts included 527 villages. The total and beneficiary populations were almost triple those of Phase 1 (Table 1).

The project was designed to reduce the principle causes of high maternal and child mortality by: (1) increasing the use of key health services and improving maternal and child health practices at the household level; and (2) increasing the capacity of local entities (the district health offices, the local NGOs and community organizations) to assume responsibility for health activities and adopt innovative approaches.

The project had identified indicators considered as critical to sustainability. In addition to reinforcing the competences of NGOs and the DPS offices (Direction Préfectorale de la Santé, or Health District) in managing health information, it achieved more than 80% coverage on all the following:

- Villages with volunteers providing community-based services;
- Villages with an emergency revolving fund;
- VHCs proficient in planning and conducting community health activities;
- Villages with an established community health plan;
- Sub-districts with associations of VHCs.

The final evaluation highlighted the importance of networking and the necessary development of functional relationships in capacity building efforts, as well as the facilitative role taken on by Save the Children. It also noted where vulnerabilities were emerging in light of USAID's end of funding.

Evolution of inputs

During the first phase (Mandiana; 1998–2002) US$1.3 million were expended by the project, compared with US$1.8 million during the second phase (Mandiana and Kouroussa; 2002–06).

In the absence of comparative expenditure tracking, the final evaluation compared three metrics for project inputs into the

two districts during the second phase of the project: (1) project expenditure per village; (2) beneficiaries of new training per village; and (3) the ratio of health animators per village. The level of inputs received by Kouroussa from 2002 to 2006 was on average 2.5 times that received by Mandiana (the Kouroussa/Mandiana ratio for these three metrics ranged between 2.2 and 2.7). Correspondingly, the estimated ratio of financial inputs per total population per year went from US$1.9 for Mandiana Phase 1 to US$1.7 for Kouroussa Phase 2 and US$0.6 for Mandiana Phase 2.[4]

Methodology

Our methodology relies on four steps: (1) evaluation of project results on health outcomes; (2) estimation of the lives saved from changes in health outcome indicators; (3) use of these estimates to model two scenarios for health investments; and finally (4) sensitivity analysis of the comparison between our two models.

Evaluation of project health outcomes

Save the Children hired international consultants to lead the final evaluations in a participatory approach. Each evaluation started with the evidence-base established by comparable Knowledge, Practice and Coverage (KPC) surveys conducted at baseline in Mandiana district in 1998 and also as part of the comprehensive 2-week evaluations of the projects in 2002 and 2006.

KPC surveys are scientifically reliable and valid, low cost management and evaluation tools. The questionnaire used at each stage was based on a standard health survey tool developed by Johns Hopkins University and Macro International, and adapted for use in Guinea by Save the Children. Definition and measure of all indicators correspond to Demographic and Health Surveys and are described in the respective KPC survey guidelines.[5]

The KPC surveys carried out in Mandiana and Kouroussa measured behavioural and coverage programme indicators. The sampling methods were based upon the WHO 30 cluster approach with a total number of 10 households per cluster. A total of 300 interviews of mothers of children less than 2 years old were conducted in each district (10 mothers in each of the 30 clusters of each district). The sampling approach allows detecting statistically significant baseline-end line differences of +/− 8% (alpha = 0.05, beta = 0.20).

The project did not engage in a pseudo-experimental evaluation design, but repeated evaluation findings involving district stakeholders strongly suggested that the project played the leading role in achievement of substantial health gains. During both project phases, the USAID bilateral PRISM project implemented by Management Sciences for Health also provided institutional support to the regional Ministry of Health overseeing both Mandiana and Kouroussa districts in Upper Guinea. The level of support from PRISM impacted equally both districts and both phases of intervention (contributing to making Intermittent Preventive Treatment (IPT) available to pregnant women, for example, during the second phase in both districts, while the Child Survival project promoted promotion and prescription of IPT at service delivery points). There were no other external projects providing health systems strengthening support. The evaluations' conclusion that the two Save the Children project phases had a major responsibility in the improvement of health indicators was supported by the more than substantial improvements in health indicators in Kouroussa during the second phase of the project, when it 'caught up' with Mandiana (see Results and Table 2).

Estimation of the number of lives saved from project coverage changes

Although Save the Children's project achieved substantial additional benefits in terms of morbidity, quality of care, community and institutional development, our analysis is

Table 2 Changes in health indicators in Mandiana and Kouroussa through two project phases

Lives saved intervention data	Mandiana CS-14 (Phase 1)		Mandiana CS-18 (Phase 2)		Kouroussa CS-18 (Phase 2)	
	Baseline coverage (*n*, *N*)	Final coverage (*n*, *N*)	Baseline coverage (*n*, *N*)	Final coverage (*n*, *N*)	Baseline coverage (*n*, *N*)	Final coverage (*n*, *N*)
Antenatal care, at least 2 visits in last pregnancy	45%	86%*	86%	88%	64%	96%*
	(133, 293)	(259, 300)	(259, 300)	(261, 298)	(379, 589)	(281, 292)
Maternal tetanus toxoid × 2, last pregnancy	24%	51%*	51%	73%*	64%	81%*
	(70, 293)	(154, 300)	(154, 300)	(129, 177)	(156, 243)	(183, 225)
Skilled birth attendance, nurse or doctor	10%	23%*	23%	40%*	20%	47%*
	(29, 293)	(70, 300)	(70, 300)	(119, 298)	(115, 589)	(137, 292)
Exclusive breastfeeding, 0–5 months	9%	39%*	39%	67%**	31%	72%*
	(7, 82)	(35, 90)	(35, 90)	(58, 87)	(46, 148)	(86, 119)
Measles immunization before 12 months	15%	68%*	68%	51%	18%	58%*
	(21, 139)	(52, 77)	(52, 77)	(43, 84)	(32, 177)	(45, 78)
Antibiotics for pneumonia, community or facility	20%	43%	43%	55%	24%	59%***
	(5, 25)	(15, 35)	(15, 35)	(23, 42)	(21, 87)	(17, 29)

Statistically significant difference: *$P < 0.001$; **$P < 0.01$; ***$P = 0.02$.
Source: KPC Surveys.

limited to the 'hard' metric of lives saved, which we will then use to model results vs. inputs under two scenarios.

The IMPACT tool[6] was developed by the Child Health Epidemiology Reference Group (CHERG[7]) for the 2003/2005 Lancet child/neonatal survival series. It estimates the impact on child mortality of increases in the coverage of evidence-based health interventions (Jones *et al.* 2003; Darmstadt *et al.* 2005). It has been used to provide estimates of mortality reduction, based on changes in coverage indicators of essential life-saving interventions in mother and child health (Masanja *et al.* 2008). This was used to estimate the number of lives saved of children under five during each of the project periods, based on the number of children under five in project areas, and the baseline and final coverage levels for each of the child survival interventions implemented,[8] based on coverage data from the KPC surveys for 0–23-month-old children extrapolated to 0–59-month-olds.[9] (See Statistical Annex for more details).

Only statistically significant positive changes were modelled. The size of the population at the mid-term of the project was used to convert coverage changes to absolute numbers of lives saved. Estimates of population growth rate were obtained from the US Census Bureau.

The six coverage indicators used in the modelling of lives saved are presented in Table 2 with the findings. Utilization of bed nets was not used due to inconsistencies during the two project phases.

Mandiana and Kouroussa thus provided three benchmarks for impact per input level:

- *Entry project*: based on Mandiana Phase 1 achievements;
- *Continuation project*: based on Mandiana Phase 2 achievements;
- *Expansion project*: based on Kouroussa (Phase 2).

The 'natural' secular trend in under-five mortality in rural Guinea during the period of study was estimated from the national 1999 and 2005 DHS surveys.

Modelling investment scenarios' inputs vs. impact

We extrapolated the Mandiana and Kouroussa benchmarks to develop two simplified models or scenarios for consecutive project funding cycles, and to examine the comparative cost of saving the life of one child. (As a post-hoc analysis this does not purport to be an econometric cost-benefit study; we only offer a *comparison* of the *relative* cost of impact in two approaches, all other things being held constant.)

Under both scenarios, we consider five districts over five project cycles of 4 years, with the following assumptions:

- All five districts have the population size, demographic and epidemiologic profile of Mandiana and Kouroussa, with 45,000 children under five as direct beneficiaries. Since our objective was to compare two hypothetical scenarios, we ignored demographic trends and assumed stability in the district populations.
- All districts have the same high baseline child mortality; and our only metric for health impact will be lives saved compared with the Year 0 status.
- We assume a population large enough and a mortality ratio severe enough at Year 0 to avoid ceiling effects in lives saved.

- The decline in under-five mortality in Upper Guinea between the 1999 and 2005 DHS provides an estimate of the secular trend in reduction of mortality (0.56% per year).
- There are no external confounding interventions except for the projects funded under the two scenarios. Assumptions for project effectiveness, based on the benchmarks set above (Entry, Continuation, and Expansion) are presented under each scenario.

Traditional scenario

For this exercise, we define the 'traditional' scenario simply as one where funding stops abruptly at the end of the first funding phase, and where subsequent funding is geographically and operationally disconnected from a prior phase. In terms of Child Survival Grants (see Box 1), from the first cycle to the 23rd cycle of funding, out of 419 grants addressing maternal, neonatal and child health, 364 grants (87%) have followed this pattern.[10] This is also the case for many small-scale health projects supported by numerous donors, some operating for months or a few years (and many failing to even have clear baseline and final assessments of population health). There are obviously more issues defining a project approach as 'maximizing sustainability' or being 'traditional' than the length of funding; these are addressed briefly in our discussion. Our modelling exercise minimizes these differences and isolates the funding strategy over time as a central incontrovertible feature.

Under the traditional scenario, a project receives US$1.5 million funding for one cycle. There is no extension after the first cycle. At each following phase, another project is funded in another district, in a different region or country. There is no natural connection between districts. A total of US$7.5 million are disbursed over five phases and benefit five different districts (Figure 1).

Assumptions about impact under this scenario are the following:

- A new project funded for one phase leads to a comparable number of lives saved as observed in Mandiana Phase 1 (Entry Phase).
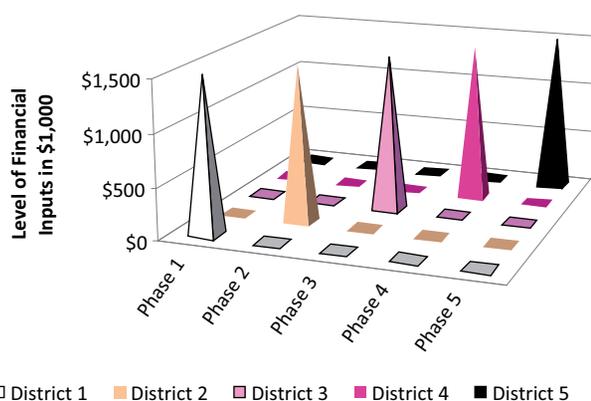- Total impact corresponds to the addition of results from five unrelated entry projects.

Figure 1 Grant scheme according to the traditional scenario (in US$1000)

- The most challenging assumption is to define how much sustainability of achieved outcomes can be expected under a traditional scenario. There is here a dearth of literature providing quantitative estimates. Past studies emphasize how gains achieved after a cycle of funding will rapidly be lost in the following years (Bossert 1990; Lafond 1995; Shediac-Rizkallah and Bone 1998; Sarriot *et al.* 2004a; Sarriot *et al.* 2004b). We probed a number of practitioners in the NGO community, at the World Bank and USAID, and could not find quantitative estimates, merely agreement with low-end estimates (from 20% to 40% sustainability of achieved outcomes). One bed-net distribution intervention in the literature reported continued progress in utilization of bed-nets 3 to 6 years after the end of a project (Lindblade *et al.* 2010). While it could be argued that this project's early focus on the post-project period separates it from 'traditional' projects, we chose to use its result as a high benchmark for sustainability of health outcomes under a traditional project scenario (120% sustainability of outcomes from one phase to the next).
- In the end, we modelled a traditional scenario and allowed the sustainability of outcomes from one phase (funded) to the next (no funding) to vary between 0% and 120%, and provided the number of lives saved at each level, as the basis for a sensitivity analysis (see below).

Maximizing sustainability scenario

In previous publications, we have described a method and approach not only to designing projects, but also to evaluating them to enhance sustainability (Sarriot *et al.* 2008; Sarriot *et al.* 2009; Sarriot and Jahan 2010). Briefly stated, the central element of this method requires the involvement of local stakeholders through a systemic approach, and the development of an evaluation model systematically including specific health outcome and health services indicators, institutional and community capacity, viability issues, and the social-ecological environment. Capacity building becomes more explicit (Sarriot and Jahan 2010) and inscribed within a local long-term perspective. All these elements cannot be discussed in depth in this paper, but our maximizing sustainability scenario focuses on the possibilities created by a long-term funding commitment (obviously with conditionalities). Investments after a first phase of funding are reduced—quite considerably— but directed strategically based on a sustainability evaluation model (Sarriot *et al.* 2009). In terms of inputs, the main feature of this scenario is a progressive phasing out rather than an abrupt end to investments in each district (Figure 2).

Assumptions for impact under this scenario are as follows:

- The initial impact of the first project (Mandiana Phase 1) and is identical to the first scenario (adjusted for level of funding).
- For additional neighbouring districts, the impact of the project cycle is that of an Expansion project (Kouroussa).
- Through improved design and targeting of funds based on a long-term sustainability strategy, the gains of one phase are maintained and augmented during the next as was the case in Mandiana Phase 2 (Continuation project).
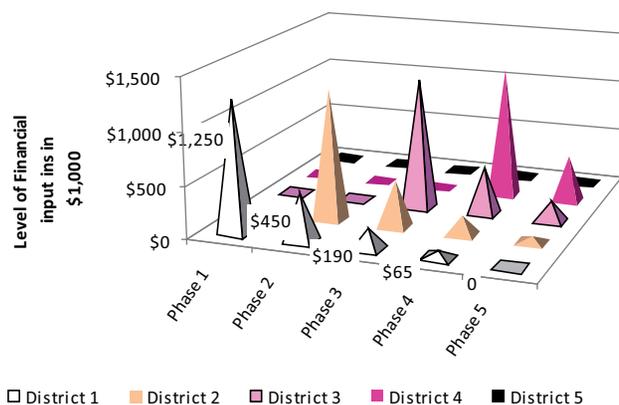

Figure 2 Grant scheme according to the maximizing-sustainability scenario (in US$1000)

- The achievements in Mandiana Phase 2 can be related to two types of effect:

(i) Sustainability of gains made during Mandiana Phase 1, which we will assume to be always at least equivalent to the sustainability level of a traditional project; and

(ii) Direct impact of continued funding in Mandiana, which we will adjust in the opposite direction to maintain the overall level of impact observed equal to that in Mandiana Phase 2 (Continuation Project). We will assume that this direct impact is never lower than under the Expansion phase (Kouroussa) benchmark.

Sensitivity analysis of the comparison of two models

Having set a variable range for the estimates of our two models, we tested the sensitivity of the observed difference in our two models' estimates, across a plausible range of results for each scenario.

Results

Lives saved (impact) in Mandiana and Kouroussa per financial inputs

The two project evaluations reported that a number of health indicators statistically significantly improved. Table 2 shows progress in Mandiana and Kouroussa for the health indicators targeted consistently by the two successive projects and used in the lives saved analysis.

Table 3 shows the resulting lives saved. Kouroussa benefited from lessons learned, institutional linkages, decreased startup challenges, and some of the momentum created by the initial project. 478 lives were saved in Kouroussa compared with 272 in Mandiana Phase 1. For Phase 2 of Mandiana, 244 lives were saved compared with the baseline of Phase 2 (2002). If we compare the mortality level with the Year 0 baseline (1998), these 244 lives saved are in addition to the 272 lives saved in Phase 1 compared with Year 0. This yields a total of 516 lives saved in Mandiana Phase 2 over the secular trend.

Table 3 Estimated lives saved during two project phases

|	Mandiana CS-14 (Phase 1)	Mandiana CS-18 (Phase 2)	Kouroussa CS-18 (Phase 2)
Lives saved from:			
Diarrhoea	40	48	73
Pneumonia	136	131	245
Measles	27	0	25
Neonatal – total	105	101	177
Asphyxia	30	22	50
Preterm	5	4	9
Sepsis/pneumonia	40	39	73
Tetanus	29	37	45
Diarrhoea	2	3	4
Total lives saved for project period	**308**	**281**	**520**
Estimated lives saved due to secular trend per project period	36	37	42
Project-attributable lives saved per project period	272	244	478
Additional project-attributable lives saved compared with Year 0	n.a.	272	n.a.
Total project-attributable lives saved compared with Year 0 (1998) [direct and maintained impact]	**272**	**516**	**478**
Baseline U5MR	210.6	203.9	203.9
Final estimated U5MR	190.1	186.7	175.8
% estimated drop in U5MR (for project period)	10.0%	8.0%	14.0%

U5MR = under-five mortality rate.
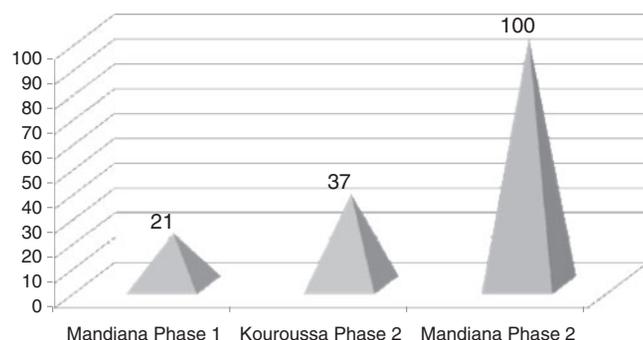
Figure 3 Children's lives saved per US$100 000 project expenditure in Mandiana and Kouroussa

Table 4 Additional lives saved under the traditional project funding scenario with 50% sustainability of outcomes from one phase to the next (on top of secular trends and compared to Year 0)

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total
District 1	314	157	78	39	20	608
District 2	0	314	157	78	39	588
District 3	0	0	314	157	78	549
District 4	0	0	0	314	157	471
District 5	0	0	0	0	314	314
TOTAL	314	471	549	588	608	2530

Both Mandiana in Phase 2 and Kouroussa show dramatic improvements in deaths averted per dollar invested. Figure 3 shows the project-attributable lives saved (LS)—excluding the secular trend—compared with Year 0 per US$100 000 in project funding for Entry projects (21 LS/100k), Continuation projects (100 LS/100k), which combine direct impact plus maintenance of first phase impact, and Expansion projects (37 LS/100k).

The number of lives saved per dollar invested for the Expansion project is nearly twice that of the Entry project. For the Continuation project, it is nearly five times greater than for the Entry phase, due to a combination of increased efficiency of funds (similar to the Expansion phase) and to sustainability of the Entry phase gains.

Impact over time of two funding strategies (scenarios)

Traditional scenario results

Each project receives the same amount of funding and achieves the impact of an Entry project. This corresponds to 315 lives saved in addition to the secular trend. If there is no sustainability at all (0%) from one phase to the next, the total number of lives saved is the accumulation from five project phases (1569 lives saved).

If we take a maximally optimistic hypothesis whereby 120% of the gains from one phase are maintained over the next phase, repeated in five districts, the total number of deaths averted (in addition to the natural trend) is 6167. These are two extreme hypotheses. Table 4 presents a middle-of-the-road hypothesis with 50% sustainability (above what most practitioners usually would expect), which results in 2530 lives saved.

The cost for one life saved over five districts and five cycles respectively is thus US$2964 (minimum: US$1216; maximum: US$4779).

Maximizing sustainability scenario results

Increases in lives saved are due to a combination of continued funding direct effects and to sustained gains from one phase to the next in the Continuation districts. They also come from the increased impact in expansion districts.

For the Continuation districts, if there were no sustainability of Mandiana 1 efforts, this would correspond to the direct impact of 100 LS/100k of the Mandiana 2 benchmark. Alternatively, the same result could be created by a reduced impact but more sustainability from the Mandiana 1 results. The lowest impact level should be that of Kouroussa 2 (i.e. 37 LS/100k), as there is no reason for Mandiana 2 to be less effective than Kouroussa 2. To obtain the same overall result, this would require 119% sustainability of Mandiana 1 achievements.

Those are the two extremes providing a range of lives saved from 4169 to 8909. Table 5 offers a breakdown based on a hypothesis of 100% sustainability (meaning no further improvement but no loss of the gains in mortality),[11] which results in 8485 lives saved.

The cost for one life saved over five districts and five cycles, respectively, is thus US$884 (minimum: US$842; maximum: US$1799).

Sensitivity analysis

Table 6 presents a range of possible and plausible scenarios for both traditional and maximizing-sustainability scenarios. Since both scenarios are based on the same total expenditure, each cell of Table 6 presents the ratio of lives saved by the maximizing-sustainability scenario over the traditional scenario. The intersection of our most plausible hypotheses for the traditional and maximizing scenarios is close to the median of the distribution of observed ratios.

The pro-sustainability investment scenario benefits 3.4 times the number of children (range 2.2 to 5.7 times the number of lives saved) as the traditional scenario. On the other hand, it fully neglects the last district.

Discussion

We discuss the limitations of our model and then implications for health sector investment strategies.

Strengths and weaknesses of our comparison

As stated in the Methodology, our two scenarios simplify the reality and do not pretend to produce econometric estimates, only relative estimates. They are, however, rooted in the experience of Mandiana and Kouroussa, which is also that of other projects. For example, a recent post-project sustainability

Table 5 Additional lives saved under the pro-sustainability project funding scenario (on top of secular trends and compared with Year 0)

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total
District 1	262	473	562	593	593	2483
District 2	0	465	676	766	796	2703
District 3	0	0	465	676	766	1906
District 4	0	0	0	465	928	1393
District 5	0	0	0	0	0	0
TOTAL	262	938	1703	2499	3083	8485

Table 6 Ratio of lives saved under the maximizing-sustainability scenario over lives saved under the traditional scenario, for a range of sustainability of outcome effects

			Maximizing-sustainability scenario: Range for post-funding health outcomes sustainability in Continuation phase [total estimated lives saved]						
			Plausible range				*Possible range*		
			119% [8909]	100% [8485]	80% [7923]	60% [7215]	40% [6326]	20% [5331]	0% [4169]
Traditional scenario: Range for post-funding health outcomes sustainability [total estimated lives saved]	*Plausible range*	0% [1569]	5.7	5.4	5.0	4.6	4.0	3.4	2.7
		20% [1863]	4.8	4.6	4.3	3.9	3.4	2.9	
		40% [2270]	3.9	3.7	3.5	3.2	2.8		
		50% [2530]	3.5	3.4	3.1	2.9			
		60% [2838]	3.1	3.0	2.8	2.5			
		80% [3626]	2.5	2.3	2.2				
	Possible range	100% [4708]	1.9	1.8					
		120% [6167]	1.4						

assessment in Bangladesh found similar efficiency gains of Phase 2 over Phase 1 and the additional benefits of working in a neighbouring municipality (as was the case with Kouroussa) (Sarriot and Jahan 2010). There is room for controversy about the scale of the differential between our two scenarios, but none about its direction. The sensitivity analysis shows a robust positive effect of the maximizing-sustainability scenario, even beyond the range of plausible values for both scenarios.

A range of factors, environmental and other, can affect our two scenarios. We must distinguish between factors likely to affect both scenarios (and which do not change the overall conclusions) and systematic errors in assumptions, which would suggest a bias in our model.

Validity of our two simplified models

Our simplified models do not delve into the details of how one would design a project to maximize sustainability, but merely model what could be expected under two different scenarios.

Concrete recommendations for improving the design and evaluation of projects toward greater sustainability are detailed in ours and other authors' publications referenced in this paper. Obviously, a 4 or 5-year project can integrate greater or lesser elements of sustainability, even within its single-phase timeframe. Our analysis merely creates an evidence-based hypothesis for the possible gains in impact to be made by designs allowing long-term, degressive and conditional funding. If fundamental conditions are not respected, however, simply maintaining funding over the long-run is not in itself a pro-sustainability choice. In fact, the case has been made that long-term funding sometimes follows unsustainable projects, because programme officers in donor offices can be tempted to 'throw good money after bad', thus contributing to aid-dependency (Catterson and Lindahl Claes 2003).

The longer timeframe and degressive funding nature of our maximizing-sustainability scenario simply creates a space allowing the respect of sound but too often neglected principles such as: a locally owned system-view of health development, which must be informed by regular measurement of population health outcomes (rather than mere inputs or even project outputs), determined efforts at capacity building joined at the hip with the kind of accountability allowed by these repeated measures, a proper accounting of social and societal issues (addressed as 'community capacity', 'social cohesion' and 'institutional partnerships'), and phased-out funding based on clear conditionalities.

The traditional scenario does not allow this, because:

- While results can be achieved rapidly, capacity building, development of partnerships, accountability and social capital simply do not happen on the same timeframe, no matter how much we want to believe it does.
- The transaction cost of continuously setting up projects remains high, and the opportunity cost of not building on successful investments is even higher.

Our model underestimates the difference in impact

Our analysis likely underestimates impact, as it only considers deaths averted, while it includes all project expenditures, regardless of programme allocation. There are certainly benefits to the health system beyond the final impact on lives saved, starting with morbidity, quality of care, capacity built, etc. Adding other achievements to the model could only reinforce our findings, but would have brought a great deal of methodological difficulty in measurement.

Similarly, experience would suggest that a district having achieved gains in one area and receiving targeted funding toward continued capacity building would be more effective at absorbing additional government or external support to address a new health issue. Our model does not examine this positive spill-over effect of capacity building.

The net result is a likely under-estimation of the impact differential between the two scenarios.

Our model assumes a baseline situation with a huge number of avertable deaths

Our model does not account for a possible ceiling effect in lives saved, once conditions have improved. As the situation improves, additional gains will become harder to achieve, and the absence of additional metrics of success (gains on morbidity, quality of care, health system overall performance) will become all the more important. The fact that our simplified model could face ceiling effects over 16 to 20 years questions the amplitude of the arithmetic difference between the two scenarios, but not the logic of it. Undoubtedly spill-over benefits would come to play a part at that stage and there would be many ways to take advantage of the new situation created.

In the 'real world' national partners and external agencies do not operate in a vacuum

There are many more external agencies and partners, big and small, treading on the same ground and this would alter the terms of our equation.

The existence of multiple agencies is increasingly a reality and sometimes as much part of the problem as part of the solution. How this affects our model is unpredictable. It is clear, however, and widely documented, that the multiplication of agencies is a factor in confusion and loss of ownership by local institutions, creating conflicting demands and priorities on already weak institutions. Recognition of this factor is at the heart of the Paris Declaration for Aid Effectiveness and calls for alignment and harmonization (OECD 2005; Gostin 2007).

In our pro-sustainability scenario, however, the long-term commitment of one agency could be a signal to other partners who would then try to work in a complementary rather than competing role.[12] This is exemplified by the role played by GAVI on immunization. What we suggest is that rationality needs to be brought to the local/field (at least district) level, to allow for an acceleration of gains. From a local stakeholder perspective, the value of one external partner with long-term commitment certainly would outweigh the value of five external partners, each with limited financial commitments, trying not to step on each others' toes, and withdrawing after premature announcements of 'success'. This would also require a clear monitoring and evaluation plan at the district level and not solely in the hands of uncoordinated projects (Sarriot et al. 2008).

The take home message about investment strategies
Consistency of purpose and practical pro-sustainability choices result in higher impact

The take home message from our 'maximizing sustainability scenario' is that consistency of purpose pays off. The Millennium Development Goals (MDGs) represent an example of consistency in setting up global development objectives, but this consistency too often fails at the level of the regional, district and sub-district interventions, which only can deliver the changes required to achieve the MDGs. The logic of discontinued projects means that once something is achieved, attention is relaxed while new projects with new objectives come on board. Under our pro-sustainability model, the agency having supported key child survival interventions, for example, would decrease its funding but maintain focus (and support for measurement) on these issues, even if it adds funding for new objectives. It is a lot easier (and efficient) to bring new interventions to an effective intervention model rather than start afresh.

Documented successes with vitamin A supplementation and treatment of pneumonia by Female Community Health Volunteers in Nepal are one example where a national commitment consistent through time, married to a consistent measurement approach (through the DHS), was able to show lasting results.

Our analysis shows that even smaller-scale efforts can have a big pay off if they take a long-term view.

Donors need to balance public health and political imperatives

In our pro-sustainability scenario, one district remains totally without assistance. This may not be a politically viable option for a donor or for a country. In a world of vast needs and limited resources, 'salt and peppering' assistance as broadly as possible will happen through processes that are understandable from a socio-political perspective. Government and donors should however use the words 'scaling' impact cautiously, if traditional strategies cannot be replaced by more promising ones.

On the other hand, if one donor is supporting work in four districts with a long-term commitment, reflected in ongoing measurement and adjustment of investments to signals about local capacity and response, and if this commitment leads to a doubling of impact, another donor might come in support of the last district. National stakeholders using consistent 'score-cards' of progress in the different districts would likely support such a move. The alignment of the first donor to an effective national commitment expressed at the district level could create a virtuous momentum, which other donors and agencies could harmonize with.

For developing countries, it is hard to dodge the logic of efficiency. The responsibility of a government is to ensure the equitable distribution of the largest amount of public good to the greatest number of its constituents. The prospect of multiplying the benefits per dollar spent has the appeal of good common sense.

We need to move from assumptions to testable hypotheses

Some assumptions in our exercise deserve testing rather than mere debating.

Our first assumption is that extension into a neighbouring district reduces the start-up costs and leads to better results/greater impact. This assumption seems fairly reasonable. Kouroussa is one such example; our recent study in Bangladesh supports it as well. Intentional investments trying to quantify the increased impact due to this phenomenon would be useful.

We offered a wide range of assumptions for sustainability under the traditional scenario for our sensitivity analysis. These effects will vary with settings, existing capacity and the specific health issues tackled. However, this is recognized by past authors and is at the heart of the interest for sustainability studies. The negative effects of start-stop funding are expanded upon in a recent review (Witter and Adjei 2007). Further studies should try to quantify possible gains due to sustainability investment and strategic phasing out of funding.

Conclusion

The size of increase of impact for the same investment will vary by place and issue at hand, and should be put to the test. Our analysis, although only suggestive, offers an evidence-based hypothesis.

It emphasizes the potential for impact if key principles are put into practice, first among which is the principle of consistency of purpose for both national and external stakeholders. Programmes which have become better institutionalized, through policies, long-term resource allocation and ongoing measurement, tend to fare better than others. In the field of child survival, immunization can be presented as one such example. Consistency of purpose, however, is frequently lacking on many health issues, particularly at the local level, where a district will be 'assisted' in pursuing one set of objectives for a 3-year project phase, and then 'assisted' by other partners to totally focus on other indicators for the next 2 years.

Complex questions of governmental commitment, involvement of civil society, local political and cultural factors will endure, but the question of accountability will be more pertinently addressed if measurement follows commitment. In an era of emphasis on country ownership, this accountability can be shared by all partners and should involve the management level (generally the district).

Regardless of who 'owns' programmes, efforts placed into testing, researching and evaluating long-term investment approaches linking sustainability and scale would benefit countries, local stakeholders, development partners and ultimately beneficiaries. This would support other ongoing efforts at moving away from a hit-and-run mode of development assistance and accelerate progress toward the MDGs.

Endnotes

[1] Population estimates are based upon the 1996 Census with a growth rate of 1.027 per annum.
[2] Data from the Demographic Health Survey 1999.
[3] Malaria control was not addressed consistently throughout the two phases and is excluded from our analyses. Some positive results in the promotion of family planning were also observed but are not presented here, as they are not used to estimate lives saved.

[4] Source for level of funding and beneficiary population: http://www.childsurvival.com, project database.

[5] Child Survival and Technical Support + Project. Knowledge, Practice and Coverage survey [Online]. October 2007. http://www.child-survival.com/kpc2000/kpc2000_new_summary.cfm

[6] The 'Lives Saved Calculator' is available at: http://www.childsurvival.com/tools/mon_eval.cfm.

[7] http://www.who.int/child_adolescent_health/data/cherg/en/index.html

[8] Coverage levels are assumed to increase linearly from baseline to final values.

[9] Coverage was measured for 0–23-month-olds in order to obtain sufficiently large sample sizes when sub-sampling for selected interventions like exclusive breastfeeding. Extrapolation to 0–59-month-olds is unlikely to cause errors in the mortality estimation larger than the single digits for the following reasons: first, close to 90% of child mortality in Guinea occurs in the 0–23-month period; and secondly, the project was in fact, designed and implemented to cover 0–59-month-olds, so coverage for appropriate interventions actually extends to those age ranges.

[10] Project database at http://www.childsurvival.com.

[11] This corresponds to the Bangladesh experience (Sarriot and Jahan 2010).

[12] Examples of this were documented in the Bangladesh post-project evaluation referenced above.

Acknowledgements

Funding

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STATISTICAL ANNEX

The sole statistical challenge in our paper rests on the estimation of lives saved. Other elements are straightforward and explained in detail in the main body of the article:

- estimates for coverage indicators,
- test for significance of an observed difference, and,

- once changes in coverage estimates have been translated into lives saved estimates, a simple computing of total lives saved under two scenarios,
- each with plausible and possible ranges of sustainability allowing for the sensitivity analysis.

This annex focuses on the lives saved calculation.

The outcome measure used in this analysis is a cost per estimated number of child lives saved. The estimation of the number of lives saved is done using a method developed by the Child Health Epidemiology Reference Group (CHERG), and first used in the calculations for a series in *The Lancet* in 2003 (Jones *et al.* 2003) to estimate the number of child lives that could be saved by scaling up a number of evidence-based interventions. Since that time, the tools developed to make this estimation have been refined and developed and the latest version is posted (Johns Hopkins University 2010). The tool is now known as the Lives Saved Tool, or LiST. The version of LiST that was used for the estimations in this article was the version that was up to date at the time (2009). The method is described in full in Jones *et al.* (2003). Below is an illustrative example of how the calculation works and was used in this paper.

First, we looked at only those interventions employed by the project that appear among the evidence-based interventions in the LiST, that have been vetted by the CHERG as having the strongest evidence for effects on child mortality.

- Correspondingly, six interventions were examined: antenatal care (at least two visits), maternal tetanus toxoid (at least two injections last pregnancy), skilled birth attendance, exclusive breastfeeding 0–5 months, measles immunization before 12 months, and antibiotics for pneumonia in either a facility or in the community. Standard definitions were used for these indicators. This is explained in the main body of the article.

The first pass in the statistical analysis was to determine for each of the indicators for these six evidence-based interventions whether there was a statistically significant change in coverage from baseline to final. Only statistically significant changes were modelled for each of the three project phases/areas. That meant that antenatal care and maternal tetanus toxoid were not modelled in Mandiana Phase 2. Otherwise, all other coverage changes were modelled in all project phases/areas. The coverage changes modelled are shown in Table 3 of the paper.

The calculation that LiST is performing to convert these coverage changes to estimates of child lives saved is explained fully in Jones *et al.* (2003) and on the Johns Hopkins University website cited, but the example of measles immunization is used here as an illustration. The calculation is, essentially, a three component equation. That is, the number of child lives saved for measles immunization equals the number dying at baseline from measles times the effectiveness of measles immunization times the coverage change. Expressed mathematically, this is:

$$LS_{meas} = BLdeaths_{meas} \times Eff_{meas} \times \Delta Covg_{meas}$$

Working through each of these terms in turn:

- The term for the number of baseline deaths is calculated partly from project-derived data and partly from LiST. That is, first the number of children under five in the project area needs to be known. This is not the number of children reached with services but rather, more akin to the catchment area of the project, giving what is often termed the 'target population'. The project used data derived from the most recent census in Guinea. The under-five mortality rate of 210.6 for Upper Guinea from the 1999 Demographic and Health Survey was applied to get the number of baseline child deaths overall, which was estimated to be 1587 for the Mandiana Phase 1 as an example. Then the LiST model uses World Health Organization estimates for the percentage of these under-five deaths that is attributable to measles. This is a national estimate. In this case, that percentage was 1.6%, giving an estimate of 25 under-five deaths from measles at baseline in Mandiana Phase 1.
- The second term of the equation is the effectiveness of measles vaccine at specifically preventing measles deaths. The value used here is effectiveness in field trials, rather than efficacy. After review of the world's literature, CHERG determined that the best estimate for the effectiveness of measles vaccine is 90% and incorporated this in the LiST model.
- The term for change in coverage comes from the project coverage data gathered through the Knowledge, Practices and Coverage (KPC) survey described in the paper and as detailed in the discussion above in terms of which coverage changes are modelled. The measles coverage started at 15% in the baseline KPC survey in Mandiana Phase 1 and was measured at 68% at the end of Phase 1, for a change in coverage of 53%.

Putting all these terms together, one arrives at the estimate of 12 child lives saved from measles in Mandiana Phase 1. This same calculation is done by LiST for the other five interventions modelled in each of the project phases/areas, counting their contributions to the estimated reduction in child mortality from each of the major causes of child death (i.e. malaria, pneumonia, diarrhoea, measles and neonatal causes).

Finally, it should be noted that the LiST model specifically calculates the disaggregated cause-specific effects of interventions like exclusive breastfeeding that have effects on more than one cause of child death. It also avoids double counts for child lives saved by multiple interventions with effects on a single cause of death (e.g. breastfeeding and oral rehydration therapy which both have effects on diarrhoea mortality). That is, a child life cannot be saved more than once.

The other elements of calculation are described in the paper.

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