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Examining the evidence of under-five mortality reduction in a community-based programme in Gaza, Mozambique

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Summary Effective implementation of programmes with the community Integrated Management of Childhood Illness model has demonstrated improvements in care-seeking behaviours and utilisation of health services. The child survival programme implemented in Chokwe district of Gaza province, Mozambique, achieved high coverage for bed net use (80%), oral rehydration therapy for children with diarrhoea (94%) and prompt care-seeking from trained providers for children with danger signs. The project also instituted a community-based vital registration and health information system for routine surveillance of births, deaths and childhood illnesses using an extensive network of 2300 volunteers. Evidence from this system indicated a 66% reduction in infant mortality and a 62% reduction in under-five mortality. To check the reliability of the findings, an independent mortality assessment was carried out using a pregnancy history questionnaire with a sample population of 998 women using standard methodologies applied in the Demographic and Health Surveys. The mortality survey showed reductions of 49% and 42% in infant and under-five mortality, respectively. The leading causes of death identified by verbal autopsies were malaria (30%), neonatal causes (17%) and pneumonia (21.3%). These findings suggest that effective community-based partnerships that support the delivery of health services can contribute to mortality reductions.

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1. Introduction

The global donor community has been challenged to revitalise its efforts for promoting child survival following the recent review articles by the Bellagio Group (Black et al., 2003; Bryce et al., 2003; Jones et al., 2003). Evidence from developing countries has demonstrated the critical role of child survival programmes in addressing the 10.5 million deaths that occur yearly in children aged under 5 years (WHO, 2002). In 1990 at the World Summit for Children, 71 nations pledged their commitment to reduce child deaths by one-third by the year 2000. According to UNICEF (2001), that goal was achieved by only 5 of the 55 countries with an under-five mortality rate (U5MR) of 100 or more per 1000. Despite the availability of cost-effective interventions that could prevent 63% of these deaths, prevailing deficiencies in and limitations of the capacity of current health systems thwart the achievement of these goals (Adam et al., 2005; Jones et al., 2003; Sachs, 2001; WHO, 2000).

Child survival programmes implemented by non-governmental organisations (NGO) play a pivotal role in advocating for equity as they operate in the poorest communities to ensure access to and quality of basic health services. World Relief, a Christian humanitarian agency, began its relief and development efforts in Mozambique soon after the signing of the peace treaty in 1992. The country ranks among the lowest in the human development index (171) and has some of the worst health indicators in sub-Saharan Africa, with an infant mortality rate (IMR) of 101 per 1000 and an U5MR of 153 per 1000 (Instituto Nacional de Estatística/Ministério da Saúde [Moçambique], 2005). Only 30% of the population has access to health services, with approximately 500 physicians for a population of over 18 million (O'Hare et al., 2005).

1.1. Project background and rationale

The World Relief child survival programme in Guija and Mabalane districts was conducted from 1996–1999 and demonstrated impressive gains in knowledge and behaviour among rural women. The model was scaled up in Chokwe district in 2000 upon the request of the district and provincial directors. It is now being scaled up to five other districts in Gaza province. These programmes implement a community-based health promotion system using a 'care group' model that engages an extensive cadre of village volunteers. The model has also been adapted by other agencies as it supports the effective implementation of community Integrated Management of Childhood Illness (IMCI) by linking communities and health systems and includes a community-based vital registration system.

In post-conflict environments where communities are dependent on fragile health systems, alternate mechanisms of engaging communities to be active partners in health service delivery and in recording vital events are required. In 2000, the Chokwe Ministry of Health (MoH) health infrastructure was fragmented, with only 1 district hospital, 3 health centres and 14 health posts; 34 of the 48 villages in Chokwe did not have a health post. The objective of the research was to measure under-five mortality reduction in a community-based child survival programme using two methods: (1) a community-based vital registration and disease surveillance system instituted by the programme; and (2) a rigorous Demographic and Health Survey (DHS) method using pregnancy histories. The first included regular reporting of births, deaths and relevant heath information by community volunteers supervised by project health personnel. The second used the standardised DHS methods focusing on the pregnancy history module.

2. Materials and methods

2.1. Study area and programme design

The study population in Chokwe district (excluding Chokwe town) was estimated at 130 000 in the year 2000. The child survival programme trained more than 2300 female community health volunteers through health educators using a cascade training approach. The community-based child survival programme ensured equitable and universal coverage of all households with children under 5 years of age by organising 173 'care groups', each consisting of 10–15 volunteers who were trained through culturally appropriate methods of instruction (drama, song, role play, etc.). Each volunteer was assigned to ten of her neighbouring households and conducted monthly home visits to provide health education for the caretaker and to register vital events. The programme monitored behavioural changes in relation to recommended health practices and the use of formal health services for the prevention and treatment of common childhood illnesses. It also created strategic partnerships and training for village health committees, village pastors and traditional healers (*inyangas*).

Before the child survival programme was initiated, a population-based household survey was conducted to determine the total number of households in the 48 villages. In October 1999 and July 2003, baseline and final Knowledge, Practice and Coverage (KPC) surveys were conducted (Child Survival Technical Support+ KPC 2000+ Questionnaire; http://www.childsurvival.com/kpc2000/kpc2000.cfm). The KPC cluster surveys follow standard quality control procedures and the instruments were standardised by the Child Survival Technical Support project at Macro Opinion Research Corporation, which designs and conducts the DHSs. The KPC cluster surveys, which collected information on coverage of service interventions, were conducted jointly by the district MoH and project staff, who were college or highschool graduates and trained in KPC survey methods. The community volunteers were not involved in the KPC surveys. To ensure data quality and to reduce bias, project staff were sent to areas that were not under their supervision. Thirty clusters were chosen systematically from the total population in the 48 villages, and within each cluster ten households were selected randomly. In each household, caretakers or mothers of children under 2 years were selected for interview. Survey questions on demographic characteristics, care-seeking practices, immunisation coverage, etc. were adapted from the KPC survey and translated in the local Shangaan language. The villages selected for baseline and final cluster surveys were the same.

The programme instituted a community-based vital registration and health information system that facilitated the

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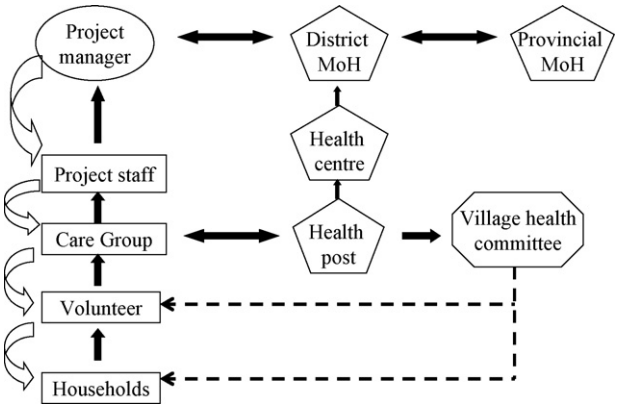

Figure 1 Community vital registration and disease surveillance system. MoH: Ministry of Health.

routine surveillance of childhood illnesses and recording of vital events. Data for the health information system were obtained by the community volunteers every month and an annual household census was conducted by programme staff. Each volunteer collected information on vital events and disease incidence every month in ten neighbouring households. This was aggregated during the monthly care group meetings and the registers were sent to the *socorristas* (MoH-trained community providers) at the health post. The *socorristas* obtained this information from all care groups and provided feedback to the village health committee, the health centres and the district MoH. This strategy also facilitated an early warning system for providing information to the community from the district or project staff (Figure 1). Supervisors also conducted routine re-assessments on a random sample of 20% of the households in the villages to check the data provided by the volunteers.

2.2. Pregnancy history survey

Long-term maternal recall for pregnancy-related events has been demonstrated to be reproducible and accurate (Tomeo et al., 1999). However, recall error for dating such events is typically greater for earlier time periods. To check the reliability of vital events data collected by programme staff and volunteers, there was an independent assessment of mortality using pregnancy histories obtained by interview teams consisting of staff members of the National Institute of Statistics (who had implemented Mozambique's 2003 DHS survey), health personnel from the provincial and district health systems and NGOs working in the district.

The birth history questionnaire used in the recent Mozambique DHS 2003 survey was modified to a pregnancy history, as birth histories are more likely to miss neonatal deaths (D. Espeut, Unpublished doctoral dissertation, Johns Hopkins University). Background variables on sociodemographic characteristics were included in the survey along with retrospective questions regarding the number and outcome of pregnancies and surviving children. Standard procedures were followed for ensuring the validity of translation from English to Portuguese. Cause of death for infants and children under 5 years was determined using standard verbal autopsy procedures described by the WHO (1999).

2.3. Study design and participant selection

To detect a 50% difference in mortality, from a baseline level of 120 per 1000 to a level of 60 per 1000, with an α level of 0.05 and power of 0.80, the formula provided by Fleiss (1981) was used to determine sample size. Assuming approximately 50% of the women have had a birth in the 3 years prior to the survey, the sample was estimated at 778 and increased to 1000 to accommodate a 10% non-response rate. A multistage stratified random sample with villages representing the strata was employed. The number of households to sample in each village was determined proportionate to the size of the village for a total sample of 1000 households assuming on average one woman of reproductive age per household. At the village level, every second volunteer was selected and one household from the ten households assigned to the volunteer was randomly selected for interview. In households with more than one eligible woman, one was randomly selected for interview.

Verbal informed consent was obtained from the women, and confidentiality of the research findings as well as the risks and benefits of participating in the study were explained. The pregnancy history survey was conducted jointly by the district MoH, the National Institute of Statistics and the child survival project staff to support the ongoing programme.

Twenty-five interviewers and five supervisors were specially trained on survey methodology and interview techniques. The interview methodology was similar to the DHS design, with teams of six (consisting of four interviewers, one supervisor and one driver). Each interviewer was responsible for collecting information on approximately 8—10 eligible women in the selected village. Data were collected over a 10-day period in May 2004.

2.4. Data processing and analysis

Data entry and analysis were performed by the National Institute of Statistics following standard procedures of double data entry and consistency checks using CSPro 2.6 (Methodology & Software Development Branch, International Programs Center, U.S. Census Bureau, Washington, DC, USA) and SPSS Version 6 (SPSS Inc., Chicago, IL, USA). Mortality analyses for the pregnancy history data utilised a specialised Fortran program (S. Becker, unpublished), which calculates period ${}_nM_x$ for any age—time period rectangle in the lexis diagram covered by the pregnancy history. It also calculates ${}_na_x$, which is defined as the average time lived in the age period for those who died in the age—time period; these two are then used with the standard exact formula to derive ${}_nq_x$ (Preston et al., 2001), i.e. ${}_nq_x = n^* {}_nM_x / [1 + (n - {}_na_x) {}_nM_x]$. Adjusted IMRs from the vital registration data were calculated using formula B of Shryock and Siegel (1976).

2.5. Data quality of the pregnancy history survey

The DHS staff and trainers were used as supervisors and trainers for the survey to ensure compliance with standard procedures. However, as in all surveys there may be inherent problems regardless of the quality control pro-

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Table 1 Child survival programme: selected indicators of health system and community capacity at baseline and final survey

Process indicator	Baseline (Oct. 1999)	Final (July 2003)
Trained *socorristas* at health posts (*n*)	3	32
Functioning health posts (*n*)	6	28
Socorristas reporting supervision in the past 3 months (%)	0	85
Trained health providers at health facility (%)[a]	1	100
Caretakers reporting counselling at health centre/post (%)	22	92
Caretakers reporting health messages from pastors in the past 2 weeks (%)	NA	50
Population with access (<5 km) to trained providers (%)	65	99
Functioning village health committees (*n*)	1	46
Village health committees reporting meetings in the past 3 months (%)	0	91

NA: not available.
[a] Providers trained in prevention and treatment of malaria, diarrhoea and pneumonia.

cedures that were instituted. Data quality of mortality estimates are affected by the completeness of reporting of deaths, the degree of differential displacement of birth dates of surviving and dead children and the accuracy of reported age at death. Heaping of age at death at 12 months is common and leads to underestimation of infant mortality. In the pregnancy history survey, the heaping ratio [5*D12/(D10 + D11 + D12 + D13 + D14)] for years 2000 to 2003 was 2.4. (The comparable value for the Mozambique DHS of 2003 was 2.9.) Also, the sex ratio of male to female children ever born was 1.05, within the acceptable limits of 1.02—1.07.

3. Results

The child survival interventions addressed three elements of the community IMCI: (1) improving partnerships between the health system and communities; (2) increasing accessible care from community-based providers; and (3) promoting essential household practices for child health (Winch et al., 2002), as illustrated in Tables 1 and 2.

Data from the vital registration from March 2000 to February 2003, which included all women of child-bearing age in the study population of Chokwe district, indicated a 66% reduction in infant mortality and a 62% reduction in under-five mortality (Table 3).

In the pregnancy history survey, 998 women (15—49 years) were interviewed with a response rate of 99.8%. This rate was unusually high as the volunteers assisted the survey team in locating the selected women. The mean age of the women interviewed was 28.9 years; 63% reported having attended school. Sixty percent were Christian, 40% followed indigenous religions and <1% were Muslims. Of the women interviewed, 83% had access to safe drinking water and 87% reported using latrines or flush toilets; these figures were

Table 2 Estimates (and 95% CI) of care-seeking and behavioural change practices of caretakers

Process indicator	Baseline (Oct. 1999)		Final (July 2003)	
	N	% (95% CI)	*N*	% (95% CI)
Mothers reporting initiation on BF within 1 h of delivery	—	—	299	71
Children with diarrhoea treated with ORT	115	53 (43.9—62.1)	110	94 (89.6—98.4)
Children with diarrhoea given extra food for 2 weeks following diarrhoea episode	115	4 (4.2—7.6)	110	87 (80.7—93.3)
Households with latrines	300	28 (10.4—45.6)	300	75 (70.1—79.9)
Children who slept under ITN the previous night	0	—	240	85 (80.5—89.5)
Children with fever treated at health centre/post within <24 h	25	28 (10.4—45.6)	20	90 (76.9—103..2)
Children with fast or difficult breathing treated at health centre/post within <24 h	50	2 (1.9—5.9)	15	60 (35.2—84.8)
Children with severe malnutrition (—3 Z-scores)	—	—	265	14 (9.82—18.2)
Mothers reporting increased food intake (past pregnancy)	300	44 (38.4—49.6)	300	82 (77.7—86.4)
Mothers reporting delivery by trained provider (last pregnancy)	300	65 (59.6—70.4)	300	87 (83.2—90.8)
Children fully immunised	128	74 (66.4—81.6)	123	89 (83.5—94.5)
Caretakers who knew three ways to prevent STIs/AIDS	300	0.3 (0.3—0.9)	300	56 (50.4—61.6)

BF: breastfeeding; ORT: oral rehydration therapy; ITN: insecticide-treated bed net; STI: sexually transmitted infection.

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Table 3 Mortality estimates (95% CI) by area, age group, time period and data source

Chokwe district (project area)	Period						Percent reduction (March 2000–Feb. 2003)
	March 1998–Feb. 1999	March 1999–Feb. 2000	March 2000–Feb. 2001	March 2001–Feb. 2002	March 2002–Feb. 2003	March 2003–Feb. 2004	
Infant mortality (per 1000)							
Vital registration			70 (62.4–77.2)	37 (32.3–41.7)	24 (20.2–27.6)	–	65.7
Pregnancy history (traditional IMR)	129.4 (79.0–179.9)	90.1 (53.4–126.9)	110 (67.6–152.5)	32.3 (10.3–54.2)	54.8 (24.7–84.9)	45.3 (21.2–69.4)	50.2
Probability of dying $_1q_0$ pregnancy history	121.6 (74.8–168.3)	108.8 (65.5–152.1)	102.4 (63.5–141.4)	35.8 (11.6–60.1)	51.5 (23.4–79.5)	52.9 (25.2–80.6)	49.7
Under-five mortality (per 1000)							
Vital registration			119 (109.6–128.4)	65 (59.2–71.4)	45 (40.0–50.2)	–	62.2
Pregnancy history (births as denominator)			162.7 (112.6–212.7)	76.6 (43.5–109.7)	100.5 (60.6–140.3)	90.6 (57.4–123.8)	38.2
Probability of dying $_5q_0$ pregnancy history			179.8 (129.6–230)	99.1 (58.6–139.5)	105 (65.4–144.5)	113.9 (74.8–153.1)	41.6
National (DHS)	1992–1997				1998–2003		1992–2003
$_1q_0$	135				101		25.2
$_5q_0$	201				153		23.9
Gaza province (DHS)	1987–1997				1993–2003		
$_1q_0$	135				92		31.9
$_5q_0$	208				156		25.0

IMR ($_1q_0$): infant mortality rate; DHS: Demographic and Health Survey; $_5q_0$: under-five mortality rate.

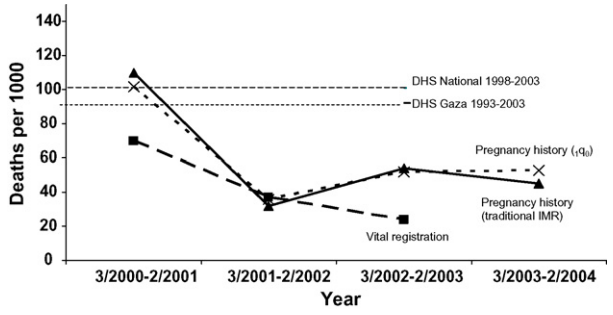

Figure 2 Infant mortality in Chokwe district, 2000–2004. DHS: Demographic and Health Survey; IMR: infant mortality rate.

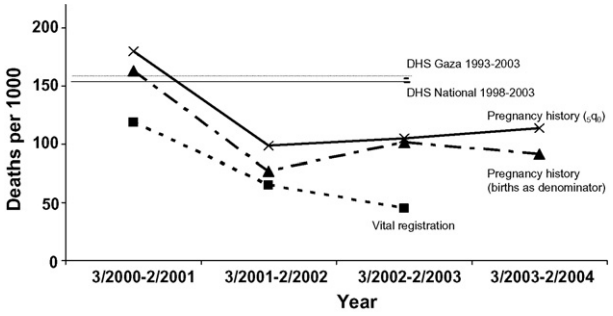

Figure 3 Under-five mortality in Chokwe district, 2000–2004. DHS: Demographic and Health Survey.

higher than the averages reported for Gaza province in the recent DHS survey (52% for safe drinking water and 63% for latrine coverage).

Mortality estimates derived from vital registration, pregnancy histories and estimates from the DHS 2003 for Gaza province are illustrated in Figures 2 and 3 for infant and under-five mortality, respectively. Estimates from the pregnancy history for March 2000 to February 2003 showed similar trends of mortality reduction as the vital registration data for the same time period but of a lesser magnitude: 49% reduction in infant mortality and 42% reduction in under-five mortality. Adjusted IMRs from the vital registration data were 40 and 24 (per 1000 births) for the years 2001–2002 and 2002–2003, close to the IMR from vital registration of 37 and 24 for the respective periods.

Causes of death were inferred from the symptoms described in the verbal autopsy data from 2000–2004. Neonatal deaths comprised 17% of the total under-five deaths. Malaria was the leading cause of death in the post-neonatal period (28.7%), followed by pneumonia (21.3%), severe malnutrition (7.5%) and diarrhoea (6.4%).

4. Discussion

The government-led sector-wide approach and poverty reduction strategies in Mozambique have attempted to improve health service delivery and access to formal health facilities for the rural poor (World Bank, 2001). These efforts have been evidenced in the improved estimates in service coverage reported by the DHS surveys (Gaspar et al., 1998; Instituto Nacional de Estatística/Ministério da Saúde [Moçambique], 2005). Mortality estimates from

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the DHS (Instituto Nacional de Estatística/Ministério da Saúde [Moçambique], 2005; Macassa et al., 2003) also show declines of 32% and 25% in the IMR, 16% and 25% for child mortality and 25% and 24% for the U5MR for Gaza province (1993–2003) and national data (1998–2003), respectively. Implementation of the child survival programme in Chokwe district resulted in improved health service coverage and utilisation as measured by the 30 cluster surveys, and showed even greater declines in mortality as evidenced both by the vital registration data and the pregnancy history data. Attributing causal factors for mortality reduction requires rigorous field trials; therefore these findings must be interpreted with caution.

4.1. Comparison of mortality estimates from vital registration and pregnancy history

The pregnancy history data were obtained retrospectively from a cross-sectional survey on a sample of the population covered by the child survival programme. The programme vital registration and disease surveillance system, on the other hand, registered deaths prospectively from 2000–2003. The programme and the vital registration were initiated after the flood and did not include flood deaths. On the other hand, for the pregnancy history survey some of the flood deaths from early 2000 may have been included because of women's telescoping of the time period, which can occur in such surveys. This difference may explain some of the discrepancies between the mortality rates estimated by the two methods. However, estimates of infant mortality from the pregnancy history in the years preceding the flood were also high (Table 3). It is evident from the pregnancy history measurements that the highest drop in mortality occurred in the first year and stabilised in the following years. We also note the considerable sampling variability of the pregnancy history mortality estimates (see confidence intervals in Table 3).

Although the estimates of the probability of death before age 5 years using the pregnancy history are higher than the estimates using as denominator either births from the pregnancy history or from the vital registration, it is reassuring that the two estimates from the pregnancy histories are nevertheless reasonably close. Prospectively planned research studies in child survival programmes are essential to substantiate such findings.

According to the Mozambique DHS data (Table 3), there was a decline both in IMR and U5MR from the 1997 survey to the 2003 survey nationally; 25.2% reduction in IMR and 23.9% reduction in U5MR. Although comparisons could have been made between the process indicators and mortality change from the two methods, the type of indicators measured and the time periods differed between the two surveys. The pregnancy history survey also measured several coverage indicators (insecticide-treated bed net (ITN) use during last pregnancy, antenatal care visits and place of antenatal care visits), but these were different from the indicators measured in the KPC cluster survey (ITN use by children, place of last delivery etc., as reported in Table 2).

The study provides encouraging evidence that child survival programmes can have a measurable impact on community health behaviours and contribute to mortality reductions. We believe that two major factors contributed to the declines in infant and under-five mortality.

4.2. Complete coverage of basic health services and equitable community health education

A multicentric approach influenced the care-seeking behaviours of community members through a trained cadre of community volunteers, pastors and village leaders who ensured equitable access to information for behavioural change and encouraged use of health services while discouraging harmful practices in the community. Unlike most programmes that provide services through community health workers, where the number of volunteers typically ranges from one to five per village (approximately 1 per 500–1000 population), the Chokwe programme was unique in training an extensive pool of 2300 volunteers who each delivered services to only ten households. The approach facilitated the motivation and retention of volunteers by providing a supportive 'care group' environment with close supervision from the programme staff and a low dropout rate of 2% per year compared with the much higher average dropout rates reported in other programmes (Bhattacharyya et al., 2001; Walt et al., 1989). The number of contacts between volunteers or health providers and caretakers of children ranged from 18 to 24 per child, thereby increasing exposure to health messages and promoting the demand for services as recommended for achieving universal coverage (Victora et al., 2004).

The child survival programme was designed as a comprehensive and integrated approach to promote breastfeeding, appropriate complementary feeding, oral rehydration therapy (ORT) and use of ITNs, which in combination have been shown to reduce child deaths by up to one-third (Jones et al., 2003). In addition to improving care-seeking practices, the project worked closely with the district health system to ensure appropriate case management for pneumonia and effective antibiotic use, which has been shown to reduce under-five deaths by 25% (Sazawal and Black, 1992). A study in Tanzania reported a 27% reduction in under-five deaths after increased coverage of ITNs (Schellenberg et al., 2001). In the child survival project area, in households with ITN reported use of ITNs by children under 2 years increased from <1% in 1999 to 85% in 2003. As part of the emergency relief operations following the flood in 2000, UNICEF facilitated the free distribution of ITNs through the network of community volunteers and continued to support the ITN retreatment operations in Chokwe district. Interventions by the International Committee of the Red Cross after the civil war were also accompanied by a reduction in under-five mortality, primarily attributable to vaccinations and vitamin A supplementation (Garenne et al., 1997). The child survival programme improved immunisation coverage and advocated vitamin A supplementation. Underweight children have an increased susceptibility to malaria; effective management of malnutrition may have further protected children from repeated malarial episodes, as in programmes that advocate appropriate management of severely malnourished children (Bolles et al., 2002; Caulfield et al., 2004).

Community structures such as the village health committee and pastors played a critical role in supporting

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community-wide initiatives to promote the activities of the volunteers. These included mobilising the women for immunisation, latrine construction, distribution and promotion of ITNs, and dissemination of health messages to the entire community. Fifty percent of the women surveyed at the end of the programme reported receiving health messages from pastors (Table 2). Participatory communication processes using a multisectoral platform can effectively link communities and health systems to address child health (Ford et al., 2005).

The child survival programme was initiated in March immediately following the flood in February 2000. Communities were eager to receive assistance from the project and other agencies such as UNICEF. Establishment of the volunteer structure facilitated access and equitable distribution of information and supplies such as ITNs and oral rehydration salts. The training programmes first focused on malaria, diarrhoea and care-seeking for danger signs. Selected indicators of care-seeking were measured and monitored routinely through quarterly rapid assessments using a random sample of approximately 1000 caretakers. One care group of approximately 10—15 volunteers was randomly selected from each of the 26 supervisory areas. Each volunteer was responsible for approximately ten neighbouring households. All caretakers in households with children under 2 years were selected for assessment. Data from the rapid assessments conducted 1 year after the project had been initiated indicated substantial improvements in care-seeking behaviours; 68% of children sleeping under an ITN; increase from 28% pre-programme to 86% 1 year later for children treated for fever at a health facility within 24 h; increase from 2% to 99% for children treated for fast and/or difficult breathing; and increase from 53% to 88% of children with diarrhoea treated with ORT over the same time period. These findings for behaviour change immediately following the flood further strengthen the evidence for the programme effect on mortality reduction achieved in the first year of the programme.

Routine collection and monitoring of data on vital events and morbidities through the programme enabled the volunteers to take timely action when there was an increased incidence of illness in the community. Several factors, including the supportive supervision of the project staff, enabled appropriate decision-making as recommended in other programmes where volunteers worked in a supportive and non-threatening environment (Mavimbe et al., 2005).

4.3. Strengthening the capacity of the district health system

Coverage and access to basic health services was increased to 99% of households as trained *socorristas* were posted in health posts that were constructed with the assistance of the village health committees. The village health committees established operational guidelines for the clinic and user fees as well as supervising the *socorristas*. The programme also addressed service quality by training the health centre staff using IMCI videos and ensuring drug availability. The programme staff also supported the immunisation outreach activities and integration of the community health information system in the district surveillance system.

Despite some limitations of the verbal autopsy methodology, this was the only available method to determine leading causes of death in children under 5 years. Malaria was the leading cause of death, consistent with results of other studies (Mobley et al., 1996; Saute et al., 2003a, 2003b). Several strategies were implemented for effective malaria control and case management (Bradbury and Edward, 2005). However, the increasing incidence of chloroquine resistance may have influenced malaria case fatality and overall mortality (Mayor et al., 2001). The death rate from pneumonia is approximately four times higher in malaria-endemic regions and this requires greater efforts to prevent and manage malaria (Morris et al., 2003). Other major causes of child deaths in the developing world are measles and HIV/AIDS, but the information in this study was not sufficient to identify deaths attributable to HIV/AIDS (Bryce et al., 2005a). The prevalence of HIV/AIDS in Mozambique (13%) poses additional challenges, and strong community initiatives are needed to care for vulnerable children as HIV accounts for an estimated 7.7% of under-five deaths in sub-Saharan Africa (Walker et al., 2002).

Although the evidence is compelling that 63% of under-five deaths globally could be prevented with available interventions (Claeson et al., 2003), additional investments are required to equip health systems and to mobilise communities and engage both as active partners in healthcare delivery. As most health systems in developing countries lack the capacity to meet the health demands of their populations adequately, private voluntary organisations can play a supportive role in eliminating the gaps by strengthening the health sector at the district level. They can help communities take more responsibility for their own health and scale up best practices to the provincial and national level through collaborative partnership of all stakeholders. As illustrated in the Chokwe programme and a similar programme in Bolivia (Perry et al., 2003), the Millennium Developmental Goal of a one-third reduction in under-five mortality can be achieved with effective community-based approaches.

The model of volunteer training using 'care groups' is now being implemented in other child survival programmes in Cambodia, Malawi and Rwanda and scaled up in five other districts in Gaza province in Mozambique. The approach follows the scaling-up principles of integrating a three-way partnership between the government, communities and NGOs and establishing a centre for innovation and learning (Taylor-Ide and Taylor, 2002). Although the care group model has demonstrated knowledge gains and improved behaviours at the community level, operations research efforts are needed to study the patterns of health service utilisation, as user fee systems have been shown to affect utilisation and health outcomes negatively (James et al., 2005; Nyonator and Kutzin, 1999; O'Hare et al., 2005).

5. Conclusion

In post-conflict Mozambique, two methods of measuring infant and under-five mortality were undertaken in Chokwe district. A 66% drop in infant mortality and a 62% drop in

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under-five mortality was documented in 3 years using a vital registration system with data collected by community volunteers. These results were further supported by a pregnancy history survey that showed an IMR decrease of 49% and a 42% drop in under-five mortality in a sample of the same population over the same time period.

The international community of donors and national health systems have ambitious Millennium Development Goals, which will be facilitated as communities learn to support effective and sustainable solutions. However, further research is needed on mechanisms and organisational interventions to mobilise communities (Akukwe, 1998; Bryce et al., 2005b; Mercer et al., 2004). These efforts can be supplemented with viable poverty reduction strategies to sustain and improve the gains achieved by child survival interventions (Bhutta, 2004). More systematic exploration of the dynamics of community-based social change integrated with new models of partnership will help bring the efforts of health services and communities together.

Finding

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Authors' contributions: The child survival project was implemented by PE; CT and AE conceived the pregnancy history study; AE and SB designed the study protocol and estimated the sampling for the pregnancy history survey; PE and EM conducted the pregnancy history survey; EM was responsible for data entry and management; SB performed the mortality analyses for the pregnancy history survey; AE, SB, CT and HP were involved in the analysis and intepretation of the data; AE drafted the manuscript with contributions from CT, SB and HP. All authors read and approved the final manuscript. All authors are guarantors of the paper.

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