CHAPTER IV. MORTALITY IMPACT ASSESSMENT

Assessment of the impact of mortality attributed to health programs is a treacherous exercise fraught with many possibilities for biased or incomplete data and also for misinterpretation of results (Gray, 1986). Therefore, most knowledgeable health professionals have delegated this task to university research centers and governmental research agencies. One informed program manager for a large international health organization wrote:

> the assumption is that improved activities at the community level will ultimately have an impact on the IMR [infant mortality rate]... CARE does not have to try to prove this relationship in each project (Horner 1989, p. 4).

One of the unique advantages of the CBIO approach is that it attempts to measure changes in health, including improved mortality rates, for each program area and therefore does not have to rely on the bold assumption which those responsible for programs using more traditional approaches to child survival must make.

Methodological Considerations

The labor and cost of obtaining the numerator and denominator data to enable the measurement of mortality rates is substantial. In order to be able to calculate mortality rates, one must have reasonably accurate information regarding the population of a program area by age and sex. Furthermore, one must have an accurate count of the deaths by age and sex. In developing countries, this is a very difficult task.

Population data in these settings usually do not exist. If they do, more likely than not they are based on national censuses which are outdated or inaccurate. Furthermore, the overwhelming majority of deaths take place in the home without any formal and direct contact with the existing health system. In addition, those with extensive field experience believe that retrospective household surveys do not provide a satisfactory degree of accuracy, particularly during the neonatal period. Hill and David (1988, p. 215), for instance, state that:

> asking household members about recent deaths ... appears to produce a serious underestimate of prevailing mortality levels and equally serious biases due to differential rates of omission (more deaths of young children are omitted than deaths of adults).

Aside from the issue of whether a family member might intentionally conceal a death, there is also the issue of remembering when a death actually took place and the age at death. Furthermore, parents may not understand the important distinction from the demographic standpoint between a stillbirth and a live-born child who died within several hours of birth. Several household surveys in Africa, for instance, registered only two-thirds of the expected adult deaths and one-half of the expected deaths among children under five (Clairin, 1985).

In developing countries, the rarely attainable "gold standard" for measuring mortality rates is the ongoing identification of all residents in a defined geographic area and the registration of vital events (births, deaths, and migrations). This is best achieved by means of ongoing visitation of all homes in the given area by persons who are known to and trusted by the household members. All other approaches, such as retrospective household surveys carried out by people not previously known to household members (for instance, the Demographic and Health Surveys which have been conducted around the world by the Institute for Resource Development/Macro Systems, Inc.) and indirect approaches such as the previous birth technique developed by Brass and Mcrae (1984) are potentially biased and appear to yield underestimates of mortality rates because of underreporting of deaths by family members.

The prospective home visitation approach to mortality rate measurement, while not affected to the same degree by the biasing and underreporting tendencies described above, may still be somewhat biased by underreporting of deaths. This could occur by the health worker not entering all deaths in the health information system, by not visiting all the homes in the geographic area, or by the family not reporting deaths which have occurred. In our opinion, the potential for substantial bias and underreporting are less with prospective home visition than with other approaches, however.

The CBIO approach, as it is being implemented by ARHC, involves routine systematic home visitation (RSHV) to all homes in the program area, with more frequent visits to "targeted" homes or to homes with persons identified as being at high risk (Perry and Sandavold, 1993). One of the targets is all women of childbearing age so that pregnancies can be identified. Once pregnancies are identified, homes are visited more frequently so that prompt care can be given to newborns, and also so that early infant deaths can be registered.

Although the ARHC field staff are aware of many shortcomings in their actual day-to-day death registration, it is nevertheless the case that the "gold standard" of death registration as described above is being met in ARHC's program areas where RSHV is underway: all homes in the program area are being visited on a prospective and ongoing basis by persons who are familiar with and trusted by family members.

A second set of methodological concerns beyond the actual accurate tabulation of population size and registration of deaths is the problem of interpretation of the data. In ARHC's three established program areas, the total population is 27,500 people. The smallest program area has 5,829 people. The numbers of deaths per year in specific age groups is relatively small, even for the infant and child age groups. For instance, in the smallest established program area (Mallco Rancho), there were only nine infant deaths in 1992, only six deaths among children 12-23 months of age, and only one death among children 24-59 months of age. Because of the small numbers of deaths involved, the mortality rates are unstable from year-to-year. Thus, the ability to answer the question of whether or not there has been a change in mortality rates depends partly on population size.

Finally, there is the important issue of defining whether any observed changes in mortality rates are actually due to program interventions or to other independent influences. More than one program has found that the observed mortality rates went up after program implementation. It is unlikely that health programs themselves actually had a detrimental effect on health, but it is understandable that death registration might improve over time, thereby appearing to show a worsening of death rates.

In most areas of the developing world, infant and childhood mortality rates are slowly improving, partly as a result of improving standards of living and nutrition and partly as a result of curative and public health efforts. Thus, observed changes in mortality rates need to be interpreted in light of the distinct possibility that they would be improving independently of specific health program interventions.

Double-blind randomized clinical field trials of a specific intervention such as Vitamin A supplementation can more readily determine whether the specific intervention has had an impact on mortality since the study design attempts to control for all other factors. This degree of rigor is not possible for evaluation of an overall integrated health care program or of new approaches to health care delivery such as the CBIO approach.

We are left with two methodologies for assessing mortality impact within ARHC's established programs. One is to determine if there has been mortality improvement over time. The second is to compare mortality rates in ARHC program areas with similar areas in which the CBIO approach has not been implemented. The problem in assessing mortality improvements over time in ARHC's currently established programs is twofold. First, the numbers of deaths on which the rates are based are small and therefore unstable. Second, because the child survival interventions were relatively well-developed prior to the initiation of routine systematic home visitation and death registration, some of the presumed mortality impact of the program may have already been achieved before mortality rates could actually be measured.

A methodology for estimating confidence intervals for death rates is needed. Most confidence intervals are based on sampling theory. In this case, we are not dealing with samples, but rather with a total population having a small number of deaths. This small number fluctuates from year to year, leading to sizeable fluctuations in observed mortality rates.

The monograph, Healthy Communities 2000: Model Standards, published by the American Public Health Association (1991), addresses this issue and provides a guide for estimating confidence intervals for mortality rates (pp. 459-461). The authors recommend that all comparisons of death rates be with rates based on at least 20 deaths. If necessary, events over more than one year can be pooled. Using this approach, Table IV.1 lists the 95% confidence intervals calculated for mortality rates based upon the number of deaths observed. For instance, a 95% confidence interval for an infant mortality rate calculated to be 100 based on 20 deaths would be:

$$100 +/- (0.40)(100)$$
$$100 +/- 40$$
$$60 - 140.$$

Appendix VI contains the description of this approach contained in the APHA monograph.

TABLE IV.1.

95 Percent Confidence Intervals for a Selected Number of Vital Events, Such as Deaths

number of events	confidence interval
20	rate +/- .40 x rate
30	rate +/- .36 x rate
40	rate +/- .31 x rate
50	rate +/- .28 x rate
100	rate +/- .20 x rate
150	rate +/- .16 x rate
200	rate +/- .14 x rate
400	rate +/- .10 x rate
800	rate +/- .07 x rate
1600	rate +/- .05 x rate

source: American Public Health Association (1991), pp. 459-461.

Pooled Mortality for ARHC's Three Established Program Sites

A critical issue to be addressed is what evidence ARHC can show that child survival is better in its program areas than in similar areas in Bolivia. Because of the small populations involved and because it was not possible to measure mortality rates prior to beginning the programs, there is so far no strong evidence that infant and child mortality rates have fallen over time within the program areas. In the case of Carabuco, infant mortality rates have increased from 74 in 1988 to 88 in 1992, presumably reflecting an improvement in death registration. In Mallco Rancho, infant mortality fell by almost half (from 78 to 46) between 1991 and 1992. In Villa Cochabamba/Montero, only baseline rates are currently available.

Our case for demonstrating mortality impact with the CBIO approach must therefore rest at this time on showing a statistically significant difference in the probability of child survival between ARHC's program areas compared to similar areas. Demonstrating a difference does not prove from the strict scientific standpoint that the program itself has led to improved mortality. The mortality rates estimated for the "control" areas may be erroneous in some way. If they are not erroneous, they may arise from populations which differ in some important way from ARHC's intervention areas. Nevertheless, it is the best that can be done under the circumstances.

The strongest case that can be made for mortality impact on child survival at ARHC's program sites must rest on comparing the probability of childhood death (based on observed mortality rates from birth to age five) compared to probabilities computed from mortality rates for infants and children in similar areas. Only through such pooling can one achieve statistical confidence in the findings.

The infant and child mortality data for all three ARHC program sites have been pooled to generate a probability of death. These data are based on three years of experience in Carabuco (1990-1992), two years of experience in Mallco Rancho (1991-1992), and one year of experience for a portion of the Villa Cochabamba/Montero Program (1992). These data are shown in Table IV.2.

These data give an estimate of overall probability of death before the age of five for ARHC's program areas. Using data from the TOTAL column of Table IV.2, the observed pooled mortality rates are shown in Table IV.3.

Estimating the probability of death before the age of five can be done in two ways. One is a cohort method in which a hypothetical cohort of births is subjected to the above mortality rates over a five year period and the percentage of the cohort which would die at these rates is determined. A second method is to simply calculate for the population of children the overall death rate per 1,000 children per year and multiply this by five.

These two methods are shown in Table IV.4. Using the cohort method, the probability of death before age five is 0.111. That is to say, we estimate that 11.1% of the children throughout ARHC'c established program sites die before reaching the age of five. Since this estimate is based on 134 deaths, we can use +/- .18 x rate as our 95% confidence interval (see Table IV.1). Thus, we estimate with 95% confidence that between 9.1% and 13.1% of the infants born in ARHC's program areas die before the age of five. Using the under-five mortality rate method whereby the number of deaths observed is divided by the population and multiplied by 5, essentially the same results are obtained.

Table IV.2

Death and Population Data for ARHC's Three Established Program Sites From Which Probability of Childhood Death Is Calculated

	Carabuco			Mallco Rancho		Montero	TOTAL
	1990	1991	1992	1991	1992	1992	
0-12 months							
# deaths	13	25	19	13	9	9	88
# births	194	228	215	164	194	142	1,137
population	219	211	210	150 (est)	150	135	1,075
12-23 months							
# deaths	4	0	3	7	6	9	29
population	236	255	228	212	187	139	1,257
24-35 months							
# deaths	4	1	1	na	na	1	-
population	288	243	221	na	na	147	-
36-47 months							
# deaths	0	1	2	na	na	0	-
population	223	267	214	na	na	123	-
48-59 months							
# deaths	1	0	0	na	na	1	-
population	254	298	259	na	na	128	-
24-59 months							
# deaths	5	2	3	4	1	2	17
population	765	808	694	488	542	398	3,695
0-59 months							
# deaths	22	27	25	24	16	20	134
population	1,220	1,274	1,132	850	879	672	6,027

source: annual censuses; birth and death registries

TABLE IV.3.

Pooled Mortality Rates for ARHC's Three Established Program Sites

infant mortality rate	77.4 deaths per 1,000 live births per year
12-23 month mortality rate	23.1 deaths per 1,000 children of this age group per year
24-59 month mortality rate	4.6 deaths per 1,000 children of this age group per year

source: derived from data in Table IV.2.

Pooled Mortality for ARHC's Newly Established Program Sites

In 1992, ARHC established two new program sites. One of these, Ancoraimes, is geographically contiguous with the established program site in Carabuco. The other new program site, Sipe Sipe, is geographically contiguous with the Mallco Rancho Program. These two new program areas are, as far as can be determined, similar if not virtually identical to the adjacent areas where ARHC has established programs except for the health program intervention.

In 1992, as new program activities began in these new program sites, routine systematic home visitation (RSHV) and census work did begin in a small portion of the new areas. In Ancoraimes, eight pilot communities were included, with a total population of 2,008 persons. In Sipe Sipe, the pilot area included eight communities with a similar population size, 2,064. RSHV was undertaken and it was possible to determine the numbers of deaths and the overall population in the pilot areas from which these deaths came for the period from April, 1992, until March, 1993. These data are shown in Table IV.5. The pooled mortality rates for these new program sites are shown in Table IV.6 and are based on the data shown in Table IV.5.

TABLE IV.4.

Estimates of the Probability of Death Before Age Five in ARHC's Established Program Areas

cohort method

age group	mortality rate	# of deaths to be expected in a cohort of 1,000 live births	cohort size at end of age period
0-12 months	77.4	77.4	922.6
12-23 months	23.1	21.3	901.3
24-59 months*	13.8	12.4	888.9

estimated percentage of live-born infants surviving to age five = 88.9%

estimated probability of death between birth and age five = 1 - 0.889 = 0.111

95% confidence limits for the estimated probability of death = 0.111 +/- 0.020 =

0.091 - 0.131

under-five mortality rate method

deaths observed: 134
under-five population: 6,027

annual probability of death for children under 5 = .022
five year probability of death
(i.e., probability of death prior to
age five) = .022 x 5 = .110

95% confidence limits for the
estimated probability of death = .110 +/- .020 =

.090 - .130

* The annual 24-59 month mortality rate (4.6) was multiplied by three since this age period covers three years.
source: Carabuco, Mallco Rancho, and Villa Cochabamba/Montero birth and death registries and annual census

TABLE IV.5.

Death and Population Data from ARHC's Two "Control" Program Sites From Which Probabililty of Childhood Death Is Calculated

age group	Ancoraimes 4/92-3/93	Sipe Sipe 4/92-3/93	Total
0-12 months			
# deaths	9	5	14
# births	73	47	120
population	60	51	111
12-23 months			
# deaths	3	4	7
population	52	69	121
24-59 months			
# deaths	2	2	4
population	183	181	374
0-59 months			
# deaths	14	11	25
population	295	301	596

source: annual census and death registry, Ancoraimes and Sipe Sipe

TABLE IV.6.

Pooled Mortality Rates for ARHC's Newly Established "Control" Program Sites

infant mortality rate	116.7 deaths per 1,000 live births per year
12-23 month mortality rate	57.9 deaths per 1,000 children of this age group per year
24-59 month mortality rate	11.0 deaths per 1,000 children of this age group per year

source: derived from data in Table IV.5.

These age-specific rates are used to calculate the estimated probability of death in the control program sites before age five years using the cohort and crude under-five mortality rate methods described previously. One can see in Table IV.7 that the estimated probability of death before age five using the cohort method is 0.182. The number of deaths on which this probability is based is 25. Using Table IV.1 again, we multiply the probability of death (0.195) by 0.38 to obtain a 95% confidence interval. This turns out to be 0.121-0.269. Using the under-five mortality rate method, we estimate the 95% confidence interval for the probability of death before age five to be very similar 0.130-0.290.

TABLE IV.7.

Estimates of the Probability of Death Before Age Five in ARHC's Newly Established "Control" Program Sites

cohort method

age group	mortality rate	# of deaths to be expected in a cohort of 1,000 live births	cohort size at end of age period
0-12 months	116.7	116.7	883.3
12-23 months	57.9	51.1	832.2
24-59 months	33.0*	27.5	804.7

estimated percentage of live-born infants surviving to age five = 80.5%

estimated probability of death between birth and age five = 1 - 0.805 = 0.195

95% confidence limits for the estimated probability of death = 0.195 +/- 0.074
= 0.121 - 0.269

under-five mortality rate method

deaths observed: 25
under-five population: 596

annual probability of death for children under 5 = 0.042
five year probability of death (i.e., probability of death prior to age five) = 0.042 x 5 = 0.210

95% confidence limits for the estimated probability of death = 0.210 +/- 0.080
= 0.130 - 0.290

* The annual 24-59 month mortality rate (11.0) was multiplied by three since this age period covers three years of life.

source: Ancoraimes and Sipe Sipe birth and death registries and annual census

Estimates of Child Survival for Other Areas of Bolivia

There have been a number of recent estimates of infant and child mortality rates in Bolivia for the country as a whole as well as for specific geographic areas (see Table IV.8). Few of these studies, however, have reported mortality rates through the the first five years of life or have assessed mortality rates for different social groups.

TABLE IV.8.

Recent Estimates of Infant and Child Mortality Rates in Bolivia

	infant mortality rate estimates	0-23 month mortality rate estimates	under-five mortality rate estimates
Bolivia nationally	89 (UNICEF, 1993)	213 (MPC, 1983)	126 (UNICEF, 1993)
	110 (Rance, 1988)		
	168 (Morales, 1988)		
rural Bolivia	120 (Rance, 1989)	253 (valleys) (MPC, 1983)	
	232 (Altiplano) (Morales, 1968)	275 (Altiplano) (MPC, 1983)	
		183 (lowlands) (MPC, 1983)	

The 1989 Demographic and Health Survey of Bolivia (Sommerfelt, et al, 1991), however, did measure age-specific mortality for the first five years of life for various regions and social groups. Although there is reason for questioning the accuracy of these estimates since they are based on a single househould visit from a person unknown to the interviewed family member, they do represent a conservative estimate of under-five mortality in Bolivia.

The probability of death before age five for specific subgroups in Bolivia as estimated by the DHS survey is shown in Table IV.9. These subgroups are comparable to ARHC's program sites in a number of respects. The three ARHC program sites are located in the Altiplano (Carabuco), valley (Mallco Rancho), and lowland (Montero) areas. Virtually all of the inhabitants in ARHC's program sites speak Aymara or Quechua, indigenous Indian languages. Two of the three program sites are rural, and the third, although periurban, is composed mostly of families who have recently migrated from rural areas. An earlier study showed that migrants to Montero had mortality patterns higher than those for long-term residents (Foxman, Frerichs, and Becht, 1984). Virtually none of the mothers in any of the program areas have over five years of education, and the great majority of fathers are agricultural workers.

We have calculated in Table IV.9 the overall average of the various probabilities of death before the age of five for these specific groups, which is 0.161. That is to say, 16.1% of the children are estimated to die before the age of five.

These data are based on an overall sample size of 7,923 women 15-49 years of age who were interviewed in 1989. The document describing the survey findings does not give the actual number of deaths recorded, nor does it provide a confidence interval for these rates. For the sake of the present discussion, using the method cited in Table IV.1, we have assigned a 95% confidence interval of +/- .02 to the above, assuming that the number of deaths on which these rates are based is around 400.

The DHS report does not provide the number of deaths used in calculating mortality rates, but 400 appears to be a conservative estimate because of the following rationale. If one assumes that only half of the mothers in the survey were in one of the social or geographic groups listed in Table IV. 9, and these mothers had only one child (both conservative estimates), then 634 deaths would have been reported by these mothers (7,923 x 0.5 x 0.161 = 634). If we again estimate conservatively the probability of death of 0.161 is based on 400 deaths, then according to Table IV.1 the 95% confidence interval will be +/- 0.10 x rate = 0.161 +/- 0.10 x 0.161 = 0.161 +/- 0.016 = 0.145 -0.177.

Thus, we would estimate with 95% certainty that the percentage of children in Bolivia in areas similar to those in which ARHC has its program areas who die before the age of five is somewhere between 14.5% and 17.7% according to the DHS data.

TABLE IV.9.

Bolivian 1989 Demographic and Health Survey Estimates of the Probability of Death Before Age Five in Bolivia, 1979-1988

subgroup of children	probability of death*
living in rural areas	0.168
living in the altiplano area	0.142
living in the valley area	0.159
living in the lowlands	0.120
speaking a native Indian language	0.186
mother's education less than six years	0.172
father's occupation agricultural	0.177
overall average	0.161

estimate of the 95% confidence interval for the calculated probability of death = 0.161 +/- 0.016

= 0.145 - 0.177

* based on a cohort method identical to that shown in Tables IV.4 and IV.7.
** see text for description of methodology

source: Sommerfelt, et al, 1991, p.8.

It should be noted that these data are for a ten year period, 1979-1988. One might argue that because of the overall improvements in mortality rates in Bolivia over time, using data for earlier periods would be inappropriate. These differences are slight, however. For Bolivia as a whole, the probability of death between birth and age five was 0.152 for the 1979-1983 period and 0.131 for the 1984-1988 period according to the DHS data.

Comparisons of Child Survival in ARHC's Established Program Sites With Similar Areas

Since ARHC's established program sites had well-developed programs before it became possible to measure mortality rates through routine systematic home visitation, it is not possible to determine what the baseline probability of childhood death was in the program areas prior to beginning the program. Our case for mortality impact, therefore, must rest on comparisons with similar areas. The geographically adjacent new program sites appear to be comparable since they share common cultural, ecological, and socioeconomic charactersitics. Furthermore, routine systematic home visitation was established from the beginning in pilot areas in these two new program sites. Thus, the observed rates are actual baseline rates, although they are from relatively small populations. The rates estimated in these two new program sites may be relatively conservative since they are based on the newly established home visitation program and the families still may be reluctant or suspicious about sharing all mortality information at the time of home visits.

The Demographic and Health Survey data for estimating probability of death before age five are based on an average of probabilities for areas similar to those of ARHC's program areas. Again, these are likely to be conservative estimates since they are based on a single household survey by someone unknown to the household member and since they are based on recall of the previous 10 years.

Table IV.10 as well as Figure IV.1 compare the probabilities of death before age five for these three sites. These comparisons demonstrate that the 95% confidence intervals do not overlap when comparing the results of either Method 1 (the cohort method) or Method 2 (overall under-five mortality) for the established program areas with the DHS data for the rest of Bolivia. The confidence intervals barely overlap when comparing the established program areas with ARHC's "control" areas using methods 1 and 2. It would appear that with continued registration over time of more deaths in control areas, a statistically significant difference will soon be seen (if the mortality rates in the newly established program areas do not drop too quickly as a result of program interventions).

TABLE IV.10.

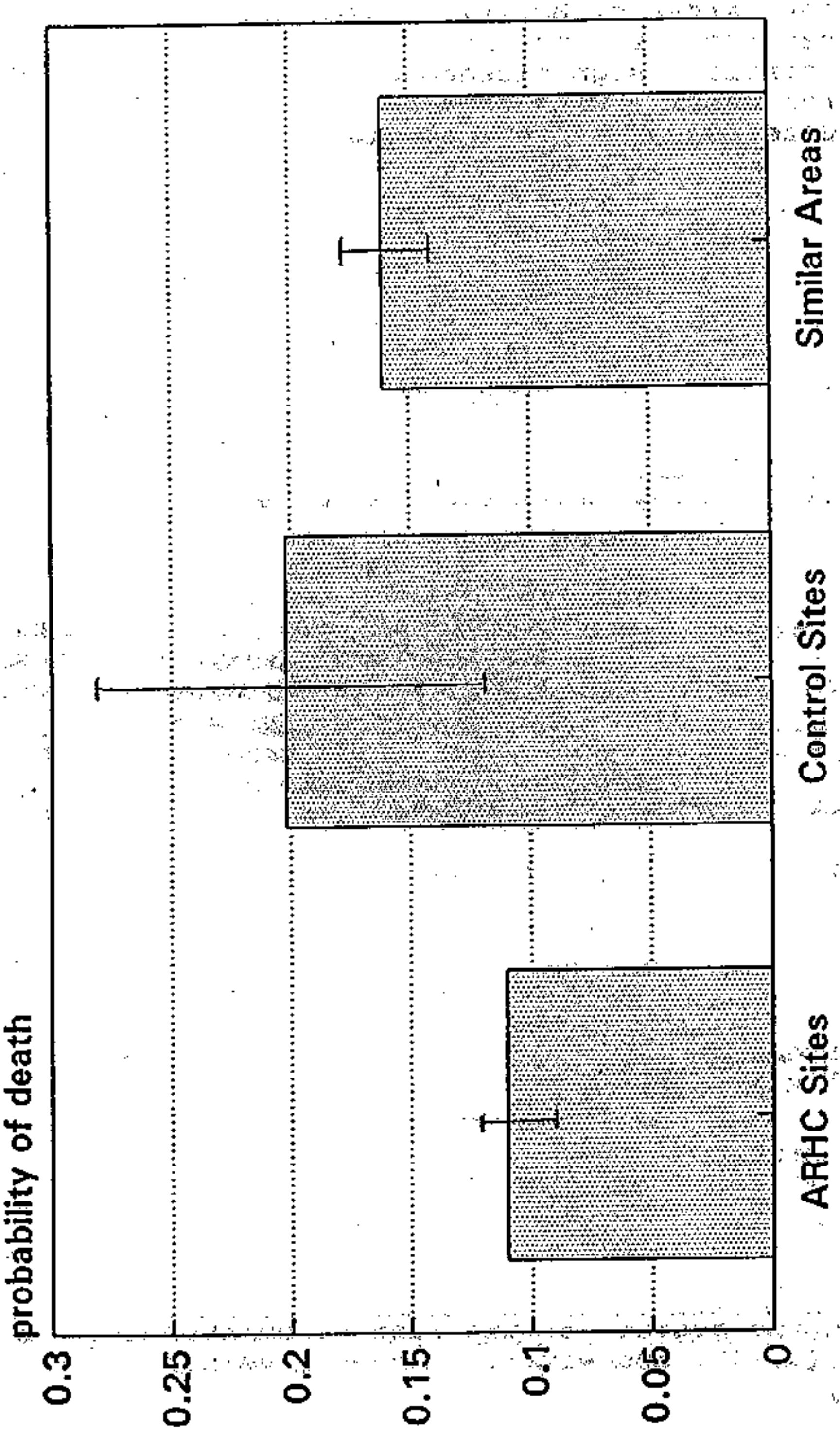
Probability of Death Before Age Five in ARHC's Established Program Areas Compared to that for Control Areas and for Similar Areas in Bolivia

population	estimated probability of death before age five	95% confidence interval	95% confidence limits
ARHC's established program areas (Carabuco 1990-2; Mallco Rancho 1991-2; and Montero, 1992)			
method 1	0.111	+/-0.020	0.091-0.131
method 2	0.110	+/-0.020	0.090-0.130
ARHC's newly established "control" areas (Ancoraimes and Sipe Sipe, 1992)			
method 1	0.195	+/-.074	0.121-0.269
method 2	0.210	+/-.080	0.130-0.290
similar areas elsewhere in Bolivia (1979-1988)			
method 1	0.161	+/-0.016	0.145-.177

method 1: based on the cohort method as described above
method 2: based on overall under-five mortality rate

source: see text

Figure IV.1.
Probability of Death Between Birth and Age 5, ARHC Programs Versus Other Sites



See Table IV. 10 and text for further details. Averages of methods 1 and 2 taken for control site calculations.

These findings indicate that the overall probability of death before the age of five in the established ARHC program areas is 32 - 46% less than that observed for control areas or for similar areas of Bolivia (see Table IV.11). When comparing the program results with those for similar areas of Bolivia, they reach statistical significance at the 0.05 level. When comparing the program results with control areas, they come very close but do not quite reach statistical significance.

TABLE IV.11.

Improvements in Child Survival Estimated for ARHC's Program Areas

population	estimated probability of death before age five	improvement in child survival relative to comparison groups
ARHC program areas	0.110	-
ARHC control areas	0.202*	46%
		$\frac{(.202-.110)}{0.202} \times 100$
similar areas in Bolivia	0.161	31%
		$\frac{(.161-.110)}{0.161} \times 100$

* this is the average of the rate calculated with the cohort method (0.195) and with the under-five mortality rate method (0.210)

source: see Tables IV.7, IV. 9, and IV.10.

Conclusions

Taken as a whole, these data provide highly suggestive evidence that child survival has been favorably affected through ARHC's application of the CBIO approach in its established program areas. However, we have not "proven" that ARHC's programs have improved child survival. The small numbers involved resulted in relatively large confidence limits, especially for the control areas. Further, there has been no randomization of the program intervention, so we cannot prove that the control areas used here are equivalent to the intervention areas. Finally, we cannot be absolutely sure that the lower childhood mortality rates observed in the program areas are a result of program interventions rather than some other unknown influence. As we saw in Chapter III, however, we do have evidence of substantial differences in coverage of child survival interventions between established program areas and new control areas.

The mortality data obtained for ARHC's program areas are based on routine systematic home visitation carried out by health personnel who are known to the families and who are part of a stable health program working in the area for several years. This method is a "gold standard" for mortality assessment in developing countries, and represents as accurate an assessment of mortality rates as can be obtained under the circumstances.

The mortality data from ARHC's control areas and from the DHS survey for similar areas are likely to represent a conservative estimate of actual mortality. In ARHC's two control areas, routine systematic home visitation had been underway for twelve months. It is quite likely that not all deaths were captured at this early point in the development of these two new programs. Furthermore, the DHS household survey data are also likely to represent an underestimate since they are based on a single household visit from a stranger who asks sensitive personal family questions regarding the past 10 years. Thus, one could argue that the observed differences between ARHC's program areas and the comparison areas would be greater if the mortality data for the comparison areas were collected in the same way the mortality data were collected in the ARHC program areas: through routine systematic home visitation over the course of several years, using prospective rather than retrospective data, in similar sized populations as those in the intervention areas, and in control areas in which child survival interventions were not being provided.

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CHAPTER V. COST, COST-BENEFIT, AND SUSTAINABILITY

The issues of program cost and sustainability of child survival programs are of great concern to everyone working in this field. It is obvious that inexpensive programs can be developed and operated, but that does not necessarily mean the program is effective, has a favorable cost-benefit ratio, or is financially sustainable. Furthermore, a program can be effective in terms of vaccination coverage or some other parameter of child survival technology effectiveness and still not necessarily improve child survival. A program which is sustainable with local resources would most likely need to have a predominately curative orientation and therefore not necessarily improve child survival.

As we review the financial aspects of the CBIO approach, it is important to bear in mind that the first criterion on which to judge the CBIO approach is its effectiveness, not its cost. If the model is in fact effective, then it becomes necessary to determine if the costs of implementing the model are sustainable in the longer run or how the cost of implementing the model can be reduced with minimal reduction in the effectiveness of the approach. One development specialist in Bolivia has stated the issue in this way:

> I believe that the criticism that the [ARHC] pilot program [CBIO approach] cannot be easily replicated nor sustained is both directed at the wrong party and very premature. It seems that it is necessary to first construct a model that works, and then formulate a plan to make it economically feasible, and not the other way around (Leonard, 1991).

Unfortunately, there is limited published data available about the cost of either comprehensive or selective primary care. Consequently, it is difficult to compare the cost-effectiveness of the CBIO approach with other primary care approaches.

With these thoughts in mind, we will summarize our findings regarding the cost, cost-benefit, and the financial sustainability of the CBIO approach as ARHC has developed it in Bolivia.

Cost

The costs of primary care activities for the program sites were analyzed for the 1992 fiscal year (March, 1992 - February, 1993). All identifiable local program costs were included (Over, 1989, p.30). Included among these were depreciation, continuing education, training, purchase of initial stocks of supplies, maintenance and repair, and identifiable costs borne by the Ministry of Health (MOH) for program operations. The calculated costs do not include the costs of operation of the La Paz or Lake Junaluska, North Carolina administrative offices nor the value of some medicines and supplies which had been donated for program operations.

Since the annual recurring costs included depreciation of capital investments, our analysis emphasizes the estimated recurring costs rather than the total program costs including capital investments.

Costs were broken down into cost categories as well as into functional program components. At each program site, an estimate was made of the program effort for each area of program activity. This was based on discussions with program staff about the relative amounts of effort given to specific program activities. Then costs per capita were assigned on the basis of population data tabulated through the programs' own census activities.

All recurring expenses were broken down into five categories. In Table V.2, the percentage breakdown for each program area is shown along with an average for the three program areas. Sixty percent of recurring expenses are for personnel. The remaining expenses are virtually equally divided between administration, transportation, supplies, and infrastructure. The administrative costs shown in Table V.2 do not include personnel costs of administration. These were included in the personnel category. These findings are also shown graphically in Figure V.1.

Table V.2.

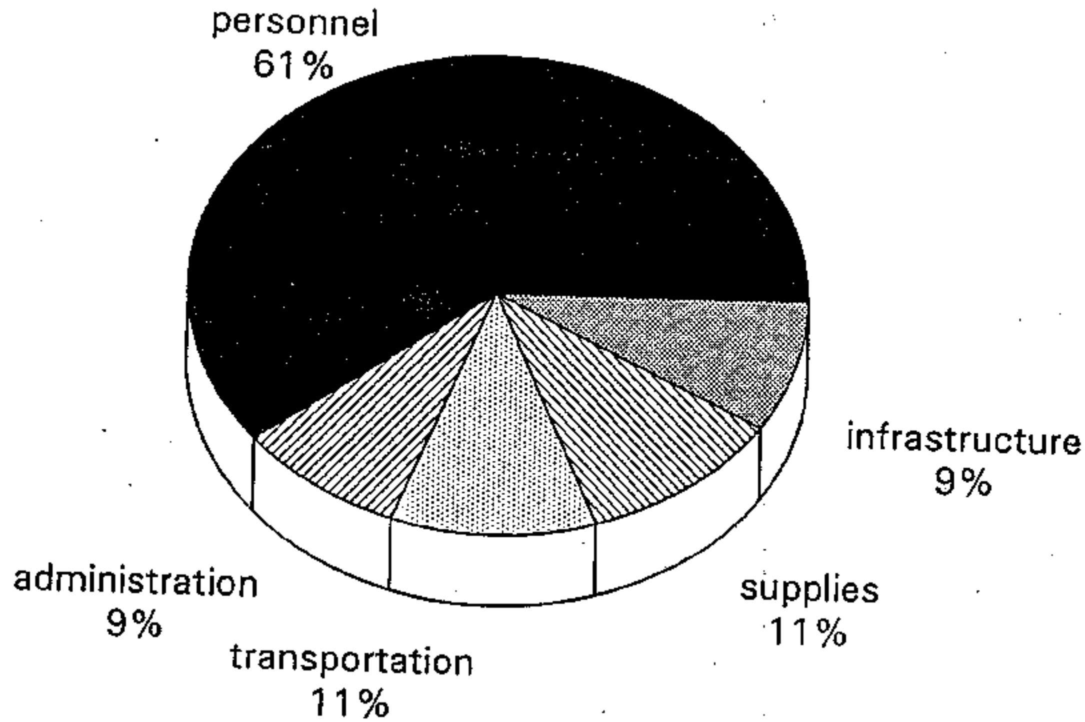
Cost Categories for Each of ARHC's Three Established Program Sites in FY 1992

	Carabuco	Mallco Rancho	Villa Cochabamba/ Montero	Average
personnel	61%	61%	59%	60%
administration	11%	8%	7%	9%
transportation	13%	12%	7%	11%
supplies	4%	10%	19%	11%
infrastructure	10%	9%	8%	9%
Total	99%	101%	100%	100%

source: local program financial records

Figure V.1.

Breakdown of Total Recurring Costs for ARHC's Established Programs, 1992



source: local program financial records

In order to estimate the cost of various functional elements of the program, it was necessary to determine the program effort which went into each function. These determinations were carried out through discussions with program staff. The percentages used for these calculations are shown in Table V.3. For all three program areas taken together, 71% of program effort was devoted to child survival primary care activities. Immunizations and nutrition were the most time consuming child survival interventions, followed by home visitation. Twenty-nine percent of program activities were devoted to non-child survival primary care activities which include adult curative primary health care as well as those components of childhood primary care not included as one of the child survival interventions. Figure V.2. shows these results in graphic format.

Table V.3.

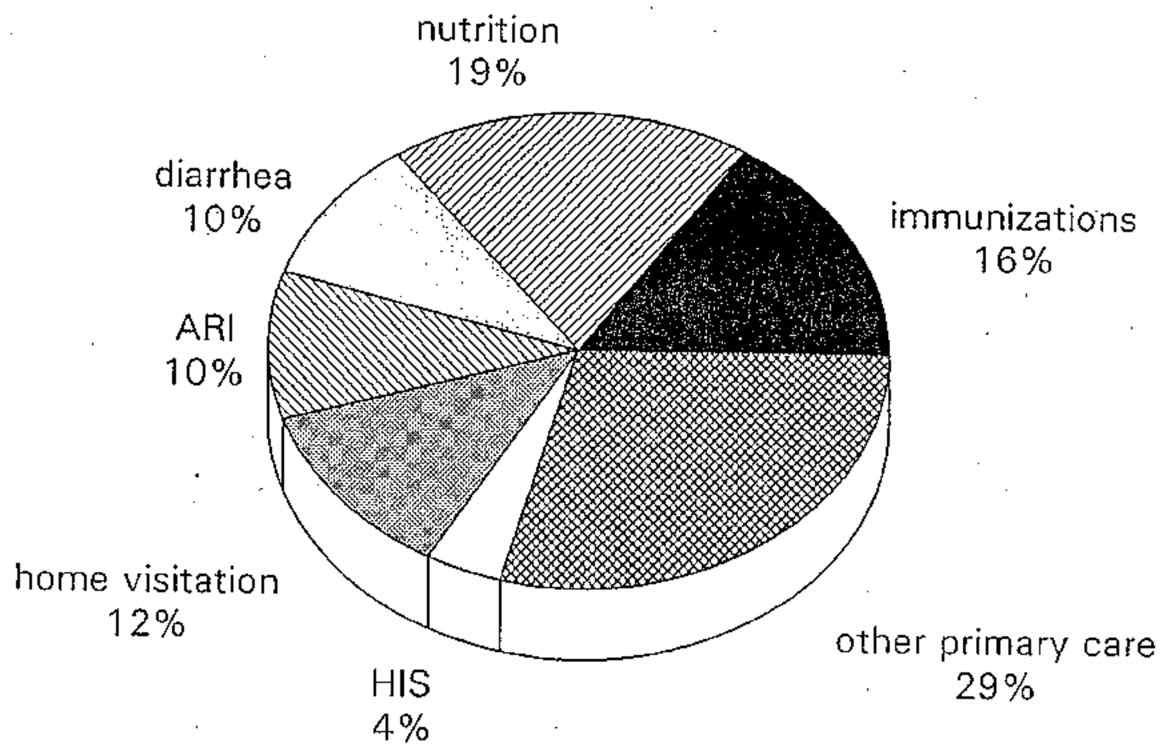
Estimated Distribution of Primary Care Program Effort According to Functional Program Category

	Carabuco	Mallco Rancho	Villa Cochabamba/ Montero	Average
child survival				
immunizations	16%	18%	17%	17%
nutrition	24%	18%	15%	19%
diarrhea	9%	11%	9%	10%
acute respiratory infection	9%	11%	3%	8%
home visitation	17%	11%	12%	13%
health information system	5%	4%	3%	4%
non-child survival primary care	20%	27%	41%	29%
Total	100%	100%	100%	100%

source: local program staff estimates

Figure V.2.

Breakdown of Primary Care Program Effort for ARHC's Established Programs, 1992



source: local program staff

Recurring costs were broken down in several different ways. Program costs were divided into child survival costs and other primary care costs. The non-child survival activities were quantified and assigned a relative value based on staff time and effort. The cost per unit of service was an average of $1.30 (see Table V.4). An outpatient consultation, for instance, was assigned a relative value of 2, and thus cost an average of $2.60. The overall cost per capita of the non-child survival primary care component was $3.09 per person per year.

Child survival expenses were calculated on a per child basis for all three programs and found to be on average $44.26 per year. When mothers were included as beneficiaries, the per capita expense dropped to $18.38. The recurring cost of the overall program, including the child survival and the other primary care components, was $8.57 per person per year when the costs for the three program areas were averaged (see Table V.4).

How do the costs of program implementation using the CBIO approach compare to other data for child survival and primary health care? Compared with the other Latin American programs of US-based PVOs receiving USAID support from the PVO Child Survival Program in Washington, ARHC's programs are moderately expensive. The calculation of cost per beneficiary in terms of AID grant support ranked ARHC fourth out of 15 PVO country projects (PVO Child Survival Support Program, 1993) Thus, ARHC's costs for program operations are not out of line with other PVO operations even though ARHC's costs are toward the upper end of the scale. The AID data do not include matching funds provided by the PVOs but they do, however, include headquarters costs which have been covered with AID funds. The costs of ARHC programs cited in the earlier tables are local program costs only.

According to a recent AID report (Martin et al, 1992), the per capita expenditure of the MOH in Bolivia in 1987 was $6.59 per year. This per capita MOH expense includes the cost of secondary and tertiary facilities which are concentrated in urban areas (Perry, 1988) and thus are not fully representative of what the MOH actually spends on child survival activities, particularly in rural areas. Based on data in Chapters IX-XI and Appendix V, we estimate the actual per capita amount spent by the MOH in ARHC's established program areas to be $0.12 in Villa Cochabamba/Montero, $1.07 in Carabuco, and $1.14 in Mallco Rancho. Thus, a combined primary care/child survival program in Bolivia costing $8.57 per person per year may be difficult to sustain in the long run without a greater commitment from the MOH, greater income from locally-generated sources, as well as long-term external financial support.

Table V.4.

Annual 1992 Recurring Costs of Child Survival Primary Care and Other Primary Care Activities for ARHC's Three Established Program Sites*

	Carabuco	Mallco Rancho	Villa Cochabamba/ Montero	Average
cost of child survival program per child	$66.35	$46.34	$20.10	$44.26
cost of child survival program per child/mother	$27.21	$19.13	$ 8.81	$18.38
cost of non-child survival primary care per service	$ 1.49	$ 1.11	$ 1.29	$1.30
cost of non-child survival primary care per capita	$ 2.32	$ 3.40	$ 3.56	$3.09
cost of overall program per capita	$ 9.70	$ 9.66	$ 6.31	$ 8.57

* includes: depreciation of buildings, equipment, and vehicles; training and continuing education but not La Paz, Bolivia, and Lake Junaluska, NC, office expenses nor the value of some donated supplies and equipment

source: local program financial information and annual census

The same AID report by Martin cited above describes the cost of child care for an AID-supported primary health care program (PROSALUD) and adjacent MOH health centers. These costs averaged to be $11.04 per child per year, considerably less than the $44.26 per child for ARHC's programs. These data, however, are for urban programs. The coverage of child survival services in the populations for which these programs are responsible is not assessed in Martin's AID report. Another study found that primary care/child survival costs in Bolivia ranged from $1.99 to $6.49 per person. These were a sample of urban and rural private and governmental programs (Cisneros, 1992, p. 20).

There are limited additional data available which can be used for comparison purposes. Patel (1989) cites data for the per capita costs of five combined child survival and primary health care programs. These vary from $3.00 to $5.50 per person per year. Patel's data are from the late 1980s. The geographic locales of these projects was not provided. Thus, in comparison, ARHC's cost of $8.57 is beyond the upper range reported by Patel, but nevertheless not totally unreasonable.

One report of almost a decade ago (Grosse and Plessas, 1984) calculated the per capita annual cost of seven primary health programs around the world. There were three large-scale programs serving from 651,000 to 12 million people and four small demonstration projects serving from 11,000 to 22,000 people. The annual per capita costs as reported in 1984 were $0.60 to $2.70 for the large scale projects and $6.10 to $15.40 for the smaller demonstration projects. Interestingly, one of the demonstration projects included in their study was in Montero, Bolivia, which had an AID-supported project in the late 1970s. The annual per capita cost was $15.40. In 1991, this would have been far greater than the $5.66 per capita spent by ARHC for its Montero program. Walsh and Warren (1979) reviewed a number of primary care programs and calculated that the median per capita cost at that time was $2.00.

Thus, the cost of the CBIO approach as ARHC has applied it is at the upper end of the scale of per capita costs and will be difficult to sustain without further efforts to reduce costs and foster local recurring income generation. This does seem feasible, however.

Cost-Effectiveness

We will limit our discussion here to the mortality benefit estimated for ARHC's programs. In Chapter IV, we estimated that the probability of death for children in ARHC's established program areas was 0.11 while for children in similar settings in Bolivia it was 0.16 and for children in sites adjacent to the established program sites it was 0.20. We will assume for the current discussion that the probability of death for children similar to those in ARHC's established program areas who receive conventional MOH-type services is 0.18.

We will assume that the CBIO approach costs $50 per child per year, and the conventional MOH services cost $5 per child per year. We will also assume that 1,000 children are cared for from birth to five years of age in each of the two programs- the ARHC program and the MOH program. The total cost for five years to ARHC would be $250,000 and to the MOH, $25,000. The difference in costs would be $225,000.

According to recent UNICEF data, the average life expectancy at birth in Bolivia is 60 years (UNICEF, 1993). If we assume that each child death occurs at age two (a conservative estimate), then each death would result in 58 years of lost life. If, for 1,000 children receiving care from ARHC, the probability of death is 0.11, then 110 children would die before the age of five. For the MOH program, 180 children would die. Thus, there would be a net difference of 70 more deaths with the MOH program than with the ARHC program. These 70 hypothetical children would have lived 4,060 years (70 x 58). The overall additional cost of the ARHC program is $225,000. Thus, for a $225,000 investment, 4,060 years of life are gained. This results in a cost of $55.41 for each year of life saved as a result of the CBIO approach.

The cost per infant or child life saved through the application of the CBIO approach is $3,214 ($225,000/ 70). In Walsh and Warren's review of 1979, they estimated a cost of $700 per infant and child death averted through basic primary care compared to $200-$250 through selective primary care. Exactly what these costs would be now, 15 years later, has not been calculated, but it would appear they would be in the same general range as we are calculating for ARHC's programs.

Sustainability

Sustainability of health programs is a simple idea on the surface, but multifaceted and difficult to measure. While sustainability of health programs is usually thought of in financial terms, it is in fact a much broader concept. In addition to non-external financial support, long-term sustainability requires local political support, local technical support, community support, and local professional/staff support. Prior to focusing exclusively upon financial sustainability, some comments regarding the nonfinancial aspects of sustainability might be appropriate.

From the standpoint of local community political support, ARHC's programs have a strong potential for sustainability. There is strong community support from individual families and from local political leaders. The linkage of the child survival component to other primary care activities makes this possible. If ARHC's programs were purely child survival, it is doubtful that they would have enough local community political support to make them sustainable in non-financial terms.

From the standpoint of broader political sustainability, it is necessary to consider the role of the Bolivian Ministry of Health. Unfortunately, the MOH has been in a process of retreat in financing of local health services for the poor, particularly in geographic areas where there is a PVO presence. While ARHC has been able to maintain or perhaps increase slightly the contribution of the MOH to its field programs, this has been as a result of great effort and persuasion on the part of ARHC's program leadership in Bolivia. It was noted by Mr. James Becht, who conducted the Mid-Term Evaluation for ARHC's Child Survival grant in the summer of 1992, that the staffing patterns for ARHC's programs are generally within the norms established by the MOH for its own programs (Becht, 1992). One exception to this has been the number of auxiliary nurses in Carabuco. This number has since been reduced within the past year and will probably be reduced further to bring it into line with MOH norms.

In terms of professional/staff sustainability, it appears that the work load and leadership required to implement this approach is sustainable. All programs are led by Bolivian health professionals and are staffed by local people along with midlevel staff who are recruited from within the country. Staffing requirements are sustainable, although ARHC does foresee the need for special training for newly incorporated staff since the CBIO approach is quite different from more traditional modes of work.

Technical sustainability is not an issue. Only very basic technology is utilized in ARHC's health programs.

Let us turn now to financial sustainability. In general, ARHC's programs try their very best to recover the cost of drugs and recover a fee for each curative service which is provided. Patients are not refused treatment if they are unable to pay, however. The capacity of patients to pay for the care they receive varies significantly. Families in the Carabuco Program Area have very little, if any, disposable income. Receiving payment for services is a very difficult proposition. In the Villa Cochabamba/Montero Program Area, on the other hand, families have more disposable income available even though it is the poorest area of the city of Montero. The families in the Mallco Rancho Program Area are in a middle position compared to the other two program areas in terms of their ability to pay for the services they receive.

Table V.5 shows the amount of funds which have been generated locally from program operations. The amount generated in Carabuco has been relatively constant since 1986, varying between $1,018 and $2,538. Locally generated funds account for only 3% of recurring program operations there.

The Mallco Rancho Health Program generated $6,133 in local contributions for primary care activities in FY 1992, amounting to 11% of the cost of primary care program operations. The Villa Cochabamba/Montero Health Program, on the other hand, generated $15,457 in local funds, which represents 23% of the recurring costs of the primary care program. The average percentage for the three programs of annual recurring primary care program costs supported by locally generated funds is 12%.

Table V.5.

Locally Generated Funds for Primary Care Program Operation, 1992

program site	amount of local funds generated	percent of recurring costs
Carabuco	$ 2,538	3% ($2,538/$95,906)
Mallco Rancho	$ 6,133	11% ($6,133/$56,333)
Villa Cochabamba/ Montero	$15,457	23% ($15,457/$67,033)

source: local program financial information

The percentage of recurring local program costs that are covered by the MOH for each program site is shown in Table V.6., and is on average 8%. Adding MOH support to locally generated support for Carabuco results in 14% of recurring program costs being met by local revenue or the MOH. In Mallco Rancho, 21% of recurring program costs are met by local revenue or the MOH while in Villa Cochabamba/Montero, it is 25% (see Figure V.3.).

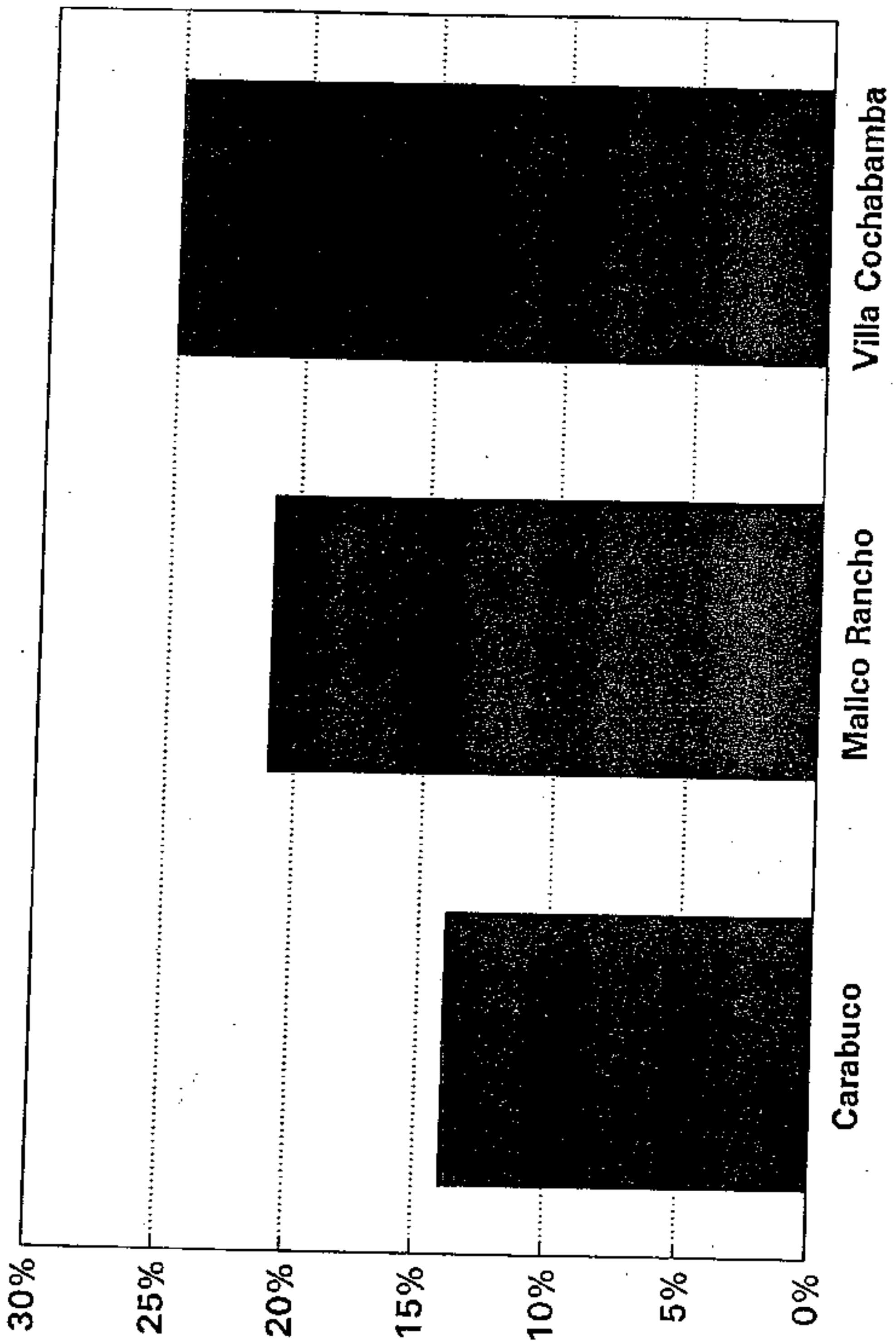
Table V.6.

Percent of Recurring Program Costs Provided by the MOH, 1991

program site	estimated value of MOH support	percent of recurring program costs	
Carabuco	$10,545	11%	($10,545/$95,906)
Mallco Rancho	$ 5,633	10%	($5,633/$56,333)
Villa Cochabamba/ Montero	$ 1,500	2%	($1,500/$67,033)

source: local program financial information

Figure V.3.
Percent of Recurring Program Costs
Met From Local and MOH Sources



source: local program financial records

It is difficult to compare these data with those for other programs. First of all, there is limited data for other programs and, secondly, it is hard to know if the data are comparable. In one review of primary health care clinics operated by a large PVO in Haiti, it was determined that, on average, 20% of the total operating costs of the PVO were recovered from user fees (Setzer and Boulos, 1992). The best estimate at the moment is that approximately 12% of ARHC's total operating costs are recovered from user fees.

Conclusion

There is no doubt that the costs of the CBIO approach as ARHC has applied it are relatively high compared to other PVOs working in child survival and compared to other primary care programs in Bolivia. We estimate the cost of saving a child's life through the CBIO approach to be $3,214, and the cost per year of life saved for infants and children to be $55.41 per year.

At present, approximately 12% of recurrent program expenses are obtained from user fees, and 8% of expenses are obtained from MOH support. Thus, four-fifths of recurrent expenses are met from external ARHC sources.

Costs of program operations could be reduced through economies of scale (operating larger programs for a smaller per capita cost) and through streamlining the approach (as will be discussed in Chapter VII). In addition, one obvious approach to lowering costs in addition to these is to substitute lower paid staff for more highly trained (and paid) staff. Another related approach is to incorporate primarily lesser paid staff as programs expand, thus achieving the same net result over a period of time.

Approximately 60% of recurring local program costs are for personnel. A heavier reliance on lesser paid staff could lead to substantial cost savings. Since ARHC's experience with volunteers so far has not been favorable, it would not be wise to shift the burden of program operations at this point on to volunteers. However, if an effective means of building program operations upon a volunteer staff could be developed as has been done at Jamkhed, India, (Arole, 1987), then the reduction in costs would be dramatic. Additional effort at local cost recovery through higher user fees will be necessary along with streamlining program operations if ARHC's application of the CBIO approach is to achieve long-term sustainability.

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CHAPTER VI. REGIONAL VARIATIONS IN THE DETERMINANTS OF CHILD MORTALITY WITHIN ARHC'S PROGRAMS IN BOLIVIA

One of the assumptions of the CBIO approach is that it is necessary to make a local community diagnosis of the most frequent, serious preventable or treatable diseases and a local determination of those at greatest risk rather than rely on data derived from other locations, nationally or internationally. This assumption is similar to the premise of the Essential National Health Services Research (ENHSR) approach (Commission on Health Research for Development, 1990).

The ENHSR approach encourages countries to gather health information from within its borders to guide national programs rather than relying on global data or data from other countries. One of the premises of the CBIO approach is that each local area is different, and information about health problems needs to be obtained from local communities before designing an effective health program. Obviously, this argument can be carried to an extreme, but at least it should be recognized that among different ecological areas and among different socioeconomic groups, the community diagnosis of health priorities may vary significantly. If each local program is going to be able to improve health, then the nature of the interventions needs to be adjusted, particularly in light of the extremely limited resources available for most health program activities.

It is this premise which will be explored here for ARHC's three established program areas reviewed in this document. As has been previously indicated, the Carabuco Health Program Area includes almost exclusively Aymara people involved in farming and other agricultural work in a relatively isolated rural area at

13-15,000 feet elevation. The Mallco Rancho Program Area includes Quechua people in mixed agricultural/commercial activities in a rural setting at 8,000 elevation feet which is near a major urban area. The third setting involves both Quechua and Spanish descendents, many of whom have migrated from the highlands to a periurban low-income area of the city of Montero in a semitropical lowland environment. This area, called the Villa Cochabamba Health Area, is densely populated and has major problems because of a lack of clean water and sanitation as well as because of high rates of bottle feeding. These problems are not encountered to the same degree at the other program sites. The Villa Cochabamba residents are involved in the commercial life of the city in some way, although many work as seasonal agricultural laborers.

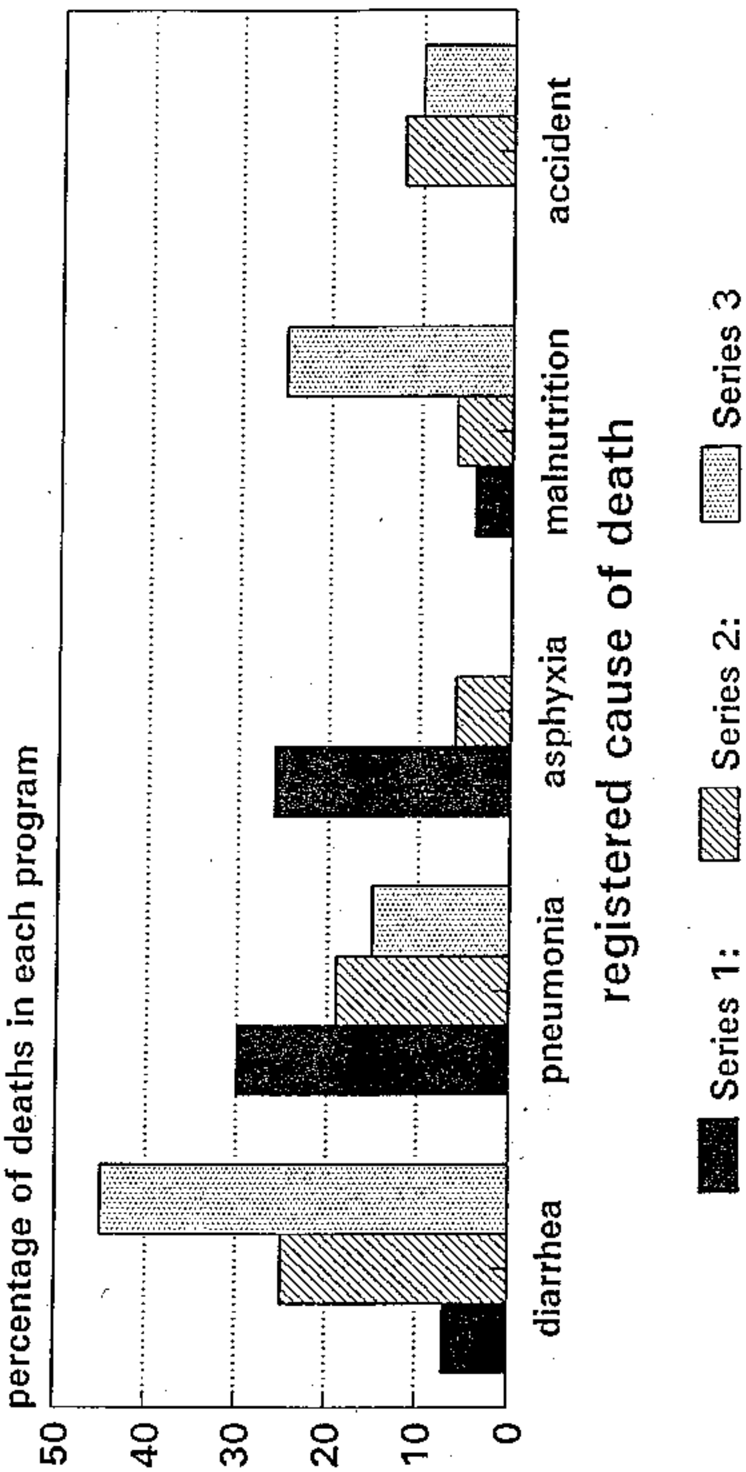
The data reported here are comparisons of causes of childhood death and age at death for these three program areas. These data are described in more detail for each program area in Chapters IX - XI. For this discussion, data have been limited to 1990-1992 for Carabuco, 1991-1992 for Mallco Rancho, and 1992 for Villa Cochabamba/Montero. The Villa Cochabamba/Montero data described here are for approximately one-third of the program population in which routine systematic home visitation (RSHV) was conducted throughout 1992. It is during these years that the registration of births and deaths on the basis of RSHV is sufficiently reliable and worthy of further analysis.

Comparisons Between Programs by Cause of Death

Figure VI.1 shows the percentage of deaths in each program area by assigned cause of death. It is readily apparent that the percentage of a program's childhood deaths due to diarrhea progressively increases as one moves from Carabuco, in the highland area, to Mallco Rancho, in the mountainous valley area, down to Montero in the semitropical lowland areas. The percentage of childhood deaths due to pneumonia is slightly higher in Carabuco than in the other two program sites. Asphyxia is a much more common cause of death in Carabuco, where it accounts for almost 20% of the childhood deaths, than in Mallco Rancho, where it causes only 8% of the deaths. In Villa Cochabamba/Montero, asphyxia was not registered as a cause of even a single death. Malnutrition was listed as a cause of death in almost one-quarter of the deaths in Villa Cochabamba/Montero and in only 5% of the deaths at the other two program sites. In Carabuco, both pneumonia and asphyxia were more frequent causes of death than diarrhea.

Malnutrition was a clinical diagnosis based on physical examination or history rather than actual height and weight measurement. Asphyxia was also a clinical diagnosis based on a history of a sudden unexpected cessation of respirations without

Figure VI.1.
Percentage of Childhood Deaths in Each Program Area by Cause



Series 1: Carabuco, 1991
Series 2: Mallco Rancho, 1992
Series 3: Montero/Villa Cochabamba, 1992

prior symptoms.

These findings are noted slightly differently in Table VI.1. Here, each death is listed only once. The classifications created for cause of death allow for more than one diagnosis. With mutually exclusive categories, it is possible to carry out a Chi Square test for statistical significance. One can see that the probability that the differences observed for the three program areas are due to chance is less than 0.005.

Comparisons Between Programs of Age at Death

Figures VI.2-4 show the distribution of ages at death for the childhood deaths registered in Carabuco in 1990-1992, in Mallco Rancho in 1991-1992, and in the Villa Cochabamba neighborhood of the Villa Cochabamba/Montero Program for 1992. A very different pattern is readily apparent in each of the three areas.

In Carabuco, there is a marked concentration of children who died before the age of three months. Over half of the childhood deaths registered occurred within the first three months of life. After three months of age, there continues to be a small percentage of deaths occuring throughout the first four years of life.

In Mallco Rancho there is also a relatively high percentage of childhood deaths occurring during the first three months of life (42%), although it is less than in Carabuco. However, there is a considerably higher percentage of children dying after three months of age, particularly in the 3-21 month age period, compared to Carabuco.

Finally, in Montero, we see a strikingly different pattern, with two peaks in the age periods at which childhood deaths were recorded most frequently: one at 3-6 months of age and a second at 15-21 months of age. The low percentage of deaths in the first three months of life in Montero compared to Carabuco and Mallco Rancho is of particular note.

The data for each program area have been collapsed into two categories in Table VI.2. The numbers of children dying during the first year of life are compared to those dying after completing the first year of life. Three-quarters of the children in Carabuco died during the first year of life compared to two-thirds in Mallco Rancho and less than half in Villa Cohcabamba/Montero. These differences have a probability of less than 0.02 of being due to chance according to Chi Square calculations.

Table VI.1

Numbers of Deaths by Diagnosis Among Children in Carabuco, Mallco Rancho, and Villa Cochabamba/Montero*

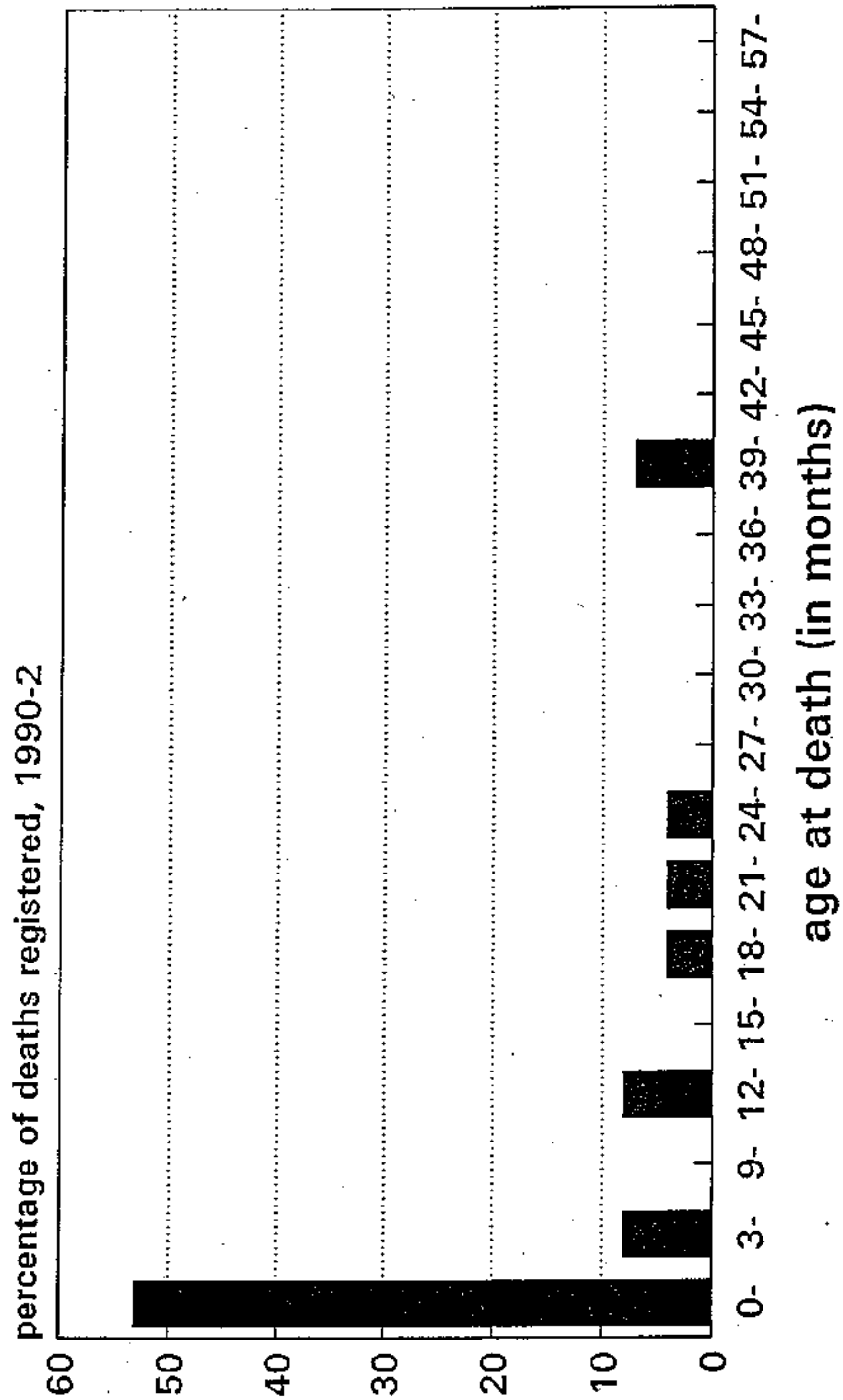
cause of death	program site: Carabuco	Mallco Rancho	Villa Cochabamba Montero	Total
diarrhea/acute respiratory infection	0	1	1	2
acute respiratory infection	12	4	2	18
asphyxia	9	3	0	12
diarrhea	2	12	6	20
malnutrition	4	2	3	9
diarrhea/malnutrition	0	0	2	2
trauma	6	4	2	12
other	16	11	4	31
Total	49	37	20	106

Chi Square = 31.34
df = 14
p = .005

* The data for Carabuco are for 1990-2, for Mallco Rancho 1991-2, and for Villa Cochabamba/Montero 1992. The Villa Cochabamba/ Montero data are for one neighborhood ("barrio") comprising one-third of the overall program area.

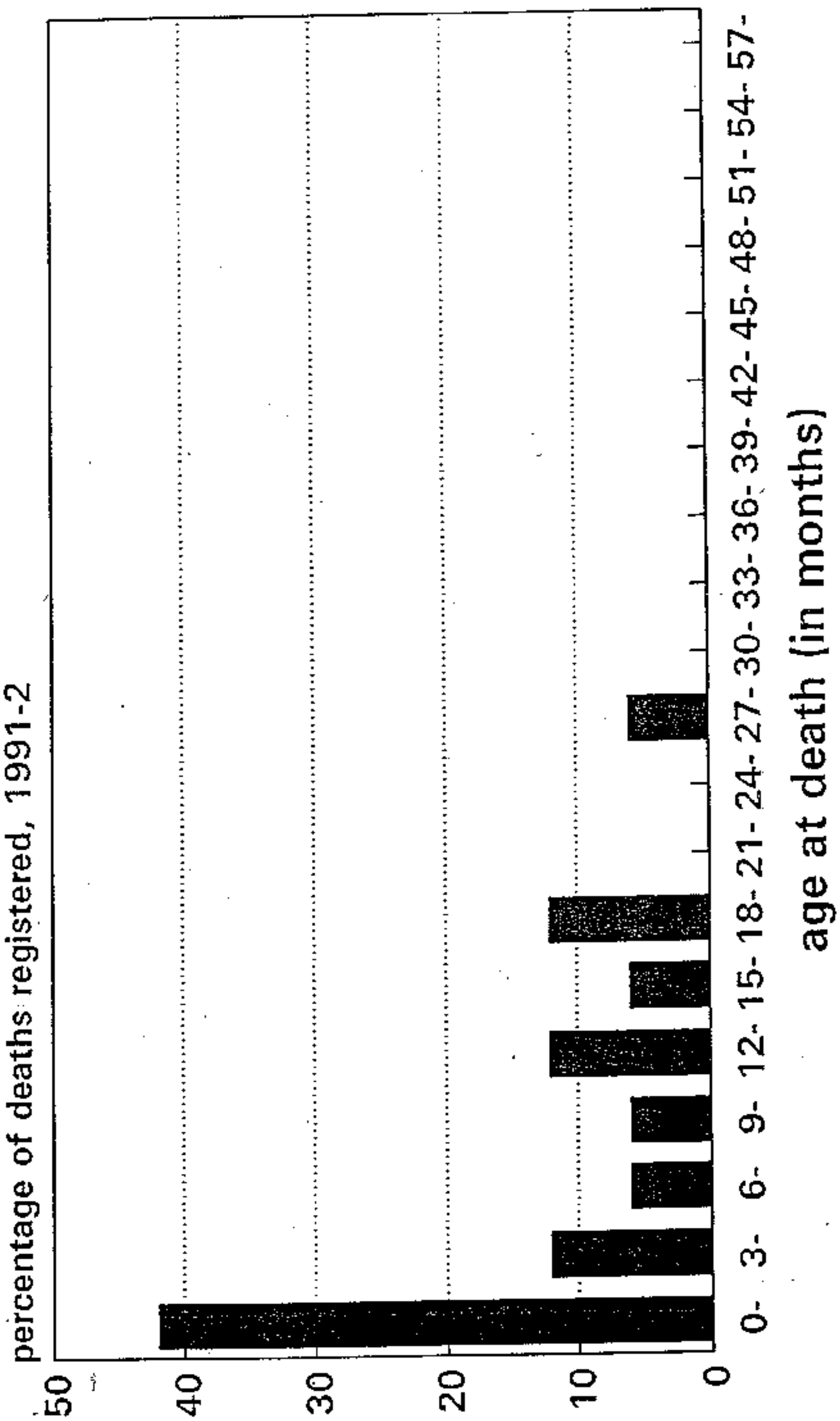
source: program death registries

Figure VI.2.
Percentage of Childhood Deaths in Carabuco by Age at Death



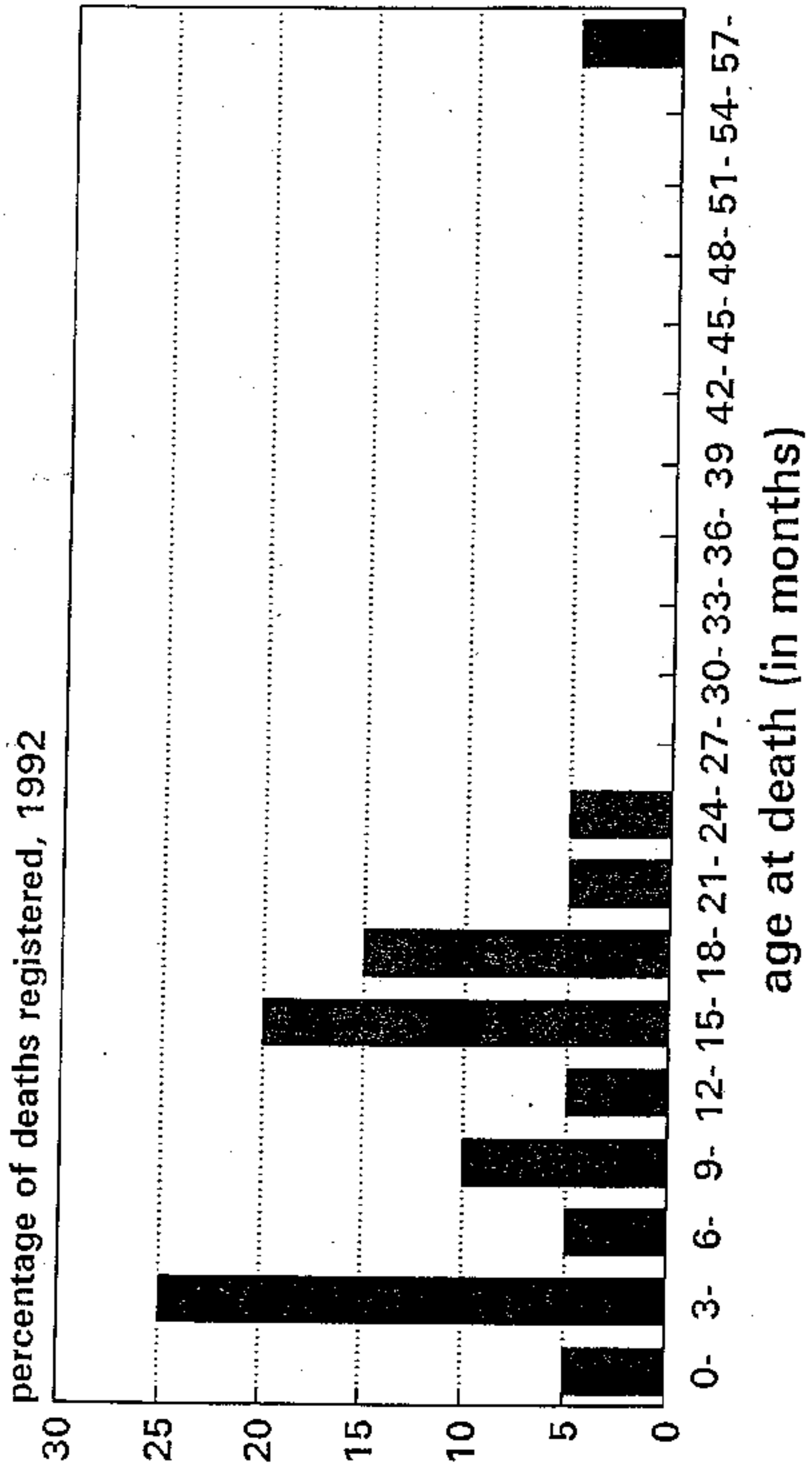
source: Carabuco death registry

Figure VI.3.
Percentage of Childhood Deaths in Mallco Rancho by Age at Death



source: Mallco Rancho death registry

Figure VI.4. Percentage of Childhood Deaths in Montero by Age at Death



for the Villa Cochabamba "barrio" only
source: Villa Cochabamba/Montero
death registry

Table VI.2.

Numbers of Childhood Deaths According to Age at Death in Carabuco, Mallco Rancho, and Villa Cochabamba/Montero*

	program site		
age at death	Carabuco	Mallco Rancho	Villa Cochabamba/ Montero
under 12 months	57 (76%)	22 (59%)	9 (45%)
12-59 months	18 (24%)	15 (41%)	11 (55%)
	75 (100%)	37 (100%)	20 (100%)

Chi Square = 8.03
df = 2
p = 0.020

* The data for Carabuco are for 1990-2, for Mallco Rancho 1991-2, and for Villa Cochabamba/Montero 1992. The Villa Cochabamba/Montero data are for one neighborhood ("barrio") comprising one-third of the overall program area.

source: program death registries

Further analyses have been carried out to determine other risk factors for childhood death. The preliminary results of case-control studies are included in Chapters IX - XI and also Appendix IV. The point to be made here, however, is that knowing the precise age periods at which children are at greatest risk of death gives the program a powerful diagnostic tool which is readily operationalized to guide its "therapy" of prevention and treatment to high-risk groups. Perhaps illnesses occur at similar frequency at other age periods but are not associated with the same mortality. These epidemiologic criteria give a basis for the program concentrating its efforts on those children who are at the highest risk of death. I have discussed at greater length elsewhere possible reasons as to why some of these differences have been observed (Perry, 1992).

Conclusions

Analysis of death data for infants and children dying at ARHC's established program sites reveals distinct patterns in the age at death and the cause of death. In the Carabuco (high altitude) program, deaths in the first three months of life and deaths from respiratory causes predominate. In the lowland program of Villa Cochabamba/Montero, deaths at 3-6 months and 15-21 months and deaths caused by diarrhea and malnutrition predominate. In Mallco Rancho (mountainous valley area), most deaths occur under 15 months of age and are concentrated under three months of age, but not to the same degree as in Carabuco. The leading cause of death in Mallco Rancho is diarrhea. The CBIO approach provides local programs with powerful diagnostic information so that resources can be targeted to high-risk groups with the aim of reducing the numbers of deaths from preventable or treatable causes and optimizing staff effort.

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CHAPTER VII. FURTHER COMMENTS ON THE APPLICABILITY OF THE CENSUS-BASED, IMPACT-ORIENTED APPROACH FOR CHILD SURVIVAL ACTIVITIES

Two issues of the CBIO approach's applicability for further child survival activities will be briefly discussed in this chapter. The first issue to be addressed is "what are the specific components of the CBIO approach as ARHC has applied it which are essential to the successes achieved?" The second issue is "how can this approach be further evaluated or replicated as one means of improving the efficacy of child survival in developing countries?

Prior to addressing these questions, it should be pointed out that the CBIO approach has been applied in three very different program settings in Bolivia in somewhat different ways, and in all three cases positive results have been achieved AND the local program staffs have all developed on their own a deep commitment to this approach. Two of these settings are in rural areas and the other one is in a periurban slum setting. The applicability of the CBIO approach in diverse settings gives some credence to the robustness of the model. The fact that ARHC's staffs in all three locations find this approach professionally appealing and workable gives even further credence to the strength of the approach.

Critical Elements of the CBIO Approach

The CBIO approach has been implemented by a PVO in Bolivia with its own unique organizational climate. ARHC's programs are led by a highly competent Bolivian staff with a deep concern for improving the health of the people served by ARHC's programs. To a significant degree, the achievements of ARHC's programs reflect this organizational climate.

Nevertheless, it has been ARHC's experience that the CBIO approach has proven to be a powerful motivating conceptual force for the entire staff once they have fully understood and experienced the approach on their own. Their enthusiasm for this approach is one of the important reasons to consider the CBIO approach for child survival activities in other settings.

The critical elements of the CBIO approach are described below.

Phase 1: Community Diagnosis

The critical elements of Phase 1 (as described in Chapter II) include a census of the program population; household enumeration on village maps and on the front of each house; and the listing in a family folder of all the inhabitants in a given household. This cannot be carried out until the practitioner has established a relationship of trust with the community. Thus, it is implied that the practitioner has been present previously and is known to the community, and the community is known to the practitioner. Once the census as described above has been completed, routine systematic home visitation (RSHV) is the next step in making a community diagnosis. Through RSHV it is possible to establish baseline mortality rates and determine the most frequent preventable or treatable causes of death in the community.

It may not in theory be necessary to visit each and every home on a regular basis as the concept of RSHV implies. Some method possibly could be envisioned in which groups of neighbors come together for some form of meeting. This could enable a health worker to determine more quickly what vital events had occurred in the family since the last contact and what the causes of death were. This approach would be suitable so long as it could be ascertained which families did not attend the meeting. Later contact with the non-attenders through a home visit could be carried out. It is those persons who "slip through the cracks" of a delivery system based on concentrations of villagers or clinic attendance who are at high-risk of death and therefore need somehow a regular contact with the health program. This is the real strength of RSHV.

Health priorities as defined by the community become apparent through the spontaneous demand for services as well as through the many interactions which the practitioner has with the community. ARHC has asked at the time of household surveys what health priorities specific individuals have. Analysis of this data has not provided any new insights that the staff did not already possess regarding the community's perceptions of its health priorities, although it did provide a way of quantifying those priorities.

In essence, community diagnosis as the initial phase of the CBIO approach cannot be readily streamlined. One issue, when thinking of applying the CBIO approach to larger populations, is whether the community diagnosis could be carried out in a small pilot area either randomly selected or somehow assumed to be representative of the entire program area. This could be carried out as one effort of "streamlining" and reducing the overall cost of the CBIO approach.

Phase 2: Program Planning

As ARHC has applied the CBIO approach, Phase 2 has not received as much attention as it should have. The definition of the resources available and the budget has always been given considerable attention (Step 1 of Phase 2), but the program priorities, as determined by the community diagnosis (Step 5 of Phase 1) and the program workplan (Step 2 of Phase 2) have not always been given as much attention as needed, especially from the whole staff. For the CBIO approach to achieve maximal effectiveness, it is necessary for the entire program staff together with the community to review critically the information arising from the community diagnosis and to formulate a workplan based on the determined health priorities and on the available resources.

ARHC is currently strengthening local staff problem analysis and planning skills through the introduction of a quality assurance process. This process is anticipated to result in a more standardized approach to program planning such as the development and use of program forms and manuals. These documents will be used by the staff to formulate health priorities, identify resources available, and create an annual work plan. We anticipate that two to three years will be needed to fully implement this process. Currently, program directors present a proposed budget and workplan each fall to the National Director of ARHC. These are reviewed and discussed in detail at an annual national meeting of program leadership staff, but thus far, the criteria for evaluating budgets and workplans are not always heavily influenced by community diagnoses.

Phase 3: Program Implementation

It is in the phase of program implementation that we can begin seriously to deal with certain elements of the CBIO approach which might be less essential than others. One aspect of the approach which all ARHC staff seem to recognize as critical is the capacity to respond in some way to the acute health needs of the people in the communities where the program is operating. Exactly how a response is made, what resources are used in providing a response, and the quality of care arising as a result of that response are all major issues which need very careful review both before program implementation begins as well as after it is underway.

Nevertheless, the critical issue is that some type of response to "calls for help" from the local community needs to be built into the program operation. This includes first aid and dependable referral of more seriously ill patients to the closest hospital as well as the provision of treatment, when appropriate, by program staff using resources which are within the limits specified by the budget and workplan. At the very least, the acute curative services must be readily available, be carried out with compassion, and cause no harm.

In addition to readily accessible primary care services, an indispensible part of the CBIO approach as developed by ARHC is the provision of basic services to treat or prevent conditions which have been determined to be epidemiologic priorities. This does raise the interesting issue of vaccine preventable diseases in the context of the CBIO approach. If no deaths, significant illness, or disability have been identified as a result of vaccine preventable diseases such as measles, why devote a major effort to the vaccination program? This also raises the question of whether an adequate "herd immunity" is being sought or whether every person is equally at risk for the particular disease.

The case for a strong immunization program rests on the fact that children remain susceptible to diphtheria, whooping cough, and measles if they are not vaccinated. Where the care of the umbilical cord of newborn children is such that neonatal tetanus occurs, then these newborn children are susceptible to neonatal tetanus if their mothers are not immunized. The efficacy of BCG against tuberculosis is still not well established, so we will leave the issue of BCG vaccination aside. Polio has been nearly eradicated from the Western hemisphere, so we will leave the issue of polio vaccination aside for the moment as well.

The question then becomes, if children are not dying from vaccine preventable diseases in the program area, how much emphasis should be given to achieving a high level of immunization coverage? How does this priority compare to the priority of devoting program resources to problems in the program area which are responsible for most of the preventable or treatable deaths?

How does a program decide on the nature and mix of the child survival interventions which it chooses to undertake. Heretofore, programs such as ARHC's have accepted the externally-generated child survival "imperatives" and tried their best to provide immunizations, education about and provision of ORT, growth monitoring, and early treatment of ARI to all children in the program areas.

But in order to target limited resources more effectively, it is necessary to find out why children are dying, at what ages, and what are the underlying as well as the immediate causes of death. Furthermore, it is necessary to determine what other characteristics besides age constitute risk factors for death. Thus, the more precise the community diagnosis has been, the more streamlined can be the program intervention without loosing efficacy. If anything, the concept of streamlining and reducing the cost of the CBIO approach as ARHC has applied it may call for even more emphasis on Phase 1 (community diagnosis).

The answer to the issue of how important the immunization program is relative to other interventions depends partly on the relative importance of immunizations as a vehicle to health improvement compared to other interventions and the relative costs of these interventions. Thus, it depends upon the local circumstances. However, if the program does give a relatively high priority to immunization, it seems necessary to try to approach a coverage level of 100% at as early an age in life as possible because children may later be in different geographic settings where vaccination coverage levels are low and therefore be unprotected by herd immunity.

An obvious question at this point is how critical is home visitation to the delivery of whatever interventions are designed? The answer to that really depends on how effective other approaches are in reaching targeted high-risk groups. If another approach is relied upon primarily (such as a rally or concentration of some sort), there needs to be included in the work plan some way of providing services to those who are at high-risk who do not attend such group meetings.

On the other hand, one could make a strong case for routine systematic home visitation (RSHV) to all homes in the program area regardless of other circumstances. This is because of the trust and confidence which RSHV engenders between the practitioner and the community, the enhanced mutual understanding between staff and families which results, and the registration of vital events made possible through this process. Families are much more knowledgeable about the program, and staff understand the community and its members much better as a result of home visitation (see Perry and Sandavold, 1993). If one accepts the thesis that all homes should be included in the visitation program, the question then becomes, what is the minimum frequency of RSHV which will not eliminate its effectiveness? Another issue is also whether RSHV might be broken down into components which could reduce the overall cost of the program. Might local informants, either volunteer or paid, be able to carry out some of the RSHV function at a lower cost than is now being borne by ARHC? These are all important questions which need further exploration.

Phase 4: Evaluation and Community Rediagnosis

Monitoring mortality impact as a result of program implementation is one of the key features of the CBIO approach which is essential to maintain. As ARHC has implemented the approach, it has used RSHV to identify and register vital events and thereby to be able to follow mortality rates over time. There are ways of maintaining periodic contact with all families in a program area other than through periodic home visitation, but it is hard to imagine that any of them would have the degree of coverage that can be achieved through RSHV. As mentioned above, it might be possible to envision other methods of home visitation that are less costly than those used by ARHC such as less frequent visitation or use of less costly staff. But somehow, at least for a sample portion of the overall program area, there needs to be ongoing contact with all persons along with registration of their vital events so that mortality rates can be calculated at different points in time. Exactly how large a population needs to be monitored depends on the level of the mortality rates as well as the precision with which rates need to be determined.

The goal of monitoring changes in mortality and in causes of death is only partly to assess program impact. As we mentioned in Chapter III, the interpretation of changes in mortality rates in a given program area is not a straightforward process, since changes could be due to factors other than the program itself and since changes may be due to random variability rather than any true change. Even so, redefinitions of the most serious preventable or treatable diseases, of those high-risk groups (partly as defined by mortality rates), and of the causes of death are critical to a community rediagnosis and a replanning of program activities.

The critical elements of the CBIO approach are summarized in Table VII.1.

Table VII.1

Critical Elements of the Census-Based, Impact-Oriented Approach

1. Establish a relationship of trust between the community and the practitioner

2. Carry out a census to identify and locate all residents

3. Communicate with community residents so that staff can learn what are the community's health priorities

4. Establish prospective regular interactions with all or a selected sample of families to establish baseline death rates, to determine the most serious, frequent preventable or treatable diseases in the community, and to determine causes of death

5. Determine program priorities by combining epidemiologic priorities and the community's priorities

6. Formulate a workplan based on program priorities and resources available

7. Provide readily available first aid, acute and ongoing primary care, and referral services

8. Ensure that basic services for priority epidemiologic problems reach a high proportion of the program population, presumably through home visitation

9. Identify as precisely as possible the immediate and underlying causes of death along with the characteristics of those at greatest risk of death

10. Provide essential services to all individuals at high-risk of death and ensure that those who do not seek out services are offered them at home

11. Visit routinely all homes or at least a representative sample of homes in the program area

12. Monitor changes in mortality rates for at least for a segment of the program area and redefine high-risk groups as well as causes of death after program implementation has been underway

How Can the CBIO Approach be Further Validated?

There are several ways to consider how the CBIO approach might be further validated. Of overriding concern, of course, is the issue of whether this approach in fact does result in lowered mortality rates for infants and children. Our analysis of mortality impact has shown that there are several problems with a decisive conclusion about whether the approach has in fact improved child survival. First of all, the approach would need to be applied in a considerably larger population, probably of at least 50,000 people. Secondly, there would need to be comparison groups which are somehow randomly determined. In these comparison groups, the CBIO approach would not be implemented, but mortality rates would be measured in a similar fashion as in the program area (i.e., through ongoing routine systematic home visitation). Another value of considering the application of the CBIO approach on a larger scale is to determine what the costs would be. It would also be possible to apply the CBIO approach at varying levels of intensity to determine the impact and the cost-benefit tradeoffs at each level.

A larger scale quasi-experimental implementation could be readily developed at each of the three regions where ARHC's programs are located. Each program site is located within a MOH district. Structures and relationships are now in place which would make "upscaling" the CBIO approach to the district level a smooth process relative to what might be experienced in an entirely new program setting. Of course, trying the CBIO approach in an entirely new setting on a large scale as a controlled field experiment is one option which could be considered.

Another means of further validating of the CBIO approach is to work with other health programs or communities which are interested in applying this methodology. This would make it possible to determine if the CBIO approach can be readily applied in other settings not associated with ARHC. Presumably, any efforts along this line would require fairly close coordination between individuals responsible for the new program with persons experienced in the CBIO approach as applied by ARHC. As the experience with the CBIO approach grows in a variety of settings, new lessons will undoubtedly be learned which can improve the overall process of implementation.

Conclusion

Further experience with the CBIO approach might yield a somewhat different set of critical elements from those I have outlined above. It is important to realize that this approach is highly flexible in its application. ARHC's application is only one of many possibilities. Determining local health priorities and carefully targeting program efforts toward all those at greatest risk will always remain central elements along with a careful evaluation of program impact. Applying this approach on a larger scale will provide many opportunities to learn how it can be streamlined without losing efficacy.

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