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THE JOHNS HOPKINS UNIVERSITY
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Health Intervention Strategies in Asia and the Near East

Past Performance and Its Implications for the Future

Kenneth Hill, Ph.D.

W. Henry Mosley, M.D., M.P.H.

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PREFACE

The Institute for International Programs, part of The Johns Hopkins School of Public Health, brings together leading Hopkins experts in biomedical, environmental, social science, and health management fields. This distinguished group of professionals, together with collaborators from established research centers and major academic institutions throughout the world, provides a comprehensive approach to international development. The Occasional Papers Series of the Johns Hopkins Institute for International Programs was established as a means of disseminating information on advances in international health.

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INTRODUCTION

The Alma Ata Declaration of 1978 established the goal of health for all by the year 2000. Strategies to achieve this goal have involved marked changes in emphasis within the provision of health services. Emphasis has shifted from the limited provision of secondary and tertiary care towards the universal provision of primary care, from relatively expensive curative medicine towards relatively inexpensive preventive medicine, and from no particular age focus to a focus on mothers and their young children. A number of international projects, such as the Expanded Program of Immunization and the Combatting Childhood Communicable Diseases program, have emerged as a consequence of these changes in emphasis. It is important to review how successful these strategies have been on a country by country basis in order to revise priorities on the basis of achievements and to identify those countries where greater efforts are still required.

This background paper will review mortality trends in the Asia and Near East (ANE) region over the last 25 years, and will examine the implications for health programs of different paths of mortality decline between now and the year 2000. We will thus be trying to assess the implications for health programs of their success: if we succeed in reducing child mortality to low levels, should we then switch resources elsewhere, or reinforce the gains made? We will also consider the implications of mortality change for the implementation of health interventions, and particularly how to improve efficiency and effectiveness as mortality declines. We will limit ourselves throughout to 16 countries, all those in the region receiving USAID assistance with the exception of Fiji, which has been excluded on the grounds that its population is below one million. Afghanistan and Burma have been excluded from detailed consideration because the mortality estimates available for them are very poor, and because they do not at present receive AID assistance.

Declines in Child Mortality in the ANE Region

Most of the countries in the Asia and Near East region lack accurate vital registration data from which measures of child mortality can be calculated directly. Estimates of child mortality thus have to be derived from less conventional data sources. Most of the estimates are based on survey information obtained from women concerning the survival of the children they have given birth to. There are two widely-used types of such data: aggregate data on numbers of children ever born and children dead, often collected by censuses and general purpose household surveys, and individual data for each child on the date of birth and, if dead, the age at death, normally collected by in-depth fertility or child health surveys. The former type of data, classified by age or duration of marriage of the mother, provides estimates of overall child mortality and trends in such mortality over the 10 or 15 years before the survey, but does not provide information about age patterns of child mortality. The latter type of data provides estimates of levels, trends and age patterns of child mortality, but usually for rather small samples of women. For three countries (Egypt, the Philippines and Sri Lanka) vital registration data validated by comparison with child survival data from surveys are used in the estimation process, and for India, data from the Sample Registration System are used. For four countries (Afghanistan, Burma, Morocco and Oman) no nationally-representative data are available, and measures are based on empirically-based estimates for similar countries and assumptions about trends.

The confidence that we can have in the estimates of child mortality for a particular country is a function of the number of observations available and the consistency observed between the observations. Thus for Jordan, we have survey estimates covering the last three decades and all giving very consistent results, so we have considerable confidence in the levels and trends estimated for Jordan from 1960 to the mid 1980s. For Papua-New Guinea, on the other hand, we have results from one apparently good quality survey from the early 1970s, but nothing more recent; trends from the early 1970s onwards are therefore largely extrapolations of earlier trends. The type of data available also determines the depth of analysis possible. The most widely used type of data, on aggregate numbers of children ever born and children dead by age of mother, does not provide estimates of infant mortality, nor of age patterns of child mortality, but rather provides generally robust estimates of the probability of dying by age five. As a result of this limitation, child mortality estimates in this paper will generally be expressed in terms of the probability of dying by age five rather than in terms of the more common infant mortality rate (which is the probability of dying by age one). The probability of dying by age five is in fact a better measure of overall child mortality than the infant mortality rate, since it includes almost all child deaths, whereas the infant mortality rate excludes deaths after age one, the numbers of which can be substantial, especially in countries where weaning often

occurs after the first birthday. The objective of child survival interventions is to increase the chances of a newborn child surviving to a healthy and productive adult life; since mortality risks from age five to age 20 are typically the lowest for any age range, survival to age five (the complement of the probability of dying between birth and age five) is tantamount to survival to adulthood. For these reasons, the probability of dying by age five is the indicator of choice for determining targets and priorities for child survival interventions.

Table 1 shows the estimated probability of dying by age five, ${}_5q_0$, for each country for each five-year period (quinquennium) from 1960 to 1985. Estimates with a strong empirical basis are shown in bold, whereas those with a less solid basis are shown in parentheses.

TABLE 1: Estimates of Child Mortality (Probability of Dying by Exact Age 5) by Five-Year Periods 1960-65 to 1980-85: ANE Countries.

Country	Quinquennium					Average % Decline
	1960-65	1965-70	1970-75	1975-80	1980-85	per Quinquennium
Afghanistan	(.372)	(.357)	(.340)	(.340)	(.340)	2
Bangladesh	(.250)	.228	.228	.221	.215	4
Burma	(.209)	(.160)	(.120)	(.105)	(.097)	17
Egypt	(.290)	.280	.240	.186	.148	15
India	(.265)	(.239)	.218	.199	(.167)	11
Indonesia	.225	.201	.173	.155	(.135)	12
Jordan	.150	.109	.092	.076	.061	20
Morocco	(.250)	(.220)	(.190)	(.165)	(.142)	13
Nepal	.290	.260	.240	(.230)	(.215)	7
Oman	(.365)	(.325)	(.271)	(.218)	(.186)	15
Pakistan	(.260)	.239	.226	.200	(.182)	9
Papua-New Guinea	.232	.193	(.152)	(.121)	(.103)	18
Philippines	.128	.114	.101	.089	.083	10
Sri Lanka	.101	.087	.079	.066	.040	20
Thailand	.136	.118	.091	.070	.055	20
Tunisia	.245	.210	.156	.116	.076	25
Turkey	.239	.206	.184	.159	(.115)	16
Yemen Arab Rep.	(.365)	(.325)	.290	.249	(.223)	12

Sources: United Nations (1988) except:
Bangladesh 1980-85, Hill calculations based on 1987-88 DMTS
Jordan 1960-65 to 1980-85, Hill recalculations
Sri Lanka 1980-85, Hill calculations based on 1987 DHS
Tunisia 1970-75 to 1980-85, Hill calculations based on 1987 DHS

All countries considered are shown to have made some progress towards lower child mortality from the early 1960s to the early 1980s, but the pace of decline has been very uneven. The probability of dying by age five is estimated to have declined by about four percent per quinquennium in Bangladesh, but by 25 percent per quinquennium in Tunisia. Bangladesh is joined by Pakistan and Nepal in the category with rates of decline of less than 10 percent per quinquennium, and Tunisia is joined by Jordan, Sri Lanka, and Thailand in the category with rates of decline of more than 20 percent per quinquennium; remaining countries had rates of decline between 10 and 20 percent. For all developing countries combined, the UN estimates a quinquennial decline of 10.9 percent in ${}_5q_0$. The majority of the countries of the ANE region have thus experienced above average declines in child mortality, but Bangladesh, Nepal, Pakistan, and the Philippines have experienced below average declines.

Child mortality estimates are not normally available, given the estimation methods on which they are based, for developing countries for time periods more recent than five years ago. As Table 1 shows, even the number of countries with solid estimates for the period 1980-85 is quite small, only seven out of 18. We thus do not know how mortality has been changing during the last five years, the period during which the application of primary health care strategies has been at its peak. There are, however, some data on utilization of services, particularly levels of immunization and use of oral rehydration therapy, for much more recent periods. UNICEF (1988) publishes estimates for all countries in which it has programs, and results have recently started to become available from the Demographic and Health Surveys (DHS) program. The UNICEF statistics, which cannot be regarded as much more than informed guesses, are available for all the ANE countries, while DHS data are available for four ANE countries: Morocco, Sri Lanka, Thailand, and Tunisia. Estimates of immunization coverage of children aged 12 to 23 months and indicators of ORT use are shown in Table 2.

The figures in Table 2 come from very different sources. The DHS-based estimates of immunization coverage are estimates of the lower bound, since all children aged 12 to 23 months are included in the denominator, but only children with complete vaccination as recorded by an immunization card are included in the numerator. Many of the UNICEF estimates are based on field office sources. Thus all the figures need to be interpreted with caution, and comparisons made with even greater care. However, the DHS and UNICEF figures for immunization coverage agree fairly well, where comparisons can be made, except for Thailand. Given that the utilization indicators in Table 2 refer to a more recent period than the child mortality estimates in Table 1, the most recent child mortality estimates do not reflect the utilization figures. It is reasonable to suppose, however, that the differentials in utilization five or ten years earlier would have been broadly similar to those in the recent past. It is then interesting to note that by-and-large the under-performers in terms of mortality decline also have rather poor

TABLE 2 : Indicators of Primary Health Care Utilization: ANE Region

Country	Immunization Coverage, Children 12 to 23 months				Use of ORS	
	UNICEF Estimates[1]			DHS Estimates	UNICEF Estimate[2]	DHS Estimate[3]
	1985	1986	1987			
Bangladesh	1	-	4	n/a	18	n/a
Egypt	74	85	-	n/a	21	n/a
India	0	-	9	n/a	5	n/a
Indonesia	14	-	44	n/a	22	n/a
Jordan	39	64	-	n/a	61	n/a
Morocco	42	48	-	38[4]	18	15
Nepal	20	-	22	n/a	14	n/a
Oman	56	-	82	n/a	82	n/a
Pakistan	23	-	47	n/a	28	n/a
Papua New Guinea	29	-	-	n/a	20	n/a
Philippines	55	53	-	n/a	19	n/a
Sri Lanka	20	-	63	57[5]	59	n/a
Thailand	26	-	48	17[5]	34	43
Tunisia	59	53	-	61[4]	106	20
Turkey	55	-	51	n/a	3	n/a
Yemen Arab Rep.	15	-	13	n/a	20	n/a

[1] The lowest of the proportions with DPT3, Polio3 or Measles.

[2] ORS packets per 100 episodes of diarrhea in under fives.

[3] Percent of prevalent cases of diarrhea receiving ORS.

[4] Lowest proportion of those with immunization cards with DPT3, Polio3 or measles.

[5] Complete coverage by all immunizations, supported by cards.

utilization levels (e.g. Bangladesh, Nepal), whereas the over-performers have above average utilization levels (e.g. Jordan, Sri Lanka and Tunisia). The relationship is shown graphically in Figure 1, which plots percent decline in child mortality from 1975-80 to 1980-85 against proportion immunized of children aged 12 to 23 months as estimated by UNICEF for 1985. Although the relation is by no means perfect, and there are clear outliers (India with a large mortality decline despite a low estimate of immunization coverage, and the Philippines with a small mortality decline despite high coverage) the countries with faster declines do seem to be those with higher levels of immunization coverage.

This relationship between rate of child mortality decline and level of service utilization is of course only circumstantial evidence of a mortality impact of service utilization. It could also suggest that service utilization is easier to achieve in populations that have experienced rapid mortality decline. The child mortality estimates in Table 1 suggest that percentage declines in child mortality are faster in countries that have already achieved substantial declines in child mortality. Figure 2 plots the rate of decline in child mortality between 1975-80 and 1980-85 against the level of child mortality in 1975-80. The relationship between the two is clearly quite strong. This association of high rates of decline with already rather low levels of child mortality may reflect the importance of service utilization in the process of reducing child mortality. Utilization of services may be expected to depend on perceptions of the effectiveness of such services, and such perceptions may in turn depend on perceptions of declines in child mortality. Thus success in terms of service utilization may feed on success in terms of reductions in child mortality, resulting in rapid rates of decline where large declines have already occurred. The important role of demand for services in addition to the role of supply of services is suggested by a number of other pieces of evidence. The important relation between child mortality and mother's education, but rather small relation between child mortality and urban or rural residence, in many multivariable studies suggests that ready access to services (in urban areas) is less important than demand for such services (as indicated by mother's education). A recent study of ORT use in Bangladesh (Osinski;1988) revealed high awareness of ORT (95%) and reasonable levels of access to ORS (over 80%) but much lower current use (27%) and even lower effective use; the author argues that the low use rates reflect a failure on the part of mothers to perceive the benefits of ORT use.

Implications of Mortality Decline for Program Priorities

It is clear from Table 1 that child mortality has already fallen to quite low levels in a number of ANE countries (notably in Sri Lanka, Thailand, Jordan, Tunisia, and the Philippines), and it is clear from Table 2 that in a number of ANE countries the level of utilization of health interventions is also quite high

FIGURE 1: Percent Decline in Child Mortality 1975-80 to 1980-85 by Immunization Coverage Estimated for 1985; Countries of ANE Region.

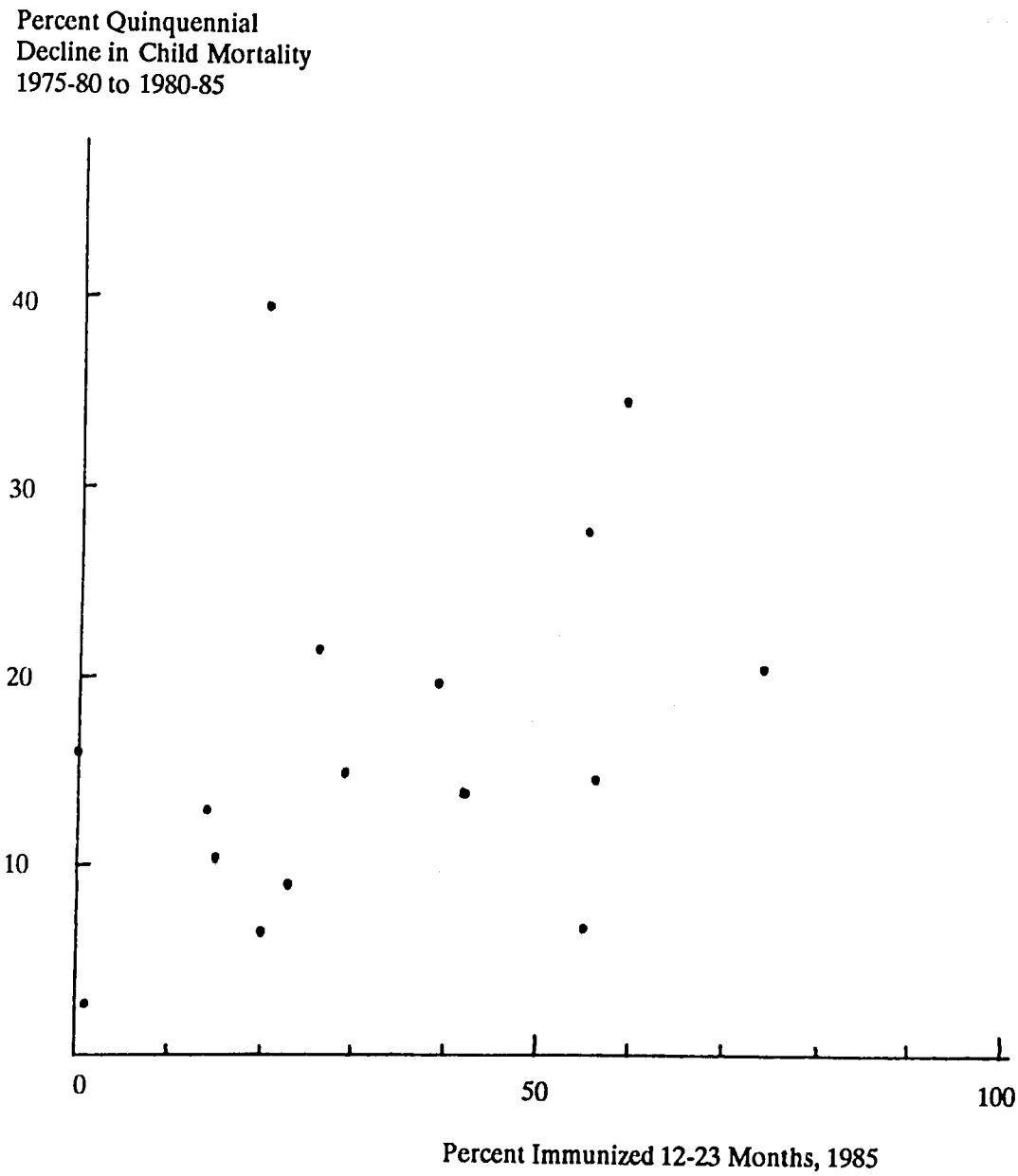
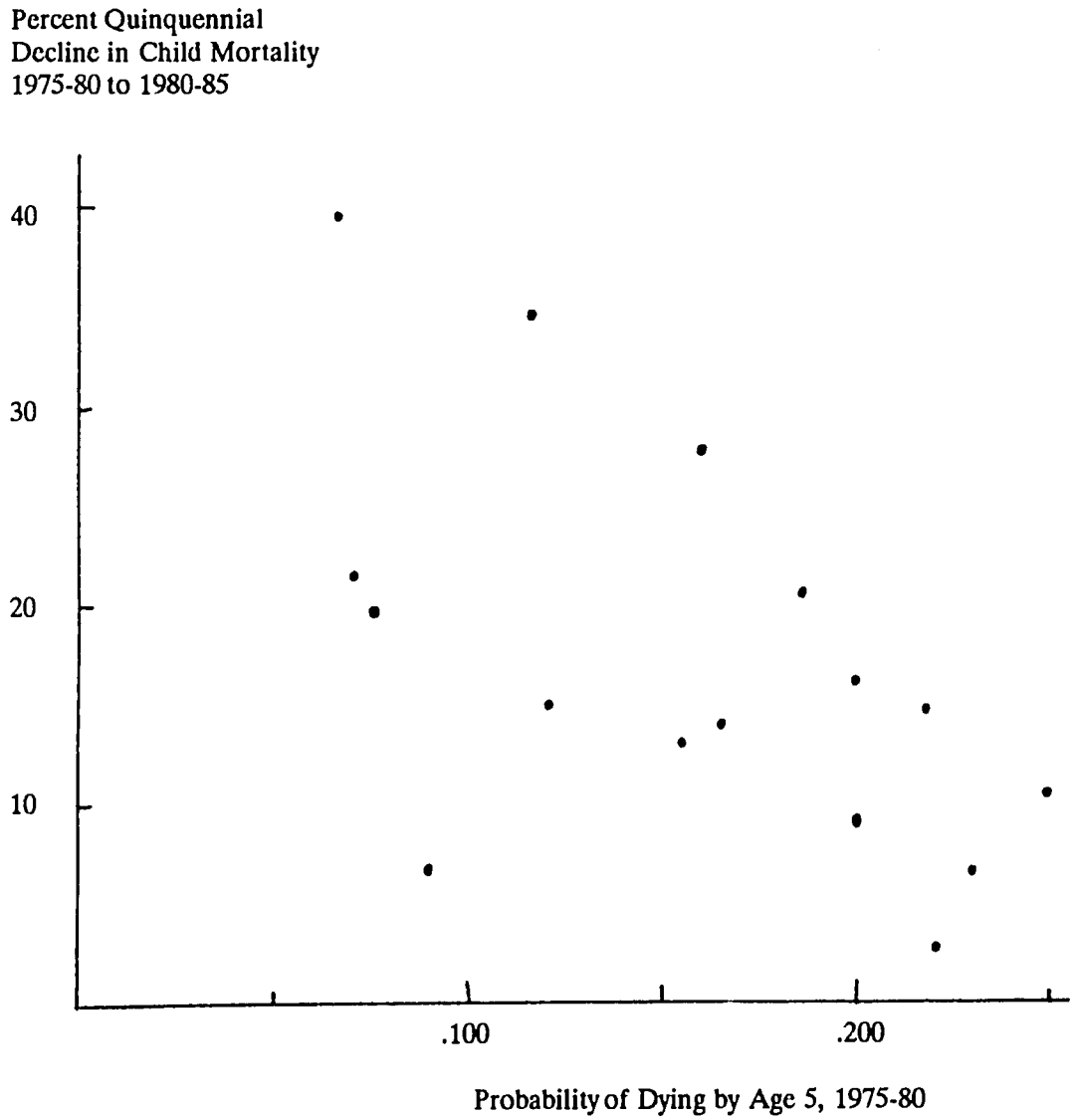


FIGURE 2: Percent Decline in Child Mortality 1975-80 to 1980-85 by Level of Child Mortality 1975-80; Countries of ANE Region.

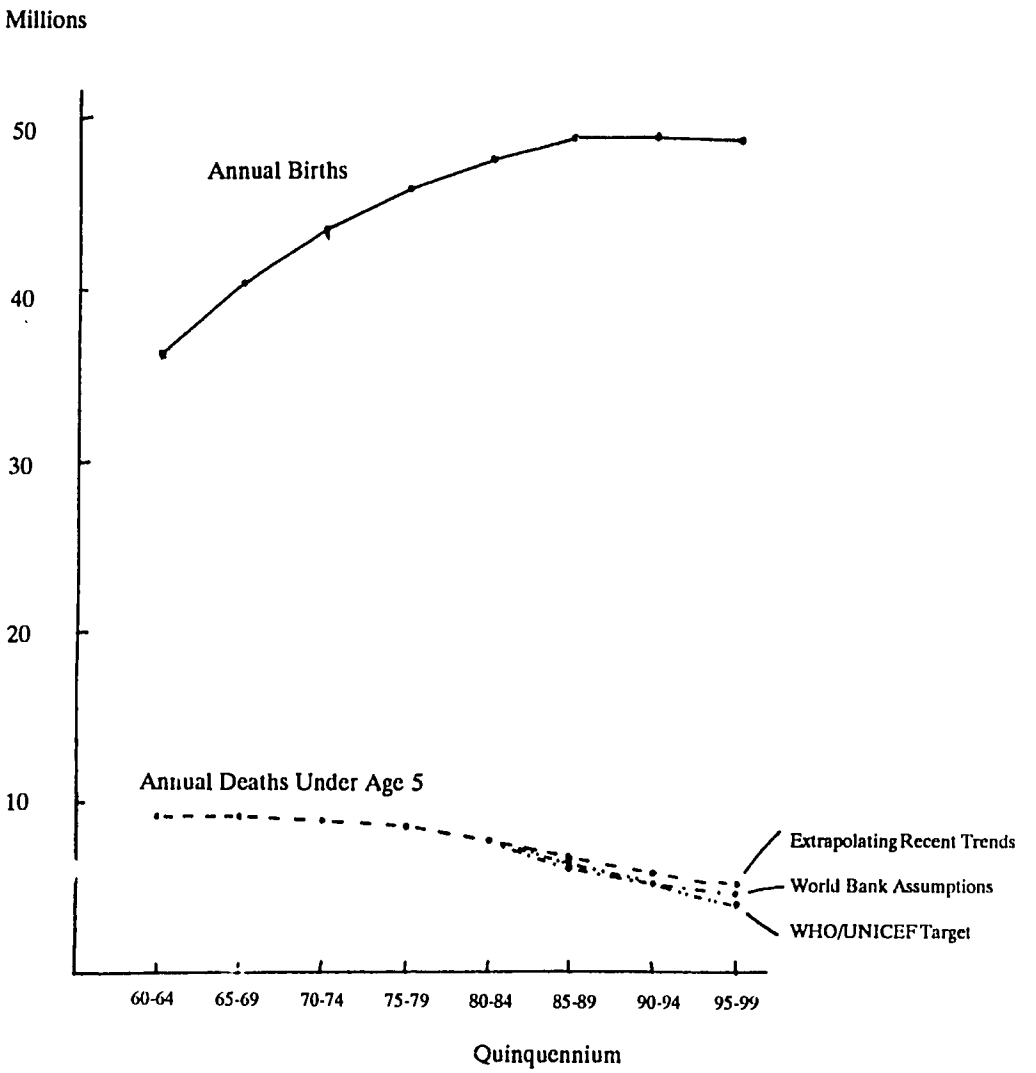


(notably Egypt, Oman, Jordan, Sri Lanka, the Philippines, Tunisia, and Turkey). On the other hand, for a number of countries (notably Bangladesh, Nepal, and Pakistan), progress towards lower mortality has been very slow, and service utilization is still low. It thus seems likely that, while child survival programs must be expanded and made sustainable in the 1990s, by the year 2000, a number of ANE countries will have such low numbers of child deaths that child survival programs will no longer look like a priority, whereas other countries will still have large numbers of child deaths.

The actual numbers involved can be estimated by projecting the populations forward to the year 2000. The base that has been used for this projection is the World Bank projections for 1987-88 (Zachariah and Vu, 1988), starting with the population and age structure estimated for each country for 1985. The fertility and migration assumptions underlying these projections are essentially those used by the World Bank. However, three different mortality assumptions have been used, the first those used in the World Bank projections themselves, the second those implied by achieving WHO/UNICEF targets for child mortality decline by the year 2000 (to reduce the probability of dying by age five to 70 per thousand or half the 1980 value, whichever is the less), and the third those implied by a continuation of the 1975-80 to 1980-85 child mortality decline shown in Table 1. The populations have also been projected backwards, from 1985 to 1960, using the mortality estimates in Table 1. Table 3 shows the annual number of births and deaths under the age of five for the period 1995-2000 under each mortality assumption. The number of births varies slightly with the mortality assumption because the different child mortality levels assumed also imply slightly different mortality levels for females of childbearing age, and thus rather different numbers of such women and hence births in each projection. Figure 3 plots the number of births, children under age five, and the number of deaths under age five for each quinquennium from 1960-65 to 1995-2000 for all 16 countries considered. India accounts for something like half of both the births and the deaths, but follows a pattern broadly similar to that of the other countries combined.

The number of annual deaths expected for the period 1995-2000 varies greatly from projection to projection. If WHO/UNICEF targets are achieved, the average annual number of deaths under age five in the ANE countries will be just under four million, whereas if recent trends in child mortality are maintained, the corresponding number will be nearly 5.2 million. The mortality assumptions underlying the World Bank projections result in an intermediate figure of 4.6 million deaths. The child deaths will be heavily concentrated in four countries, India, Pakistan, Bangladesh, and Indonesia, accounting for 84 percent of the region's child deaths under the WHO/UNICEF targets, and 86 percent if recent trends continue. These countries will account for 80 percent of births and 79 percent of total population of the ANE countries by the end of the century, with India alone contributing 57 percent of deaths under age five, 50 percent of births

FIGURE 3: Annual Numbers of Births and Deaths Under Age 5 by Quinquennium; 16 ANE Countries



NUMBERS FOR FIGURE 3

Total Numbers of Births, Deaths under Age 5, and Population under Age 5 by Quinquennium, 1960-65 to 1995-2000, Countries of ANE Region. In Millions

Period	Births	Deaths < 5	Population < 5 (end of Period)
1960-65	181.5	45.4	145.3
1965-70	201.5	45.5	165.3
1970-75	217.5	44.6	181.7
1975-80	229.0	42.5	194.7
1980-85	238.5	38.2	207.5
a) World Bank Assumptions			
1985-90	244.1	30.1	219.5
1990-95	244.3	26.3	222.6
1995-00	243.5	23.0	224.3
b) UNICEF/WHO Targets			
1985-90	244.1	32.7	217.5
1990-95	244.6	26.4	222.8
1995-00	244.4	19.9	227.6
c) Extrapolation of Recent Country-Specific Mortality Trends			
1985-90	244.0	33.7	216.7
1990-95	244.2	29.4	220.1
1995-00	243.2	25.8	222.0

and 53 percent of total population. It is interesting to note from Figure 3 that despite increasing numbers of births from the early 1960s to the late 1980s the number of deaths under age five fell from over nine million annually in the early 1960s to below eight million by the early 1980s, and the average annual number expected for the late 1980s is below seven million. Declining mortality rates have more than outweighed increasing numbers of births. Despite the very substantial declines in mortality built in to all three projections, the problem of child mortality does not disappear by the end of the century. Even under the most optimistic assumptions, that the WHO/UNICEF targets are achieved, there will still be nearly four million child deaths a year in the 16 ANE countries considered. Under a more plausible scenario of mortality decline (that recent trends are maintained), there will be over five million child deaths a year. The numbers are not very different from those for the latter part of the present decade: the average annual number of deaths under five for the period 1985-90 is 6.5 million given the WHO/UNICEF targets, or 6.7 million given a continuation of recent trends. Thus numbers of deaths in absolute terms are only going to shrink by between 20 and 40 percent, hardly enough to justify proclaiming final victory over child death in the region.

A rather similar conclusion is reached by looking not at outcomes but at inputs, in this case the number of births per year that will provide the child population in need of preventive and curative primary health care services. Under all three projections, the annual number of births remains virtually constant between 48 and 49 million throughout the period from 1985 to 2000. The number of births remains essentially constant because the effects of declining fertility per woman are offset by age distribution effects -- the well-known phenomenon of population momentum, whereby the legacy of earlier high fertility is increasing numbers of women of reproductive age and thus numbers of births that increase every year even if fertility rates are constant. With a constant number of births every year, and a gradual decline in the number of child deaths, the number of surviving children requiring services will increase gradually until the end of the century. In order to consolidate health gains already achieved, it will be necessary to maintain current levels of preventive services; in order to continue to reduce child mortality, it will be necessary to increase current levels of service.

It is interesting to compare the rates of decline required to achieve the WHO/UNICEF targets for child mortality decline with the rates of decline estimated to have occurred over the period 1975-80 to 1980-85. Table 4 shows for each ANE country the levels of ${}_5q_0$ required for each quinquennium in order to achieve the target and the levels expected given recent trends. A number of countries can be expected to achieve the target easily: Jordan, Sri Lanka, Thailand, Tunisia and Turkey can be expected to reach their targets by the middle 1990s. Other countries will get close to their targets: Egypt, India, Indonesia, Morocco and Papua New Guinea can all be expected to get within 15 points of

their target. However, a number of countries will not even get close given their recent performance in child mortality change: Bangladesh, Nepal, Pakistan, the Philippines and the Yemen Arab Republic will all fall short by wide margins (the estimates suggest that Oman will also fall short by a wide margin, but the recent estimates for Oman are particularly weak, and should be interpreted with extreme caution). Progress towards the goals for the year 2000 can thus be seen to be very uneven; a group of mostly small countries will achieve their goals, a group including the two largest countries in the region will get close, and a group including the next two largest countries will not even get close. If USAID programs are intended to help achieve health for all, the under-performing countries should become priorities. If, on the other hand, a decision is taken to get the best value for money in terms of child deaths averted, the middle group of countries should probably be regarded as the priority, since it is in these countries that external support for health services may have maximum effect.

It is sometimes suggested that program emphasis on child survival, insofar as it has an impact on early child mortality, merely postpones deaths from early childhood to later childhood. An examination of this issue clearly requires information not only on levels but also on age patterns of child mortality. As indicated in the second section of this paper, such information on age patterns is only available from accurate vital registration systems or from in-depth surveys collecting the date of birth and, if applicable, the age at death of each child. Such data are available for only a minority of the countries examined here. However, the use of the probability of dying by age five as the index of mortality greatly limits the potential size of such an effect, since mortality rates after age five are universally low. Further, an examination of trends in age patterns of child mortality by Hill and Pebley (1988) for a number of developing countries with the necessary data (including Sri Lanka and Indonesia from the ANE region) found that such age patterns conformed closely to model mortality patterns, the models being based on historical series for the now-developed countries. There is thus no evidence at present that program emphasis on child survival has had the effect of postponing deaths to later ages of childhood. The indications are that reductions in early child mortality, whether program induced or otherwise, do translate into greater survival to adulthood.

A final consequence of changing levels of child mortality is on the overall age distribution of deaths. A distribution of deaths with high proportions of deaths occurring after childhood, and only low proportions during childhood, could be taken as support for a change in emphasis of health services from childhood to adulthood, and from acute to chronic diseases. Table 5 shows the proportions of all deaths that occur under the age of five for each quinquennium 1985-90 to 1995-2000 and each mortality assumption. For the region as a whole, about 37 percent of all deaths are currently deaths under age five. Under the most optimistic assumptions about mortality decline (the WHO/UNICEF targets for

2000) this proportion falls to around 26 percent for the five years before 2000, and under likely mortality decline assumptions (extrapolations of recent trends) falls only to around 29 percent. Thus, although the age pattern of deaths will change as mortality (and fertility) decline towards the end of the century, there will still be many more deaths under age five than in any other five year age group. There is, however, a great deal of variation in the age structure of deaths among countries of the region. Taking the likely (extrapolation) assumptions about mortality decline, the proportion of all deaths that occur under age five will be close to 10 percent for Sri Lanka, Thailand, and Tunisia by the year 2000, whereas it will still be over 40 percent (that is, above the current average for the region) in Bangladesh, Nepal, Oman, Pakistan, and Yemen Arab Republic.

Given that child mortality has already fallen to quite low levels in a number of ANE countries, and can be expected to fall to very low levels by the end of the century in Jordan, Sri Lanka, Thailand, and Tunisia, the question arises of how health services should be focused once low mortality levels in childhood have been achieved. If we take expectation of life at birth as our ultimate goal, how low does child mortality have to fall before it ceases to be of primary importance? In a population with an expectation of life at age five of 60 years, typical of many ANE countries now, the expectation of life at birth will vary with the probability of dying by age five roughly as follows:

Probability of Dying by Age Five:	.200	.150	.100	.050	.025	.010
Expectation of Life at Birth:	52.2	55.4	58.6	61.8	63.4	64.4

As can be seen, the effects of reducing under five mortality on expectation of life at birth, given fixed survival probabilities after age five, remain substantial even at quite low levels of child mortality. Thus halving child mortality from 0.200 to 0.100 increases life expectancy at birth by 6.4 years, halving again to 0.050 results in a further increment of 3.2 years, and halving again to the low level of 0.025 still increases life expectancy at birth by 1.6 years. Thus child mortality remains an important target until quite low levels, similar to those in many developed countries in the 1960s, have been reached.

In order to identify other target age ranges, the implications for expectation of life at birth have been examined given 10 percent reductions in mortality rates for given age ranges. The results, in terms of percentage gain for expectation of life at birth given an initial level of 55 years, are as follows:

Age Range Enjoying 10% Reduction:	0-4	5-39	40-64	65+
Percent Increase in Life Expectancy:	1.5	0.9	0.9	0.7

In these terms, under five mortality is clearly the target of choice. Ten percent reductions in mortality for the age ranges 5 to 39 and 40 to 64 have rather similar effects on expectation of life at birth, and it is hard to choose between them for program priorities: the age range 5 to 39 might be preferred on the grounds of saving more years of productive life, but causes of death in this age range, in which accidental or violent causes are often predominant, are difficult targets for program interventions.

Strategies for Improving Program Efficiency and Effectiveness

USAID has been on the right track with the promotion of child survival strategies. The key to completing the child survival revolution, particularly among those countries in the region that continue to show high mortality and a slow decline will be to take steps to improve program efficiency and effectiveness. This section will underline several general principles that address these issues.

First, it must be recognized that the fundamental premise underlying the child survival strategy is that families, particularly mothers, are the primary "producers" of infant and child health. They achieve this by taking care of themselves during pregnancy and childbirth and then by nurturing the infant and growing child. Following from this premise, it should be clear that the role of health programs is to support and strengthen the capacity of mothers in this productive process. This can be achieved by providing mothers and families with information, skills, resources, and technologies that promote health, as well as through mobilizing political and social institutions plus the private sector to be supportive in this effort. From this perspective, it becomes clear that child survival programs, like family planning programs, are population-based and will involve fundamental changes in human behavior in most societies. It also becomes evident that managing child survival programs will involve tasks that ministries of health, typically being structured to operate hospitals and health centers, are not well organized to provide. Thus, the child survival revolution is as revolutionary to health systems as it is to changing health conditions among families.

It is in this context--transforming the operations of ministries of health--that USAID and other international agencies have promoted a number of highly efficacious technologies at the leading edge of the child survival revolution. Examples of such technologies include oral rehydration therapy, stable vaccines, and growth monitoring. In terms of maximizing program effectiveness and efficiency, it is important to understand both the biological interactions of these technologies as well as the social and economic constraints to program implementation. Critical issues relating to these two facets of program strategy are highlighted below.

It has long been recognized that there is a biological synergism between malnutrition and infection that enhances the likelihood of death. For far too many mothers to be, this synergism begins during pregnancy and continues through the whole of early childhood. What has been less appreciated until recently is that in most developing countries it is primarily the multiplicity of infections, particularly recurrent illnesses like diarrhea and respiratory infections as well as parasitic infestations, which are the major determinants of the physiological deterioration in infants and young children resulting in increasing frailty and death. The key technologies being promoted in support of child survival--immunizations,oral rehydration therapy, growth monitoring, vitamin A supplementation, breastfeeding, birth spacing, and personal hygiene--each have their individual strengths in terms of efficacy or efficiency; the same is true of prenatal care, though it may be more difficult than the others to implement as an intervention. However, given the synergisms that exist between various diseases and morbid states, full efficiency in improving child survival can only be reached by programs that combine these interventions. This can be simply illustrated by a few examples.

Diarrheal diseases in developing countries are characterized by their frequent recurrence; therefore, the risk of death comes not only from the acute episode but, more importantly, from the progressive deterioration in the health of infants and children manifested most obviously by malnutrition and growth faltering. Intervening only with oral rehydration solution may prevent an acute episode of death; however, returning the child to the same environment will result in many recurrent diarrheal episodes, each requiring retreatment, as well as gradual deterioration in the child's nutritional status leading to a greater likelihood of death from other conditions such as respiratory infections. Thus ORS, which is inexpensive and efficacious at the level of the individual morbid event, turns out to be of limited cost-effectiveness at a population level if applied as a single intervention. On the other hand, interventions to improve personal hygiene can be quite efficient in terms of reducing the transmission of infectious agents although being of low effectiveness in saving lives since such interventions provide no help for those few individuals who may still have a life-threatening episode of diarrhea. Combining the two interventions, however, has a multiplier effect. The efficiency of ORT is vastly increased because there are fewer episodes of diarrhea to treat, while the effectiveness of hygienic practices is improved because those cases that still occur can be provided with a lifesaving intervention.

This picture can be expanded to include the other technologies as well. Tetanus toxoid immunization of mothers is highly efficacious in preventing deaths from neonatal tetanus; however, in populations with high levels of morbidity and mortality from all other causes, its overall potential for improving child survival will be severely attenuated. This is particularly true because infants most likely to die of neonatal tetanus are also those most likely to be afflicted by all the other

conditions associated with the poor social and economic circumstances into which they are born. Availability of a broad spread of child survival interventions will aid the survival of those children whose deaths from tetanus are averted by immunization.

An integrated child survival strategy can take advantage of the positive synergisms among the technological interventions. Proper antenatal care coupled with birth spacing can reduce the incidence of low birthweight births and, therefore, lower the risks of death from a whole range of diseases of infancy and childhood. Similarly, vitamin A supplementation programs in deficient populations appear to enhance resistance to many infections, resulting in fewer deaths from diarrheal and respiratory diseases. Measles immunization not only prevents a few acute measles deaths, but also eliminates the widespread morbidity and complications associated with measles episodes that lead to high death rates from other infectious diseases among children recuperating from measles.

In summary, to maximize program effectiveness and efficiency, child survival strategies must first take into account the biological synergisms of the diseases and the technological interventions themselves. While economic and logistic constraints may necessitate the initial introduction of only one or two technologies, in the long run the organizational and institutional frameworks must be established to provide the information, skills, and resources available to mothers and their families to utilize effectively the full range of child survival interventions necessary to complete successfully the child survival revolution.

The second facet to consider in improving program effectiveness and efficiency is program management. Figure 4 provides a conceptual framework to describe how a direct intervention program may operate to produce health impacts in a population. The components of direct intervention programs are the inputs, processes, outputs, outcomes, and impacts. These categorizations fit within the framework of USAID's classification of evaluation strategies: Tier 1 evaluation involves measurement of the inputs, processes, and outputs; Tier 2 evaluation focuses on outcomes (coverage); and Tier 3 evaluation assesses program impact.

The diminishing size of the arrows from inputs to impacts is illustrative of how program interventions can be attenuated by a variety of constraints at each stage in program operations. The major constraints are the social, economic, and environmental factors in the setting where the program is being implemented. In the figure there are arrows of increasing size related to these external factors that illustrate how each of these determinants can operate more powerfully as the stages of the intervention activity move progressively from the clinic and health center setting to the community and ultimately toward influencing behavioral changes at the household level.

A clear example of this process of attenuation is provided by the data from Bangladesh concerning use of ORT (Osinski; 1989). A very high proportion of women in Bangladesh, over 95 percent, were aware of ORT; even in rural areas, over 80 percent of households could obtain ORS within 30 minutes travel time. Inputs and processes, in terms of availability and IEC (information, education, and communication), were therefore excellent. Ever use of oral saline was also high, around 70 percent overall of mothers with children under age five. However, current use, among children under five with diarrhea in the two weeks before interview, was less than 30 percent; in these cases, although use was initiated promptly by nearly 70 percent of mothers, only some 50 percent of mothers prepared the oral saline correctly, and only a small minority of cases were treated for an appropriate duration. Thus the attenuation from inputs and processes to outputs and outcomes was substantial. A major reason for this attenuation seems to have been the perception among mothers of ORT as a cure for diarrhea; when the diarrhea did not stop, the treatment was deemed a failure, and was discontinued. No estimate of impact is available from the survey, but it seems reasonable to suppose that it was minimal.

This conceptual framework illustrates critical areas where operations research will be essential to improve program effectiveness and efficiency. At the level of inputs, there is the continuing need to develop appropriate technologies that are inexpensive and efficacious at the community and household level. Examples of this that are currently supported by USAID range from the Dietary Management of Diarrhea project to efforts to develop malaria vaccines and heat-stable measles vaccines of improved antigenicity to reach children at a younger age. In terms of program processes, research is needed both to define the range of providers that could improve the accessibility of mothers to child survival technologies as well as means to strengthen provider-client communication. Outputs are measured in terms of effective users. Here, again, there is a critical need for research to overcome the high dropout rates in immunization programs, the ineffective home use of oral rehydration solutions, the decline in breastfeeding practices, and the lack of compliance with guidance given in antenatal care and growth monitoring programs. Issues related to outcome are concerned not only with the proportion of the population covered but, more specifically, whether the interventions are effectively targeting the high risk groups. Typically, health services are utilized by those least in need of preventive and curative measures. The critical research agenda is how to target child survival interventions to those households with the highest levels of morbidity and mortality. Finally, the ultimate goal of the intervention program is to achieve a demographic impact in the population in terms of measurable improvements in morbidity and survival. The degree to which child survival interventions are effective and efficient in reaching their goals can only be determined by measuring the impact in the population. Currently, few programs incorporate impact measurement into their program design. Again there is an urgent need for

operations research to establish the best means of measuring program impacts in order to assess the cost-effectiveness of alternative intervention strategies.

Major gains have been made in child survival interventions in the Asia and Near East region; however, there are many lessons yet to be learned before effective, efficient, and self-sustaining child survival programs can be institutionalized. It should be clear from the issues and questions identified here that programmatically it would be premature to turn away from this effort before the lessons being learned can be integrated into the national health strategies in all of the countries in the region.

Conclusions

Major declines in child mortality have occurred over the last two decades in most countries of the ANE region. Major portions of these declines occurred before the implementation of Health for All and primary health care strategies aimed at mothers and young children. However, evidence from a variety of sources suggests that utilization of primary health care services, particularly immunization, has increased rapidly in many countries of the ANE region during this decade. This increase has not yet been fully reflected in available estimates of child mortality, since such estimates always lag behind actual change. We can therefore expect to see child mortality continue to decline in the near future, and we can also expect to see clear effects of preventive interventions on child mortality.

However, an examination of recent mortality trends for countries of the ANE region suggests that a number of countries will certainly not achieve the WHO/UNICEF target of reducing the probability of dying by age five to 70 per thousand or half its 1980 level, whichever is lower, by the year 2000. In Bangladesh, for example, the target for the year 2000 is 70 deaths under five per thousand live births, but the extrapolation of recent trends suggests that the true figure will be close to 195 per thousand. Clearly, it is too soon to proclaim victory over child mortality, and divert resources elsewhere.

The decline in child mortality will also change the distribution of deaths by age. Population projections under three different assumptions about mortality decline suggest, however, that the effect will not be all that large by the year 2000, reducing the proportion of all deaths that occur under age 5 from around 37 percent now to around 26 percent in the late 1990s, under the most optimistic assumptions possible. Total numbers of deaths under five decline

under all three mortality assumptions, but again the total number under the most optimistic assumption is close to four million child deaths a year by the year 2000. The same projections indicate that the total number of births, an indicator of the numbers of children requiring services, will remain constant at 49 million annually between now and the end of the century. Even if child morbidity and mortality decline, thus reducing the need for curative services, the need for preventive services will not change. In mortality, there is no rule of nature that states that what goes down stays down; although in general mortality declines have not been reversed, preventive services must be maintained in order to ensure that this general observation remains true in the future.

The achievements of child survival programs in increasing the us of immunizations and oral rehydration therapy in the countries of the ANE region have been impressive. When mortality estimates for the period are fully available, equally impressive gains in child survival can be expected. These achievements should not be taken as final victory, or as a justification for reallocating international health assistance to other priorities. Several countries are not making satisfactory progress, and must be made priority targets. Even in those countries with satisfactory progress, efforts are still required to make sure that targets are reached. It is in only a small minority of countries (mostly with small populations) that the child mortality revolution has effectively run its course, and that resources can be safely reprogrammed to other target areas.

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APPENDIX

TABLE 3: Annual Births and Deaths Under Age Five, 1995-2000, Under Three Mortality Assumptions: ANE Countries (Thousands)

Country	Mortality Assumptions of: World Bank		WHO/UNICEF Target		Extrapolation of Trend	
	Births	Deaths <5	Births	Deaths <5	Births	Deaths <5
Bangladesh	4268	595	4308	408	4222	841
Egypt	1733	103	1715	139	1717	130
India	24297	2177	24334	2065	24272	2426
Indonesia	5211	476	5231	417	5222	468
Jordan	169	7	169	6	170	6
Morocco	921	69	921	75	920	84
Nepal	924	150	943	88	927	164
Oman	63	7	64	5	64	7
Pakistan	5081	653	5152	452	5099	702
Papua N-G	148	17	151	9	151	10
Philippines	1907	95	1904	94	1898	129
Sri Lanka	402	11	402	11	403	6
Thailand	1288	59	1295	46	1297	35
Tunisia	258	14	259	13	260	6
Turkey	1509	69	1549	109	1501	66
Yemen Arab Rep.	517	109	533	49	527	85
Total	48695	4608	48872	3979	48648	5164

TABLE 4: Child Mortality Declines Needed to Achieve WHO/UNICEF Targets, and Declines Expected on Basis of Recent Trends; ANE Countries.

Country	$_5q_0$ Estimated For 1975-80	1980-85	Percent Decline	$_5q_0$ for 1980	2000 Target	$_5q_0$ Expected or (Required) for: 1985-90	1990-95	1995-00
Bangladesh	0.221	0.215	- 2.7	0.218	0.070	0.209 (0.188)	0.203 (0.141)	0.198 (0.094)
Egypt	0.186	0.148	-20.4	0.167	0.070	0.118 (0.119)	0.094 (0.100)	0.075 (0.080)
India	0.199	0.167	-16.1	0.183	0.070	0.140 (0.138)	0.118 (0.111)	0.099 (0.084)
Indonesia	0.155	0.135	-12.9	0.145	0.070	0.118 (0.116)	0.102 (0.098)	0.089 (0.079)
Jordan	0.076	0.061	-19.7	0.069	0.034	0.049 (0.050)	0.039 (0.044)	0.032 (0.037)
Morocco	0.165	0.142	-13.9	0.154	0.070	0.122 (0.120)	0.105 (0.100)	0.091 (0.080)
Nepal	0.230	0.215	- 6.5	0.223	0.070	0.201 (0.184)	0.188 (-.139)	0.176 (0.093)
Oman	0.218	0.186	-14.7	0.202	0.070	0.159 (0.153)	0.135 (0.120)	0.116 (0.087)
Pakistan	0.200	0.182	- 9.0	0.191	0.070	0.166 (0.156)	0.151 (0.122)	0.137 (0.087)
Papua-New G.	0.121	0.103	-14.9	0.112	0.056	0.088 (0.088)	0.075 (0.075)	0.064 (0.062)
Philippines	0.089	0.083	- 6.7	0.086	0.043	0.077 (0.074)	0.072 (0.062)	0.067 (0.049)
Sri Lanka	0.066	0.040	-39.4	0.053	0.026	0.024 (0.027)	0.015 (0.027)	0.009 (0.026)
Thailand	0.070	0.055	-21.4	0.062	0.031	0.043 (0.045)	0.034 (0.040)	0.027 (0.034)
Tunisia	0.116	0.076	-34.5	0.096	0.048	0.050 (0.055)	0.033 (0.052)	0.021 (0.049)
Turkey	0.159	0.115	-27.7	0.137	0.068	0.083 (0.089)	0.060 (0.081)	0.044 (0.072)
Yemen Arab Rep.	0.249	0.223	-10.4	0.236	0.070	0.200 (0.187)	0.179 (0.140)	0.160 (0.093)

TABLE 5: Proportions of All Deaths that Occur Under Age Five: by Country, Quinqennium and Mortality Assumption; ANE Region

Country	Proportion of All Deaths that Occur Under Age Five								
	1985-90			1990-95			1995-2000		
	World Bank	WHO/ UNICEF	Extrap-olation	World Bank	WHO/ UNICEF	Extrap-olation	World Bank	WHO/ UNICEF	Extrap-olation
Bangladesh	0.45	0.45	0.46	0.40	0.40	0.43	0.38	0.34	0.[illegible]2
Egypt	0.31	0.35	0.35	0.27	0.30	0.30	0.22	0.26	0.25
India	0.33	0.34	0.34	0.28	0.29	0.30	0.24	0.24	0.25
Indonesia	0.34	0.33	0.34	0.30	0.29	0.30	0.25	0.24	0.25
Jordan	0.35	0.35	0.35	0.35	0.29	0.27	0.26	0.24	0.26
Morocco	0.47	0.47	0.47	0.43	0.43	0.43	0.38	0.38	0.39
Nepal	0.50	0.49	0.50	0.49	0.46	0.49	0.45	0.39	0.46
Oman	0.53	0.60	0.56	0.53	0.50	0.56	0.44	0.42	0.44
Pakistan	0.51	0.50	0.51	0.47	0.45	0.47	0.43	0.39	0.44
Papua-New G.	0.43	0.38	0.38	0.40	0.32	0.32	0.35	0.26	0.28
Philippines	0.32	0.33	0.33	0.26	0.27	0.29	0.21	0.21	0.25
Sri Lanka	0.14	0.13	0.13	0.12	0.12	0.08	0.10	0.10	0.07
Thailand	0.23	0.20	0.20	0.19	0.16	0.15	0.14	0.13	0.10
Tunisia	0.29	0.25	0.24	0.26	0.23	0.16	0.21	0.20	0.13
Turkey	0.24	0.27	0.27	0.20	0.24	0.21	0.16	0.21	0.16
Yemen Arab R.	0.62	0.61	0.61	0.61	0.58	0.59	0.59	0.52	0.57
Total	0.36	0.37	0.37	0.32	0.32	0.33	0.27	0.26	0.29
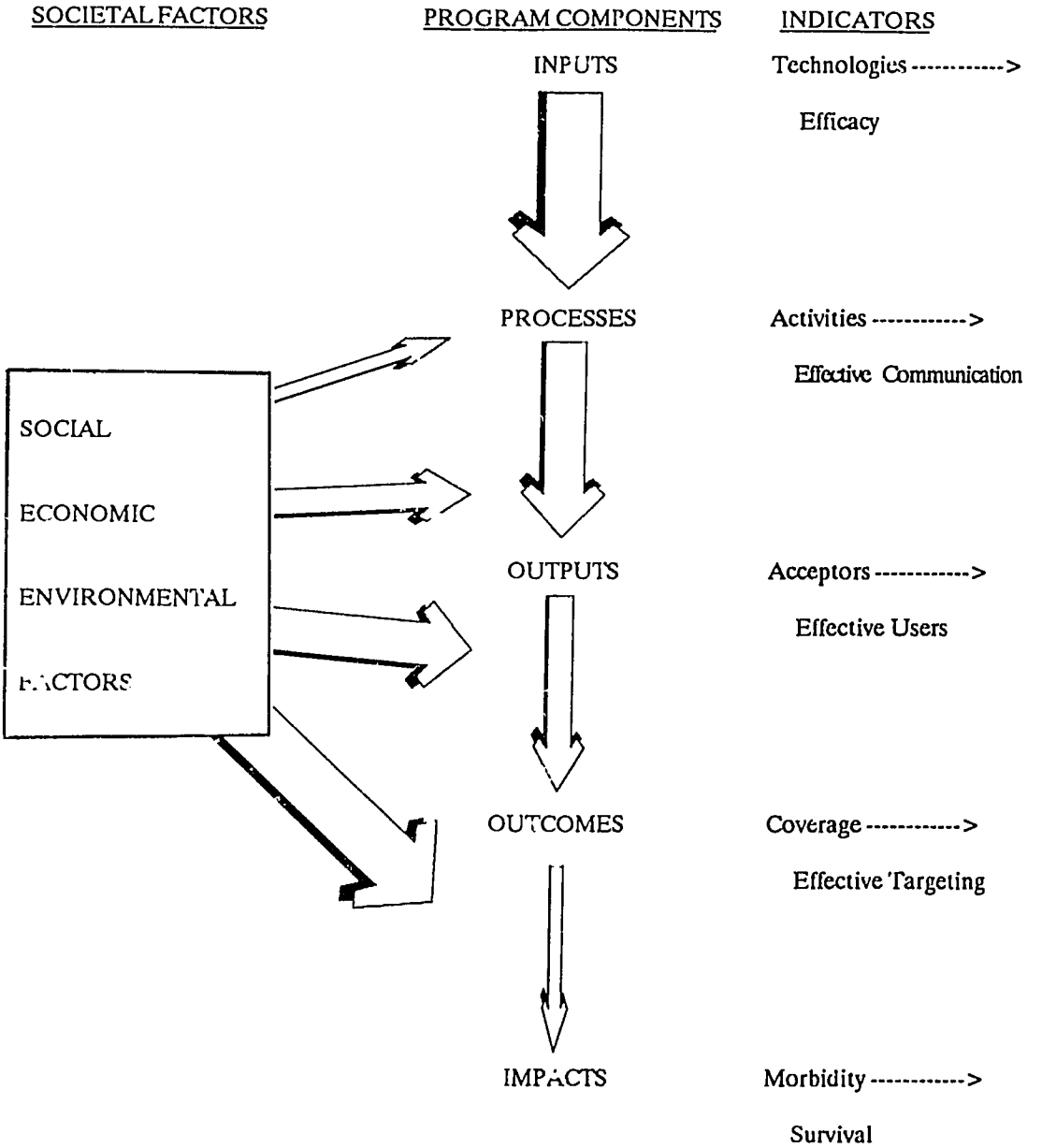
FIGURE 4: Direct Interventions for Improving Child Survival