Lives Lost, Lives Saved

Excess Mortality and the Impact of Health Interventions in the Somalia Emergency

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CENTER FOR POLICY
RESEARCH AND ANALYSIS
ON REFUGEE ISSUES

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RPG is an independent, non-profit organization established in 1982 to improve international and domestic policy on refugee issues. The first center of its kind anywhere, RPG informs policymakers, program implementors, and researchers through its reports, briefings, meetings, and resource center.

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EXCESS MORTALITY AND THE IMPACT OF HEALTH INTERVENTIONS IN THE SOMALIA EMERGENCY

STEVEN HANSCH
Senior Program Officer
Refugee Policy Group

SCOTT LILLIBRIDGE
Disaster Assessment Section
Centers for Disease Control and Prevention

GRACE EGELAND
Reproductive Health Unit
Centers for Disease Control and Prevention

CHARLES TELLER
Consultant

MICHAEL TOOLE
International Health Program Office
Centers for Disease Control and Prevention

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RPG
Refugee Policy Group
CENTER FOR POLICY ANALYSIS AND RESEARCH ON REFUGEE ISSUES

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INTRODUCTION

This report is the result of a collaborative study by the Refugee Policy Group (RPG) and the U.S. Centers for Disease Control and Prevention (CDC). Team members included Steven Hansch and Charles Teller of RPG, and Scott Lillibridge, Grace Egeland and Michael Toole of the CDC. A number of analysts from CDC have served advisors to this core team, including Brent Burkholder, Leslie Boss, Kevin Sullivan and Deborah McFarland.

For both RPG and CDC, this study followed considerable analytic work on the Somali emergency. RPG monitored and advised on the situation as the emergency developed.[1] CDC invested an unprecedented number of staff for the USAID and UNICEF activities in Somalia from June 1992 until June 1993. CDC staffers helped establish a surveillance and reporting system in late 1992 and early 1993, based in Mogadishu.

Since 1988, civil war has ravaged Somalia, destroying the country's food production and distribution system and much of the life sustaining public health infrastructure. As a consequence, in the period of 1991-1992, severe famine and disease outbreaks, particularly measles, occurred throughout Somalia. Without doubt the civil strife, drought, collapse of the government, and damaged infrastructure had an enormous impact on mortality and morbidity in Somalia during 1991 and 1992. The number of lives lost during this period, however, is unknown.

The task of this study is to piece together a complete picture of the health crisis in Somalia in order to answer several important questions:

- What was the magnitude of the famine?
- How many people in fact died?
- How effective were international relief efforts; in other words, how many deaths of Somalis were prevented by international intervention? and,
- What more could have been done, and how?

Actually counting those who died in humanitarian emergencies and those who might have died, but were saved, is so fraught with methodological problems that it is rarely attempted. One of the main challenges of the study, therefore, was to face these methodological problems head-on. It attempts to lay the groundwork for future efforts to measure the impact of humanitarian interventions in relation to the lives at stake.

First, the team examined available evidence to estimate how many people died as a result of the humanitarian emergency during the 1991 to 1993 period. Crude death statistics (either in the form of rates or total numbers of deaths) were gathered from site-specific mortality surveys and other sources.

Second, projections were made to estimate how many people would have died, if no interventions had occurred, or if the timing or type of relief efforts were different. Unlike prior estimates of total Somali deaths, the team took into account: (a) the wide variations in total population size estimates; (b) baseline (non-famine-year) mortality estimates; and, (c) the limitations of extrapolating mortality data from specific populations to broader famine-affected areas. In analyzing how many deaths were averted it was necessary to examine the profile of diseases and the cause-specific death rates for each.

Third, the team documented how the health crisis unfolded and how the international community responded. This meant piecing together the chronology and geography of famine deaths, as well as social, migratory, and epidemiological factors. The study also emphasized how the international community used disease surveillance data in designing and targeting response.

The team conducted interviews and collected documents in the U.S., Europe, and Nairobi; Somalia site visits were made to Mogadishu, Kismayo, Baidoa, and five rural locations in the Bay and Bakool regions. Team members conducted 95 interviews with health practitioners or officers of operational agencies: 42 NGO, 12 UNOSOM, 8 UNICEF, 4 UNHCR, 4 WHO, 7 WFP, 6 USAID, and 12 ICRC officers. Following an extensive search, the team reviewed project documents, survey results,[2] NGO, hospital and clinical records. Finally, RPG convened a meeting in Nairobi on April 6, 1994, at which health officers from a dozen agencies compared information on the nature of the famine in different regions and the causes of famine-related deaths.

CAUSES OF DEATH AND ILLNESS

The Health Consequences of the War

The effects of war in southern Somalia from 1990 onward compounded by drought increased vulnerabilities of the population. The health care network, which served only a fraction of the population to begin with, collapsed entirely. Essential drugs became unavailable thereafter throughout most of the emergency. New immunizations of children ceased.[3] Access to water became a crisis on its own, as wells, boreholes and irrigation infrastructure were destroyed, or plugged up, requiring heavy effort to remedy, particularly in the Hiraan and Bay regions.

The drought was preceded and accompanied by periods of intense fighting that, in some cases, directly targeted women and virtually whole households for extermination. Entire villages were eliminated and large populations were systematically debilitated through looting of life-sustaining crops, livestock, and food stores. Conflict precipitated food insecurity in four ways: (1) fighting destroyed the harvest; (2) militia took household assets necessary for planting and sowing; (3) bandits effectively closed off transport of foods to markets and eliminated any positive incentive for farmers to produce; and, (4) since building household food stores might incite further looting attacks, this fear discouraged farmers from growing anything even for their own households.

Even after civil conflict was reduced in late 1992 to lower-intensity skirmishes principally in Kismayo and Mogadishu, the threat to farmers transporting their food to market remained. As peasant agriculturalist Somalis have little tradition working in cooperatives, small farmers had to incur individual risks in the transport of foods they produced for sale. The dangers associated with transporting and selling foods thus continued to act as a drain on regional food availability.

While fighting and looting[4] led to food insecurity in rural areas, food insecurity in urban and peri-urban areas was related primarily to pervasive unemployment. With international and inter-regional trade constrained by fighting and looting, households could no longer trade to obtain goods for survival. Mortality rates -- the proportion of people dying -- varied significantly among regions and among clans not only because of varying risks but also because of variance in the existence and efficacy of social support networks[5] that helped families subsist despite years of formal unemployment and no income.[6] Many families benefited from large sums of remittances from Somalis working overseas.[7] Otherwise, many more urbanites would have suffered starvation than was actually observed.

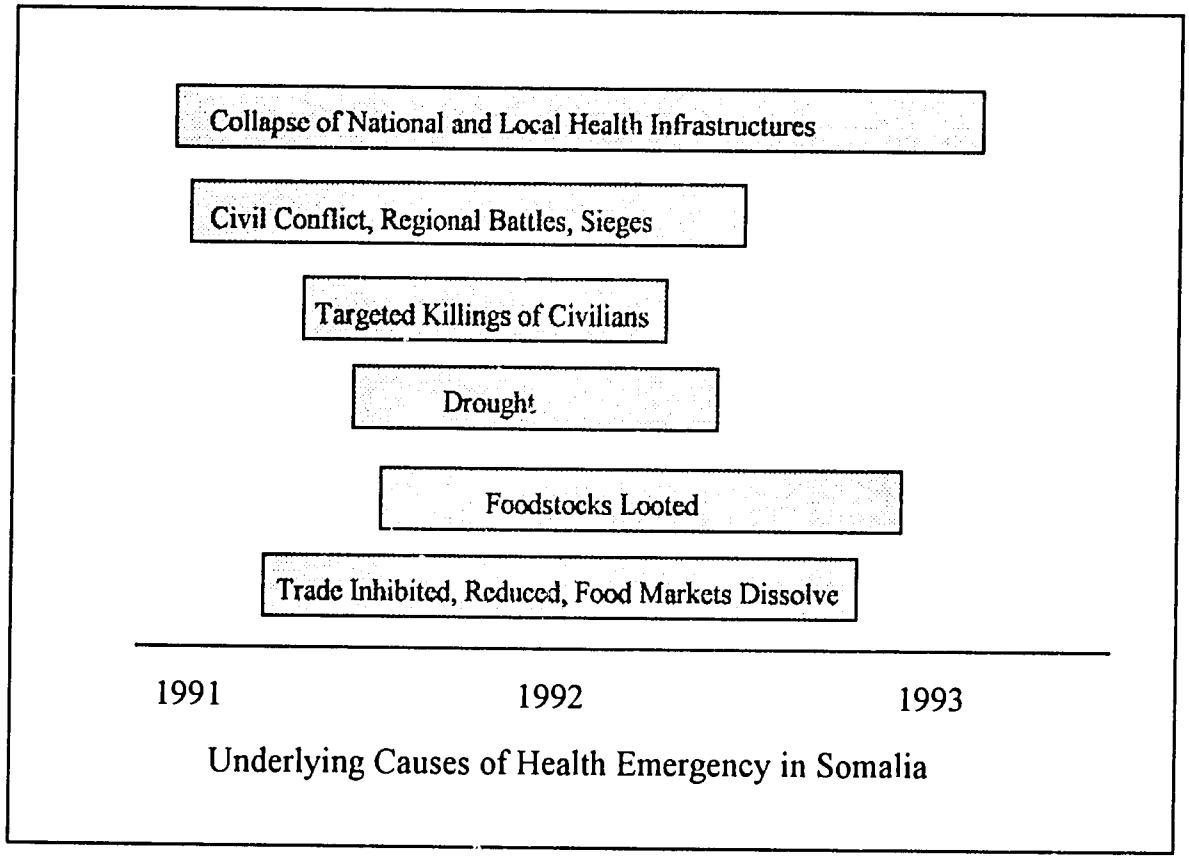

Figure 1. The timeframes of root causes of health problems in southern Somalia.

Demographic Effects

As early as 1990, the effects of the war and food insecurity were leading to famine, increasing the risk of stillbirths and a reduction in fertility.[8] Interviews conducted in the Bay and Bakool regions suggest that fertility rates, among the highest in the world in normal times, declined. Some of the reasons may include famine amenorrhea, reduced desire for children as a conscious coping strategy during lean times, increased birth spacing particularly among transient pastoralists on the move, and separation of husbands and wives.[9]

Decreasing birthrates resulted in fewer young children under the age of four by the time the famine peaked. Fewer live births occurred during the years prior to the peak of the famine relief, thus there were somewhat fewer infants and children at the beginning of the emergency period.

Relief workers entering villages for the first time remarked that they saw very few young children, concluding that the high death rates had depleted the entire infant and

young child population, consistent with what was known of the elevated mortality rates. What was less well recorded was when whole towns and villages disappeared or were depopulated.

Another reasonable inference that one might make from the disappearance of children from villages is that children had been taken to relief centers or refugee camps. While men went off to war, women and children often fled to displaced camps in towns such as Belet Huen, Kismayo, Afgoi, Johar and Mogadishu, and to refugee camps in Kenya.

Displacement

Violence, the threat of violence, and the scarcity of water and food compelled several hundred thousand Somalis to uproot during 1991 and 1992. In late 1991, hundreds of thousands of rural dwellers fled to coastal urban areas in search of sustenance. They did not find it. The influx of large numbers of migrants may have spurred other migration, for hundreds of thousands of those in cities fled as well, often to other countries.

While many Somali refugees continued to inhabit refugee camps in northeast Ethiopia (from a period prior to the famine), another 50,000 refugees fled to Ethiopia in late 1991 and early 1992. Those who went to Ethiopia were largely from the Central regions, Bakool and Gedo.[10] More Somalis might have fled to Ethiopia if the Ogaden border region had not also been undergoing a food crisis and increased banditry. ICRC even considered moving food through southern Somalia into the Ogaden of Ethiopia to feed Ethiopians. Over 350,000 Somali refugees came to Kenya over the course of the emergency. Those fleeing to Kenya included many from the urban middle class, including many doctors. They brought with them assets, such as cars, which they sold in Kenya.

War-related Physical Trauma

Conflict-related injuries accounted for most of the pre-famine excess mortality[11] during 1991. Famine deaths were not widely seen during this period of intense fighting. The earlier civil war that unseated Siad Barre's government raged throughout the country, leading to the destruction of homes and infrastructure in central and northern regions. Fighting in 1991, however, was more localized and focused in the southern regions and Mogadishu. The conflict in the Bay and Bakool regions in early 1992 led to the greatest numbers of uprooted and impoverished families.

Somalis and other key informants attest that killings of civilians, often in conjunction with banditry and campaigns against clan groups, accounted for more deaths than deaths among combatants in pitched battles. In the Bay region, the Marhehan armies targeted women as a means of genocide against the Rahanweyn clan.

Fighting in the Juba and Gedo regions in late 1991 led to perhaps the highest mortality rates seen. By August of 1991, the health consequences of being internally displaced began to outweigh the direct risks from violence. After February 1992, casualties directly from violence were exceeded by secondary effects of fighting such as famine and infectious disease.

While war-related killings and injuries continued beyond 1991, other health problems loomed larger. Massive deaths began to occur in early 1992, as a result of the fighting, scorched-earth campaigns of armies, increasing looting, breakdown of civil society, and famine in November and December of 1991.

Proximate Causes of Death During the Somalia Famine

The collapse of the health system, lack of security, and reduced food trade were preconditions that disposed the population to heightened levels of malnutrition and disease. Other consequences were social, most importantly, the increasing inability of social and kinship ties to provide for daily needs.

During famine conditions, particularly when persons have been displaced and the public health infrastructure has been disrupted, the risk of disease is dramatically increased.[12] Consistently the highest mortality rates during the famine were reported among persons who were displaced[13] and among those children less than 5 years of age.

As a result of these conditions, the proximate cause of death for most famine victims is usually related to endemic infectious diseases rather than purely starvation. The synergistic effect of malnutrition, particularly vitamin A deficiency, and disease[14] in contributing to the overall mortality rate has been noted in other famines. The reasons for this effect are related to crowding, lack of clinical services, inadequate immunization status of the population, limited access to potable water and poor sanitation. Historically, measles, acute respiratory illness and diarrhea tend to be the most common reported causes of mortality for displaced and refugee populations, as well as developing countries in general.[15] Particularly in the Horn of Africa, cholera, hepatitis E,[16] malaria and tuberculosis are also common scourges among uprooted populations.

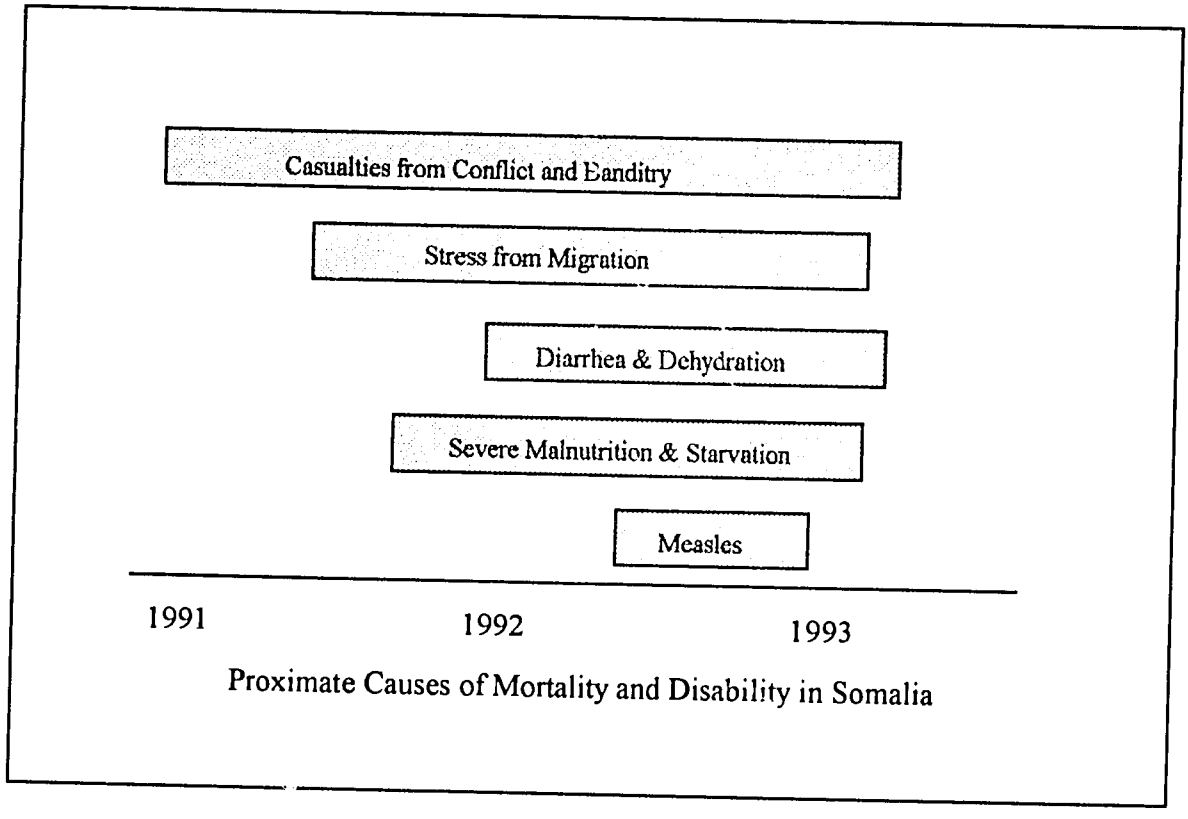

Figure 2. Primary illnesses during the emergency

It is likely that the high mortality experienced by the Somali population during this famine was equally associated with Somalia's chronically underdeveloped public health infrastructure, as well as with the lack of food. For example, a review of the most frequent causes of death for persons under 5 in Somalia reported in 1987 (one year before the civil war) is remarkably consistent with the causes of death associated with the recent famine, albeit to a lesser extent in terms of magnitude.

Somalia presented an unusual challenge for public health during the famine years of 1991-1992 because of the absence of a functional Ministry of Health (MOH) and the range and complexity of endemic diseases during the recent famine. In addition, numerous reports indicate that baseline public health indicators in Somalia were very low prior to the current period of civil conflict and subsequent famine. For example, only 30 percent of the rural population had access to potable water and, when surveys were conducted, much of the preschool population was chronically malnourished.[17]

Major Illnesses

The primary causes of illness and death in Somalia were malnutrition, measles, and diarrhea; the effects of these conditions in the population are cumulative. The fact that such common and easily preventable illnesses occurred among so many is not in the least surprising; indeed, it would have been surprising had they *not* occurred. The fact that approximately 1 million Somalis were displaced[18] during the emergency led health analysts to predict in advance that measles would become epidemic, as they did in late summer 1992.

Based on its human ecology, a number of infectious diseases are either endemic or potentially epidemic in Somalia.[19] What is relevant to note in the Somalia emergency is that few of these diseases were significant health problems during the crisis; there was minimal pertussis, postoperative infections, schistosomiasis, onchocerciasis, or meningitis. Cholera was not reported, and apparently did not occur, until 1994.

Tuberculosis, malaria, and dengue fever were prevalent in the population before the emergency, but population movements increased the transmission of diseases and malnutrition reduced immune capacity and reactivated sub-clinical cases (as in TB). The intensity of dengue hemorrhagic fever prevalence was particularly high in the Bardera area.[20]

Malaria transmission accelerated with the rains in September and October 1992, contributing to the high mortality in October. It is possible that the severity of cases -- and the resulting mortality -- were related to specific populations having moved from sparsely populated arid areas to more densely populated endemic areas. Another peak in malaria incidence was reported in January and February 1993.

Diarrheal disease is epidemic in most displaced populations, and particularly among pastoralists who have little custom-based appreciation for sanitation systems. In Somalia, sanitation-related diarrhea became a problem early in the emergency, as water utilities, access to wells, and other clean water sources became increasingly restricted. Pastoralists are particularly vulnerable to epidemics of diarrhea transmission in displaced camps where defecation habits, based on rural/nomadic lifestyles, lead to increased exposure and transmission.

Shigella, largely fatal in Somalia, was reported in relief centers in Somalia and refugee camps in Kenya and was of concern to physicians, as it resisted standard antibiotics. The epidemic occurrence of Shigella in these locals reflected the poor sanitary conditions in the relief centers and displaced persons camps. Few of the relief programs were able to address this problem on a population basis.

The Role of Malnutrition

Very high rates (over 20 percent) of severe, acute malnutrition[21] were reported from most displaced population encampments. As with mortality data, it is difficult to extrapolate these observations to the much wider, unseen, non-displaced population. Experts on Somali culture report that only the most desperate migrated away from their homesteads to the displaced camps, suggesting that those who stayed behind were more robust and therefore probably incurred less mortality. Many whole families and communities migrated en masse due to insecurity. Yet rural survivorship surveys in Somalia show that in the worst affected regions, half of all deaths occurred in rural villages among the non-displaced.

During a famine, malnutrition, by definition, poses a health risk to a large proportion of the population. For many who died, the primary diagnosis -- the "last straw" -- was measles, diarrhea, etc. But those who died of these diseases were vulnerable to these infections and to high case fatality rates because of their malnutrition.

Global epidemiologic studies suggest that moderate and severe malnutrition is implicated in up to 80 percent of deaths, particularly among children, in countries like Somalia.[22] In refugee-like situations where tens of thousands are displaced, malnutrition is seen to correlate closely with mortality.[23] Surveys indicate that Somalis had numerous micronutrient deficiencies, including avitaminosis,[24] scurvy, and extreme anemia[25]. Widespread severe anemia, in particular, combined with dehydration and protein-energy malnutrition to increase the risk of death from common infections such as malaria,[26] measles, and pneumonia.

THE COURSE OF THE FAMINE

Deaths occurred in what might be described as three famine "waves." The visual image of a "wave" conveys several relevant concepts: 1) incidence: a curve of severity over time as well as space; 2) transmission: the rolling, spreading, evolving nature of severity and causality across the geographic landscape, as the shock of famine is carried from place to place by displaced populations competing for food, water, and work; and, 3) causality. The three waves are distinguished by different trends in precipitating events: in the first wave, economic collapse and warfare; in the second case, food insecurity; and, in the final wave, epidemics.

Epidemiologists characterize infectious disease epidemics as "common source" (arising from a common contaminated water supply), or "propagated"[27] (communicated from person to person). Field workers often can identify the cause of an epidemic by noting the curve over time of when people are affected. Propagated epidemics have a more complicated pattern, spaced over a greater period of time. Famines can have characteristics of both types of temporal curves. First, famine can result from a common natural event (harvest failure). Second, famine can be propagated, as afflicted populations impose new stresses on the areas to which they move.[28] As rural populations move to towns, for instance, they draw down on the local food stocks and water supplies, compete for space and relief supplies, and introduce infectious diseases.[29] Despite these interacting social and biological effects, famines nevertheless tend to ebb and wane over time. The concept of a "wave" helps to depict the dynamic of these processes.

The First Wave: Famine Conditions

The first famine wave began in April 1991, as General Siad Barre's government troops retreated from Mogadishu. It hit hardest in mid to late 1991. Starting between Mogadishu and Kismayo, the wave affected the Lower Shabelle and Lower Juba regions and the cities themselves. Hundreds of thousands were caught in conflict zones; hundreds of thousands more became displaced. Fighting and insecurity led directly to 10,000 deaths and indirectly to economic collapse and dispossessions of assets. Large movements of displaced people gravitated toward cities and relief centers, forming squatter settlements around the emergency feeding programs in north and south Mogadishu. While unemployment was pervasive in Mogadishu, few of the original inhabitants of Mogadishu died in Mogadishu; many migrated south into Kenya. Thus, this famine wave carried

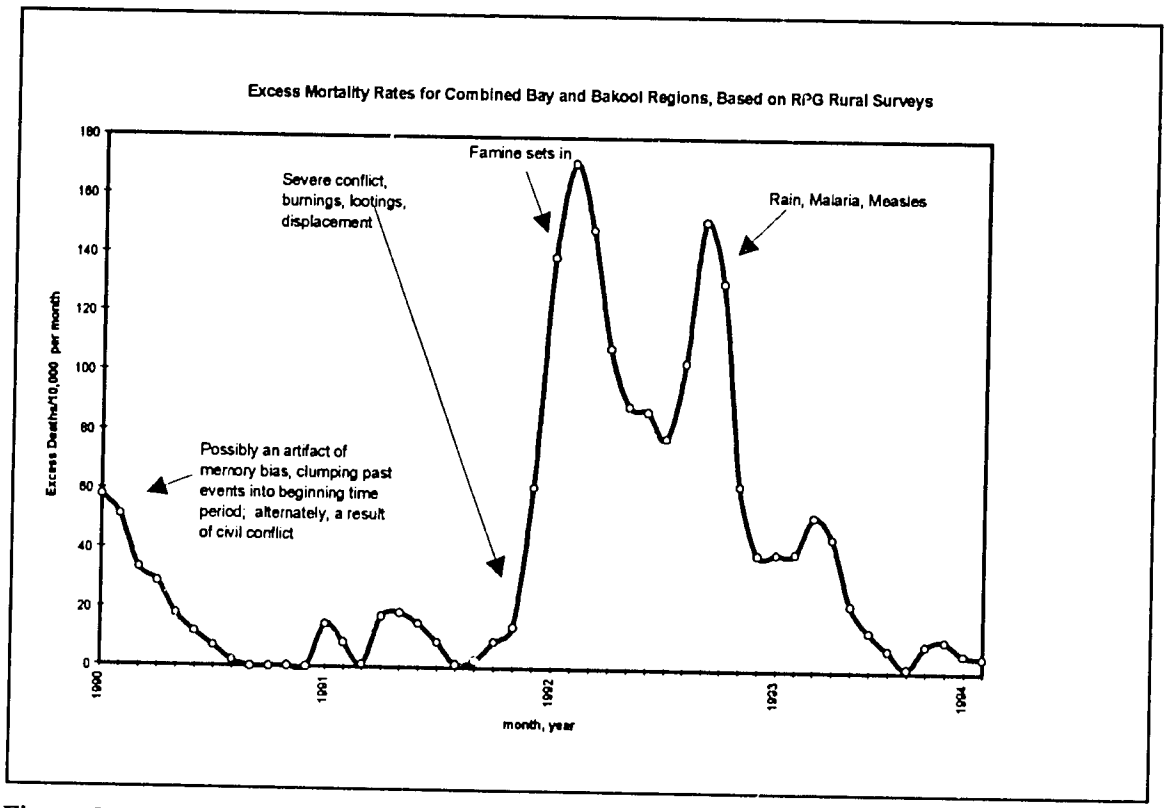

Figure 3. Excess deaths reported by families expressed in terms of deaths per 10,000 population per month. Responses were given by heads of households living in three rural districts in Bay and Bakool. The blackened curve represents the reported deaths per month. Reported deaths were clumped in early 1992 and around September 1992. The

north from battle areas into population centers and south into refugee camps along the border of Kenya. Those who came from rural areas into the cities died in large numbers because there was little support for them. Those who escaped to Kenya faced health problems due to lack of potable water and overcrowding, but at the peak of the famine inside Somalia, mortality remained modest in the camps in Kenya.

Second Wave: The Famine Intensifies

The second famine wave, depicted in Figure 3, emanated from the Bay region, focused in the area of Baidoa, following the looting and slaughter of local residents by the retreating troops loyal to Siad Barre in late 1991 and early 1992. Rahanweyn peasants in this region were targeted.[30] Assets were looted or destroyed, leaving villages empty not only of food but also of any assets with which to procure, trade for or produce food. Many Bantu residing in this region also lost their possessions. The wave consisted mainly

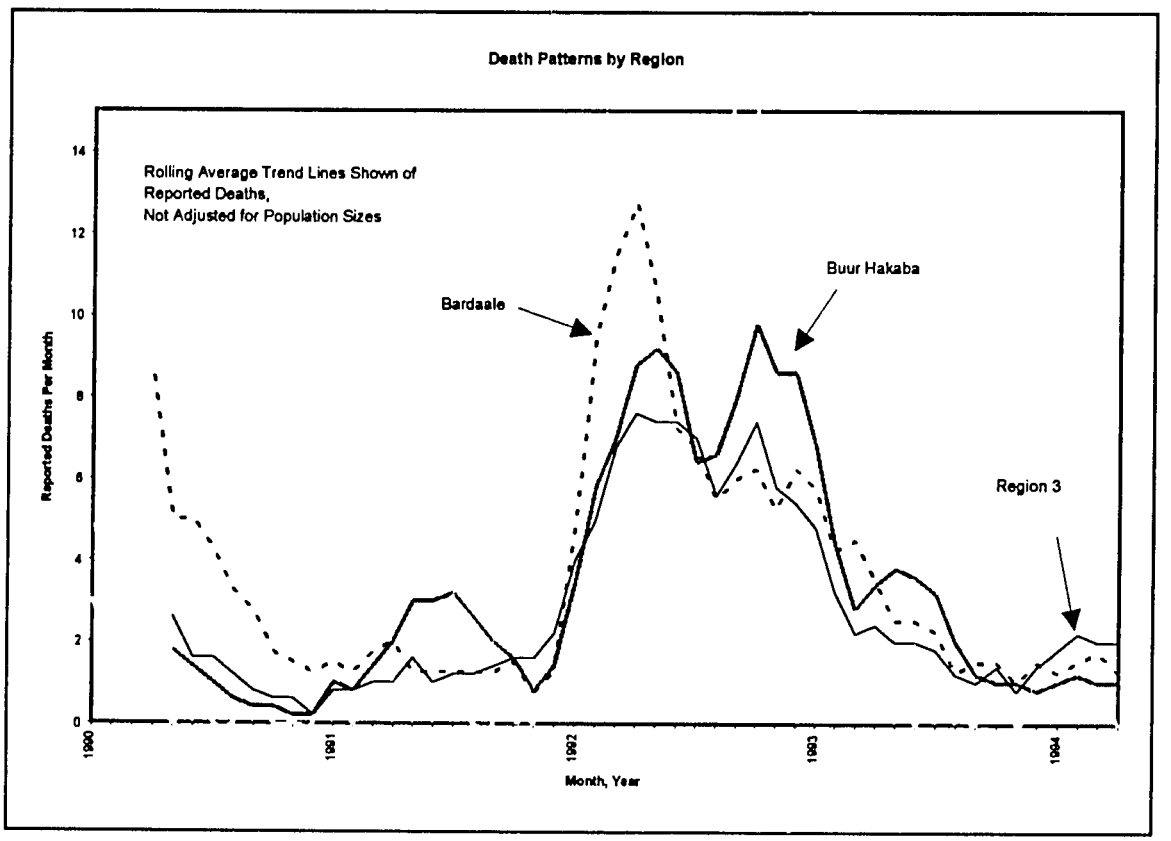

Figure 4. The aggregate famine wave of the three districts which were clumped together in chart 3. Data from household retrospective surveys conducted by RPG.

of the approximately 70,000 persons who were most vulnerable to illness and death who had migrated into Baidoa -- most to die.

The incidence of deaths in each of the three regions is seen in Figure 4, on the following page. As the graph depicts, each district experienced a peak mortality several months after the initial fighting that led to famine conditions.

Relief agencies arrived in the Baidoa area for the first time in April and May of 1992. Before then, health workers had little evidence of any crisis in this area. The ICRC resisted airlifting food until such evidence existed. By the time the first feeding programs had been established, excess mortality had already peaked.[31] By the time the media had visited Baidoa and relief flights were ongoing, the peak of the mortality had already passed.

This second famine wave led to an outpouring of tens of thousands from the Bay and Bakool regions into adjacent regions. Thus, the severely malnourished observed in

the second half of 1992 in relief centers in these other regions -- Belet Weyne in Hiraan, Bardera in the Gedo region, and Mogadishu itself -- were actually the famine victims of the neighboring Bay and Bakool regions.[32]

Deaths from this famine wave peaked between April and June of 1992, with malnutrition the main cause.[33] By this point in the famine, very severely malnourished adults were seen. NGOs had to rethink their entire approach to saving lives when confronted with such elevated mortality among non-children. Retrospective surveys[34] support the observation that while the greatest age-specific death rates were, as always, among young children, adults and older children had surprisingly high proportionate increases in mortality.[35]

Those individuals strong enough to make it to Kenya or Ethiopia were able to access food and water and escape this famine wave. Those who remained in rural villages in the Bay region found only continued food shortage. Those who migrated to sites of relief distribution in nearby regions congregated in displaced camps where public health services were unable to prevent disease transmission.

Third Wave (July to Mid-October 1992)

In the late summer of 1992, a third and final wave of mortality swept the countryside. It peaked in mid October. In this wave, measles, diarrhea and malaria swept the already-malnourished. Daily mortality rates peaked in conjunction with the autumn rains. One estimate put the total deaths in September at 30,000.[36] Deaths per day were seen to peak immediately following rains, likely a result of the fact that the malnourished also had little shelter to protect them from evening hypothermia. It certainly also reflected increased spread of diarrhea and more mosquitoes, which increased the transmission of malaria and dengue fever.

In all three waves it is apparent from rural surveys that at least as much[37] mortality occurred outside of camps and cities as within camps and cities. Thus the total numbers of deaths recorded in the urban, town and camp sites[38] are only a fraction of the total deaths that occurred throughout Somalia.

The Influence of the International Relief Effort

The delivery and distribution of food contributed to the reduction of starvation deaths. Food delivery greatly accelerated U.S. forces landed in December1992 and vast quantities of food were distributed throughout Somalia during 1993 under the aegis of the U.N. coalition forces.

Another important factor contributing to reduced famine death rates was the application of a known public health measure to the leading cause of mortality among famine victims. In accordance with the U.N. plan of October 6, 1992, a mass immunization campaign focusing on measles[39] was implemented beginning in February 1993, which transformed various ad hoc efforts into a nationwide operation. UNICEF records of immunization activities in Somalia indicate that during the 5 month period of September 1992 and January 1993, before the U.N. mass immunization campaign was formalized, approximately 140,000 persons in 9 regions received measles vaccinations. However, during the next 5 months after a national UNICEF immunization campaign was established, approximately 500,000 persons in 16 regions were vaccinated.

By late 1992 ICRC and a network of NGOs were providing or supporting a host of medical (e.g., clinical services, therapeutic feeding) and public health services (e.g., immunizations, mass feeding, vitamin A prophylaxis, oral rehydration, water pumps and cleaning, surveillance, community health workers). At the peak, an estimated 1 million Somalis were being fed through a plethora of on-site and take-home feeding programs. These activities dug in and matured throughout 1993.

The massive health interventions during the first ten months of 1992 helped hundreds of thousands of Somalis. Field workers and Somalis from around the country agree that by the end of 1992, food supplies and access to food were vastly improved. They also concur that there were not the same scale of mass population dislocations that was characteristic of early late 1991 and early 1992.

Due to relief interventions along with the dying out of the most at-risk groups, malnutrition and mortality rates declined sharply after September and October 1992. Systematic random-sampling surveys and general (whole population) observations conducted in places like Baidoa indicated that monthly deaths generally decreased after July and August. Later, 1993 and 1994, surveys confirm that the population's nutritional status had improved by late 1992, and continued to improve during 1993.[40]

HOW MANY PEOPLE DIED?

The true number of Somalis who died can be measured, at best, only to a range. The uncertainty of how many Somalis who died is plagued by a more fundamental uncertainty about how many Somalis were alive before the famine.

Reports of the numbers of people who have died in famines in developing countries are rare, vague[41] and frequently inaccurate by wide margins. Analysts of the 1968-1973 drought in the Sahel present a range from 50,000 to 150,000 deaths, a wide confidence interval. Indirect evidence of famine deaths from China/1959 and Cambodia/1979 have been used only many years later to reconstruct general mortality estimates. Deaths are not commonly reported with precision by field personnel involved in relief activities. Usually, mention is made of the "affected population," which is derived from some estimate of the pre-emergency population in the affected geographic areas. Estimates of lives spared as a result of intentional humanitarian interventions are even less scientifically based.

Recent efforts by CDC and allied agencies have begun to remedy this inattention to accurate mortality estimates. Increasingly, epidemiologists have included mortality assessments in their field studies and reports.[42] In Somalia, CDC, MSF, SCF and UNICEF personnel made unprecedented efforts to conduct randomized, retrospective surveys to estimate the crude death rates in specific sites. Unfortunately, these methods were not fully standardized or explained.[43]

The first step in estimating total mortality is to judiciously estimate the size of the affected, at-risk population. Somalia's total population is perhaps the least accurately known of any in the world.[44] The estimate of the current total population that was used by agencies working in Somalia was a rough extrapolation of the population in the 1975 census, making assumptions about the rate of natural increase (births minus deaths).[45] Not only are the extrapolations speculative in their assumptions, but the 1975 census, in retrospect, seems to be highly suspect in its accuracy.[46]

Informants repeatedly expressed the view that among the many estimates of Somalia's total population, the most likely correct population guess would fall at the lower end of this range of population estimates. This comports well with the additional observation that Somalis make themselves "felt," disproportionate to their actual numbers, in refugee situations: for instance they are rarely under-counted and frequently over-counted (as through multiple registration).[47] The most common view of informants

is that Somalia's population is 4.5 million, but the U.N. recently adopted a planning figure of 5.5 million.[48]

The dilemma of total population size is closely related to the proportion of the total population that is pastoral vs. agricultural. There are several million agropastoralists in the southern portion of the country and for decades the conventional wisdom (printed in government documents and international guides) record that 2/3 of the population are migratory pastoralist. Therefore, one might conclude that there must be at least five million pastoralists (assuming a high-end figure of 7 million total in Somalia). Throughout the famine, however, these pastoralists, whatever their number, were largely unseen by relief agency staff -- except by the ICRC which managed a widespread livestock vaccination program.[49] It appears there are far fewer "pure" pastoralists than the conventional wisdom would suggest, and this correction accounts for the "missing" four to five million in the range of population estimates.

In the following calculations, a total of 5.1 million is used. Planning figures used by WFP during the emergency itself estimated the population in Somalia at 4.5 million. Including an estimated 400,000 at-risk Somalis who fled to Kenya during this period, the 4.5 million figure is increased to 4.9 million. By the time of UNITAF, on the order of 200,000 persons had perished.[50] The estimate used here of the pre-famine (1991) population is 5.1 million.

Of this total population, citation is frequently made of the "at-risk" population: in other words, those Somalis who lived in the geographic areas hardest hit by famine and without high economic resources to help them cope. The U.N. and secondary sources gave 1.5 million as the population most at risk of famine.[51]

In associating death rates with subpopulations, the main problem is tracking populations as they move. For example, a large proportion of the populations of Mogadishu and Kismayo at the beginning of 1991, were no longer resident in these cities by early 1993. However, many of the most vulnerable groups from nearby regions relocated themselves to camps in and surrounding these cities, replenishing the total population sizes of these areas.[52] The non-displaced resident populations of these cities were observed to exhibit only modest excess mortality while many of the displaced manifested very high death rates, both in transit and shortly after encampment.

Baseline Mortality

It has been surprisingly hard to estimate the normal-year death rates in Somalia. The infant and child mortality experience in Somalia has been poorly monitored over the

years; there have been few population-based surveys. The best estimate of Somalia's infant mortality rate is 180/1,000 live births,[53] and a child mortality rate of 280/1,000 live births, during good years. The life expectancy in Somalia in normal times is estimated to be at least 45 years. Based on all these considerations one might expect 97,000 deaths during a baseline one-year period of time.[54]

Assessing Famine Mortality

There was no "original source" found by the study team for the often-repeated estimates of 200,000 to 500,000 deaths. It is very likely that the estimate for Somalia was a back-of-the-envelope extrapolation[55] from the mortality rates reported in a few sites. Mohamed Sahnoun reports[56] that 300,000 had died from hunger by March 1992 when he arrived in Somalia.[57]

Somali mortality data include surveys of feeding-center deaths, prospective surveys of graveyard, body, or burial shroud distributions, and retrospective population-based mortality surveys.

Data on feeding-center populations, while helpful in estimating the "at-risk population," is not directly useful in estimating mortality. Evidence of *severe* malnutrition among large feeding center populations can be of limited use in suggesting the scale of the problem in the larger population; but, estimating mortality <u>from</u> malnutrition data is a very inexact science.[58]

Graveyard or body count data are also not easily translated into mortality rates because of the uncertainty about the population denominator from which deaths are drawn.

Numerous retrospective surveys were conducted using the verbal autopsy method.[59] These provided the best indication of mortality rates and are the focus of this written review. These were conducted by various agencies (CDC,[60] UNICEF, MSF) and varied slightly in their methods and the calendar periods used for review.[61]

Data from these surveys indicate that mortality rates were much higher in November and December 1992 than in preceding months.[62] These higher death rates in late November and December appear to contradict other evidence that the famine had passed its peak months earlier. But this anomaly may be explained in three ways:

- Respondents "clumped" deaths into the near-term period, perhaps influenced by delays in information about kin deaths coming to them,

particularly where families had been disrupted, or by the desire to emphasize the immediacy of their plight; it is likely that respondents were motivated to report the high October deaths in November, since the previous month was singled out, but no questions referred to the previous two months.

- Respondents, being displaced and being in emergency/displaced camps at the time of the survey, were more representative of households for whom the height of suffering and disruption was recent. The sampling strategy could not fully account for those who had relocated during earlier periods of time. Thus this method of inquiry under-represented households where stress and death had peaked earlier -- households which may have died out entirely or moved from the displaced camps.

- There truly was higher mortality in the late 1992 period than in previous months, though complementary data suggests that this was not the case.

The authors tried to glean from these studies an order of magnitude of death rate per region.[63] They did not try to test whether some death rates were significantly different from others.[64] The statistical power of these studies is not high; but, estimating the "effect size"[65] (i.e., the numbers who died) is of value even if the confidence interval is wide (i.e., precision is lost). These studies represent valuable efforts to gauge the general severity of famine, not to test finely-drawn hypotheses about risks. Compared to other health status measures, mortality is fairly unequivocal. In the absence of cross-checks, it is not clear what is being examined in these studies,[66] as they dealt with very different populations. In most cases the interview pools were from areas or populations that were likely to have been magnets for the most severely affected and the internally displaced.[67] They also suffered from a counter-bias in that households where all the adults died or where all surviving adults who migrated to rural areas or to other countries were under-sampled.[68]

In the end the study did not simply merge death rates from multiple studies or regions to determine a single, overall death rate.[69] Theory cautions against selectivity studies, however well-intentioned . Reviewer bias is introduced in judging which studies to accept and which to discard.[70] Instead, all studies were accepted as pieces of evidence of the severity of conditions within the region where they were conducted.

Population Death Rates

Based on selective survey results, mortality rates (per 10,000 per day) varied by survey site, ranging from 1.9 deaths per day in Jowhar and 2.9 per day in Merca/Qorioley to 11.8 per day in Bardera and 12.5 in Mogadishu.[71] Eleven percent of the population in Afgoi had died based on surveys among surviving family members.

In most developing countries, the expected mortality per 10,000 per day for the general population is 0.5 (or approximately 2 percent of the total population dies per year in the case of Somalia). Thus, the observed mortality rates during 1992 reflect an excess mortality ranging from 3.8 to 25 times the expected rate for a developing country.

Similarly, the percent of the survey population that died during the recall period -- usually from late 1992 back to March 1992 -- ranged from 6 percent in Jowhar to 36 percent in the Marin camp in Mogadishu.

CARE reports a total average mortality rate in the southwest Bay region of 2 persons dying per family (mean family size of 8), giving a 25 percent crude mortality rate for the emergency period (April 1992 to February 1993).[72] In a similar survey in Bur Hakaba, World Vision reports an 18 percent death rate during this period.[73] It was reported that 39 percent of persons had died in displaced camps around Baidoa.[74]

Among children under 5 years of age, the mortality rates were higher than that of the general population, with rates ranging from 3.2 per day in Mogadishu and 3.8 per day in Jowhar to 19.8 in Hoddur and 22.7 in Bardera. The expected mortality rate per 10,000 per day for children under 5 years of age in developing countries is 2. Thus, the observed mortality rates during 1992 reflect an excess mortality ranging from 1.6 to 11 times the expected rate. The percent of the survey populations who died during the recall period ranged from 12 percent in Jowhar to 62 percent in Bardera. In contrast, we would expect that 4.9 percent of children under 5 years of age would have died within an 8-month period based on the expected daily mortality rate among children under 5 years of age in developing countries.

Those surveys which separately examined mortality of displaced and non-displaced individuals consistently found that mortality rates were higher among the displaced.[75] The highest mortality rates were generally observed among displaced persons residing in camps rather than towns, and for displaced children residing in camps. Taking the highest displaced mortality rate (town or camp) from each survey, the mortality rate ranged from 4.5 to 16.8. Dislocation, in itself, was the most dramatic risk factor. The excess mortality relative to non-displaced persons ranged from 1.5 to 3.7, with a midpoint of a 2-fold excess mortality relative to non-displaced groups.

For displaced children under 5 years of age residing in camps, the mortality rate per 10,000 per day ranged from 6.6 in Merca/Qorioley to 32.0 in Baidoa rates that are 3.3 to 16 times the normal expected background rate of 2 deaths per 10,000 per day. Among the 4 studies comparing displaced rates to non-displaced rates, the relative risk of excess mortality among displaced children ranged from 1.3 to 2.1, with a midpoint value of a 2-fold excess above non-displaced rates.

The famine was typical in that most of the lives lost were among the young: 47 percent[76] of all deaths were under 8 year olds. On the other hand, the proportion of all deaths suffered by the very young is usually higher. So, as a multiple of baseline conditions, the increase in death rates was proportionally more for adults.[77] The famine in certain areas was so extreme that adults suffered severe malnutrition on a scale that is rare. Unlike famine victims in other parts of the world, these adults had too little body fat or protein to carry them through a prolonged period of deprivation.

Converging Evidence on Total Famine Mortality

Estimating the number of deaths, while a related issue, is slightly distinct from estimating the proportion of Somalis who died. A lower bound on the numbers that died can be gauged through the deaths observed by field workers, predominantly at centers where relief assistance was administered.

Minimum and Maximum Bounds

International observers witnessed and verified through surveys general levels of deaths in major population centers, principally during 1992. Based on their reports a conservative estimate would put the number of deaths in Baidoa at least 20,000,[78] 10,000 in Bardera,[79] 10,000 in Mogadishu,[80] 10,000 in Kismayo,[81] 7,000 in Jowhar, 2,000 in Afgoi, 5,000 in the Jilib area of the lower Juba,[82] and 5,000 in centers along the coast south of Mogadishu (e.g. Merca[83]) and riverine centers (e.g. Quoreiley).[84] Therefore, even if no excess deaths occurred outside of the major population centers, which we know not to be true, a minimum estimate would be that at least 70,000 persons died due to famine in 1992/1993, a minimum estimate.

An upper bound on the numbers of deaths can be derived through consideration of the numbers at-risk in the affected regions. Approximately 2.5 to 3 million persons lived in famine-affected regions of the country. In each region, the population estimated to still

live in the region, following the famine, or accounted for in refugee camps was typically not at variance from original estimates by more than 200,000 (Bay Region), and more in the order of 20,000 to 50,000 in other affected regions (Middle Shabelle, Lower Shabelle, Middle Juba, Lower Juba). Based, therefore, on this liberal use of "missing" populations,[85] the highest upper bound possible number of deaths for the famine is 700,000.

Extrapolating From Proportions that Died

The bulk of the evidence on starvation and starvation-related (e.g. famine) deaths refers to the massive increase in affected populations in 1992. Most of the surveys conducted on death rates refer to the period after the 1992 Ramadan. Most of the key informant experiences also date from about that time. Therefore, most of the estimation of famine death involves the twelve-month 1992 period; less is known about starvation during 1991. Consequently, conservative estimates made here of total famine deaths conclude with comparatively few during 1991.

During 1992, the range of survey data might be synthesized down to a single estimate that could be applied to a broader population of famine-affected Somalis. One median estimate of the numbers that died during the famine period (March to December, 1992) is 7 per 10,000 per day.[86] Since the baseline crude death rate in such a population is approximately .5 per 10,000 per day, then the crude excess mortality rate might be estimated at 6.5 per 10,000 for the affected population. This leads to an estimate of 1,950 deaths per 10,000. For an at-risk poulation of 1.5 million, this implies an excess mortality of roughly 290,000 for 1992.

But this approach treats all regions of Somalia as if they were homogeneous. And it over-simplifies the famine as occurring at similar levels in different places at different times.

The study team took advantage of available evidence to contrast regions and time periods, allowing for a further step of refinement in the analysis of the total deaths during the famine.

Accounting for Regional Distinctions

Mortality rates were estimated by applying observed crude mortality rates to specific populations based on regional disaggregation. The ranges of deaths calculated are shown in Table 1 on the following page. In this table, the reported range represents the

plausible death rates per region. In this instance, "plausible" means reasonably possible, a liberal estimate. In contrast, the most likely, or probable death rates (a more conservative range) are presented in the rightmost column, "probable excess deaths."

The first column of Table 1 lists several of the key regions of Somalia, breaking out the most famine-afflicted. The second column cites the estimated population of each region.[87]

The rest of the table gives mortality data.

The third column presents a range of the proportions of Somalis dying during the twelve-months of calendar year 1992. This is the only row citing percentages. The percentage range in the third column cites the realistic outside boundaries of how many people may have died.[88] Because of biases in the representativeness of information about deaths and because of measurement errors,[89] it is not practical to narrow the plausible range of death rates beyond these wide intervals.

Specific death rate intervals are estimated for each of the major regions, based on evidence from key informant interviews and general health status reports from those regions.[90] For example, few reports from the Central regions of Somalia (e.g. Bari, Mudug) indicated famine conditions.[91]

Table 1. Geographic Area	1991 Pop in '000s	Plausible proportions of populations dying: a range	Net deaths 1992, range in '000s	Baseline crude deaths (1.9% Rate), in '000s	**Excess** (Net minus baseline) mortality 1992, in '000s	**Probable** excess mortality 1992, '000s
Bay	600	12% - 25%	72 - 150	11.4	60 - 138	100 - 110
Lower Juba	200	6% - 16%	12 - 32	3.8	8 - 28	12 - 16
Lower Shabelle	450	6% - 15%	27 - 68	8.5	18 - 59	25 - 28
Bakool	140	6% - 13%	8 - 18	2.6	5 - 17	5 - 8
Middle Juba	240	3% - 8%	7 - 19	4.6	2 - 12	6 - 9
Mogadishu	800	3% - 8%	18 - 64	15.2	3 - 48	14 - 16
Middle Shabelle	300	3% - 7%	9 - 21	5.7	3 - 15	10 - 12
Hirran	160	3% - 6%	5 - 9	3	2 - 6	5 - 6
Other	2,210	2% - 5%	48 - 123	42	6 - 98	25 - 30
Total	**5,100**		**206 -514**	**97**	**109 - 417**	**202 - 238**

This step -- synthesizing death rates from small samples and applying them as indicative rates for large regions -- is the most critical and controversial step in the overall analysis. Some argue that too little is known about the geographic variation in the famine to justify one figure as more or less representative of populations that were not directly observed. Indeed, no one conducted systematic comparisons of health or mortality between any regions during the famine. However, health professionals involved in assessment and effective reporting[92] on an operational basis did have meaningful observations of conditions across regions where they individually worked. It was the task of many project planners working with UNICEF, CARE, and UNOSOM (to name only a few agencies) to determine the magnitude of dying in different regions. The study team focused on culling the knowledge of field staff with respect to such geographic comparisons.

ICRC held a unique role in this regard, because it provided assistance in virtually every region of the country. Throughout the period of emergency, it needed to make site visits and comparative estimates of levels of severity of the health crisis across regions in order to determine the level of response per region.

Column 4 converts the percentages in column 3 into numbers of Somalis, merely multiplying the rates of column 3 with the population sizes of column 2.

Column 5 lists estimates of the baseline, or pre-famine mortality, in each region, in terms of thousands of persons dying in a normal twelve-month period. This is calculated roughly, without adjustment for age profile, as .02 multiplied by the population size.

Column 6 arrives at the numbers of persons dying in each region that were "excess" during the famine period. These numbers are merely the estimates of column 4 minus the baseline figures in column 5.

Column 7 (the far right column in Table 1) narrows the range from plausible to probable. While the plausible interval encompassed a wider range of uncertainty, the "probable" interval uses information to hone in toward the true range. By sacrificing certainty, the probable range has a higher likelihood of error.[93]

This narrower range is derived not from merely selecting the middle range from the plausible range, but by accounting for varying levels of certainty. For instance, the plausible range of deaths for the northeast and Gedo regions of the country (0 to 98,000) allows for the possibility that up to 100,000 died, the lack of evidence is suggestive that the true death count is at the low end of this range (here, 25,000 to 35,000). In contrast, the probable range of deaths of those beginning the period living in the Bay region (100 - 110) are believed to be at the high end of the plausible range (60 - 138) as so much survey

evidence points to high rates of deaths, even though most of these deaths were not directly seen or demonstrated.

The estimated total excess mortality of Somalis during the main famine period of 1992 is between 202,000 and 238,000, based on adding the "most probable" mortality figures for each region (the right-most column of Table 1).

This range is an interval of relative confidence; the true number of deaths may fall anywhere within this range. Any point estimate within this range is approximately as likely as any other to be the true figure. It is important to stress the high level of uncertainty that remains over the calculation of deaths and that any one point estimate can mislead the reader. However, for convenience purposes, the midpoint of the range may be cited, in this case 220,000, keeping in mind that it refers to a confidence interval.

In addition to the 202,000 to 238,000 excess deaths that occured during the 1992 famine, another 10,000 persons are estimated to have starved in early 1993, based on the famine curve trends evident in late 1992.[94] An estimated 10,000 starved as a result of displacement and food insecurity in 1991.[95] Therefore the total excess deaths attributable to starvation[96] over the wider 1992 - to - 1993 period of emergency is 212,000 - 248,000.

Other deaths related to the humanitarian emergency include persons killed directly through violence. An estimated 50,000 died in the course of the fighting that led to the ouster of Siad Barre from power 1985 to 1991.[97] During 1991 and early 1992 another 15,000 to 40,000 may have been killed in inter-clan fighting. During 1993 some have estimated that up to 10,000 were killed, largely in the conflict between international troops and Aidid's forces in Mogadishu. Overall, up to 90,000 may have died directly from fighting.

HOW MANY LIVES WERE SAVED BY THE INTERVENTIONS?

There is a tendency to estimate the impact of an intervention based merely on the magnitude of the intervention, as opposed to the quality of the intervention or the nature of the risks involved. For example, some have spoken of the numbers of lives "saved" in the Somalia relief effort, as well as other famine relief efforts, in terms of the millions of persons "reached" through assistance. Indeed, this approach helps set an upper boundary for the number of persons helped and the numbers potentially saved. In the case of Somalia, at least one million Somalis received relief in the form of foods and medicines at some point in time during the crisis. And another million agropastoralists and city-dwellers benefited from the increased access to food that occurred as a result of the expansion of food supplies in the country and the drop in food prices in late 1992.

But the numbers reached, or covered, by interventions are unlikely to closely approximate to the number of lives saved. Many of those most at risk of death die anyway, despite receiving assistance. More important, however, is the fact that the majority of the population that benefited would not have died whether they had received aid or not.[98] In general, the greater the aid coverage of a large population, the lower is the marginal effectiveness of such aid in saving lives.[99]

Few evaluations of emergency assistance venture beyond this step of identifying total numbers "reached." There are, in fact, no guidelines for how to synthesize additional information on the nature of the risks of death, the rates of death, and the efficacy or "fit" of health interventions with respect to health problems. This lack of simple formulae is due to the exceeding complexity of the issue: hundreds of thousands of people exposed simultaneously to numerous health problems.

For example, persons on the verge of death from dehydration, who are assisted with a lifesaving new water system, may nevertheless die the following week, from, for instance, a measles epidemic. In the famine-ravaged zones of Somalia, illnesses "competed" with one another to be the final, lethal blow. Of those who died few perished from only one cause. Those who died of fever, respiratory infection, diarrhea and dysentery also suffered in great proportions from undernutrition, fatigue, dehydration, and anemia.[100] The synergistic effect of these conditions greatly increased the crude mortality rate in the affected population.[101]

Therefore, in calculating the numbers of lives that were "saved" or were "savable," other questions must be answered along the way:

1. What proportion of deaths were related to specific illnesses? (this proportion is referred to by epidemiologists as the "attributable risk," or the "population attributable risk percent");

2. What is the lethal impact of the interaction (combination) of these illnesses on each victim, or on a population, accounting for group effects (such as "herd immunity")?

3. What is the predicted impact of any chosen health intervention on reducing or postponing deaths from each illness or combination of illnesses?

Much of the literature on lifesaving efforts in large populations is based on studies of long-term (non-emergency) situations. In this regard, some lessons of history are instructive, as most countries confronted high-infectious-disease regimes in past centuries, if not still today. As many Western nations moved from high mortality rates (from cholera, dysentery, tuberculosis and typhoid) to stable low-mortality patterns, they did so prior to the advent of effective curative care or the existence of immunizations. "The rapid decline of mortality from diseases spread by water and food since the late nineteenth century owed little to medical intervention. The predominant influences which led to the improvement in health in the past three centuries were nutritional, environmental, and behavioral,"[102] writes one historian. Progress was due mainly to reduced contact with micro-organisms. Water purification, efficient disposal of sewage and food hygiene reduced exposure to water and food-borne diseases. Improvements in nutrition and hygiene also made significant contributions to the overall reduction in mortality.[103] In modern times, Sri Lanka, Costa Rica and India's state of Kerala show that the conscious extension of public health care structures and public health campaigns can successfully and markedly reduce mortality in advance of other development achievements.[104]

The circumstances within the Somalia famine were not unprecedented. In Meiram, southern Sudan in 1988, similar problems occurred. As ICRC later did in Somalia, MSF-France in Sudan ceased distribution of dry rations in providing relief to internally displaced because dry food leaked out of the camps. They began, instead, to give out mass distribution of cooked food. Also similar to Somalia, deaths from diarrhea were high as the displaced depended on stagnant water pools because they could not afford to use local pumps. Hypothermia was reported and the lack of blankets was identified as a relief problem.[105]

Health experts tend to agree that in Somalia-like famines, excess mortality is controlled primarily through the control of epidemic infectious disease and malnutrition. In Somalia, malnutrition clearly underpinned most of the vulnerability to death that occurred. So many hundreds of thousands were severely malnourished in Somalia that it became meaningless to speak of "who" was malnourished as opposed to "how" malnourished.[106] That these Somalis had gone many months without adequate food

strongly suggests that they were additionally deficient in micronutrients, particularly water soluble vitamins thiamine, riboflavin, pantothenic acid, folic acid, niacin, and ascorbic acid.[107]

Thus, interventions that targetted the nutrition aspect of health risks combatted all diseases at once. The reduction of malnutrition will, by itself, lead to reductions in diarrhea and related mortality.[108] They address the underlying cause of "frailty" to other infections.[109]

But to achieve high coverage and high impact, feeding programs became very expensive. Famine relief programs with high food transport expenses have cost over $200 per year per person reached. This contrasts sharply with the expense of measles immunization which costs in the range of $1 to $10 per person reached in a war zone.

The Role of Food Aid

Food aid is the program of first and last resort because it has a high profile and its health benefits are universally accepted. Relative to other commodities, cash, or works projects, food aid is felt to be self-targeting, particularly when distributed through on-site feeding centers (kitchens). In Somalia, because malnutrition and diarrhea did create a great need for food and feeding programs, food aid was an appropriate response.

Ideally, a greater total volume of food could have been delivered to more rural distribution points and by an earlier date. More was clearly needed in early 1992 when ICRC was bearing most of the logistical burden of delivering food aid.

However, in an ideal program, the proportion of expenditure and effort on food -- relative to other health interventions -- would have been significantly less. CARE, CRS, World Vision, ICRC, WFP, and UNHCR focused largely on food distributions[110] while other programs were comparatively under-represented: water, sanitation, essential drugs, case-finding, public health worker outreach, surveillance, and other health interventions. NGO decisions as to what interventions they would undertake were based more on their organization's past activities than on any coordinated review of needs in Somalia.

Over time, NGOs took on additional tasks as institutions learned more about broader program of health care. IMC and CRS are two cases in point: by 1994 both agencies were implementing extensive primary health care training in the Bay region. By the end of 1992 large quantities of food were reaching most rural markets, increasing immediate food security, yet possibly slowing the process of reconstruction.[111]

Thus, the large-scale food/nutrition interventions mounted largely by ICRC[112] were effective in addressing these problems and in preventing deaths in mid and late 1992. The monetization program was designed to direct commodities back through the formal business sector, thereby re-empowering wholesalers. Monetization occurred well after the decline in food prices, however, and thus did not have a direct impact on food security during the crisis.

Lives Saved 1991 - August 1992

The work of NGOs in Somalia in 1991 was geographically restricted, largely to Mogadishu and the border areas. Their activities were focused primarily on medical care, which fit the early needs of casualty-related trauma. No literature was found to help in making estimates of the relationship between medical/surgical interventions and the rates of deaths averted. Thus such estimates are mostly speculative. The emergency medical and surgical efforts of relief organizations such as MSF,[113] IMC, and ICRC reached some 5,000 war victims[114] and may have affected the prognosis or survival rates of about half, or 2,500.

Many of those who received aid at therapeutic feeding centers went on to die. In effect, the food aid postponed these deaths but did not avert them. Other Somalis were supported until they could recover fully. There were still others who received food aid, immunizations, and medical care, which influenced their health status, but did not save their lives because they would not have died during this period in any case. Estimating this later proportion is a process dependent on projecting the course of the famine itself had there been no massive relief effort.

Some proportion of Somalis, who would not have otherwise done so, died because of relief activities.[115] For example, the camp settings to which many displaced persons were drawn,[116] created new, additional health risks that claimed some lives that would not have been lost. It is questionable, for example, whether there would have been a measles epidemic had populations not congregated in densely-settled camps.[117] There continues to be a debate in the epidemiology literature about the degree to which measles epidemics, such as the one in Somalia, are precipitated more by malnutrition or by the heightened exposure that occurs when populations come into contact with one another as in displaced camps.[118] Dysentery and respiratory infections were also exacerbated by the increased transmission that occurs in camp settings.

Intensive feeding around the feeding centers saved the lives of some fraction of the total population served. Of the persons who received assistance in the most dire displaced

camps, a large proportion were extremely malnourished. Based on these malnutrition rates, case-fatality may well have been as high as 50 percent. Indeed, high case-fatality rates were seen. It is necessary to base estimates of lives saved on known statistical correlations between malnutrition and mortality. Such a simplistic approach neglects, however, the tight interaction between disease and malnutrition: "The practice of quantifying the relative contribution of various diseases to mortality... presumes implicitly that malnutrition's contribution is additive.[119] Over one-third and in some cases over half of those dying in the famine zones had listed as primary cause of death "diarrhea," which leads to malabsorption of nutrients. Therefore, sometimes malnutrition cannot be fully remedied merely through more food. Feeding programs may help to interrupt a downward spiral of infection and malnutrition, but, alone, they may not suffice to reverse the spiral to recovery of those who are already ill.

Because ICRC and the NGOs were feeding in excess of 1,000,000 Somalis at one point in time, some have argued that the numbers of lives saved was of a higher order of magnitude -- possibly in the hundreds of thousands. This is plausible. However, experience in other famines suggests that it may be impossible to know: in some famines where no food aid is given, mortality, while raised, does not claim a large proportion of the population. In other famines it does. In Somalia, it is difficult to determine what would have been the nature of the food economy had no food assistance been delivered. It is possible that even greater numbers of refugees would have fled to Kenya and Ethiopia. If no food aid had been provided in refugee camps in Kenya, would those refugees have found other means to cope?

Beginning in early 1992, the operations of these organizations expanded ever further, encompassing greater geographical regions, emphasizing more on primary care and food aid. ICRC and many NGOs began operating wet feeding programs. ICRC began dry feeding distribution, bringing food by dhow to numerous coastal ports, including the central regions, and cross border from Kenya. By March 1992, the ICRC began a shift to airlifting food and in April began providing wet feeding at Red Crescent -administered kitchens. The peak of mortality for the famine hit during this expansion of relief programs.

The numbers of persons who survived this period, later returning home from the feeding centers, was of the same order of magnitude as those who died within or in the vicinity of the camps -- some 70,000 to 100,000.[120] Without question, many of these survivors would not have lived without relief assistance. Very few were saved through hospital or curative care. Few, also, were saved through immunizations or MCH programs, as they were almost non-existent during this time. Some benefited from provision of new water systems, but these were often implemented only in conjunction with feeding centers.[121] Thus, most of the lives saved during the first half of 1992 can be

credited to the benefits of the food programs (and whatever care and rehydration therapy was provided at the feeding centers).

Malnutrition and mortality have been found to be highly correlated in emergency settings, particularly among displaced populations.[122] While correlation does not prove causality, a reasonable approximation of the proportion of the 100,000 survivors from these programs who would not have survived without food aid would be half. In other words, of the 100,000 who were at risk during this period, received food aid during this period, and lived beyond this period, some 50 percent would not have lived had food aid not been received. Thus the total number of lives saved during this period was 50,000.

Lives Saved September 1992 through December 1992

The continued work of the ICRC and the NGOs from August to December 1992 arguably saved more and more lives, and this effort was enabled powerfully by the US/Canada/Germany/WFP/UNICEF/ICRC airlift that expanded in August. At the same time, more food began to come into the country through overland routes as well, as CARE, CRS and other NGOs entered the relief effort in a large way. Much of the food coming into the country began to reach the rural areas, affecting markets countrywide.

Analysis could focus on the numbers of persons who could rely on these emergency kitchens. But a more telling finding was the degree to which these food programs helped stabilize food availability and access country-wide. By November 1992 the price of food, an inverse reflection of its availability, had plummeted well beyond anyone's expectations or predictions.

By the end of October, mortality rates associated with the famine were steeply declining.[123] All told, over 1 million were reached by relief directly, and most of the rest of the population indirectly, through greatly increased food availability. As the famine declined and the scale of emergency efforts increased, the marginal benefit of interventions declined.

When the famine would have declined based on its own natural history is subject to much debate. On the one hand, the third wave of mortality hit hard in the early fall, and death rates in places like Bardera were still high in December 1992. During September and October, mortality rates appeared to climb, though not to the same levels seen in May to July, and measles was rife despite stepped-up efforts.

However, much of the apparent increase in deaths was really due to the increased visibility of famine-affected populations, as the last victims were drawn to the over 1,000 feeding centers around the country. In fact, death rates had steeply fallen in most places, including the Bay region, by December. The famine curves shown in Figures 1 and 2 suggest that the famine had followed a natural curve-shaped course, and may have been self-limiting in this manner.

Economists might argue that it was the market effect of the bringing in of food aid,[124] not predominantly the individual feeding programs, which broke the back of the famine through sheer food supply. In any case, the mortality curves were on the downswing. The famine was burning itself out, but the assistance was having its beneficial impact as well.

During this period, the international assistance effort had greatly increased. In addition to those persons directly receiving assistance, most of the total population benefited from the food market effects of the assistance. The numbers of people benefiting was higher than in previous periods, which would imply that the impact of the relief during this period was greater than during the previous period: up to 60,000 lives saved. However, the numbers of people at risk of death were likely to have been fewer than in the earlier (second wave) famine period. Except for a few abrupt spikes in death rates in September (due largely to measles) and October (accompanying the rainfall), the long-term famine curve was declining after July 1992. Evidence from key informants confirms that the peak period of deaths had already passed before the food airlift began and the fall 1992 increase in NGO activity. Many of the deaths in this period represented the inevitable "playing out" of cumulative nutritional stress and disease. By this reckoning, fewer lives were saved than during the previous period, perhaps as few as 20,000.

The probable number of lives saved during this period may be said to fall in the middle of these two estimates: 40,000.

Lives Saved December 1992 through 1993

Following the UNITAF intervention, mortality rates were no more than, and probably less than 10,000 deaths per month.[125] Deaths in Baidoa had dropped to 8 per day by December, lower by January; deaths in Bardera were reported at 20 to 25 per day in January, but this was probably not accurate.[126] Perhaps most of these deaths resulted from months of cumulative malnutrition and illness, and not new health risks.[127] Therefore, many of these deaths were very likely to have occurred with or without UNITAF's

intercession. The combined UNITAF and relief effort interventions might be said to have speeded up the conclusion of the famine curve by one full month. This follows from examination of the curve of mortality in figures 3 and 4.

Note that the steep drop in deaths from October to November to December cannot be attributed to UNITAF, nor to the relatively good Deyr (January 1992) harvest.[128] Rather it reflects the cumulative food-distribution, immunization, and rehydration efforts of all programs countrywide. UNITAF's accomplishment was to have helped numerous NGOs reach more areas more quickly with more resources. Again, from January to April 1993, this might be said to have sped up the end of the famine curve by a total of one month.[129] Therefore the lives saved was perhaps as low as 10,000.

However, UNITAF accomplished more than merely speeding up the conclusion of the famine waves that were underway at the time. UNITAF also reduced the likelihood of increased violence, warfare and secondary food insecurity. By reducing the presence and activity of "technicals"[130] the UNITAF forces induced a calm and level of safety that allowed merchants and farmers to reestablish some trade. Because new famine waves did not begin in late 1992 and early 1993, it is plausible that UNITAF prevented large numbers of starvation deaths.

During the period of the famine, however, just looking at December 1992 up through March 1993, excess deaths ranged from 10,000 to 25,000.

HOW MANY ADDITIONAL LIVES COULD HAVE BEEN SAVED?

Had relief assistance been implemented more wisely, most Somali deaths could have been averted. But, how many? The answer depends heavily on how many resources could have been available for an earlier, larger, and more difficult set of interventions. This, in turn, depends on how political will might developed earlier. This line of questions increasingly touches on politics more than on health science.

Preciously little literature reports or validates efforts to measure the extent of deaths in health emergencies in large populations But, most of the required concepts have been in place for some time. For example, epidemiological science uses the concept of "preventable fraction,"[131] meaning the proportion of health events known to be preventable. This ratio tends to be used in reference to a single procedure or preventive program. There are no intermediary terms that denote the proportion of deaths that would be averted in emergency circumstances where coverage is partial.

Under theoretically ideal conditions, virtually all of the excess mortality in Somalia could have been mitigated.[132] With sufficient food aid, vaccinations, and other primary care, little excess mortality should occur, even in emergencies. Based on past experience with displaced populations, one could predict malnutrition and infectious diseases would lead to high case-fatality rates in Somalia. In large-scale emergencies, diseases like malaria, shigellosis, and pneumonia frequently are associated with high, 20 percent fatality rates if untreated.[133]

The cost of creating ideal conditions inside Somalia, however, may have exceeded resources available from the international community. Compared to after-the-fact curative or therapeutic interventions (wet feeding centers, chemotherapy, medical care), preventive measures prove more cost-efficient and more effective as a strategy for protecting a large population.[134]

There was little likelihood that the medical infrastructure could have been put into place under realistic conditions to fully treat the health problems of rural Somalis during the famine. But public health and primary care measures -- food, water supply, immunizations, wise camp siting, vitamin A capsule distributions, recruitment of sanitation workers -- could have saved most of the lives lost.

The question therefore depends on the level of effort available over and above normal relief interventions. In fact, the resources, political will and effort were not

available when needed. Relief aid in the form of timely immunizations, food safety nets, surveillance, could, in theory, have reduced or prevented:

- 95 percent of the severe malnutrition -- and therefore almost all starvation deaths,[135]
- at least three-quarters of measles deaths,[136]
- and 40 percent of other infection-related or rehydration-related, non-starvation, excess deaths.[137]

Thus, approximately 70 percent of famine-related deaths could have been averted during 1992. 154,000 lives were lost that, from a public health viewpoint, could have been saved.

Food and public health interventions should have been implemented at earlier stages of the crisis. Surveillance systems needed to be reporting from sentinel sites and monitoring malnutrition in the general population (not just camps) by August 1991.[138]

Automatic immunizations campaigns should have reached all large displaced populations receiving assistance beginning in 1991. The provision of dry food aid in a diffuse manner throughout the countryside would have mitigated the need for comparatively more expensive on-site (wet) feeding programs.

In all, the necessary assistance programs could have been implemented for infinitely less than the $2 billion that was eventually spent on the international interventions.

Roughly twice the level of effort, as was provided, would have been necessary for primary care and public health work in the displaced camps and cities. Ten times the level of effort that occurred would have been minimally appropriate for rural areas in the Juba, Shabelle and Bay regions.[139] Had these programs been instituted in early instead of late 1992, it would have required additional financial resources (between $50 and $100 million), over and above the expenditures implementing relief agencies did inevitably incur, and some novel means of providing physical security for these resources and the implementing staff. The result, however, would have been approximately twice the payoff from the investment that did occur, and the airlift and military intervention might have been avoided, saving billions of dollars.

To sum up:

- The estimated population of Somalia during 1991-1993 was 5.1 million;
- Of this total population, some four million Somalis lived in famine-afflicted regions in southern Somalia, where they faced extreme food insecurity and heightened risk infectious disease;
- Of these four million, some 330,000 Somalis were at imminent risk of death during 1992 and 1993;[140]
- Of those at imminent risk, 110,000 lives were sustained (deaths averted), due to health, food, and other interventions that reached over 1 million Somalis; and,
- Of the 202,000 to 238,000 famine-related deaths that did occur in 1992, at *least* 70 percent (154,000) could have been prevented, had proven primary health strategies been implemented earlier and more widely.

Preventable diseases caused most of the deaths that occurred during the 1991-1993 crisis. One of the most disturbing findings of this study, therefore, is that simple health care interventions could have saved most of the lives lost during the crisis.

ENDNOTES

1 For example, see Dennis Gallagher, Susan Forbes Martin 1992 *The Many Faces of the Somali Crisis: Humanitarian Issues in Somalia, Kenya and Ethiopia* Washington, DC: RPG.

2 Throughout the emergency, surveys were conducted and reported by Save the Children, the U.N., MSF, CARE, UNICEF, USAID and CDC.

3 Immunization levels in Somalia were already among the lowest in Africa, certainly no higher than 20% of under-fives.

4 Rural agropastoralists suffered from the looting of assets, particularly livestock and cereal stores.

5 Food sharing is common within not only extended families but within the clan itself.

6 Even in normal times, Metz reasons that "In the potential urban labor force of 300,000 - 360,000 there were only 90,000 wage earners, which suggested ...employment was only ...part of a family survival strategy." pg. 146 1992 *Somalia Country Study* Washington DC: Library of Congress.

7 Many Somalis work in the Gulf, the U.S. and Canada.

8 Evidence comes from interviews with Somali health workers and from the studies of family histories conducted in the Bay and Bakool regions.

9 Particularly among agropastoralists, coping strategies require that the family split - some to seek relief in refugee camps while others guard herds or the homestead.

10 According to AMREF, the regional capital city of Luuq depopulated to just 600 people. See 1994 *Updates from Luuq* Nairobi: AMREF International.

11 The number or rate of deaths in a time period that exceeds the baseline crude death rate for that population in a "normal" year.

12 Morbidity Mortality Weekly Report 1992 *Famine-Affected, Refugee and Displaced Populations: Recommendations for Public Health Issues* Atlanta: CDC.

13 This finding was reported many times by many agencies. See for example Center for Public Health Surveillance January 1993 *Results of Morbidity, Mortality, Nutritional, and Vaccine Assessment Cluster Survey of North-Mogadishu, Somalia.*

14 Synergism refers to interaction between risks when the combined impact of risks is greater than adding the separate impacts: the whole is greater than the sum of the parts. Extreme synergism occurs between diarrhea and malnutrition; see R Guerrant et al. 1992 "Diarrhea As a Cause and an Effect of Malnutrition: Diarrhea Prevents Catch-up Growth and Malnutrition Increases Diarrhea Frequency and Duration" *Am J Trop Med Hyg* 47(1) Supplement pp 28-35.

15 With the exception of heightened severe undernutrition and Shigella, it is not possible to say, based on the data, that the *comparative pattern* of diseases during the famine differed from the pattern of diseases that predominate in most underdeveloped countries as discussed in J Walsh 1992 'The Burden of Illness" *Tropical and Geographical Medicine* K Warren, A Mahmoud eds. NY: McGraw Hill.

16 Over one-third of suspected hepatitis cases examined among patients in Mogadishu, Afgoi, Bardera, Baidoa and Merca tested positive for hepatitis E IgM antibody.

17 See UNICEF 1988 *Somalia Situation Analysis* Mogadishu: UNICEF.

18 See John Rogge 1992 *The Displaced Population in South and Central Somalia and Preliminary Proposals for their Reintegration and Rehabilitation* Manitoba: Disaster Research Unit.

19 Selected endemic infectious diseases of Somalia which may be rapidly fatal: malaria (including chloroquine resistant strains), plague, typhus (epidemic louse-borne, African tick borne, murine), meningococcal disease (meningitis), congo-crimean hemorrhagic fever, relapsing fever, rabies, enteric fever, viral hepatitis, arboviral illness (dengue, rift valley fever, sandfly fever), brucellosis, Q fever, leishmaniasis, leptospirosis, and cholera. See 1993 "Extraordinary Epidemiologic, Environmental Health Experience Emerges from Operation Restore Hope" *JAMA* 269(22):2833-34.

20 Evidence of geographical concentration of Dengue comes largely from the experience of expatriates. Half of US military cases of Dengue were among the few troops in Bardera. Three of the five IRC staff in Bardera were infected as well

21 A child is judged to be severely acute malnourished if his/her weight is less than 70% of the weight for height average for a "well-nourished" population. This is a measure of the population severity of short-term nutritional stress.

22 D Pelletier, E Frongillo, D Shoreder, and J Habicht 1994 *A Methodology for Estimating the Contribution of Malnutrition To Child Mortality in Developing Countries* Report to UNICEF.

23 M Toole 1992 "Protecting Refugees' Nutrition with Food Aid" Presentation to the ACC/SCN.

24 See J Palmer 1993 "The Hidden Crisis in Somalia" *Monday Developments* Feb 1.

25 Several reports during the 1980s and early 1990s noted the very high prevalence of micronutrient deficiencies among displaced persons in camps housing Ogadenis, Ethiopians and Somalis. It appears that most of the population in these camps, and possibly local Somalis, as well, had very low hemoglobin levels; see R Yip, S Gove, B Farah, HM Mursal 1990 "Rapid Assessment of Hematological Status of Refugees in Somalia: The Potential Value of Hemoglobin Distribution Curves in Assessing Iron Nutrition Status" *Colloque INSERM* 197: 193-196.

26 The high prevalence of malaria, schistosomiasis, and hookworm infections, in turn, led to malabsorption and increased nutrient requirements, thus to higher rates of nutrient deficiencies. See D Calloway 1982 "Nutritional Requirements in Parasitic Diseases" *Reviews of Infectious Diseases* pp 891-895.

27 See for example J Kelsey 1986 *Methods in Observational Epidemiology* Oxford U Press.

28 This has been elaborated in the case of Sudan by Alex de Waal 1989 *Famine that Kills* Oxford: Clarendon.

29 In addition to introducing infectious diseases, the higher population densities increase the microbial densities to which people are exposed, increasing everyone's risk of illness.

30 Much of the killing in late 1991 was a form of ethnic cleansing, aimed at the Rahanweyn who were believed to be tacitly allied with the Hawiye clan.

31 Based on key informants, graveyard statistics and retrospective mortality surveys.

32 Famine victims from western Bay fled to Bardera; those from Bakool fled to Hiraan.

33 A survey among the internally displaced in Merca and Quorioley by Epicentre found that of persons in households surveyed for the May 1991 to April 1192, over half had died in the immediately preceding three months. See S Manoncourt, B Doppler, F Enten, A Nur, A O Mohamed, P Vial and A Moren 1992 "Public Health Consequences of the Civil War in Somalia, April , 1992" *The Lancet* 340, July 18.

34 The authors of this report conducted household surveys to asses past mortality through interviews with families in the Bay and Bakool regions. Questions tracked all cohabitating family members forward in time beginning from January 1990.

35 Infants usually account for a high proportion of excess deaths. See for instance R Yip, T Sharp 1993 "Acute Malnutrition and High Childhood Mortality Related to Diarrhea: Lessons from the 1991 Kurdish Refugee Crisis" *JAMA* 270(5):587-590.

36 J Drysdale 1994 *Whatever Happened to Somalia* London: Haan Associates.

37 The surveys conducted by the study team found that at least half of famine deaths reported by persons in the Bay region happened in rural villages.

38 Estimated overall to have exceeded 80,000.

39 In addition to measles immunization, UNICEF and NGOs distributed vitamin A capsules, known to significantly protect children from mortality due to measles. See P Nieburg, R Waldman, R Leavell, A Sommer, EM DeMaeyer 1988 "Vitamin A Supplementation for Refugees And Famine Victims" *Bulletin of the World Health Organization* 66(6): 689-697.

40 Apparent improvements in nutrition status should be examined with caution. First, nutritional status of the living will seem improved if the a preponderance of the worst off all die off. Second, nutritional status of whole populations fluctuate naturally, often seasonally. Even without intervention, many of those most malnourished ("outliers") will improve over time, a statistical tendency described in some situations as "regression to the mean." In any case, changes in nutritional status can not all be attributed to the benefits of assistance.

41 Frequently, net death estimates are cobbled together using a panoply of heresay estimates, which are fraught with reporting bias, and observational and rounding errors (e.g., M Burr 1993 *Quantifying Genocide in Southern Sudan 1983-1993* Washington, DC: US Committee for Refugees.

42 See for example B Gessner 1994 "Mortality Rates, Causes of Death, and Health Status Among Displaced and Resident Populations of Kabul, Afghanistan" *JAMA* 272(5):382-385.

43 See L Boss, M Toole, R Yip 1994 "Assessments of Mortality, Morbidity, and Nutritional Status in Somalia During the 1991-1992 Famine" *JAMA* 272(5): 371-376

44 Some believe the population to be nine million, some closer to three million. Most published estimates range from 4 million to 7 million.

45 WFP 1993 *Demography and Distress Survey of Somalia* Nairobi: WFP.

46 Total numbers appear to be inflated, as various subnational groups jockeyed for apparent predominance. Much of the discrepancy relates to the "missing nomad" issue.

47 U.N. officials working in nearby Uganda remarked that a local refugee population of 10,000 Somalis is as "noticeable," vocal and active as 50,000 refugees from another country such as Ethiopia.

48 Agreed to at the Somalia donor coordinating council meeting in May, 1994, Nairobi, Kenya.

49 Pastoralists tended to move far and fast. Most of the refugees in Dadob, Ifo, Mandera and Ethiopia were pastoralists.

50 This estimate is fed back from the conclusions of this paper.

51 This figure looms large in analyses of the overall crisis, such as S Makinda 1993 *Seeking Peace From Chaos: Humanitarian Intervention in Somalia* Boulder: Lynn Reinner Pub. Ocassional Paper Series of the Intl. Peace Academy pg 43.

52 1992 OFDA Situation Reports cite estimates of populations displaced to cities are 400,000 in Mogadishu, 60,000 in Kismayu, 50,000 in Baidoa, and 60,000 in Kismayo. In each case this doubled the population size of the city, replacing the fleeing portions of the pre-war city populations.

53 Based on UNICEF 1989 Somalia Situation Report and on rates in comparable populations in neighboring countries.

54 A monthly CMR of 1.6 per 1,000 population (with is more than that in nearby Kenya, but greater than the CMR in nearby Ethiopia) translates to 24 annual deaths per 1,000. For a population of 5.1 million this suggests a total annual mortality of 97,000.

55 Perhaps done by an ICRC worker in response to a query from a journalist, or by a UN staffer in preparing the DHA consolidated appeal.

56 In 1994 *Somalia: The Missed Opportunities* Washington, DC: U.S. Institute of Peace Press.

57 Sahnoun relies on the 1992 UN document, *The Situation in Somalia, Report of the Secretary General,* S/24480.

58 *Levels* of mortality, but not exact rates, are correlated with malnutrition and therefore predictable from malnutrition data. See M Toole 1993 "Protecting Refugees' Nutrition With Food Aid" in ACC/SCN (U.N., Geneva) *Nutritional Issues in Food Aid.*

59 Verbal autopsies have been largely a means to identify *cause* of death in recent studies, not death *rates.* (see RH Gray 1990 *The Use of Verbal Autopsy Method to Determine Selected Causes of Death in Children* Baltimore, MD: Johns Hopkins, School of Hygiene and Public Health, Ocassional Paper #10; 1990 S Pacque-Margolis et al. 1990 "Application of Verbal Autopsy During a Clinical Trial" *Social Science and Medicine* 31:585-591). The accuracy and reliability of this method for comparing mortality across time blocks remains largely unexplored.

60 Summarized in Patrick Moore et al. 1993 "Mortality Rates in Displaced and Resident Populations of Central Somalia During 1992 Famine" *Lancet* 341(April 10): 935-938.

61 Two basic forms of survey methods were utilized in the mortality assessments conducted in Somalia between 1991 and early 1993: the two stage random cluster method, and the sentinel site method. Two stage random cluster method involved mapping and dividing the survey area into zones and defining the number of clusters to be sampled from each zone dependent upon the relative population density of each zone (stage one), and the process of selecting households within each cluster (stage two). The cluster sampling requires information on the population

density and relative differences in the population density over the area to be surveyed. During emergency situations, with highly fluctuating population movements into and out of the area of interest, ensuring an appropriate sampling protocol becomes problematic. In the second stage, the first household within each cluster is selected randomly and a systematic process is used to select the additional households within each cluster area. Most studies selected 30 clusters of 7 or more households in each cluster. During emergency situations, however, especially those involving the safety of public health workers, a systematic and random sampling of households may become unrealistic.

The other method used was the sentinel community surveillance method. This method involved taking large samples in each sampling area. Unfortunately, little documentation exists on the method used, thus it is not clear how clusters are defined or how households are selected.

62 For instance, the Afgoi survey suggested that, among the displaced, 23/10,000/day had died in the month preceding the survey, while 9.4/10,000/day died in the earlier seven months.

63 Given the a priori assumption that death rates did vary by region, as testified by virtually all key informants.

64 In effect a Glassian meta-analysis was conducted assessing effect sizes rather than significance levels.

65 Effect size, here meaning the amount of increase in mortality over the baseline rates, is a term epidemiologists use, and not to be confused with the closeness of correlation of variables, or the "significance" of an observed relationship.

66 The "construct validity" of the various studies makes it difficult to merge or compare results. In different situations, respondents may consider "family" members to include different people. In some instances, respondents may consider missing (displaced) persons to have died. It is also debatable whether different interviewers framed the calendar periods differently for the respondents. It is clear that the clumping of reported deaths toward the more recent time periods (those that occurred closest to the time of the interview) throws the results of many of the surveys into question.

67 This is known as "selection bias" error due to systematic differences between subjects included in a study and those who are not included. Another form of selection bias is often occurs in research when those who are living are compared to those who have died.

68 The majority of surveys did not state whether they asked about live births and deaths during the recall period, and in the event that a livebirth, which resulted in death, was identified during the interview, it is not clear how this information was handled in the data collection process. Most studies fail to mention how analysis accounts for individuals who left the household during the recall period. Also, studies differ in how they define the household or family unit differently. These issues occur regularly in epidemiological studies and have much in common with general non-response bias. Statistical methods exist for imputing to fill these gaps, but these methods are weak where the bias is systematic in one direction, but but the direction is unknown. See J Lessler, W Kalsbeek 1992 *Nonsampling Errors in Surveys* New York: John Wiley & Sons.

Not all studies reported on the cause of death, but those that did used a verbal autopsy method where interviewees were questioned about the probable causes of deaths, and about the specific symptoms prior to a death. The method in which the verbal autopsy was conducted was either not mentioned or was a structured approach where respondents were asked about trauma, measles, diarrhea, respiratory disease and malaria in this order.

69 Surveys used varying lengths of follow-up and reported results in a number of different ways, such as mortality rate per 1,000 per year, deaths per 10,000 per day, or percent deceased. In order to compare the results, data were reviewed and whenever possible converted into deaths per 10,000 per day. For example, mortality rates presented per 1,000 per year were converted to rates per 10,000 per day by multiplying the rate by a factor of 10 and by dividing this number by the length of follow-up in days. For example, a crude mortality rate of 116 per 1,000 per year becomes 3.2 deaths per 10,000 per day (1160 per 10,000 per year/365 days). Similarly, data presented as percent deceased was converted by multiplying by a factor of 100 and dividing by the length of follow-up in days. For example, 13% deceased over a 304 day period becomes 4.3 deaths per 10,000 per day (1300 deaths per 10,000/304 days).

70 J Hunter, F Schmidt 1990 *Methods of Meta-Analysis: Correcting Error and Bias in Research Findings* Newbury Park: Sage Publications.

71 From UNICEF, MSF and Save the Children surveys.

72 J Exner, G Buckwalter 1993 *Southwest Bay Region Baseline Health Assessment Survey* Nairobi: CARE.

73 World Vision 1993 *Bur Hakaba District Bay Region Somalia: Baseline Health and Nutrition Survey* Nairobi: World Vision.

74 When death rates are so high, the biases introduced become enormous. Many social and illness-related factors contribute to high selection bias, for instance. Tens of thousands of displaced persons flowing from the Bay and Bakool regions came to Baidoa for food from March 1992 onward; some continued on, traveling to other towns, or to the region or to Kenya. Those who remained behind at the time of the retrospective survey and continued to live in the displaced camps may have been more likely to (a) have been too weak to proceed on to other destinations, (b) too weak to return home, (c) have lost family members in the camps themselves and have fewer kin elsewhere whom they could return to, (d) to be incapacitated by grief. In addition, because death rates were so high, the proportion of whole families that died is likely to have been very high; thus the error introduced by this survivorship bias is higher than in other instances. In the end, the results provide a floor for knowing the minimum number of people dying in Baidoa itself. Other evidence is needed to estimate the mortality rates of the larger (sending) population of the predominantly rural region. Such evidence came later from NGO surveys.

75 In other words, death rates per 10,000 were higher among the displaced. However, given that most Somalis were not displaced, they accounted for at least half of all deaths.

76 RPG rural surveys in Baidoa

77 In other words, the ratio of famine adult deaths to baseline adult deaths was higher than the ratio of famine child deaths to baseline child deaths. This was the major observation of ICRC headquarters staff, of Irish Goal, of Concern, and other persons conducting site visits.

78 Documented by Irish Concern, the Red Cross, IMC, Trocaire, and Save the Children, U.K. Death count data from the Somali Red Crescent Society appeared in CDC 1992 *Morbidity and Mortality Weekly Report* 41(49):913-916.

79 Documented by AICF, ICRC, corroborated by CARE and IRC.

80 Best estimates for Mogadishu came from Save the Children, UK.

81 Reference to MSF/Spain, UNICEF.

82 Witnessed by World Concern.

83 B Doppler, F Enten, S Manoncourt 1992 *Demography, Nutrition, Mortality, Water and Sanitation Assessment of Merca- Quoioley Areas* Paris: Medecins Sans Frontieres.

84 Team leaders from Save the Children U.S. and MSF provided these figures.

85 The sum of 200,000 (Bay) plus 50,000 each for Lower Juba, Lower Shabelle, Bakool, Middle Juba, Mogadishu, Middle Shabelle, Hirran, Gedo, Central and Northern Regions, and Mogadishu and its environs.

86 The median estimate is derived from the list of collected single-estimate crude mortality rates. 7 per 10,000 was reported, for instance, by Epicentre as the Merca/Quorioley CMR in November of 1992 based on MSF data: *Health and Mortality Assessment in Merca-Quorioley Areas, Somalia 11/92- 12/1992.*

87 Based on extrapolations from the 1975 government census and adjusted according to the advice of UN and NGO officials in each region. For example, the Bay region population is estimated by some at 500,000 and by others at 1 million. Those working in a range of rural disticts -- i.e. IMC, CRS -- believe that the lower-end is the more realistic estimate.

88 Though not using tests of significance in arriving at these estimates, "plausible" includes a wide enough range that there is approximately 95% confidence that the true proportion falls within this range.

89 Based on sample surveys, it is the total effect size (proportions dying) that is of interest, not the statistical tests of variation. It is expected a priori that mortality experience should vary enormously between districts, regions, clans, and urban/rural areas.

90 Granted, evidence from individuals and from reports were not systematic, referring to various points in time, basing on different sets of observations of varying quality and representativeness. Generally speaking, it was rare that informants or surveyors gained a good picture of rural health conditions -- except in the Bay and lower Juba regions.

91 Though retrospectively assessed crude mortality rates among displaced families were elevated several-fold, indicating some excess mortality -- see Serge Manoncourt, Jean-Harve Bradol, Elizabeth Lary *Health, Nutrition and Health Information System: Assessment of Bari and Mudug Regions: NorthEast Somalia* Paris: Epicentre; also, L Colijn "Survey of Water Points in Hiran and Galgadud Provinces" Nairobi: ICRC.

92 Oftentimes unsystematically.

93 The probable range has a confidence equivalent of approximately 80%.

94 In fact, death rate data in early 1993 indicates that mortality was still on the order of 100 to 200 per day during the month of January, 1993. However, this data became more suspect as the "counting" game became more evident to local counterparts who saw that when deaths decreased, their jobs and income would be soon phased out.

95 In addition to another 10,000 to 30,000 killed in fighting during that period.

96 i.e. baseline deaths are treated as non-starvation. In other words starvation-related is another manner of referring to excess deaths.

97 See Helen Metz 1992 *Somalia a Country Study* Washington DC: Library of Congress.

98 Quite commonly, food aid will reach over 60% of the population in an affected, targeted region. Yet only in the most extreme circumstances will more than 10% of a local population die in a period of extreme food insecurity.

99 One recent effort at modelling mortality in high-morbidity situations such as Somalia notes, "*The results from the model clearly show that fairly large increases in intervention coverage do not necessarily lead to large decreases in mortality. For example, in West Africa and South Asia where Oral Rehydration Therapy coverage levels are initially quite low, increasing them to 60% has very little effect even on diarrheal mortality. ...This speaks for the need to implement a complementary set of preventive and therapeutic interventions.*" S Becker, R Black 1994 *A Model of Child Morbidity, Mortality and Health Interventions* (unpublished manuscript) Hopkins School of Hygiene and Public Health.

100 Each form of illness can be thought of as an "effect modifier" when looking at the incidence, prevalence, duration and case-fatality of each other form of illness. In most instances, illness increase the likelihood of incurring and manifesting another disease. In some, one illness may actually reduce the likelihood of another developing. Severe anemia, for example, is believed to reduce the incidence of malaria infection.

101 Competing risk analyses of high-illness circumstances such as famines are few. The study team was unable to take advantage of previously developed and validated methods for adjusting for the interaction among diseases in calculating their course and case fatality. One effort is W Mosley 1984 "An Analytical Framework for the Study of Child Survival in Developing Countries" in *Child Survival: Strategies for Research* W Moselly and L Chen (Eds.) ia special issue of *Population and Development Review* Vol. 10 (Supplement).

102 T McKeown 1979 *The Role of Medicine* NJ: Princeton Univ. Press pgs. 9 & 49.

103 The overall reduction in deaths in many countries today is also clearly attributable to improvements in sanitation, hygiene, and nutrition.

104 J Caldwell 1986 "Routes to Low Morality in Poor Countries" *Population and Development Review* 12(2): 171-220.

105 D Keen 1994 *The Benefits of Famine: A Political Economy of Famine and Relief in SouthWestern Sudan, 1983-1989* Princeton University Press Princeton, New Jersey pg 134.

106 It is a statistical effect that the levels of severe malnutrition can rise to only a certain level among those who are surveyed. Because the death rate increases exponentially with severe malnutrition, people die off. Thus, only the *more* well nourished survive to be included in surveys.

107 A Tomkins 1991 "Nutritional Deficiencies During Famine" *Tropical Doctor* 21 (Supplement 1), 43-46.

108 See B Burkhalter, E Abel, M Parlato 1994 "The Structure and Models Used in Profiles 2.0 With Application to Bangladesh" Washington, D.C.: Academy for Educational Development.

109 Vertical health interventions that respond to one cause of death may leave individuals highly vulnerable to other causes of death. The concept of "frailty" is an important component of the current competing risks literature. See WH Mosley, S Becker 1991 "Demographic Models for Child Survival and Implications for Health Intervention Programs" *Health Policy and Planning* 6(3):218-233.

110 These agencies focused on what they knew best, and what they felt could be accomplished given physical insecurity (robbery and violence).

111 Food aid can be harmful in terms of creating dependence, favoring food trade networks that encourage more imports to urban areas as opposed to encouraging rural-urban linkages and thereby discouraging domestic food production by lowering prices below production costs. There is no evidence that the depressed food prices in fact discouraged agricultural production. But analysts Alex de Waal and Michael Marin separately claim that too much food was delivered to Somalia and that unseen discincentive effects did occur. Indeed, the market was saturated in the sense that the January 1993 price of staple grains (e.g. maize) was lower in Mogadishu than anywhere in the world. Food sales in Kenya are based on interviews with market researchers and food aid officers.

112 With the support of Lutheran World Federation, USAID, the European Community Humanitarian Office.

113 See for example F Vautier 1993 *Kismayo-Somalia Medical Report* Nairobi: Medicins Sans Frontieres (Belgium), noting that in late 1992 and early 1993 approximately 200 to 400 casualty cases per month were seen requiring some 50 surgical interventions.

114 Based on extrapolation from project documents.

115 Iatrogenic (medical problems related to intervention) consequences of relief have been documented in many circumstances. Some conditions are created or exacerbated by the form of assistance (drugs that precipitate nutrional deficiencies) while others occur because of indirect consequences of relief (such as overcrowding in relief camps).

116 Though NGOs and the UN did not create relief camps, the nature of relief delivery, particularly ICRC's during the phase of on-site feeding programs, necessarily pulls people to extended delivery points. The relief community sought ways to decentralize these delivery points as much as possible. Nevertheless, when feeding an entire population, a finite number of delivery points are inevitable.

117 It is a familiar phenomena that measles becomes a post-disaster risk simply because people become displaced in a manner which raises their contacts with other people.

118 Peter Aaby argues that intercountry comparisons of measles infection do not justify an emphasis on malnutrition as a predisposing factor. Instead, he argues, it is the level of exposure, and the extent of past exposure that affect the severity of infection and mortality: see 1992 *Health Transition Review* Vol. 2 (Supplementary Issue) pp 155 - 184. By his argument, immunization is far more effective at preventing deaths due to measles than general feeding. Others argue that, indeed, measles deaths among the malnourished are prevented by immunization, but most who may have died may yet die of other causes: see Kasongo Project Team 1981 "Influences of Measles Vaccination on Survival Pattern of 7 - 35 Month Old Children in Kasongo, Zaire" *Lancet* 1:764-7. Final death is attributable to measles risk, malnutrition, overcrowding, diarrhea, etc: see P Nieburg, M Dibley 1986 "Risk Factors for Fatal Measles Infections" *International Journal of Epidemiology* 15(3): 309-311.

119 D Pelletier, E Frongillo, J Habicht 1993 "Epidemiologic Evidence for a Potentiating Effect of Malnutrition on Child Mortality" *American Journal of Public Health* 83(8):1130-1133.

120 In some camps (Baidoa, Bardera) more than half of all who came may have died; in others (camps in Kenya, those around Mogadishu, those around Belet Huen), mostly clearly did not die.

In Bardera for example, ICRC gravedigger data indicate that as many people died during the Fall of 1992 as were alive in the displaced camp at any one time. Thus, approximately half those coming to those camps died during that period. In Kenya, excess mortality in the camps, as reported by MSF and AICF to UNHCR, was much lower.

121 In later 1992 rehabilitation of water systems for large populations expanded.

122 Based on malnutrition/mortality correlations across many countries, See B Person-Karrel 1992, M Toole 1993 (opp citation).

123 Some debate when the famine was "burning" itself out. Some (UNICEF) retrospective mortality surveys suggest that mortality rates were not significantly different in late 1992 compared to mid-1992. However, these surveys were conducted among self-selected camp populations, many of whom had arrived in the feeding camps recent to the surveys, while others had left or died prior to the survey, and were not counted. Rural surveys, more representative of the broad at-risk population, indicate that mortality was steeply declining by November 1992.

124 See S Hansch 1993 *Monetizing Food Aid, 1993* Washington, DC: Food Aid Management.

125 Adding up the graveyard counts at sentinel sites, the numbers dying in January in each of ten major relief centers was between 150 to 600. The numbers dying in rural villages of course remains the big mystery; assuming it was as large as the numbers dying in cities and camps implies a total of at least 6,000 per month.

126 CARE field staff report that in Bardera the gravediggers were aware of the link between mortality and their continued employment and were likely to over-report during this late period. Most other field observers agree that both mortality and severe malnutrition were much lower in key project sites by February 1993. Pockets of food insecurity and malnutrition were believed at that time to be between Jilib and Bardera where convoys were still unable to travel.

127 Though there was an upsurge in malaria in January 1993.

128 As argued by Alex de Waal. The winter harvest contributed not only to bringing more food on to local markets, but also in helping to pull people back to their places of origin. Even though the Deyr harvest is the smaller of the two annual harvests, the difference in supplies was sufficient to renormalize markets and reduce the desperation killings that kept farmers, traders and consumers alike out of normal trade routes.

129 The successful Deyr harvest of the winter of 1992/1993 can in part be credited to the relief effort. World Vision, CARE, CRS and others distributed seeds and tools during the Fall of 1992. ICRC in particular focused on this Deyr harvest beginning in April 1992, through extension work, provision of maize, sorghum, vegetable, and cowpea seeds: see E Koenig 1992 *Agricultural Assistance Somalia* Nairobi: ICRC.

130 Vehicles with mounted guns that were instrumental in much of the looting during 1992.

131 Technically defined, with reference to a population *without* an intervention, as the hypothetical mortality spared (following the appropriate intervention) divided by the observed mortality.

132 Without the development of any novel cures or implementation schemes., but using ORS, food aid, proper case-management.

133 P Bres 1986 *Public Health Action in Emergencies Caused by Epidemics: A Practical Guide* Geneva: World Health Organization.

134 See G Rose 1993 *The Strategy of Preventive Medicine* Oxford Medical Publications.

135 Timely food aid has been successful in preventing almost all starvation deaths if the effort is really massive and well timed, as occurred in the 1992 southern African drought relief. Here "starvation" deaths -- uncomplicated by infection or war -- are treated as only one third of all deaths. The premise in the 95% calculation is that "timely" food aid would have prevented the occurrence of malnutrition, not merely treated it. Treatment of severe malnutrition would have a much lower rate of death prevention; instead of 95% well-targeted but late food aid might spare only half of otherwise-occurring deaths.

136 As in other famines, severe malnutrition can be prevented through adequate provision of food. Even when given, measles vaccines do not all "take," some are spoiled, some of those receiving injections are too malnourished to mount an effective antibody response. But some 90% will be effectively immunized. It is rare and unrealistic that an immunization program can reach more than 80% of a population in a short period of time. Thus, even ideally, 70% of the population would be effectively immunized.

However, trying to address a predominantly rural population in a conflict situation, vaccination coverage probably could not have reached more than 50% of the population without incurring unheard of costs. Assuming that 50% were reached, at 90% efficacy, then some 45% of persons would be immunized effectively against measles, directly reducing infection and deaths. With this much protection, it is likely that transmission would have been reduced. Thus it is possible that the entire epidemic would be avoided. Thus, even at a lower rate of immunization, over two-thirds of measles incidence might have been spared.

137 The protective value of food and primary care lessens when targeting those who are not dying from severe malnutrition. At the one extreme, oral rehydration therapy has a high protective value for the severely dehydrated. At the other extreme, primary care has little to offer a victim of dengue fever, a landmine, or ambush.

138 Knowing the diseases that disable and afflict is one thing. Knowing which diseases were associated with Somali deaths is an extra piece of information that was not tracked in real time, but should have been. See N Hirschhorn, M Grabowsky, R Houston, R Steinglass 1989 "Are We Ignoring Different Levels of Mortality in the Primary Health Care Debate?" *Health Policy and Planning* 4(4):343-353.

139 In addition to *earlier*, more *targeted*, and more expansive relief interventions, relief should have been tailored to address more root causes of the health crisis. Some examples are: reconnaissance to rural villages and targeting resources only to villages not to cities, avoiding camp situations; transport of already-displaced to their final destinations, sparing them 500 mile walks in weakened physically vulnerable conditions; protection and relocation of pastoralists who lost their herds (these had the highest mortality rates); negotiation of corridors of tranquillity for small farmers to bring food to market, crop insurance programs (insured against theft); and, local purchase of food inside Somalia, working through local merchants and wholesalers for local purchase, import, and transport.

140 Here, "imminent risk of death" is defined operationally: the total number of Somalis who either did die or *would have* died, had there been no relief.