Famines

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Introduction

The recurrent specter of famine provides one of the most dramatic examples of contradiction in our modern, technologically advanced world; however, it is far from being a contemporary phenomenon. Historically, famine dates back to Biblical times, with the earliest record of famine—found at the First Cataract of the Nile—more than 5,000 years old (1). References in the Old Testament to 7 years of famine (Genesis 47:13-26) probably date back to around 1,700 B.C. (1). Most recently, a severe famine ravaged many parts of sub-Saharan Africa in 1984-1985, which may have killed more than a million people. In addition to high mortality, the consequences of famine can be far-reaching, creating mass migration of the affected populations. More than a million Irish escaped the potato famine of 1846-1850 and emigrated to America. Members of other populations have crossed into neighboring countries in large numbers, such as when the Kampucheans moved into Thailand in 1979, and the Ethiopians fled into Somalia in 1979-1980 and Sudan in 1984-1985.

Some of the most serious famines of the 20th century have occurred in Europe (e.g., the Ukraine in 1921 and Holland in 1944-1945), however, since the end of World War II, famine has exclusively been a problem in certain areas of the developing world. Hardest hit regions have included the Sahel and the Horn of Africa, and southern and eastern Asia. Economic development, improved agricultural techniques (e.g., the green revolution), improved information dissemination, government systems of food procurement and distribution, and more equitable social systems have all but eliminated famine in developed and many developing countries. Table 1 lists some of the most severe famines of this century.

Definition and Causes of Famine

Famine is defined as a condition of populations in which a substantial increase in deaths is associated with inadequate food consumption (2). The key word in this definition is consumption, since—contrary to popular belief—famines are not always due to problems of food availability. While natural catastrophes often act as a trigger, the underlying conditions within a population which allow famine to develop are generally human generated. Lack of food for consumption may be due to one or both of the following events:

1. Failure to produce food, because of adverse climatic or other environmental conditions. Contributing events may be slow in onset, such as drought or locust infestation, or acute, such as severe flooding, which has often been a precipitating factor in Bangladesh.

2. Failure to distribute food and/or collapse in the marketing system affecting part or all of a population due to political, environmental, or economic crises.

Famine is usually the escalation of an already-existing situation of high undernutrition prevalence in which many individuals within a population experience starvation during so-called "normal" times. Such situations are characterized by endemic poverty, landlessness, intractable debt, and underemployment. The mechanism by which labor, services, or goods are exchanged in normal times for food has been termed "entitlement" by Sen (3); when this process fails the onset of starvation can be rapid. Frequent crop failures in Ethiopia, Somalia, and the Sahel in recent years have been attributed to progressive deterioration of the ecologic environment. Rapid desertification and extensive soil erosion have resulted from deforestation, poor agricultural practices, and over-grazing by pastoralists (4); however, all these environmental factors have been strongly influenced by social and political forces. Famine generally reflects profound societal ills.

Loss of purchasing power through rapid inflation and/or unemployment—such as occurred in Ghana in the late 1970s—may lead to a collapse of the market system. Hoarding, imagined scarcity, and price manipulation were major causes contributing to the 1943-1944 famine in Bengal in which an estimated 1 million people died (3,5)

A common feature of many recent famines has been the influence of widespread political upheaval and armed con-

TABLE 1. Famines of the 20th century

China	1920 and 1960
Germany	1917-18
Russia	1919
Ukraine	1921
India (W. Bengal)	1943
Holland	1944-45
Ethiopia	1972-74
	1984-85
Bangladesh	1971
	1974-75
Sahel	
Senegal	1968-73
Mali	1985
Upper Volta	
Niger	
Chad	
Nigeria (Biafra)	1969
East Timor	1976
Kampuchea	1979
Uganda	1981
Sudan	1985

flict. During the Nigerian civil war, the war which resulted in the creation of Bangladesh, the chaos of the Khmer Rouge regime of Kampuchea, and the disturbances preceding the overthrow of Haile Selassie in Ethiopia, famine occurred among civilian populations. In the 1980s, armed secessionist movements in the northern Ethiopian provinces of Eritrea and Tigre and in the eastern region of the Ogaden, and widespread antigovernment insurgency in many parts of Mozambique have been associated with severe famine, resulting in the deaths of hundreds of thousands in each country (6,7). Not only does this upheaval contribute directly to the creation of a famine situation, but it also seriously disrupts famine relief operations.

Most disturbingly, intentional starvation has apparently been used as a deliberate weapon by some governments and political organizations. Examples of such include the allied blockade of Germany in 1916-1918 (8), the siege of Leningrad in 1941, the war between federal Nigerian forces and the secessionist state of Biafra (9), and the obstruction of relief aid to the Ethiopian provinces of Eritrea and Tigre in 1984-1985 (10) and again in late 1987 (11).

Although historians, disaster-relief organizations, and the press frequently attribute a famine to a single cause (e.g., the Irish potato famine, the Sahelian drought), the cumulative and frequently synergistic interactions of multiple risk factors upon a population are often responsible The following description of famine in Karamoja, Uganda, in which infant mortality was estimated >600/1,000 live births, provides an example (12):

> With attention focused on political problems in the aftermath of Uganda's liberation, drought in remote Karamoja went unnoticed. Crop failure has a long history and is substantiated by agricultural records since 1924. But the Karamojong have always had a good security system which allowed several fall-back positions, thus avoiding full-scale famine during years of crop failure: reliance on blood and milk from their livestock, the trade of cattle to neighboring districts for grain, interval commerce of surplus grain and food distribution through local government administration.

Famine in Karamoja resulted not only from the drought but also from the breakdown of the reserve food-supply system. Alertness to the multiple risk factors that may lead to famine is essential to the early recognition of prefamine situations and to the initiation of corrective action. The following list categorizes these risk factors by time, place, and person (13)

TIME

- Seasonality of food availability and malnutrition
- Triggering event (natural disaster, war, crop failure)

PLACE

- Political instability
- Developing, poor societies
- Marginal lands (deforested lands, steep slopes, eroded land, desert, low-lying delta)
- Agrarian or nomadic, pastoralist societies (dependent upon single crop or livestock)
- Fragile food chain: production, distribution
- Weak information dissemination and transportation infrastructure
- Limited governmental capacity to predict and respond to food shortages

PERSON

- Infants, young children, elderly people, pregnant and lactating women
- Poor, landless, underemployed, and unemployed families
- Ethnic, religious, and political minorities
- Refugees and internally displaced persons
- Chronically ill and undernourished individuals with restricted nutritional reserve

Detection of Famines

Despite modern systems of information dissemination, the recognition of—and response to—famines in the 1980s has been slow. Even at times that objective data have indicated a serious and worsening situation, such as in Ethiopia in 1984, major food mobilization did not occur until international public opinion was aroused through massive and graphic media depictions of starving and dying children (14-16) Thus, the prevention of famine requires not only a sensitive and specific warning system but also—and above all—an increased willingness and capability of governments and international relief-assistance organizations to respond quickly to prefamine situations.

Traditionally, famines have been assessed in terms of cases, rates or degrees of malnutrition, and/or numbers of deaths from undernutrition. Such indicators quantify the damage—much of it irreparable—that has taken place, but they are of limited use in terms of prediction and prevention. Improved famine detection requires that authorities responsible for famine response shift their attention from the traditional "trailing" indicators to more appropriate "leading" and perhaps "intermediate" indicators, as shown below.

LEADING INDICATORS
- Low acreage under cultivation
- Drought
- Floods
- Low food reserve
- Political instability
- Population movement
- Strong black market
- Insect infestation (e.g., locusts)

INTERMEDIATE INDICATORS
- Crop failure
- Increased price of staples
- Rise in ratio of staple crop price to daily wage
- Increased lending rates
- Sale/consumption of livestock
- Death of livestock in pastoral societies
- Sale of valuable possessions (animals, jewelry, ornaments, farm tools) at less than market value
- Increased seed cost
- Seed shortage
- Consumption of seed grain
- Sale of land
- Population migration
- External market-price manipulation

TRAILING INDICATORS
- Increased rates of low or abnormal anthropometry
- Edema/marasmus among young children
- Increased rates of vitamin deficiencies
- Increased rates of other nutritional deficiencies
- Increased mortality

If trailing indicators alone are relied on to trigger a response, a portion of the high-risk population will experience excess morbidity and mortality. In the words of Jon Rohde (13), "The earlier the intervention, the more likely the later manifestations (particularly deaths) will be avoided. When market prices rise, government grain release can assure stable affordable supplies When buying power is reduced, food-for-work or test relief projects can provide needed purchasing power." A word of caution here regarding government subsidies of food prices for certain segments of the population, such as urban dwellers, since this may act as a disincentive for farmers and may lead to decreased food production.

New satellite technologies are particularly applicable to improved monitoring of some leading indicators. Through the use of the National Oceanic and Atmospheric Administration satellites' intensified imagery and computer analysis, historical weather records, and crop condition indices, drought and food shortage alerts on some 400 agroclimatic zones are available biweekly from the Assessment Information Service Center This system, in its fourth year of operation at the time this report was written, is expected to provide a 3- to 6-month lead time on potential drought and food shortage areas (17).

Currently, the U.S. Agency for International Development is implementing a famine early-warning system in sub-Saharan Africa. Available local data, reports from satellites, and selective field surveys are being used to track changes in the level of critical risk factors. This new system might substantially increase the timeliness of recognition and response to famine (18); however, it is one thing for technicians to provide data that indicate the imminent onset of famine and quite another for politicians and decision makers to trigger an adequate response.

Effective early-warning systems would have the distinct advantage of enabling governmental and other types of organizations to provide food to people who need it, without disrupting the recipients' social structures. Once famine and migration occur, people move to urban slums or temporary settlements or "camps" in which population density is high, housing poor, sanitation almost nonexistent, and health services are lacking. Crowding itself leads to an increased risk of exposure to infections. The recognition of impending famine and the provision of food to people in their normal surroundings diminish social disruption, limit exposure to infectious agents, minimize the hopelessness of dependency, and increase the probability of eventual rehabilitation.

Health Consequences of Famine

Just as the causal structure of famine is multi-factorial, the health consequences of famine emerge from multiple aspects of the famine phenomenon. The migration of people away from their homes, their congregation in crowded and unsanitary camps, the frequently associated political violence, and the insidious depression and apathy that result from their plight all contribute to the health problems that afflict victims of famine.

The most obvious results of famine are severe undernutrition and death. While studies have demonstrated that undernourished individuals—especially young children—are at higher risk of mortality (19), the immediate cause of death is usually infectious disease. The groups within a population that are most vulnerable to the effects of famine are also those that are at high risk of premature mortality in non-famine times—namely the poor, the landless, the underemployed, and—within these groups—the oldest and youngest.

Protein-Energy Malnutrition

The signs and symptoms of protein-energy malnutrition (PEM) have been adequately described elsewhere (20,21). In famine situations, the victims of starvation undergo devastating physical and psychological deterioration. Starving individuals generally show weight loss, weakness, apathy, and depression, and symptoms progress to cachexia, diarrhea, anorexia, immobility, and finally death. Edema is rarely seen in association with total starvation but is commonly seen with semi-starvation (8). While the predominant type of PEM affecting young children is marasmus, there are circumstances that can produce kwashiorkor, such as those in Biafra in 1969 when children were given cassava as an energy source but received almost no protein (9).

DIAGNOSIS

Reflecting the situation in "normal" times, PEM affects certain segments of the population more than others. Most severely affected are persons with the highest energy and protein requirements—infants, young children, pregnant and lactating women, the chronically ill, and the elderly. Nutrition status is measured for individual children by anthropometry, whereby certain measurements are compared with those for the World Health Organization (WHO) reference population. The most commonly used indices are weight-for-height, weight-for-age, height-for-age, and mid-upper arm circumference (MUAC).

The index that most sensitively detects recent PEM, or wasting, is weight-for-height (22), which is used to assess children <5 years of age or <115 cm in height. MUAC—provided it is accurately measured—can be useful to screen children 1-5 years of age. Assessment of PEM for older children and adults is done by clinical examination. Height-for-age is a sensitive index for assessing long-term PEM, or stunting, and weight-for-age reflects either recent or longer-term nutrition status.

Acute PEM is generally defined as weight-for-height >2 standard deviations below that for the median reference population, or mid-upper-arm circumference of <13.5 cm. Severe PEM is usually defined as weight-for-height >3 standard deviations below that for the median reference population, or a MUAC of <12.5 cm. In the past, moderate and severe PEM have been defined as weight-for-height <80% or <70%, respectively, that of the median reference population.

PREVALENCE

The prevalence of PEM in populations affected by famine has only been estimated by anthropometry within the past 20 years. Prevalence rates as high as 70% were recorded for children in Ethiopian camps in 1985 (23). Estimates have been made through random sampling of populations, screening total populations as they arrived at settlements, and as they participated in mass public health campaigns such as vaccination. Table 2 lists the prevalence of PEM recorded for various famine populations since 1975.

Many, though not all, nutrition surveys have been performed in relief settlements or refugee camps in which the most severely affected elements of a population may have gathered or in which nutrition status may have deteriorated because of inadequate rations and frequent infections.

Micronutrient Deficiencies

Although not commonly perceived as important by the public or by medical-relief workers, several of the micronutrient deficiency syndromes have contributed greatly to mortality and disability among members of populations with acute starvation. Xerophthalmia related to vitamin A deficiency was first described in the Irish famine of 1845-1847 (31). Numerous reports of vitamin A-related blindness among famine victims have since been published (32). In addition to being an effective mechanism for preventing blindness, vitamin A supplementation has recently been suggested as having a role in the prevention of mortality among children (33).

Vitamin C deficiency (scurvy) has been reported from refugee populations in both Sudan and Somalia (23,34) with thousands of individuals being affected. These outbreaks have occurred when traditional diets containing vitamin C (e.g., camel's milk in the Ogaden) were replaced by imported rations of cereals and oil that contained no vitamin C. Likewise, such rations often have not contained enough iron and folic acid for the needs of women of child-bearing age, and widespread iron- and folate-deficiency anemia has been reported in association with famine and refugee situations (35).

Infectious Disease

Most famine-associated deaths result from infection. There are two reasons for this. First, the poor environmental conditions in relief settlements promote the spread of infectious disease Second, the body's immune defenses against these infectious diseases are seriously impaired as a result of starvation

In such settings, one of the most important infectious diseases is measles, which causes high mortality rates among young, undernourished children Reports from the refugee camps of eastern Sudan attribute 50% of all deaths in February 1985 to measles, describing measles-specific mortality rates of 30/1,000/month for children <5 years of age and case-fatality rates as high as 32% among infected children in one camp (29,36). Measles case-fatality rates of 50% were

TABLE 2. Undernutrition prevalence in famine-affected populations

Population*	Year	Percent acute undernutrition†	Reference
Kampuchean refugees	1979	10-18	24
Ogaden refugees in Somalia	1980	28-39	25
Mozambique	1983	12-28	7
Mauritania	1983	8 2-17.2	26
Niger	1984	11.5-12 2	27
Burkina Faso	1985	6-10	28
Tigrean refugees in Sudan	1985	13 8-50	29
Eastern Sudan (nonrefugees)	1985	17	29
Ethiopia (Korem camp)	1985	70	23
Ethiopia (N. Shoa)	1985	26	30

*Based on surveys of children < 5 years of age

†Defined as weight-for-height < 80% median World Health Organization reference population

described among children with kwashiorkor during the Nigerian civil war (37).

Diarrheal diseases are common—especially in camps in which the water supply is unsafe and sanitation facilities are absent. While acute, watery diarrhea accounts for most of the morbidity and mortality in these situations, large outbreaks of cholera and bacillary dysentery have been reported from Sudan, Somalia, and Ethiopia (36,38). Other communicable diseases that often afflict famine-affected populations include acute respiratory infections, meningitis, hepatitis, tuberculosis, typhus, relapsing fever, and typhoid fever. It should be stressed, however, that significant mortality from epidemics of unusual diseases has been the exception; the rule has been that *people have most often died from such common diseases as measles, diarrhea, and pneumonia* (23,36).

Problems of Food Toxicity

When common foodstuffs are scarce, there is increased consumption of wild, or so-called "famine foods'. Foods that were previously not eaten or else would normally be prepared differently may be consumed in desperation. Reports from Mozambique in 1983-1984 (39) describe many deaths among starving villagers who ate parts of the cassava plant that contain cyanogens that break down into cyanide. This event occurred because normal precautions against toxicity were not taken during these times of extreme hunger.

Mortality

For an individual with severe protein-energy malnutrition and infection, death is the inevitable end result. In a famine setting, large numbers of deaths occur; however, accurate mortality figures are often lacking and difficult to obtain. Mortality estimates that are prepared most commonly come from camps or settlements.

Point estimates of mortality in certain camps have been so high that if translated from daily to annual mortality rates they would approximate 100%. For example, in one camp in Ethiopia, the average daily mortality rate between October 1984 and January 1985 was 49/10,000/day (23). In the Wad Kowli camp of eastern Sudan, mortality rates of 30/10,000/day were recorded in February 1985 (23)

In one of the few population-based mortality surveys in Ethiopia in 1985, a crude mortality rate equivalent to an annual rate of 92/1,000 was found (30). Overall, a conservative estimate of excess mortality (i.e., the mortality over and above that recorded in non-famine times) in 1985 from the Ethiopian famine has been put at 50/1,000. This represents approximately 500,000 deaths in the affected regions of the country. In the eastern Sudan camps, an estimated 5% of the people in eight Tigrean refugee camps died in the first 3 months the camps operated (36).

Age-specific mortality data from Ethiopia and Sudan in 1985 showed that children 1-4 years of age suffered the greatest *excess* mortality of any age group (23). During the 1971-1972 Bangladesh war, however, the highest excess mortality (expressed as percentage increase over normal mortality rates) was found for children 5-9 years of age (40). Infants <1 year of age often experience the highest *absolute* mortality rates of any age group (36); however, the increase over "normal" infant mortality rates is not as significant as that for older children. Surveys in Darfur, western Sudan, in 1985 showed that excess mortality was far higher for boys 5-9 years of age than for girls in the same age group. No such sex differential was found for mortality for other age groups (41).

Different mortality rates have been identified within certain socio-economic groups, even when the difference in resources available to the groups seems minimal. For example, in a rural area of the Bangladesh delta during the post-flood famine of 1974, the mortality rate for landless peasant children 1-4 years of age was 86.5/1,000, while mortality for children in families that owned at least 3 acres was 17.5/1,000 (40).

Response to Famines

A food shortage should be responded to long before undernutrition prevalence increases in a population (see the section on prevention of famines) Even when it appears that an overall food deficit that cannot be prevented by local redistribution of resources is going to occur, timely intervention with food supplies from non-local sources should still be possible. Such intervention depends largely on the quality of the surveillance system in place and the willingness of donors to respond promptly. Given the abundant food reserves in Western countries and even in a number of developing countries (e.g., Zimbabwe, Thailand), there is no logical reason to prevent organization of effective relief programs. Relief operations face a number of constraints locally—including lack of transport and fuel; poor information dissemination; lack of available, skilled managers; and armed conflict in the areas of greatest need. A relief program requires good management, logistics, and nutrition expertise. Medical personnel should play a complementary role. Of profound importance is leadership; one of the major problems in a relief program is the multiplicity of agencies; thus, it is essential that a **lead** relief agency be designated which is either part—or has the active approval—of the government of the affected country.

There are basically four main components of a famine relief program—feeding, prevention of disease, treatment for disease, and epidemiologic surveillance. Feeding is the critical component.

Feeding

Undernourished populations are at an increased risk of dying. A comparative study of the Kampuchean refugee population in Thailand in 1979-1980 and the Tigrean refugee population in Sudan in 1984-1985 clearly demonstrated the close association between undernutrition and mortality in such displaced, famine-affected populations. While each group had a high prevalence of undernutrition upon arrival at the various camps, the mortality rate for the Kampuchean population fell rapidly as the undernutrition prevalence decreased. The opposite was the case for the Tigrean population, for which both the undernutrition prevalence and mortality rate remained high for 7-8 months (29).

One critical difference between the relief operations for the two populations was the numbers of calories provided daily to refugees in the early phases. Simply stated, insufficient food was provided to the Tigrean refugees. Distribution of adequate food to all is essential for the nutritional rehabili-

tation of undernourished populations and cannot be replaced by either selective feeding programs or other preventive programs. Four food-distribution strategies have been described (42).

General food distribution. Dry food is distributed to people who are able to prepare their own meals—preferably in their own homes.

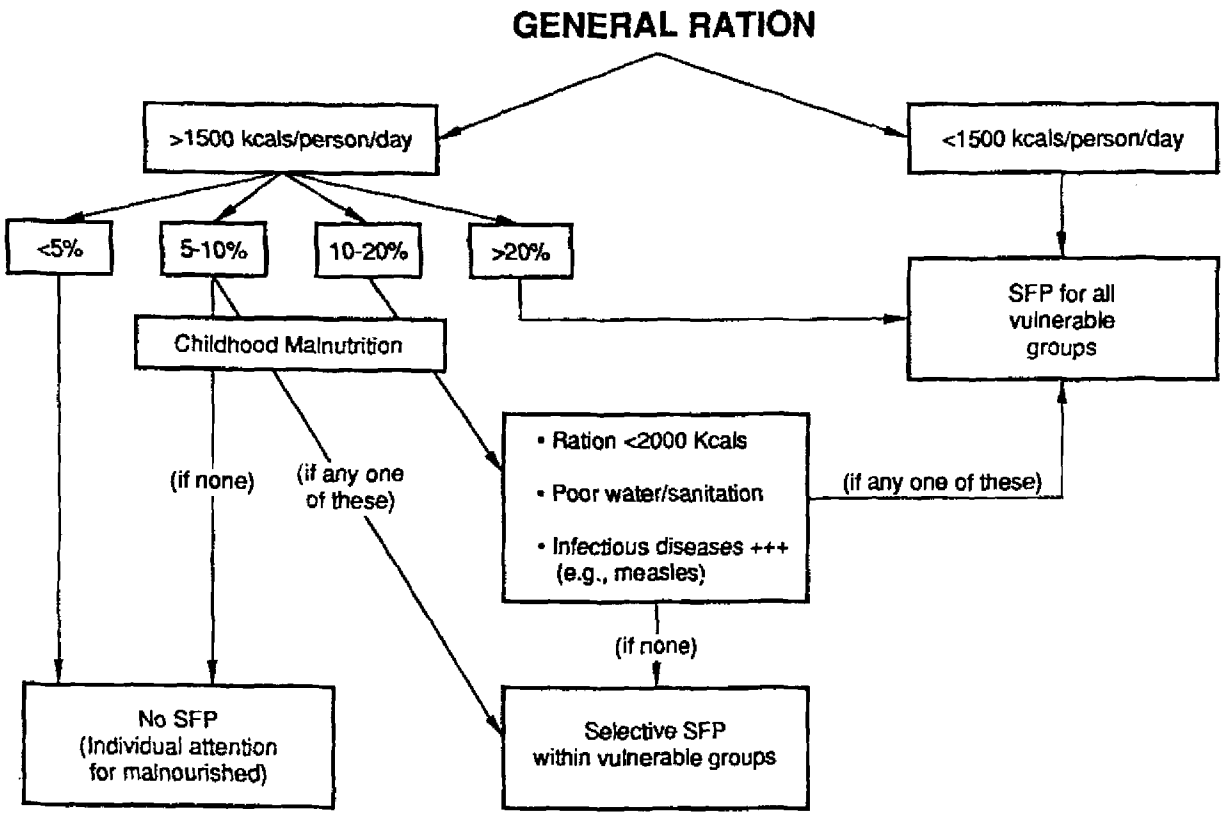
Mass feeding. Prepared, "wet" meals from a central kitchen are served to the population, usually in a camp setting.

Supplementary feeding. In addition to the ration described above (dry food or wet meals) for the whole family, vulnerable groups receive an extra meal or ration to meet their particular needs. This is basically a preventive feeding program for those at high risk.

Therapeutic feeding. Special high-energy, high-protein foods are fed to persons with protein-energy malnutrition. This is a curative program. The procedures for distributing food and organizing various feeding programs are described in several excellent manuals produced by the WHO and Oxfam (42,43). Certain important principles which should be followed in a famine relief operation are listed below.

- Every attempt should be made to distribute food in a community setting, rather than attracting people to relief camps where infectious disease will be endemic and mortality will increase.
- So-called "survival" rations (1,500-1,800 kilocalories/person/day) should not be relied upon for the nutritional rehabilitation of undernourished populations. These rations may allow the well-nourished to survive short periods of time; however, famine victims are generally already suffering from prolonged undernutrition by the time a relief program commences and need a full ration for survival. As a guide, a daily ration containing at least 1,900 kilocalories should be provided to each person, regardless of age.
- While satisfactory energy intake is the most important component of the diet, foods containing protein, iron, vitamin A, vitamin C, and other essential nutrients must be included in the general ration in adequate quantities. Vitamin A supplementation is recommended for all children > 6 years of age in famine situations in developing countries (44). Iron supplements are also recommended for pregnant and lactating women (45).
- Supplementary feeding programs (SFPs) are only of value if a full general ration is being distributed to all family members. SFPs are often poorly attended for a variety of reasons (46). These include the inability of mothers to accompany children in feeding centers for long periods of time when they have to care for other sick siblings, collect water and cooking fuel, and prepare meals. Full enrollment of eligible children in SFPs will only occur if the community is actively searched, if the community is educated to the benefits of the program, and if population-based surveys monitor its coverage. Several thorough reviews of SFPs exist in the literature (47,48).
- Deciding whether to begin an SFP in a particular population depends on a number of factors. While there can be no rigid rules for making such a decision, Figure 1

FIGURE 1. The indications for implementation of supplementary feeding programs in famine relief



presents an algorithm that might assist the decision-making process. It is based on the nutritional status of children in the population, the adequacy of general rations, and the presence of such communicable diseases as measles. The algorithm is adapted from Oxfam's *Practical Guide to Refugee Health Care* (49).

- General rations should routinely include items appropriate for use as weaning foods in order to prevent weaning-age children from becoming malnourished in the relief-program environment (50). Utmost care must also be taken to provide grinding facilities for unmilled grains, sufficient cooking fuel, and community education on preparing unfamiliar foods.
- Many imported food items may be too unfamiliar or culturally unacceptable (e.g , some canned meats) to be of value in a relief-assistance program. Problems are frequently encountered with donated dried milks, dried eggs, dairy products, and canned baby foods. A mechanism should be in place to screen unsolicited donations of food (and non-food) items and reject them if they are not useful.

Prevention of Disease

Measles vaccination is the single most important and effective preventive measure that can be taken during a famine emergency. Within the crowded environment of many famine situations, measles—once introduced—spreads explosively and is associated with high mortality. Measles vaccination is best administered to children upon their arrival at a camp or at the beginning of a village-based relief program. It can be combined with initial nutritional screening and other preventive activities such as vitamin A supplementation.

Although WHO recommendations for routine measles vaccination target the 9- to 23-month age group, the increased mortality risk associated with measles in undernourished populations warrants an expansion of the age for measles vaccination to 6-60 months. Undernourished children respond serologically to measles vaccine, and there is evidence that it is protective for most of them (51). Some 30%-50% of children given measles vaccine at 6-8 months of age will not respond immunologically because of residual maternal antibody; thus, children vaccinated before 9 months of age should be revaccinated at 10 months (52). While measles vaccination is an absolute first priority, other vaccinations (diphtheria-pertussis-tetanus, poliomyelitis) should follow when adequate food, water, and sanitation have been provided.

Another major cause of famine-associated mortality is diarrheal disease. Although not all diarrheal diseases are spread by the fecal-oral route, the provision of safe drinking water and sufficient quantities of water for domestic purposes, simple—but well-maintained—sanitation facilities, appropriate weaning foods, encouragement of breast-feeding, and a hygiene education program will minimize the enteric disease risk. The Office of the United Nations High Commissioner for Refugees estimates that at least 15-20 liters of water are required/person/day in a camp situation (45) Expert assistance is needed to properly plan water and sanitation systems. However, careful consideration of water and drainage needs in the selection of camp sites can prevent many unnecessary problems.

Treatment for Disease

Since the response to famine frequently mobilizes medical personnel from a variety of backgrounds, both the establishment of a health-coordination unit and the development of standard criteria for diagnosis and treatment for common conditions are essential. The selection of treatment regimens requires understanding of endemic diseases, drug availability, drug efficacy, costs, and local practices.

An important principle in the organization of curative services in a famine-relief situation is decentralization. Large, crowded outpatient and inpatient facilities create chaos, promote the spread of disease, and take up a disproportionate amount of medical personnel time. Prompt training of health workers selected by the local community in the prevention and treatment of common ailments—as well as the establishment of small, peripheral health posts—can expedite adequate coverage of the population with curative services. Inpatient facilities should be kept to a minimum.

Two major causes of morbidity (and mortality) in undernourished populations are diarrhea and acute respiratory infections. Some 30%-40% of famine-related deaths are associated with diarrhea (36) Although diarrhea can be of noninfectious (nutritional), viral (measles, rotavirus), or bacterial (*Escherichia coli; Shigella, Vibrio cholerae)* origin, appropriate clinical management can significantly reduce mortality from dehydration. The WHO manual titled *The Treatment of Acute Diarrhea* (53) provides guidelines on the use of oral rehydration therapy, intravenous fluids, and antibiotics. Guidelines for the treatment of acute respiratory infections are also available from WHO (54).

Several manuals describe the management of common health problems in famine and relief-camp situations (45,55).

Epidemiologic Surveillance

Epidemiologic surveillance provides quantitative data on populations at risk, identifies health problems that require special action, and monitors the effectiveness of input directed at reducing mortality and improving nutritional status. During the Nigerian civil war, famine surveillance was divided into three stages by Foege (56): immediate ('quick and dirty'), short-term, and ongoing.

IMMEDIATE SURVEILLANCE

Immediate surveillance consists of a rapid appraisal of an affected area, the population involved, and the nature and extent of the problem. After the 1970 cyclone in East Bengal, the use of helicopters enabled authorities to rapidly identify relief needs. In that disaster, which caused an estimated 225,000 deaths, the initial global response was to provide medical relief teams and field hospitals. However, the helicopter survey of the affected area revealed high mortality and few injuries, but a complete loss of seed and draft animals. Relief response, therefore, was shifted from the provision of medical care to the provision of seed and

animals. An in-depth, follow-up survey confirmed the major findings of the rapid assessment (57).

Another example of rapid assessment was in the Sakeo refugee camp in Thailand. A 1-week survey of 33,000 newly arrived Kampuchean refugees identified high mortality—9.1 deaths/10,000 population/day, equivalent to an annual rate of 332/1,000 population—and an unexpected problem of severe malaria (58).

SHORT-TERM ASSESSMENT

Short-term assessment provides two types of data—a cross-sectional assessment of the health status of the population and the identification of high-risk groups for special feeding programs.

Mortality data are basic to this assessment, since they provide a clear, easily recognizable measure of the severity of the situation and establish a baseline for measuring trends over time. Data on deaths, however, are not always easy to obtain. If all deaths occur in medical facilities and are registered, or if registration is required before burial, mortality can be measured or tracked through the use of available data. Otherwise, creative approaches are required, such as monitoring fresh graves, counting the burial shrouds distributed, or reviewing vouchers of burial contractors.

Although mortality rates are generally expressed as deaths/thousand/year, during famine situations they are better expressed in terms of deaths/10,000 persons/day or/1,000 persons/month. This facilitates the monitoring of mortality trends over short periods of time.

Assessment of nutritional status is usually directed primarily at the high-risk age group of children <5 years of age. Monitoring of this vulnerable group provides sentinel information on the community at large. As discussed above, weight-for-height is the established index for detecting acute undernutrition. Standard methods of estimating the nutritional status of populations have been developed (42,59). Using the cluster-sample method, data are collected on the height, weight, and presence of edema for children 1-5 years of age in each of 30 clusters selected from the population. Screening for suspected vitamin deficiencies can also be included in this survey. If survey data indicate a need for supplemental and/or therapeutic feeding, screening of the entire high-risk age group is then required for enrollment in the program.

ONGOING SURVEILLANCE

Ongoing surveillance provides two types of data: **trend** data on mortality and nutritional status over time and **morbidity** data on conditions of public health importance.

Mortality and nutritional status can be monitored as described under short-term assessment for camps and settlements. The estimation of population-based mortality may require demographic surveys which rely on recall of deaths by family members. The value of monitoring the effectiveness of programs can be seen from the graph in Figure 2, which shows mortality and undernutrition prevalence over 8 months in the Tigrean and Kampuchean refugee populations discussed earlier (29). Although these data were plotted several years later, had the trends been closely observed at the time of these relief operations, appropriate corrective action might have been taken in the case of the Tigrean population (which experienced prolonged undernutrition prevalence and high mortality).

Data on morbidity are available from four sources—inpatient admissions, outpatient consultations, outbreak investigations, and population-based surveys. In famines involving large populations, collection of quality data from selected, or sentinel, inpatient and outpatient facilities has proven useful in identifying disease problems in the community.

Data collected on morbidity should be limited to information about diseases for which control programs are under way or for conditions that, if found, would lead to specific interventions. Listed below are some of the important conditions that should be considered when a surveillance system for famine areas is being developed.

Major causes of mortality

Undernutrition
Measles
Diarrhea (including cholera)
Dysentery
Pneumonia
Malaria
Meningitis

Epidemic diseases that require immediate action

Measles
Meningococcal meningitis
Cholera
Malaria
Polio
Typhus

Specific nutritional deficiencies

Xerophthalmia
Scurvy
Beriberi
Pellagra
Microcytic anemia (iron deficiency)
Macrocytic anemia (folate and B12)

Note that almost all these conditions are preventable the programs discussed earlier are implemented.

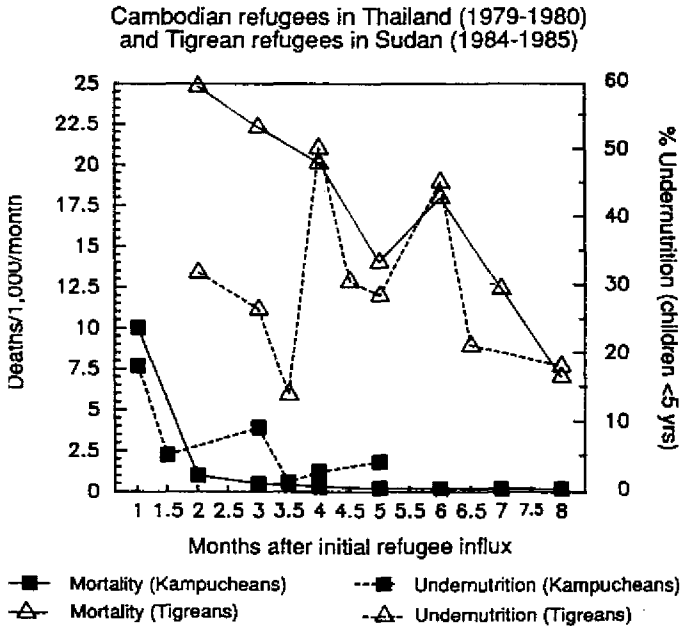
In the establishment of a disease surveillance system for famine areas, the five principles below are useful.

- Data collection should be limited to information required for monitoring health status (mortality and nutritional status) and key medical conditions for which interventions are available and feasible and for which diagnoses can reliably be established. For example cough and fever is preferable to pneumococcal pneumonia.
- The reporting form should be limited to one page if possible and should be formatted for data entry and compilation.
- Reporting frequency should depend on need—daily (in acute emergencies), weekly, or monthly. In stable,

post-famine situations, monthly reporting is usually adequate.

- Reporting compliance should be monitored, with active follow-up for missing reports. Negative reporting—that is, the filing of reports even if there are no cases—is essential.
- Analysis should be rapid, with immediate actions taken in response to identified problems. Feedback of analyzed data to implementers, data providers, and program decision-makers should be prompt. In Somalia, this feedback has been successfully carried out via a monthly newsletter to staff in refugee camps.

FIGURE 2. Crude mortality rates and prevalences of childhood undernutrition



Prevention of Famines

As discussed earlier, early-warning systems offer considerable hope in accelerating the response to a prefamine situation. Experience has shown, however, that the knowledge afforded by data generated by an early-warning system do not necessarily stimulate potential donors to act. For famine-prone countries, there is much that can be done in advance of a possible famine, including storage of food reserves, plans for mobilization of transport, and training of civil servants in disaster relief, but these measures are difficult to enact in the countries that need them most.

The prevention of famine requires the combined efforts of agriculturalists, economists, nutritionists, and planners. Since famines generally strike the poorest of the poor in developing societies, measures that are required include changes in land ownership and tenure, an increase in government resources devoted to rural development, and the encouragement of agricultural production, as well as taxation and price policies that bring about better equity (60,61).

Relief efforts need reliable information in place on the availability of local foods, local food tolerances and preferences, transportation available for the distribution of food relief, quality of the civil infrastructure of the latter, and the nature and extent of the food shortage. The lack of such information has been responsible for much confusion and inefficiency in the past (8).

Need for Further Study

The need for study of the causes, prediction, control, and prevention of famine is too vast to cover here, spanning as it does so many disciplines. In the field of famine epidemiology, further field studies are needed in the following areas:

1. Improvement in nutrition and mortality surveillance systems;
2. Prospective studies of the correlation between undernutrition and mortality;
3. Studies of the association between certain micronutrient deficiencies and morbidity and mortality;
4. Prospective studies of the daily energy and protein needs of certain at-risk groups within populations;
5. Trials of certain supplementary and therapeutic feeding protocols in the prevention and treatment of protein-energy malnutrition.

Conclusions

Famine is largely a preventable phenomenon. The failure to provide sufficient food for consumption by all members of a population is the result of a number of interacting factors—some unavoidable natural calamities, but most caused by humans. Famines will continue to occur given the continued political turmoil, economic decline, and rapid population increases in some parts of the world. The following assessment, made in 1972, remains true today (62):

"Famine occurs months or even years after the primary event. Famine relief, then, is an admission of failure to tackle the primary event. Famine is the disaster situation with a long enough incubation period that it should never occur on a mass scale."

If and when famines do occur, their impact will be minimized if relief programs include the following components:

1. Effective nutritional and mortality surveillance;
2. Community-based provision to all families of adequate general rations;
3. Appropriate preventive actions, such as measles vaccination and control of diarrheal disease;
4. Supplementary and therapeutic feeding programs, when indicated; and
5. Immediate interventions to rehabilitate the food production and distribution systems.

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