

# Policy Development in Disaster Preparedness and Management: Lessons Learned from the January 2001 Earthquake in Gujarat, India

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**Keywords:** Aid, humanitarian; coordination; disaster management; disaster preparedness; disaster relief; disaster responses; earthquake; India; intelligence; need assessment; policy development; preparedness; primary health care; public health; risk evaluation

## Abbreviations:

ANM = auxiliary nurse and midwife  
CHW = Community Health Worker  
DOTS = Directly Observed  
Treatments  
EPI = Expanded Program of  
Immunization  
MPW = multi-purpose health worker  
NGO = non-governmental organization  
NorAid = Norwegian Medical Aid  
System  
PAHO = Pan-American Health  
Organization  
PHC = Primary Health Care  
RNAT = Rapid Need Assessment  
Team  
SAR = search and rescue team  
SUMA = Relief Supply Management  
System  
TB = tuberculosis  
U5MR = under-5 year mortality rate  
UN = United Nations  
UNHCR = United Nations High  
Commission for Refugees  
UNICEF = United Nations Children's  
Fund

## Abstract

**Introduction:** During the last decades, several humanitarian emergencies have occurred, with an increasing number of humanitarian organizations taking part in providing assistance. However, need assessments, medical intelligence, and coordination of the aid often are sparse, resulting in the provision of ineffective and expensive assistance. When an earthquake with the strength of 7.7 on the Richter scale struck the state of Gujarat, India, during the early morning on 26 January 2001, nearly 20,000 persons were killed, nearly 170,000 were injured, and 600,000 were rendered homeless. This study identifies how assigned indicators to measure the level of health care may improve disaster preparedness and management, thus, reducing human suffering.

**Methods:** During a two-week mission in the disaster area, the disaster relief provided to the disaster-affected population of Gujarat was evaluated. Vulnerability due to climate, geography, culture, religion, gender, politics, and economy, as each affected the outcome, was studied. By assigning indicators to the eight ELEMENTS of the Primary Health Care System as advocated by the World Health Organization (WHO), the level of public health and healthcare services were estimated, an evaluation of the impact of the disaster was conducted, and possible methods for improving disaster management are suggested. Representatives of the major relief organizations involved were interviewed on their relief policies. Strategies to improve disaster relief, such as policy development in the different aspects of public health/primary health care, were sought.

**Results:** Evaluation of the pre-event status of the affected society revealed a complex situation in a vulnerable society with substantial deficiencies in the existing health system that added to the severity of the disaster. Most of the civilian hospitals had collapsed, and army field hospitals provided medical care to most of the patients under primitive conditions using tents. When the foreign field hospitals arrived five to seven days after the earthquake, most of the casualties requiring surgical intervention already had been operated on. Relief provided to the disaster victims had reduced quality for the following reasons: (1) proper public health indicators had not yet been developed; (2) efficient coordination was lacking; (3) insufficient, overestimated, or partly irrelevant relief was provided; (4) relief was delayed because of bureaucracy; and (5) policies on the delivery of disaster relief had not been developed.

WADEM = World Association for  
Disaster and Emergency Medicine  
WFP = World Food Program  
WHO = World Health  
Organization

**Received:** 24 September 2002  
**Accepted:** 17 November 2003  
**Web publication:** 11 June 2004

**Conclusion:** To optimize the effectiveness of limited resources, disaster preparedness and the provision of feasible and necessary aid is of utmost importance. An appropriate, rapid, crisis intervention could be achieved by continual surveillance of the world's situation by a Relief Coordination Center. A panel of experts could evaluate and coordinate the international disaster responses and make use of stored emergency material and emergency teams. A successful disaster response will depend on accurate and relevant medical intelligence and socio-geographical mapping in advance of, during, and after the event(s) causing the disaster. More effective and feasible equipment coordinated with the relief provided by the rest of the world is necessary. If policies and agreements are developed as part of disaster preparedness, on international, bilateral, and national levels, disaster relief may be more relevant, less chaotic, and easier to estimate, thus, bringing improved relief to the disaster victims.

**Bremer R: Policy development in disaster preparedness and management: Lessons learned from the January 2001 earthquake in Gujarat, India. *Prehosp Disast Med* 2003;18(4):372-384.**

## Introduction

The earthquake in Gujarat, India was one of many human emergencies that have occurred during the past decades. During this period, an increasing number of humanitarian organizations have been providing assistance to the affected societies. On Gujarat's national holiday, 26 January 2001, the students at Lalim College were gathered outside for a parade at 08:50 hours, when the ground started to move beneath them. An earthquake with an amplitude of 7.7 on the Richter scale left an area with a diameter of more than 500 km in the state of Gujarat in ruins. None of the students at Lalim College were killed, classrooms were turned into heaps of rubble. It took just 80 seconds to kill almost 20,000 people, injure 170,000, render 600,000 homeless, and destroy 910 villages. Official buildings, like schools and hospitals, were among the least earthquake resistant buildings; millions of people were affected.

India is one of many disaster-prone countries. In addition to earthquakes, floods, cyclones, and epidemics are frequent events. Its government has been fighting against overpopulation and poverty. Learning by experience, the Indians have improved disaster preparedness considerably during the last years. In May 1998, when a devastating cyclone struck the Kutch District in Gujarat, a network of 22 grass-root organizations working on disaster preparedness, called the Kutch Nav Nirman Abhiyan, was founded as a response.

## Methods

During a two-week mission in the disaster area after the earthquake in Gujarat, India, an evaluation was conducted of the relief interventions that were provided by observation, deduction of assigned indicators, and interviews. Outcome of the disaster was studied.<sup>1</sup> The levels of public health and health care were estimated by assigning indicators to the

eight ELEMENTS of Primary Health Care as advocated by the World Health Organization (WHO): (1) education; (2) local disease control; (3) expanded program of immunization (EPI); (4) mother, child and family planning; (5) essential drugs; (6) nutrition and food supplies; (7) treatment of diseases; and (8) safe water and sanitation.<sup>2-3</sup> An evaluation of the impact of the disaster was conducted by measuring changes in the assigned indicators. Representatives of the major relief organizations operating in the region were interviewed in regards to their relief policies. The assigned indicators should be informative, reliable, valid, simple, practical, and easy to understand.<sup>4</sup> Throughout these interviews, aspects of relief policies, coordination of activities, timeliness of the intervention, and feasibility were emphasized.

## Results

### *Factors Influencing the Outcome of Disasters*

When the earthquake struck the state of Gujarat, the state already had been affected by serious drought for the three years previous. This factor added to the complexity of the disaster. India has more than 40 different tribes, accounting for 7.3% of the total Indian population, with different cultures, languages, and traditions.

## Vulnerability

### *Climate and Geography (natural vulnerability)*

Local weather conditions influence the survival time among people trapped in collapsed buildings.<sup>5</sup> The area involved in the earthquake lies on the Tropic of Cancer, and by the end of January, enjoys a pleasant temperature during daytime, but the nights are quite cold. This might have contributed to the deteriorated state of many of the trapped individuals.<sup>3</sup> The Rann of Kutch is a savannah-like area (semi-arid desert), which is totally dependent upon the monsoons to arrive by the end of May for the fields to give their harvest. Thus, the area is prone to drought; drought had persisted in the affected region for three years. The arrival of the monsoons could render tents insufficient, and the government had wanted all families to have at least one earthquake-proof room before that time. Of the resident population, 70% are poor peasants, and are dependent upon selling cattle milk for their income.<sup>6</sup> During the drought, some had left their homes for six months in order to take their cattle to more fertile areas in order to improve their milk production. However, the cooperative purchasing of large amounts of feed during the low-price period may have made this migration superfluous.

### *Community Structure, Politics, and Economy*

Gujarat is blessed with 42 of India's more than one billion people.<sup>7</sup> Situated in the northwest of India with a border to Pakistan (Figure 1), the state is a military stronghold. There are daily flights to Bombay and Delhi from the airport in Bhuj. The main roads are well-kept and the city also is connected to the Indian railway system.

Since 1947, after Mahatma Gandhi managed to detach the country from British rule by his passive resistance (satyagraha) and disobedient campaigns, India has been the largest democracy in the world. Fifty-three percent of

	India	Norway
Population	1,013 million	4.5 million
1. Education		
Adult literacy rate	M: 71%, F: 44%	100%
Physicians/100,000 people	48	ca 300
2. Local disease control	Inadequate	Good
Tuberculosis cases/100,000 people	115	6
3. EPI		
Vaccination coverage	55–72%	92%
4. Mother's health		
Maternal mortality ratio per 100,000 live births	410	6
Births with skilled staff	34%	100%
Child health		
Under-5 mortality rate (probability of dying between birth and five years of age expressed per 1,000 live births)	98	4
Family planning		
Total fertility rate (number of children born per woman)	3	1.9
5. Essential drugs		
Drug consultative committee established	1979	
6. Nutrition and food supplies		
<5 years underweight	53%	Close to 0
7. Treatment of diseases	Inadequate	Good
Life expectancy (years)	63	78
HIV/AIDS (10,000 people)	35	3
8. Safe water		
Access to safe water	88%	100%
Sanitation		
Access to sanitation facilities	31%	100%

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**Table 1**—Indicators assigned to the eight ELEMENTS of the Primary Health Care System with Norway as comparisons (M = male; F = female) Data taken from the World Guide and alternative reference to the Countries of Our Planet 2001<sup>14</sup> and The state of the World's Children 2001.<sup>12</sup>

the population in India lives under the poverty level, which is defined as income less than US\$1 per day. A scattered tribe population inhabits the Kutch district, 90–95% of them being peasants and nomadic herdsmen. The principal crops include wheat, pulses, mustard, and vegetables.<sup>6</sup> In the villages, a variety of well-known Indian handicraft, like intricate mirror-work, embroidery, beadwork, and patchwork, can be found and are protected by cooperatives.

#### Development

The potential impact of disasters may be determined partly by the level of development.<sup>8</sup> India, a land of contrasts, has gained an advanced technical level that produces electronic equipment, motorcycles, diesel motors, and atomic weapons.

There are vast differences between the city and countryside, and between the low-cast and high-cast. Incubators are used in the treatment of premature babies, while auxiliary health workers provide health care to millions of people in the countryside. The gap between urban and rural development is reflected in the differences in access to clean water and sanitation (Table 1).

#### Religion

Eighty percent of the population in the region belongs to the Hindu religion. Thus, religion is an integral part of life

with daily rituals. Cows and dogs peacefully walk in the streets, and most people eat a predominantly vegetarian diet. They patiently accept their fate: it was difficult to realize that the people just had gone through a terrible disaster. Though abandoned by law in 1949, the cast system continues to keep 70–80 million people (“untouchables”) in poverty, in which the tribe population of the Kutch District is included. Discrimination of minorities adds to dissatisfaction, aggression, and anger. Situated close to the Pakistani border with nearly 20% Muslim inhabitants, frequent clashes between Hindu and Muslim extremists add to the instability in the area. The Christian minority is exposed to frequent assaults from Hindu extremists.

#### Gender

Lack of equal rights between men and women represents a vulnerable situation. As an example, well educated mothers feed their children better than illiterate mothers. Even if high-cast women in the cities have obtained a university education and high positions in the society, the progress has not reached women in the slums and in the countryside. The adult literacy rate is 71% for men, but only 44% for women. School enrollment is 14% higher for boys than for girls. A girl often is considered just an expenditure, predestined for her family in law from an early age. In fact,

Health Facility	Number of People to Serve	Health Personnel	Beds	Destroyed
Hospital	100,000	Specialists	100–150	2
CHC	50,000	Specialists (3–4)	30	8
PHC	10,000	General practitioner	3–4	42
Dispensary		General practitioner		37
Sub-center	3,000	ANM/MPW		227

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**Table 2**—Destruction of health facilities (ANM/MPW = auxiliary nurse and midwife/multi-purpose health worker; CHC = community health center; PHC = primary healthcare)

expenses for the bride's price (dowry) may ruin a poor family with several girls. The old method of killing baby girls still is being practiced, but is being replaced by selective abortion, by tracing female fetus by ultrasound. Burning of brides (dowry burning) is becoming more common, especially in the northeastern states. Burning of widows also still may be practiced.

### Acute Event Phase

Thus, the society was not prepared to care for the nearly 170,000 injured persons that this devastating event created. The medical military unit in Bhuj, having stored equipment and supplies to treat 750 casualties, treated thousands of patients during the few days following the earthquake. Operating in four tents that functioned for less than one week, 11 surgical teams from different parts of India performed 2,002 major operations and 7,524 minor operations. Their only amputation saw had to be cleansed with gluteraldehyde between the amputations. There was a shortage of hospital beds and linens, no running water, and no electricity or laundry services. Large quantities of biomedical wastes and human refuse accumulated. The availability of fuel, tents, and food was restricted. There was no time for orthopedic or neuro-vascular corrective procedures.

Due to poor construction and lack of reinforcement, many schools and official buildings collapsed. This led to criticisms of the government.<sup>9</sup> Old buildings with a lack of concrete and steel reinforcements were extremely vulnerable to the seismic forces, leading to a complete collapse of the old parts of cities. In the newer sections, the lower floors of many multi-story buildings collapsed. Because of the after-quakes, buildings with severe cracks were unsafe. Search and rescue teams (SARs) and dog teams coming from abroad managed to dig out a few patients alive, but the bulk of patients were rescued by their neighbours using simple means.<sup>10</sup>

### Post-Event Phase

The most severely affected cities like Bachau, with 50,000 inhabitants, were almost completely deserted after the earthquake. Half of the population had died, and 90% of the survivors had left for other areas. Many displaced families stayed with relatives, but many had to stay outside in the cold nights with only a couple of blankets for cover and tarpaulin for shelter. With seemingly no plan for distribution, by the end of February, 120,000 tents were waiting for distribution.

The Voluntary Network of Abhiyan had been undertaking planning, lobbying, and capacity-building activities to strengthen the voluntary movement, working in 400 villages in the Kutch District. After the earthquake, it organized a detailed survey of 327 villages. Unfortunately, not all of the villages were included because of capacity problems. Every morning, the Abhiyan organized coordination meetings with the foreign relief organizations. The meetings coordinated the different activities to a certain degree, but there was no systematic recording of activities. There was no central coordination of the different medical teams and no reporting system for the teams operating in the field.

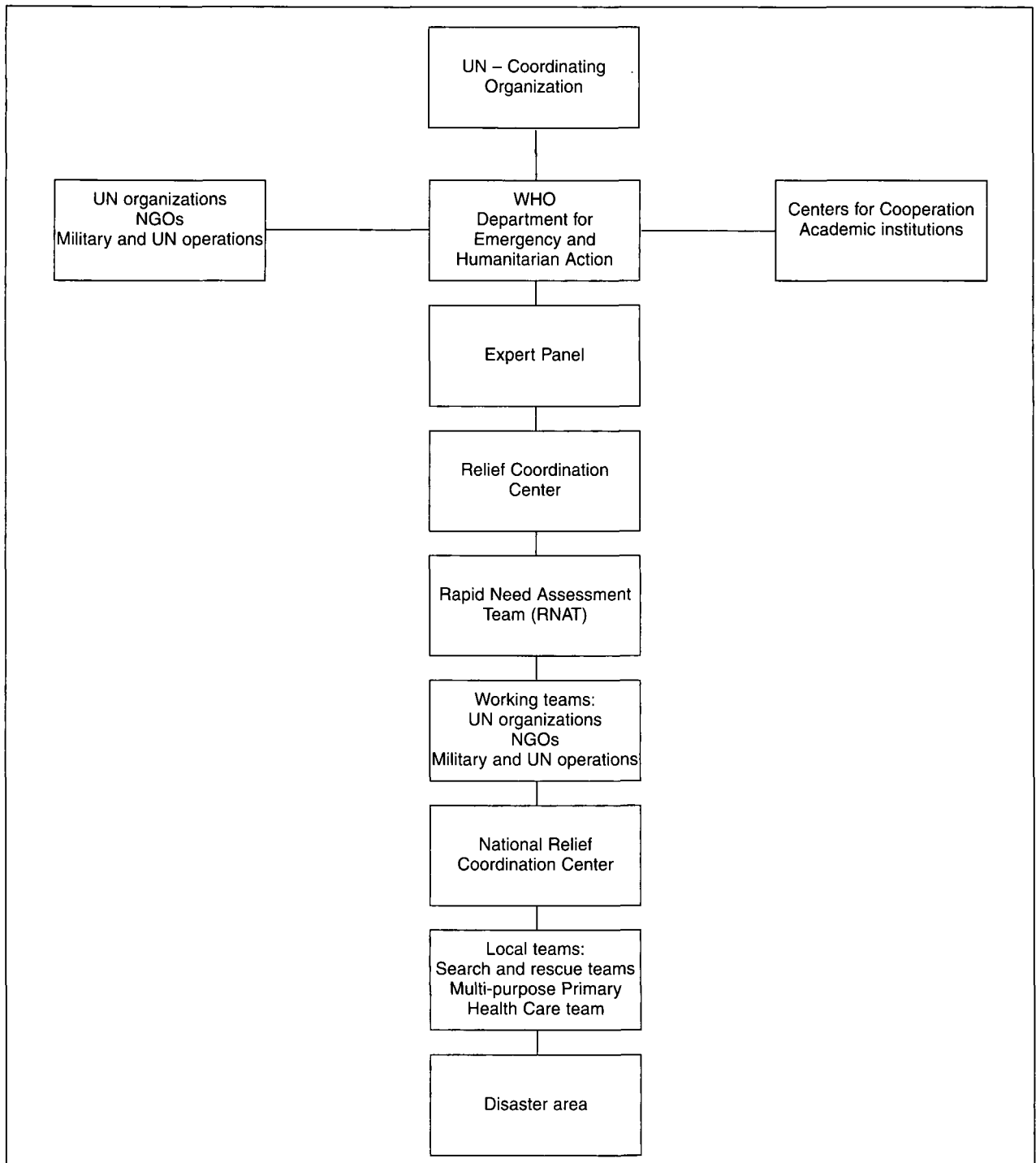
### Primary Health Care

Through its Alma Ata declaration, the World Health Organization (WHO) proclaimed health for all by the year 2000.<sup>11</sup> By defining indicators assigned to each of the eight ELEMENTS of the Primary Health Care System, covering even a broader issue than public health, the level of health care in a country may be defined and used in the evaluation of the impact of the event and disaster management (Table 1). In the Guidelines for Evaluation and Research in the Utstein Style, the Task Force for Quality Control of Disaster Management appointed by the World Association for Disaster and Emergency Medicine (WADEM) has listed 14 societal functions affected by disaster.<sup>2</sup> The eight ELEMENTS of Primary Health Care, cover five of these functions: (1) education; (2) nutrition; (3) public health; (4) medical treatment; and (5) water and sanitation.

Evaluations of the functions of a society, particularly in relation to its culture and religion, are difficult, especially when they are seen through the eyes of a foreigner. Therefore, a set of standard indicators is required. Examples include those selected by UNICEF in "The State of the World's Children", those promulgated by the Sphere Project that provide minimum standards for humanitarian relief, and international laws and definitions. These standards have been used in the process of assigning indicators.<sup>12,13</sup>

### 1. Health Education in India

Though hospital coverage in Gujarat is quite adequate with one bed for each 300 persons, the number of educated physicians is only 48 per 100,000 people in India as a whole, which is far too low, since most of them work in urban areas.<sup>14</sup> As far back as 1940, a Planning Committee



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**Figure 1**—Coordination of international action in disasters; a suggestion (NGO = non-governmental organization; UN = United Nations; WHO = World Health Organization)

of the Indian National Congress called for the training of one health worker for every 1,000 people. A report published in 1946 proposed a national health program bearing all of the hallmarks of the Primary Health Care (PHC) strategy as declared by the WHO Alma Ata Conference in 1978. The Community Health Worker (CHW) Scheme, launched by the Indian government in 1977, was a new means of providing primary healthcare services to India's rural masses. Thus, the great differences in urban and rural

health care have partly been wiped out by education of auxiliary health staff placed in the villages.

#### *Pre-event Situation*

India has an excellent infrastructural layout for the delivery of PHC services through a network of sub-centers, primary health centers, community health centers and hospitals in both the public and private sector (Table 2).<sup>16</sup> However, the health pyramid does not function effectively because of

Primary health care	Pre-event Situation	Problem/destruction	Disaster Preparedness	Disaster Management
1. Education	Literacy rate M:F = 71%:44% Physicians/100,000 people: 48	Destruction of schools Destruction of health facilities Health personnel dead	Education of SAR teams Education of health personnel	Medical teams from other parts of the coun- try and from abroad
2. Local disease control	TB cases/100,000: 115 Frequent epidemics with typhoid, cholera, measles, hepatitis A	Measles cases Epidemic with hepatitis A	Rapid response teams Multi-purpose teams Full disease control	Disease surveillance and control
3. Expanded Program of immunization (EPI)	Vaccination coverage = 55–72%	Measles cases	Increase vaccination coverage	All six vaccines of the EPI
4. Mother's health Child health Family planning	Maternal mortality ratio 410/100,000 live births Births with skilled staff: 34% Under-5 mortality rate: 98/1,000 live births Total fertility rate: 1 per 3 women	Lack of female gynecologists Lack of pediatric drugs and equipment Lack of FP devices	Reduce pregnancy- related mortality and under-5 mortality rate Reduce fertility rate	Equipment and experts in women, children, and family planning
5. Essential drugs	Local production up, 1970 Drug consensus committee, 1979	Chaos Storage problems	Drug policy Bilateral agreements Standard case management	Pharmacies
6. Nutrition and food supplies	Under-5 underweight: 53%	Warehouses and shops destroyed Collapse of Public Distribution System	Nutritional survey Growth monitoring Education	Early involvement of WFP Focus on children <2 years Proper weaning food
7. Treatment of diseases	Auxiliary health work- ers educated	High number of casualties Primitive conditions	Increased prepared- ness in the care of casualties Improve general health	Capacity for casualties Early request for relief
8. Safe water and sanitation	Improved water: 88% Sanitation facilities: 31%	Destruction of water systems	Improved capacity	Chlorination, tankers Toilet facilities

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**Table 3**—Disaster preparedness and management related to the eight ELEMENTS of the Primary Health Care System (M = male; F = female; FP = family planning; EPI = Expanded Program of Immunization; SAR = search and rescue; TB = tuberculosis; WFP = World Food Program)

limited resources, communication delays, lack of managerial skills, and political will. The auxiliary nurse/midwife (ANM) works in the villages and is available once each week at the sub-center. The multi-purpose health worker (MPW) has one year of public health training. In addition to public health, s/he also is responsible for special programs like malaria, tuberculosis (TB), and leprosy. The community health worker (CHW) is responsible only part-time for health promotion and rehabilitation. The Anganwadi teacher promotes better nutrition among the children.

#### Post-event Phase

Many health workers were killed in the collapse of the numerous health facilities, many were wounded, and others moved in with relatives and were not accessible. A lower number of health personnel were available to meet an increased amount of health needs. When this was not feasible, assistance was brought from outside. There was an immediate response with numerous health teams coming from different parts of India to assist in the post-event phase. Many doctors and nurses subscribed to a list to work

in the affected area for one to two weeks. Female doctors were discouraged from responding during the acute phase because of the lack of facilities; this created an urgent need for female doctors, especially gynecologists.

#### Disaster Preparedness and Management

It is impossible for a poor country, like India, to handle a disaster like this without foreign assistance. After four to five days, international teams began arriving. Foreign surgical teams and field hospitals were needed for post-operative care, special surgery, and the everyday acute cases. Better coordination was needed to secure an appropriate distribution of health services. Some doctors were treating up to 500 patients daily. National search and rescue teams (SARs) and surgical teams were needed at the scene within the first 24–48 hours to handle the vast bulk of casualties, but most arrived too late to be of much value (Table 3).<sup>10</sup>

## 2. Local Disease Control

### Pre-event Situation

Epidemics after sudden-onset events are not common,

even in the developing countries where factors like poverty, poor access to clean water, poor sanitation, and low immunization coverage increase the risk. For example, the efficiency of disease control may be reflected in the number of tuberculosis cases, which in India is 115 per 100,000 people.<sup>14</sup> Weaknesses in the epidemiological and laboratory surveillance systems have led to an increasing trend of epidemic emergencies in India.<sup>17</sup> In the state of Gujarat, diseases such as hepatitis A, cholera, and typhoid fever are endemic. The high incidence of falciparum malaria is a threat, especially during the rainy season.

#### *Post-event Phase*

Through a syndrome-based reporting system with 620 reporting sites and 140 mobile teams submitting the epidemiological data, the WHO, in cooperation with the government, initiated a surveillance system. Several of the medical officers working in the polio and tuberculosis programs were re-deployed for surveillance. A few measles cases were discovered in a village outside Bhuj, and by the end of March, an epidemic of hepatitis A broke out in a village near the city of Rapar.

#### *Disaster Preparedness and Management*

A health information system is an important part of disaster preparedness. Public health teams with multi-purpose functions like vaccination, treatment, and prophylaxis, visiting all disaster-affected villages on a regular basis, and also may perform surveillance and report disease outbreaks and potential epidemics to the disaster committee.<sup>3</sup> This will provide the newly established "Global Outbreak Alert and Response Network", under the Department of Communicable Disease Surveillance and Response in WHO, high quality data.<sup>18</sup> The network should support an affected country with rapid identification and technical assistance, and may contribute to long-term preparedness for an outbreak.

### **3. Vaccination (Expanded Program of Immunization (EPI))**

#### *Pre-event Situation*

From a vaccination coverage of the world's population of <5% in 1974, the Expanded Program of Immunization (EPI) now is established in most countries, and the vaccination coverage has increased to approximately 80% worldwide. Even if 800,000–900,000 children die from measles yearly, the number has been reduced by 50% since 1974. The overall vaccination coverage in India is 72% for BCG, 69% for DPT/polio, and 55% for measles.<sup>12</sup> Measles coverage was reported to be 70% in Gujarat. The WHO program on eradication of polio had a mopping-up campaign in Gujarat shortly before the earthquake.

#### *Post-event Phase*

When an outbreak of measles was reported in a village close to the city of Bhuj early in February 2001, the United Nations Children's Fund (UNICEF) started a vaccination campaign, using health personnel from the local clinics. However, there were several villages in which vaccination had not been done. The ordinary vaccination program was

interrupted because of a lack of vaccines and a disruption of the cold chain.

#### *Disaster Preparedness and Management*

High vaccination coverage protects against epidemics when disaster strikes. Measles epidemics in refugee camps are known to produce high mortality rates.<sup>19</sup> To maintain a satisfactory level of primary health care, all six vaccines recommended by the EPI program should be administered, including the vitamin A capsules to reduce the incidence of blindness and mortality from measles (EPI + program).<sup>11,20</sup> Re-establishment of the cold chain will secure continuity of the vaccination program, and in case of epidemics, vaccination may start as soon as the vaccine required is on hand. Improvement of vaccines may lead to a change in vaccination policy, e.g., two new cholera vaccines with a protection of 85–90%, led to the recommendation by the WHO of vaccination in high-risk populations.<sup>21</sup> Incorporation of Haemophilus influenzae Type-B and Hepatitis B vaccines in the vaccination program also may be cost-effective and reduce the consequences of disaster.

### **4. Mother's Health and Child Health and Family Planning**

#### *Pre-event Situation*

India is the second most populated country in the world after China; the total population now exceeds one billion. A visit to India leaves no doubt that the Indian Government has placed much effort in reducing the birth rate. A family planning program that began in 1962 has succeeded in reducing the crude birth rate (annual births per 1,000 population) from 40 to 25, and the total fertility rate (the number of children born per woman) from 4.2 in 1987 to 3.0 in 1999.<sup>18</sup> Maternal illness and mortality is a major problem in the developing world. Complications related to pregnancy and delivery account for more than 500,000 deaths per year, of which 200,000 are caused by illegal abortions. The maternal mortality ratio in India is 410 (annual maternal deaths per 100,000 live births), about 100 times that for the developed countries. The utilization of antenatal and natal care is poor; 73% of pregnant women get tetanus vaccination, and trained health personnel attend only 34% of deliveries. Maternal hospitals in India have a simple standard and the hygiene is poor. Access to maternity wards is limited, and female gynecologists, though increasing in number, still are far too few.

#### *Post-event Phase*

Following the earthquake, foreign field hospitals had to replace the collapsed maternity wards. The Norwegian-Finnish Red Cross hospital had employed a midwife and included equipment for maternity care. The Israeli Field Hospital also was fully equipped for maternity care, but departed India two weeks after the earthquake.

#### *Disaster Preparedness and Management*

The WHO mother-baby package includes the four pillars of good and safe health of the mother, family planning, antenatal care, and care for the newborn baby.<sup>22</sup> Access to essential obstetrical care is necessary to reduce maternal

mortality. To treat the three major causes of maternal death during pregnancy and delivery: hemorrhage, infection, and toxemia, special equipment, drugs, and skills are required. Traditionally, field hospitals used in disasters are of military origin and pay little attention to the needs of women and children.<sup>23</sup> Over the last five to ten years, equipment for maternity care has been included, and are important tools for reducing pregnancy-related mortality. Family planning measures and female doctors still are lacking.

In the Norwegian Medical Aid System (NorAid), maternity modules with personnel and equipment required for the delivery of reproductive health services, including measures for family planning was developed in 1992.<sup>23</sup> The Minimal Initial Service Package (MISP) introduced by the United Nations High Commission for Refugees (UNHCR) in 1999, addresses reproductive health in refugee emergencies, focusing on maternity, sexually transmitted diseases, sex violence, family planning, HIV/AIDS, and youth problems.<sup>24</sup> The increased number of abortions, premature labors, and fetal deaths observed after the earthquake in Gujarat, calls for a stronger emphasis on reproductive health also during natural disasters.<sup>25</sup>

## Child Health

### *Pre-event Situation*

A considerable part, direct or indirect, of the 11 million children that die every year, die as a result of war and disaster.<sup>23</sup> They die from causes that easily could be prevented by the use of simple means such as vaccinations, rehydration salts, and antibiotics. Lower respiratory tract infection is the leading cause of child mortality, followed by diarrhea.<sup>26</sup> A high under-5 year mortality rate (U5MR) of 98 in India ranks number 49 among 193 countries. The infant mortality rate is 70 (probability of dying between birth and one year of age expressed per 1,000 live births).

### *Post-event Phase*

At Dr. Shantu Patel Paediatric Hospital in Bhuj, the children had to be moved out of the hospital into tents. Pediatricians and nurses came from Bombay to work 1–2 weeks on rotation at the hospital. Pneumonia demanded its death toll among the disaster victims. A lack of adequate skills, equipment, and drugs may have been the contributory causes. Pediatric-formulated drugs and equipment like antibiotic syrups, deworming syrup, iron, and vitamin mixtures were also lacking. The two incubators donated by the Israeli Field Hospital were essential in keeping the premature babies warm during the cold nights.

### *Disaster Preparedness and Management*

While pediatricians from other parts of India came to assist Gujarat after the earthquake, the international community was not prepared to assist with pediatric drugs and equipment. If the occurrence and causes of childhood and infant mortality were mapped, special programs for mortality reduction may be initiated. A study from rural India on perinatal and neonatal mortality highlights the need for training workers at the grass-roots level for the improvement of infant care.<sup>28</sup> The WHO and UNICEF have introduced the Integrated Management of Childhood

Illnesses program, in which health workers are trained in total evaluation of the child using flow-charts.<sup>27</sup> Development of national policies on case management will protect against chaos and confusion during a disaster.

## 5. Essential Drugs

### *Pre-event Situation*

Essential drugs as defined by the WHO have as characteristics, safety, efficacy, and affordability,<sup>29</sup> indicating that they are of utmost importance and necessary for the health of the population. The first official list of essential drugs, published in 1977, played a critical role in promoting a new approach to drug policies. By the end of the last century, about 90 countries had developed a national strategy for essential drugs. The concept now has expanded to include the rational use of drugs to avoid misuse and excessive consumption.<sup>30</sup>

In the early 1970s, India decided to increase the local production of drugs and purchase a limited number of essential drugs in their generic form in bulk. Since 1979, when the Drugs Consultative Committee began to review fixed-dose combinations, 27 categories of potentially harmful drugs have been banned.<sup>31</sup> One of the main constraints to drug use in India is purchase without prescription. Misuse of antibiotics in self-limiting diseases has led to the development of drug resistance all over the world, and India has been no exception.

### *Post-event Phase*

Drug stores and the drug distribution system collapsed following the earthquake. Nearly three weeks after the earthquake, pharmaceuticals had piled up in large quantities in tents without cupboards and without order, the ambient temperature rising above 50°C (122°F) during daytime. Advanced hospital drugs and narcotic drugs were inter-mingled with drugs that required refrigeration. Some of the drugs were labeled in a foreign language, some of them were nearly outdated or without relevance to the disaster situation. Though prefabricated facilities were about to be built, the drugs probably would have been destroyed by the time the buildings were completed. The scarcity of pediatric drugs was obvious.

### *Disaster Preparedness and Management*

The chaos associated with pharmaceutical agents might have been less if national guidelines on administrative procedures had been developed as part of disaster preparedness.<sup>32</sup> Specifying the needs, indicating the required quantities, and prioritizing the items for 10,000 people could be done prior to the development of the disaster. The WHO's "new" Emergency Health Kit is stocked by several major international suppliers (for example, UNICEF) and easily could be provided during disasters. The contents, however, are very basic, and additional drugs may be identified that comply with the affected country's developmental level and needs. The NorAid system also is being stored in the Oslo region by a grant from the Norwegian Foreign Department, and contains a wider selection of pediatric drugs. The standard case management policy introduced by WHO, may help to combat misuse of antibiotics.<sup>23</sup>



## 6. Nutrition

### *Pre-event Situation*

It is estimated that malnutrition may be the underlying cause of 50% of deaths in children below five years of age worldwide. In India, more than 50% of the children under five years of age are underweight. Because of late introduction to weaning foods, children will start their life with an insufficient diet and increased susceptibility to infections. Parasites, including hookworm and malaria, contribute to the commonly seen anemia. More than 50% of the women in India exclusively breast-feed their children up to three months of age. Making a 500-calorie, nutritious meal, the Anganwadi teacher will teach the mothers and children about nutrition, spending four hours with them. However, referral and follow-up of the malnourished child may be lacking partly because there is no good link to the health system.

### *Post-event Phase*

In the drought-struck Gujarat state, the government only decided to alarm the World Food Program (WFP) five days after the earthquake, when the food situation started to become desperate. Warehouses and shops belonging to the Public Distribution System had collapsed, and people had lost their ration cards. After distribution of fortified biscuits during the first phase, the Integrated Child Development Services were re-established. The Anganwadi centers were supplied with Indiamix, a low-cost, micro-nutrient fortified, pre-cooked food supplement made from wheat, full-fat soya-bean, and maize.

### *Disaster Preparedness and Management*

Mothers and infants should be considered a top priority during disaster emergencies. Mothers with nursing problems are in need of supplementary feeding and advice. The stressful conditions during disasters may cause the mother to lose her milk.<sup>34</sup> Resourceful mothers with a surplus of milk should be registered for wet nursing in a day-care nursing and feeding center. For those infants who cannot be breast-fed by their mothers, the use of wet nursing is a good alternative in areas with a low level of HIV prevalence. Modern formula feed is the best alternative when a need for breast-milk substitutes is established. Because of the high risk of bacterial contamination, breast-milk substitutes only should be administered by cup and spoon.

Crises in regions in which breast-feeding is not the norm have revealed serious problems with regards to infant feeding.<sup>33</sup> Bottle-fed infants are more vulnerable in disasters compared to breast fed, because of reduced hygiene and the lack of powder milk. Besides poverty, a lack of knowledge is one of the most important causes of malnutrition with late introduction of weaning food. The difficulty of treating a severely malnourished child makes preventive efforts, like growth monitoring, very rewarding.<sup>11</sup> Any reduction in the level of malnutrition during normal times will make the child better prepared for disasters.

With little coordination, UN organizations and NGOs have developed their own policies on nutritional emergency responses.<sup>33</sup> Study of operational habits and mapping of commonly used weaning food should be part of

disaster preparedness. In Gujarat, a millet called bagera, commonly is used as a weaning food; it is rich in calcium, but poor in iron. During disasters, proper weaning food commonly has been lacking. The most common micro-nutrient deficiencies should be identified and the best strategies for improving the nutritional status of the population should be developed using supplementation, food fortification, and dietary diversification.<sup>20</sup> The strategy must be context specific and take into account climate, agricultural potential, local infrastructure, food beliefs and practices, and socioeconomic status of the population. Dietary approaches are the cheapest and most sustainable method for improving the nutritional state of the population.

If growth monitoring has not been established, surveys of the nutritional status using weight-for-height assessments should be part of disaster management.<sup>34</sup> The survey may act as a baseline to diagnose the problem, monitor the situation, and monitor the impact of interventions. A survey also should identify the groups at highest risk, e.g., nomads, displaced groups, and specific age groups, and estimate the number of people needing assistance.<sup>35</sup>

## 7. Treatment of Diseases

### *Pre-event Situation*

Life expectancy, which in India, is 63 years, is related to the level of healthcare services available.<sup>12</sup> Disasters may increase the transmission of communicable diseases due to overcrowding, lack of hygiene and sanitation, and deterioration of the environment.<sup>13</sup> Tuberculosis represents a special problem in disasters because of its long treatment duration, its association with the HIV/AIDS pandemic, and the risk of spreading resistant bacilli due to the interruption of treatment. Nearly two million deaths worldwide were recorded during 2000.<sup>36</sup> Malaria yearly kills 1–3 million people, and may cause problems in disasters with displacement of unexposed people into infected areas.

The concept of primary health care also includes treatment at the first-line hospital level. Though Gujarat was fairly well equipped with hospitals, the level of primary health care in the countryside had serious shortcomings with a lack of educated health personnel, low vaccination coverage, and frequent epidemics.

### *Post-event Phase*

The earthquake destroyed an estimated 650–700 hospital beds, of which around half were surgical beds. Around 700,000–900,000 persons completely or partly had lost their access to primary health care services (Table 2). During the first week after the earthquake, the army had to handle the enormous patient load. After four to six days, a great influx of field hospitals from overseas countries started to flood into the disaster area. Because of their late arrival, hardly any casualties from the earthquake remained to receive medical care. A Norwegian-Finnish-German Red Cross cooperative venture resulted in the establishment of a hospital with the potential of 300 beds, which was in operation by the sixth day after the earthquake. At least 500–600 hospital beds arrived in the disaster area; most were surgical beds.

### *Disaster Preparedness and Management*

The collapse of healthcare facilities in earthquakes often creates a need for foreign assistance. Even if the acute phase was over when foreign relief arrived, re-operation, re-dressing, and treatment of infections of the earthquake-related casualties and new surgical casualties made foreign hospital beds and staff necessary. When the acute phase was over and foreign medical staff had left, the health personnel who perished in the earthquake were not replaced, and the remaining staff were over-stretched and exhausted. The workload still had not returned to normal levels. In Gujarat, the many cases of mal-union of bones and limb gangrene were seen after the earthquake, perhaps related to negligence and the lack of medical follow-up.<sup>25</sup> Past experiences from post-disaster responses in India showed serious deficiencies in care for the disabled. A report from the Kutch Nav Nirman Abhiyan demanded increased compensation for paraplegics, comprehensive medical rehabilitation centers, and community-based rehabilitation centers. Still, the field-hospital capacity arriving to the disaster area often exceeds the need for surgery, while other medical needs are neglected. In Tamale Regional Hospital in Ghana, only 15% of the patients needed surgery.<sup>37</sup> Ninety-seven percent of the deaths had medical diagnoses, indicating the need for medical equipment, drugs, and skills also in disasters. If public health teams are organized to visit the villages on a regular basis, they also may do medical treatment and preventive health care along with medical intelligence and need assessment (Figure 1).<sup>3</sup>

The complexity of preventing and treating certain diseases has led to the implementation of special programs by the WHO. The global plan to stop the epidemic, "Stop TB Partnership", was launched in October 2001 by the WHO and the World Bank, proposing the expansion of national access to Directly Observed Treatments (DOTS).<sup>38</sup> When applied properly, this strategy provides treatment success rates worldwide, reaching nine out of 10 people. Taking the great risk of tuberculosis transmission into account, the WHO tuberculosis programs DOTS should be implemented or followed up in disasters also.

## **8. Water and Sanitation**

### *Pre-event Situation*

In India as a whole, 88% of the population use improved drinking water, 92% in urban and 86% in rural areas. Only 31% of the population use adequate sanitation facilities, 73% in urban and 14% in rural areas. Waterborne and water-related disease epidemics constitute >70% of the epidemic emergencies in India, indicating inadequacies in water management practices.<sup>17</sup> Potable water is the most important relief commodity for ensuring the survival of disaster-affected populations.

### *Post-event Phase*

Three of nine tube wells, 50% of the pipeline network, and half of the cistern pump machines were destroyed in the earthquake. Twenty-two dams had cracks. Because of power failure, water could not be drawn from the wells. Twelve days after the earthquake, not enough tankers were

available, and the water supply to the villages was inadequate. Chlorination was done at the water source. The WHO had brought in water engineers and chloroscopes for the measurement of chlorine.

### *Disaster Preparedness and Management*

Since quality and quantity of water resources are closely related to the health status of a disaster-affected population,<sup>38</sup> emergency water programs must be an integral part of the public health component in disaster responses. Potential water sources should be assessed on the biological and chemical risks associated with them. When mapping of climate, rainfall, seasonal changes, and local water resources is done as part of disaster preparedness, an environmental survey easily can be done during the post-event period to help public health authorities establish relief priorities related to water management. Specialist teams composed of water engineers, sanitary workers, and hygiene specialists should be involved at an early stage.

The building and maintenance of small local dams to collect rainwater, the digging of wells, and the provision of water-tanks are among the main actions of the Self-Employment Women's Association, India's largest labor union.

## **Discussion**

Weaknesses in every society may lead to rapid deterioration in disasters.<sup>3,4</sup> In addition to mapping disaster-prone areas, identification and analysis of vulnerability, as well as strengths in a society are crucial in the strategic development of disaster preparedness and relief. Identification of discriminated groups is part of the process, and may reveal potential instability in the community. Evaluation of the pre-event status in Gujarat revealed a complex situation in a vulnerable society with substantial deficiencies in the health system that added to the severity of the sudden-onset disaster. Poverty imposed by the cast system, drought for three consecutive years, illiteracy, frequent epidemics, low vaccination coverage, high mother and child mortality, lack of adequate numbers of health personnel, and poor hygienic conditions all compromised the public health status during the delivery of disaster relief. Indicators selected to assess the level of function of the Primary Health Care System are simple, easy to understand, and provide a good picture of the pre-event status (Table 1).<sup>3</sup> Compared to a developed country like Norway, India clearly is more vulnerable.

Disaster relief in Gujarat had low quality for several reasons: (1) proper public health indicators had not yet been developed; (2) efficient central and local coordination was lacking; (3) insufficient, overestimated, or partly irrelevant relief was provided; (4) the relief was delayed because of bureaucracy; and (5) policies on delivery of disaster relief had not been developed.

## **Public Health Indicators**

General improvements in public health, such as better vaccination coverage, will make the country better prepared to handle sudden-onset events such as earthquakes. By identifying the vulnerabilities associated with climate, geography,

and in the society as a whole, including public health, the shortcomings may be attacked during the acute phase of the disaster (Table 1).<sup>3</sup>

The assignment of indicators to the eight ELEMENTS of PHC may provide a useful measure of the disaster impact and the level of development within public health/health care, and provide an indication to the type and amount of relief required, thus making disaster relief more relevant and feasible.

#### *Central and Local Coordination*

Experience from past disasters repeatedly calls for a strong, centralized coordination and control system to channel aid resources to those most in need.<sup>34</sup> A Relief Coordination Center that receives reports from the whole world on a 24-hour basis may direct the relief through the right channels (Figure 1). An Expert Panel should secure coverage of all aspects within health, and build an estimated need for disaster relief on the assessments from a Rapid Need Assessment Team, ready to go to the disaster area within 24 hours. If the UN organizations and NGOs are allocated responsibilities for different aspects within disaster relief, a more relevant relief program with less overlap probably would result. Countries with bilateral agreements also may include disaster relief as part of their cooperation. Development of a strong level of disaster preparedness at the local level may reduce unnecessary delays of disaster relief. Following the devastating cyclone that struck Kutch in May 1998, the Kutch Nav Nirman Abhiyan emerged as a network of voluntary organizations, undertaking coordination, planning, lobbying, and capacity building in the district. After the earthquake, Abhiyan took the lead for coordination. It registered all organizations and their resources, and had daily meetings with them for the first two weeks; later, twice each week.

Unfortunately, need assessments were not conducted in all of the affected villages, and some of the most affected villages did not receive relief for several weeks. Continual surveillance was lacking, and many organizations had to make changes in their programs because of overlap. A Rapid Need Assessment Team established locally, that knows the language and the culture, could be in place shortly after the event strikes, and could make immediate requests to the National Relief Coordination Center based on an estimate of needs.<sup>32</sup>

The usual healthcare system had partly collapsed, and the NGO organized mobile health teams with different functions. Unfortunately, their move into the villages was not organized properly, and many villages did not receive the needed help. The organization of mobile, multi-purpose Primary Health Care teams, covering all aspects of the Primary Health Care System on regular visits to all villages, also may conduct surveillance and inform the National Relief Coordination Center on the different needs in the villages.<sup>3</sup>

#### **Overestimated or Partly Irrelevant Relief**

When the field hospitals eventually arrived, they had an over-capacity of surgical beds, while other medical fields were neglected. Lack of skills, equipment, and drugs,

demanding its death toll among the children in the post-earthquake phase. Only the Israeli field hospital brought equipment and drugs for infants and children. Fortunately, maternity services had been provided by the Israeli unit during the last few years. Several pre-packed kits for emergency relief have been designed, like the WHO New Emergency Health Kit. The Norwegian Medical Aid System (NorAid) is designed to cover the need for Primary Health Care as defined by the WHO, with a focus on women and children. This type of equipment was urgently needed by a population of 700,000–900,000, who completely or partly had lost access to primary healthcare services.<sup>23</sup> One year after the earthquake, doctors and nurses still were working out of tents or other temporary shelters with scant resources and work overload.<sup>25</sup>

#### **Relief Delays Due to Bureaucracy**

The first days after a sudden-onset event strikes must be managed using the affected country's own resources, even when the time before foreign relief arrives is shortened. When foreign field hospitals arrived five to seven days after the earthquake, almost all of the casualties already had been operated on. The military medical department in Bhuj had to manage the great bulk of the injured victims created by the earthquake, supported by surgical teams from other parts of India. Distribution of tents for shelter turned out to be a great problem. More than 120,000 tents had piled up in Bhuj by the end of the fourth week after the earthquake because there was no distribution code. Pre-event agreements on distribution could solve this problem for future catastrophes.

As a response to the UN Resolution A/RES/46/142, adopted 19 December 1991, the UN Office for the Coordination of Humanitarian Affairs (OCHA) has developed a Central Registry of Disaster Management Capacities as an operational tool to support the UN and the international community, and to ensure expeditious delivery of humanitarian emergency assistance. However, the UN system is delayed by its own bureaucracy and security regulations. Being dependent on a request for assistance from the receiving country, both the WHO and the WFP were delayed getting to the disaster area by five to six days.

Software called Relief Supply Management System (SUMA) has been developed by the PAHO/WHO to coordinate donations, standardize equipment, and exchange information between the organizations.<sup>40</sup> The software currently is being tested in several countries. On condition of NGO willingness to collaborate under the inspection of SUMA and under general coordination of the WHO, this project may be an important step in the right direction.

#### **Policies on Delivery**

There is little time for policy-making and implementation of rules during the acute phase of a disaster. Therefore, policy-making related to disasters must be part of disaster planning in both receiving and donor countries. Through a carefully developed disaster relief policy, intervention in disasters may be based on commonly agreed upon criteria, where the distinctive characteristics of each country are

taken into account.<sup>3,34</sup> The relief policies should be in accordance with the WHO's policies on Primary Health Care as stated in the Alma Ata Declaration of 1978,<sup>3,34</sup> and linked to the level of development in every country. The receiving country should make agreements with UN organizations on when and how interventions should take place.

### International Agreements

To avoid delay in customs, pre-event simplification of bureaucracy must be worked out. The Japanese field hospital was released only after two days in customs because lists of the equipment were lacking. There is a lot of paper work to be done before the equipment is ready to be shipped, even with pre-packed kits. United Nations organizations are dependent upon requests from the disaster-affected country before they can intervene. Some countries only reluctantly ask for disaster relief, and a hesitant Indian government only asked key organizations like the WHO and WFP for assistance after five days. The delay might have been avoided if pre-event agreements on disaster assistance had existed.

### WHO Policies and Guidelines

In the urgency of giving relief to the disaster-affected victims, rules and regulations often must be omitted. The WHO has developed policies and guidelines on essential drugs, drug handling, feeding practices, and standardized case management. Incorporation of these guidelines into legislation and the implementation of them, will simplify standard relief in disasters. Guidelines for drug donations are made by the WHO in cooperation with NGOs, and are intended to serve as national or institutional guidelines to be reviewed, adapted, and implemented by governments and organizations dealing with drug donations.<sup>29</sup>

### Conclusion

To optimize the effectiveness of limited resources, disaster preparedness, and the provision of feasible and necessary aid is of utmost importance. A successful disaster response will depend on profound medical intelligence and socio-geographical mapping in advance with the use of assigned indicators, during and after the event(s) that cause the disaster.

An assessed, rapid, crisis intervention may be achieved by ongoing surveillance of the world's situation by a Relief Coordination Center. A panel of experts could evaluate and coordinate the disaster response and make use of stored emergency material and emergency teams. More effective and feasible use of the equipment coordinated with the relief provided by the rest of the world is necessary. In all types of disasters, there is a need to restore and maintain the primary health care/public health services and handle all types of medical problems in all ages, with special focus on vulnerable groups like women, children, the elderly, and those with chronic diseases. Primary Health Care teams with multi-purpose functions covering the whole disaster area on a regular basis will secure surveillance and provision of the goods and services necessary to meet the needs of the disaster-affected population.

If policies and agreements on when and how to intervene are developed as part of disaster preparedness, on international, bilateral, and national levels, disaster relief may be swifter, more relevant, less chaotic, and easier to estimate, thus bringing an improved relief to the disaster victims. By assigning indicators to the eight ELEMENTS of the Primary Health Care System, the level of development and measurement of disaster impact hopefully will become more standardized and make disaster relief more relevant and feasible.

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