

## Disaster Preparedness

### An International Perspective

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**Establishing a national disaster medical system requires considering the goals and appropriate expenditure levels for emergency preparedness. The United States has placed a relatively low priority on national programs for disaster response. Such programs have been controversial because of their relationship to civil defense against nuclear attack. Switzerland and the Soviet Union have long-established, elaborate medical response systems that should be studied.**

**MODERN SOCIETY** has dense concentrations of population and a dependence on technologic life support systems. These factors have created an unprecedented vulnerability to disaster resulting from natural phenomena, technologic failures, or military conflict.

Tornados caused more than 1000 casualties within 5 hours in the Carolinas in March 1984 (1). An earthquake in California could injure up to 100 000 people (2). Between 1970 and 1981, the United Nations Disaster Relief Organization estimated that 354 000 deaths were caused by windstorms, 442 000 by earthquakes, and 64 000 by floods (3).

The most serious recent technologic disaster was a gas leak at a chemical plant in Bhopal, India, which killed more than 2000 people (4) and injured perhaps 200 000 (5). Because of a fire at an oil-fueled generating facility near Caracas, Venezuela, 40 000 people had to be evacuated in December 1982 (6).

The worst type of likely catastrophe is due to military conflict. Modern warfare inflicts the heaviest losses upon civilians. In World War I, 20 soldiers died for every civilian death; World War II claimed equal numbers of victims among civilians and soldiers. In Vietnam, the ratio of World War I was reversed; 20 civilians died for every combatant. The ratio might be 100 to 1 in a future war (7).

Terrorist actions that indiscriminately threaten civilian populations are increasingly common. Although the actual number of terrorists may be less than in past decades, there is evidence of better coordination and training (8). Relatively simple means could be used to interrupt the water, food, oil, or electrical power supply of an industrial society. In addition, the miniaturization and decreased cost of modern weaponry, including nuclear warheads the size of a suitcase (9), could enable small bands of revolutionaries to jeopardize thousands of lives.

In situations with mass casualties, management techniques appropriate for a few casualties are not applicable. Yet, although trauma care in general has improved sub-

stantially, disaster response has not changed much since World War II. There has been no systematic approach to planning (10). As a result, victims die who might be saved. A study of more than 100 disasters, which reconstructed 3 in detail, concluded that in earthquakes 73% of the deaths could be averted with improved preparations and rescue operations. In a volcanic eruption, 74% of the victims had injuries that might have been prevented by protective equipment. In the crash of a scheduled airliner, perhaps 25% of those who died could have been rescued with optimum equipment and effort (11).

Some requirements for the care of mass casualties (triage, transportation, communication, supplies, trained personnel, shelter, food, and water) are similar, regardless of the cause of the disaster. Thus, preparations for natural disasters overlap civil defense measures for nuclear war. Indeed, "dual use" has been the stated policy of the Federal Emergency Management Agency (12). Opposition to civil defense has resulted in diminished funding even for peacetime medical preparedness. Physicians groups, notably Physicians for Social Responsibility, have opposed both the Civilian-Military Contingency Hospital System (13) and the National Disaster Medical System (14).

In other nations, the relationship between preparedness for natural, technologic, and military disasters is also recognized. However, belief in the hopeless prognosis of nuclear warfare, reflected in the American medical literature (15, 16), generally does not predominate elsewhere, and fears of provoking nuclear conflict do not impede emergency planning. The United States could benefit from a study of foreign medical preparedness programs.

#### Swiss Medical Preparedness

Although Switzerland has been at peace for more than 150 years, it is located in the center of a frequently war-torn continent. The Swiss believe they are the potential target of weapons of mass destruction, or at least may suffer the effects of weapons detonated in neighboring countries. They also recognize the dangers posed by conventional weapons, as well as by biological and chemical warfare.

Swiss civil defense has three goals: "In case of war or emergency . . . [to] enable the majority of our population to survive unharmed, and thereby create the precondition for living on, for reconstruction and the continued exist-

tence of our nation"; to increase "capability of resistance against aggression and attempted blackmail by foreign powers"; and to assist in the event of natural or technical catastrophes (17).

The federal law on Swiss civil defense created a medical service to carry out the rescue and care of the injured and the infirm. Protected, underground medical facilities make this mission feasible even under conditions of war or disaster. Sheltered beds are planned for 2% of the population, one third each as first aid posts, auxiliary medical stations, and stations of definitive treatment (including operating rooms). By 1982, about half the planned facilities had been constructed. These facilities are dispersed to the extent permitted by cost considerations.

The proportion of the population assumed to be injured may seem unrealistically low, unless one realizes the emphasis placed on prevention, which is undoubtedly the most cost-effective approach. A space in a normal Swiss shelter—which includes protection against blast, thermal radiation, ionizing radiation, and chemical and biological agents—is estimated to cost about 600 to 1000 Swiss francs, whereas a bed in a protected first aid post costs about 8000 Swiss francs, and in a station of definitive treatment about 20 000 Swiss francs (7).

Training the personnel to operate the emergency centers involves a 5-day initial course, followed by yearly 2-day exercises. Of the 420 000 Swiss men involved in compulsory civil defense service, about 10% could be assigned to the medical service. Volunteer women would be expected to supplement this number. In addition to medical duties, the medical service is trained for fire-fighting and rescue functions (7).

Swiss expenditures for civil defense preparedness amount to about \$29 per capita per year, which is about 0.195% of the gross national product (18). In comparison, about 70 times as much is spent for social and other types of insurance (19).

#### Soviet Medical Preparedness

Like the Swiss, the Soviets have an organized civil defense system that involves the entire population, and is designed to respond to all types of disasters. The Soviet philosophy toward civil defense, expressed in *Voyennyye Znaniya* (Military Knowledge), a monthly civil defense journal, is that the protection of the population, especially of children, is a "humane, crucial, and noble task" (20). In addition, "preserving the population—the basic productive force of the country—ensuring economic stability, and preserving the material and technical resources are of paramount importance during a war. Thus, under modern conditions, *civil defense has become a factor of strategic importance*. To a considerable degree, the success of civil defense measures predetermines the viability and stability of the country" (emphasis in original) (21).

Unlike the Swiss, who rely almost exclusively on shelters, the Soviets place a heavy emphasis on evacuation, while the shelter inventory is being expanded. If there is a threat of war, plans call for relocating various urban hos-

pital systems to rural areas. Plans before attack include discharging ambulatory patients, evacuating patients requiring further hospitalization, and moving patients unfit for travel to the hospital's on-site shelters, along with a portion of the medical staff (22).

In an actual disaster, a two-stage medical evacuation system is supposed to be activated consisting of mobile rescue, triage, first aid, and emergency treatment squads at the disaster site, and generalized and specialized hospitals to be established in areas outside cities (23). Supporting the field detachments are dedicated motor vehicles, equipped with tents, mobile electric power generators, mobile water supply, radios, dosimeters, chemical detection kits, heating units, medical supplies, stretchers, and other supplies. Special brigades are organized to deal with potential epidemics. A mobile hospital for infectious diseases is said to have the capacity to hospitalize and treat 200 patients for 1 month. A comprehensive plan for the triage of patients and for evacuating the injured to hospitals equipped to care for them has been developed (22).

Because medical response to disaster may be delayed for various reasons, including danger to the rescuers, training the citizenry is given a high priority. All citizens are instructed in first aid as part of the compulsory civil defense training that begins in the second grade (22). During the last 2 years of high school, all students have twice-weekly instruction in military subjects and civil defense (24). Even students in the humanities at Soviet universities have 40 hours of civil defense medical instruction, including 24 hours in the care of hospitalized patients. The curriculum also covers hygiene and epidemic prevention, organization of first medical assistance teams in zones of destruction, and the responsibilities of nurses for patient care (22).

Besides the usual basic civil defense course in warning signals, protection of food and water supplies, decontamination, shelters, and evacuation, medical students receive advanced instruction to prepare them for duty in the civil defense medical service. The handbook used in this course includes the organization of medical assistance, methods for the evacuation of injured, projections of various types of casualties in the different zones around the detonation of a nuclear warhead, medical assistance to a population being evacuated, and problems of operations in zones of biological or chemical contamination. Exercises and examinations may be conducted at training sites simulating a zone of nuclear destruction. Working medical personnel also take compulsory postgraduate training in medical preparedness, and exercises are conducted periodically (22).

The ability of this system actually to function under wartime conditions is, of course, uncertain. The Soviet Union faces some of the same problems as the United States does, especially the concentration of population in urban areas. In addition, even in peacetime the Soviets must cope with shortages of basic equipment and drugs (24), and of trained specialists. However, the personnel are better prepared to work under primitive conditions. Despite civilian deprivation during peace, the Soviet Un-

ion appears to be committed to the maintenance of large wartime reserves of various commodities; it is not known to what extent medical supplies are stockpiled.

The success of preparedness measures depends to a large extent on the type and scope of the disaster. For example, the effects of a nuclear attack would vary with the targeting strategy, the number of warheads used, and the amount of warning time. Soviet estimates of the probable number of casualties are considered secret; public discussions are based on foreign scenarios and estimates derived from studies of the unprotected populations of Hiroshima and Nagasaki. Soviet civil defense manuals point out that a surprise attack on an unprepared city could result in 50% to 60% casualties, whereas use of the best available shelter would reduce deaths substantially, and evacuation of most residents might reduce the casualty rate to 5% or 6% (22). The type of casualties would also depend on the preventive measures taken. Burns, trauma due to flying debris, and severe radiation sickness—the main causes of morbidity and mortality in an unprotected population—would be uncommon in a sheltered population.

Although many Americans assume that a nuclear war would begin with a massive surprise attack on cities, some experts think this is the least likely scenario (25). Other possibilities include a limited attack designed to achieve specific military objectives (26), a "counterforce" strike against military installations, the slow and deliberate destruction of cities (27), and nuclear blackmail (28).

Many experts dismiss the "temporary" efficacy of life-saving civil defense measures because of the delayed effects of nuclear conflict, which, it is believed, would prevent the recovery of civilization, even if the human race did not become extinct (29). Clearly, the Soviets do not share the view that recovery efforts would be futile. A textbook used in universities describes emergency restoration work: how to reinforce or demolish unstable buildings, how to repair damaged sewer lines, and how to reestablish communications (21). Since 1966, the Soviets have emphasized defense as well as economics in placing their industrial plants, so that their heavy industry has been dispersed considerably (30, 31).

The delayed effects of nuclear war might, of course, be more severe than previous calculations indicated. For example, the climate may be perturbed by the smoke and dust produced in nuclear explosions. Such an outcome, though possible, is speculative. If the amount of smoke assumed in the "nuclear winter" report (32) were decreased by a factor of 2.5, the climatic effect would probably be trivial. In considering the actual terrain that surrounds most likely targets, the probable type of explosions (ground bursts against hardened military facilities), the overlapping of targets, and conditions that could reduce the incendiary potential of the thermal pulse, critics of the report believe that the quantity of smoke from nonurban fires has probably been overestimated by at least a factor of ten (33). Rathjens and Siegel (34) believe there would likely be four times less smoke and eight times less soot from cities than estimat-

ed in the National Research Council study. Rational military planners would be expected to modify targeting strategy in such a way as to minimize the climatic impact (34). In any case, the nuclear winter theory has not yet caused a noticeable modification in Soviet civil defense efforts or foreign policy. If a severe and protracted nuclear winter did occur, then all expenditures for civil defense would be wasted—but then so would all expenditures for other programs (child care, clinics, cancer screening, rehabilitation, and the like). On the other hand, in the event of a nuclear war without a nuclear winter, the lack of civil defense would mean tens of millions of preventable casualties.

The high priority accorded by the Soviets to civil defense is apparent from their annual expenditures, estimated to be about \$3 billion (22): about \$11 per capita, or 0.37% of the gross national product (18). Approximately 30% is believed to be designated for the medical service (22).

#### **American Medical Preparedness**

In contrast to Switzerland and the Soviet Union, and other nations not discussed here (France, Sweden, Finland, and the People's Republic of China), the United States has neither a credible medical response plan, nor a system of preventive measures (such as shelters) to aid the civilian population in the event of a nuclear attack or other nationwide catastrophe. In fact, the civil defense program that was begun in the 1950s and 1960s (12) has largely been dismantled (35). Training programs, considered to be of vital importance elsewhere, are minimal in the United States. Only eight medical schools in this country have a required course on the effects of nuclear war (36). A 3-hour course at the University of Arizona College of Medicine included a description of the effects of a 1-megaton explosion over Tucson, a critique of the evacuation plan, and a discussion of the effects of radiation. None of the principles of mass casualty care was presented; nor are these principles included in the course outline suggested by Physicians for Social Responsibility (37). Prevention, in the context of nuclear war, is taken to mean arms control, not prevention of burns and radiation sickness in the event that an attack occurs despite arms control agreements.

The U.S. budget for emergency management is less than \$1 per person per year, about 0.006% of the gross national product (18). Most of this funding is earmarked for natural disasters; about 9 cents per person per year is for civilian protection in the event of war (38).

#### **Should Disaster Planning Be Improved in the United States?**

The United States Congress has frequently cut the budget for emergency planning (12), believing that this type of social insurance is too costly. Obviously, the Swiss and the Soviets have a different perception. What would be a rational level of spending?

Although one might contend that life is priceless, a dollar value is often placed on it for various practical purposes. Based on a Rand Corporation study of wrongful-death awards in Chicago, an American life is worth

about \$500 000 (5). It is often considered worthwhile to spend \$65 000 on rescue helicopters to save a single life, \$30 000 per life saved by a mobile intensive care unit, or \$400 000 per life saved by tire inspection (39). On the other hand, \$1000 may be thought too much to pay for a space in a blast shelter.

In general, society has shown a willingness to spend substantial sums to prepare for common types of accidents, and less to plan for the rare but catastrophic event. However, decisions are not always based on rational cost-effectiveness analysis. Expensive emergency preparations are mandated for nuclear power plants, although the probability of mass casualties from a nuclear accident is from 1000 to 10 000 times less than from other industrial-age events, such as dam failures or chlorine releases (40), for which no contingency plan may be developed.

The amount we should be willing to invest in national disaster planning depends partly on the probability of a nationwide emergency. To protect against more likely or more devastating events, the insurance premium is higher. The probability of a situation involving mass casualties seems to be increasing; widespread terrorism and civil strife are particularly ominous prospects. Some persons believe that the probability of nuclear conflict is also increasing. Another consideration is the benefit to be achieved. It has been assumed that disaster planning would be of essentially no benefit in the event of a nuclear conflict (41). This assertion is doubtful (42-45), and in any case does not apply to other catastrophes.

Other nations have undertaken disaster preparations that are vastly more extensive than those of the United States. Per capita, Switzerland spends about 30 times, and the Soviet Union about 20 times, as much for this purpose as the United States does. In view of the hazards of modern technology, a reevaluation of American philosophy and practice is indicated.

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