The World Health Organization Network for Radiation Emergency Medical Preparedness and Assistance (REMPAN)

Guennadi Souchkevitch

World Health Organization, Geneva, Switzerland

The World Health Organization (WHO) has established a system of collaborating centers known as the Radiation Emergency Medical Preparedness and Assistance Network (REMPAN) to promote radiation emergency medical preparedness, assistance, and advice to countries in cases of overexposure of populations from any source of radiation. This network consists of 13 specialized institutions located in 10 countries. Within the REMPAN there are three separate but linked activities. The first is aimed at strengthening radiation emergency medical preparedness and assistance to treat and monitor acutely exposed individuals. The second activity is directed toward improving public health advice to mitigate long-term effects of exposure to low and protracted doses that might accrue in populations living in the affected territories. This involves giving advice on protecting public health, e.g., iodine prophylaxis, psychosocial risks associated with countermeasures, and public information strategies. In addition, the REMPAN develops activities aimed at improving long-term follow-up studies and preparedness for epidemiologic investigations in territories contaminated by radionuclides from a nuclear accident. The WHO’s response in a radiation emergency depends on the type of accident and its time phase. This includes a wide range of actions from studying the situation to providing medical and public health assistance through the network of collaborating centers and relevant institutions within the REMPAN. The process of creating a reliable international system for radiation emergency medical preparedness and assistance has not yet been completed. Deficiencies in this system are outlined in this paper to attract the attention of specialists in the field of radiation protection and potential donors of the WHO program. — Environ Health Perspect 105(Suppl 6):1589–1593 (1997)

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Introduction

The need for local and national capacity to avert and respond to human-induced accidents that have significant impacts on health has increased dramatically because of socioeconomic development and political instability. International capacity to provide emergency assistance is also needed, particularly in situations in which national resources are inadequate. Malfunctioning of industrial plants and accidents during the transportation and handling of hazardous material are common causes of technological disasters. Emergencies also frequently occur during violent conflict and warfare. Mitigation of the public health consequences of disasters and emergencies depends heavily on the speed of an effective response, which in turn depends on preparedness to act and access to information about the hazards involved. Emergency preparedness and response are determined in part by the type of natural or technological disasters anticipated or that have occurred.

Technological disasters that cause radiation hazards are of special concern. From 1944 to 1995 about 382 major radiation accidents have occurred (1). The largest nuclear accident to date occurred 26 April 1986 at the Chernobyl nuclear power plant in Ukraine. This accident resulted in acute radiation sickness of 134 individuals and the death of 30 workers at the reactor site. It also created the potential to adversely affect the health of approximately 5 million people living in territories where 137Cs soil contamination density is higher than 37 kBq/m². In addition, about 800,000 accident recovery workers who participated in clean-up operations and were exposed to radiation are being continuously monitored through medical examinations. The probability of the next nuclear accident in the decade 1996 to 2006 is 66% (2). Because of widespread radioactive fallout, such accidents are not limited to the country where the accident occurred. It means international efforts must be undertaken for preparedness and response in the event of future accidents.

This paper aims to strengthen international cooperation between the World Health Organization (WHO) and specialists in the field of radiation emergency medical preparedness and response and to call to the attention of scientists and potential donors the unsolved problems in this field.

REMPAN Infrastructure

The World Health Organization approaches to improving radiation emergency medical preparedness and response include development at the national and the international levels of a well-coordinated infrastructure for monitoring health hazards and providing assistance. In cooperation with other international organizations, the WHO is involved in developing basic standards for radiation protection (3). The Chernobyl accident gave added impetus to development of WHO activities in the field of radiation emergency medical preparedness and response. In 1988, the WHO took a decision to accede to the Convention on Early Notification of a Nuclear Accident and to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. The specific role of the WHO in the family of United Nations organizations is to address issues directly relevant to the medical community and health authorities in member states. Therefore, to accomplish these goals,
the WHO established a system of specialized institutions known as the Radiation Emergency Medical Preparedness and Assistance Network (REMPAN).

The REMPAN consists of 13 WHO collaborating centers located in specialized radiological institutions in Argentina, Armenia (nominating the WHO collaborating center is in progress), Australia, Brazil, France, Germany, India (nominating the WHO collaborating center is in progress), Japan, the Russian Federation, United Kingdom, and United States. However, in the broad sense of the word, the REMPAN is a system, which in addition to the WHO collaborating centers, includes other elements.

Countries that do not have collaborating centers participate in the network through liaison institutions. For example, the WHO/REMPAN collaborating center in Argentina has been developing a regional network of liaison institutions in South America. This network includes relevant institutions in Chile, Paraguay, Peru, and Uruguay.

Contributions are also expected from support institutions, i.e., WHO collaborating centers and national institutions that could be activated and were invited to help solve particular problems, especially in emergency situations. Thus, the WHO has established a collaborating center in the Medical Radiological Research Centre in Obninsk, the Russian Federation, for radiation epidemiology, and in the All Russia Centre of Emergency and Radiation Medicine at St. Petersburg, Russian Federation, for treatment and rehabilitation of participants in the clean-up operations after the Chernobyl disaster. Close relationships exist between the REMPAN and the Institute of Radiology Medicine, Beijing, China, which has experience in treatment of radiation victims.

The REMPAN infrastructure also incorporates another network of WHO collaborating centers called the Global Environmental Radiation Monitoring Network (GERMON). This network comprises about 25 liaison institutions that provide regular data on the average radioactivity values of air, precipitation (rain, snow, dry deposition), and milk. This information is collected and analyzed in the WHO collaborating center on Environmental Radiation Monitoring in Le Vésinet, France. In the event of a major radioactivity release the GERMON’s main role is to generate and speed circulation of information needed for decision making within the REMPAN. In case of a nuclear accident or radiological emergency affecting any WHO region, the regional offices respond and assist member states to alleviate the medical and public health consequences. To strengthen the REMPAN infrastructure, the WHO/HQ (headquarters) initiated the integration process with regional offices in this field. Taking into account that the European region, because of its relatively high population densities and large number of nuclear facilities presents particularly urgent problems in the area of public health emergency preparedness and response, the WHO/HQ and WHO/EURO (regional office for Europe) jointly developed a plan to further strengthen the REMPAN infrastructure and its activities. To facilitate this goal, EURO established a system of National Health Advisers for Radiation Emergency in more than 30 countries. The next step planned is the establishment of a WHO project office in Helsinki, Finland, which will be an integral part of the REMPAN infrastructure in the European region.

REMPAN Objectives and Main Activities

Preparedness for large radiation emergencies includes planning, response, and assistance to the country in which an accident occurs. The primary objectives of the REMPAN are to promote preparedness for radiation accidents among WHO member states and to provide advice and assistance in case of a radiation accident and radiological emergency as well as assist in any follow-up studies.

There are within the REMPAN three separate but linked activities. The first is aimed at strengthening radiation emergency medical preparedness and assistance in order to treat and monitor acutely exposed individuals. The second activity deals with improving public health advice to mitigate the long-term effects of exposure to low and protracted doses of radiation that might accrue in the populations living in affected territories. This may involve giving advice on protecting public health, e.g., iodine prophylaxis, psychosocial risks associated with countermeasures, or public information strategies. The third activity involves an analysis of radiation emergencies and development of recommendations for long-term follow-up studies of the medical consequences of radiation.

Medical and Public Health Preparedness

To promote the medical and public health preparedness of member states for radiation emergencies, REMPAN participants develop guidelines and recommendations related to planning for and management of radiation emergencies. REMPAN personnel also provide training courses, seminars, and on-site assistance in planning preparedness for radiation accident/incidents. WHO REMPAN collaborating centers a) disseminate material developed within the network to appropriate liaison institutes within their geographical regions and act as training sites, particularly for developing countries; b) encourage fellowships; c) consider their role and constraints in implementation of the content on assistance in the case of a nuclear accident or radiological emergency; and d) compile and periodically update information about the capabilities of the countries involved in the network.

To facilitate training in diagnosis of radiation injuries and medical monitoring of radiation victims, the WHO international computer database on radiation exposure case histories (4,5) has been established within the REMPAN network. This database was developed by WHO/REMPAN collaborating centers in Germany (Ulm) and the Russian Federation (Moscow) and the REMPAN liaison institution in Ukraine (Kiev).

The Follow-up Study

In addition to its functions on radiation emergency medical and public health preparedness and assistance, the REMPAN would benefit from sharing its experience with and unique expertise in follow-up studies. For example, members of the REMPAN have analyzed experiences gained from the Chernobyl, Goiania, and El-Salvador accidents and made recommendations for well-designed follow-up studies. These recommendations include the following:

- establish registries of exposed people in an accident and in affected countries as soon as possible in an accident and in affected countries
- include exposed groups and controls and the children of these people (F1 generation) in future studies
- confirm the cause of death by autopsy whenever possible
- organize regular medical checkups for those alive, ideally at least once a year
- estimate individual radiation doses as soon as possible
- record other factors that could have influenced exposure and health effects.

These recommendations are closely linked with a new initiative within the REMPAN framework that is aimed at improving
radiation emergency epidemiologic preparedness. Epidemiologic investigations may involve large long-term follow ups of cohorts of affected populations and these studies must be carefully planned, organized, and supported financially, technically, and methodologically. The Chernobyl accident demonstrates that failure to develop a system for wide-range epidemiologic studies before this type of disaster created many difficulties in collection and interpretation of data on morbidity, congenital anomalies, disability, and mortality among population exposed to radiation. Promotion of activities in the area of epidemiologic preparedness for radiation emergencies may assist in the development of infrastructures for various epidemiologic studies in population groups affected by radiological accidents. This would also help avoid loss of start-up time in epidemiologic investigations. Two models at the national level may be considered to foster better epidemiologic preparedness. The first is designed for epidemiologic studies of the whole spectrum of radiation- and nonradiation-related diseases that may develop after a radiation emergency. Establishing and maintaining such an infrastructure model requires significant financial support and could be established in countries at high risk to be directly affected by a major nuclear accident. The second model is designed for selected epidemiologic investigations which are considered by national health authorities to be of high priority for given countries. These priorities may include only radiation-related diseases, such as childhood thyroid cancer, leukemia, hereditary disorders, and mental disorders in children exposed to radiation in utero. In this case, case-control study is one of the more cost-effective methods that could be used to investigate links between a radiation factor and identified pathology in an affected population.

REMPAN Actions for Assistance to an Accident Country

Major actions that REMPAN collaborating centers might take in possible radiation emergency situations are given in Table 1.

**Actions to Be Taken When an Accident Occurs**

**Early Phase**

The early phase is the time from a threat of a serious release to the first few hours after the start of the radiological release. The International Atomic Energy Agency (IAEA) is the first international organization to be notified of a nuclear accident and be provided with the relevant information about the accident by the country in which an accident occurred or an affected country. The WHO, as well as other international organizations, should immediately obtain this information through IAEA. Further WHO actions at this phase include establishing communication links between relevant international organizations, WHO regional offices, Ministries of Health of the country in which the accident occurred, affected states and those considered at risk to be affected, and collecting as much data as possible on spreading of a radioactive cloud. The WHO will also alert the REMPAN and the GERMON, provide their members with necessary information, and request REMPAN and GERMON members to provide the WHO with information on their readiness to assist (upon request) the country where the accident occurred and affected states.

**Intermediate Phase**

During this phase (from the first few hours after the start of the release to 1 or 2 days), WHO/HQ may receive an urgent request for assistance directly from the country where the accident occurred, affected countries, or through the IAEA. All messages should begin with the code word EMERCON repeated twice. Telephone calls in English are understood by all responsible officers. Depending on the person receiving the telephone call, French and Russian may also be understood at the WHO/HQ. French at the regional office for Africa (AFRO), Spanish at the regional office of the Americas (AMRO), Arabic at the regional office for the East Mediterranean (EMRO), French, Russian, and German at EURO, and Chinese at the regional office for the Western Pacific (WPRO). Telex, telefax, telegrams, and e-mail preferably should be in English. A few other languages may be tried (especially official languages at the WHO and at its regional offices), but this may sometimes cause delays in replying to the request.

Upon request, the WHO helps establish links between the country making the request and the REMPAN assisting center(s), keeping all REMPAN centers informed about details of the accident and progress in its management. Even if there is no request for assistance from the accident country in which the accident occurred or the affected countries, the WHO will take the actions necessary in order to evaluate the situation and keep the REMPAN involved.

**Recovery Phase**

The recovery phase may extend from some weeks to several years. WHO actions during this phase depend on the nature of the request from the country in which the accident occurred or the affected countries. In addition, the WHO, with the agreement of

| Type of accident | Roles of the collaborating center |
|------------------|----------------------------------|
| A major release of radioactive material from a nuclear reactor | Provide assistance and advice in the management of exposed individuals<br>Provide a team for on-site emergency treatment<br>Transfer (if possible and necessary) severely exposed patients<br>Provide for collaborating centers for specialized medical care<br>Provide facilities and staff for medical investigations and treatment<br>Assist in the development of measures necessary to limit health effects<br>Follow up medical supervision and treatment. |
| The loss of high-activity sources leading to severe exposure of some individuals | Visit accident site to identify and isolate source of irradiation<br>Make an assessment of likely exposure<br>Recommend appropriate medical treatment<br>Transfer of patients in specialized medical facilities (if necessary and requested)<br>Assist in development of procedures to strengthen the countries' abilities to manage such accidents<br>Circulate information relating to such incidents for the benefit of member states |

Table 1. Major roles of collaborating centers within REMPAN in possible radiation emergency situations.
any interested states, may initiate international programs aimed at evaluation and alleviation of the medical consequences of the accident. The Chernobyl experience has shown clearly that it is especially important during this phase for the international scientific community and public health authorities to combine efforts to study the health effects of radiation and to develop appropriate diagnostic, treatment, and rehabilitation methods. The WHO International Programme on the Health Effects of the Chernobyl Accident (IPHECA), established in 1991, is an example of international cooperation and the effective role of the REMPAN in conducting follow-up studies of the nuclear accident. A draft of the program was discussed at a REMPAN meeting held in St. Petersburg of the former Soviet Union. Priorities for the program pilot phase were set by the WHO Scientific Consultative Committee at its meeting held in Hiroshima, Japan, in 1990, with active participation by the Radiation Effects Research Foundation, which is a REMPAN member. REMPAN participation influenced subsequent development of the program by assisting national health authorities in Belarus, the Russian Federation, and Ukraine to monitor thyroid pathology and leukemia in residents of contaminated territories as well as brain damage in children exposed to radiation in utero. In addition, the IPHECA was instrumental in helping to improve national registries of the Chernobyl victims (6,7).

Further REMPAN Development

Creating a reliable system for radiation emergency medical preparedness is an ongoing process and undoubtedly the WHO will continue its activity in this field. The necessity for this is dictated by the spreading of peaceful uses of radiation, by the growing number of local military conflicts, and by terrorist acts. There presently are 437 nuclear power reactors in the world, and 39 reactors are under construction. Huge amounts of radioactive waste have been collected in nuclear enterprises, which is only part of the potential risk of radiological disaster. At the 6th REMPAN meeting held in Hiroshima in October 1995, the main deficiencies in WHO/REMPAN were identified and a number of activities proposed in order to correct these deficiencies. Taking these proposals into account, the WHO/HQ jointly with the WHO/EURO prepared a 5-year program for further development of REMPAN. This program includes general activities and those that should improve medical or public health preparedness and assistance. General activities include, for example, strengthening the REMPAN infrastructure; improving communication between network members; supporting research investigations; preparing training material for health authorities, specialists, general practitioners, and nurses; and organizing training courses/workshops.

There is a need to further develop international databases on radioprotectors, signs, and symptoms of radiation injuries and diagnostic methods and treatment of acute and chronic radiation sickness. There is also a need to develop diagnostic and treatment kits for the first aid to nuclear accident victims. Earlier published guidelines on medical preparedness for accidents should be updated taking into account lessons learned from Chernobyl. To improve public health preparedness and response to a nuclear accident, the WHO plans as soon as possible to revise the WHO/EURO Guidelines for Iodine Prophylaxis following Nuclear Accident. Follow-up of the Chernobyl accident indicated a sharp increase in thyroid cancer incidence, especially among children living in the radiocontaminated areas. This increase was noted particularly in Belarus and also in the Russian Federation and Ukraine. Before the Chernobyl accident in 1986, the annual incidence of thyroid cancer among children was some 0.5 per million. In 1994 in Belarus cancer incidence was 34 per million in children, a 70-fold increase. In Belarus more than half the childhood cancer cases occurred in Gomel Oblast directly to the north of Chernobyl and along the path of the initial radioactive cloud. Morbidity in 1994 exceeded 100 per million children, approximately 200 times higher than before the accident. There appears to be little doubt that the sharp increase in the incidence of childhood thyroid cancer is due to radioactive emissions from the Chernobyl reactor (6-9). These data have been taken into account by Ministries of Health in France, which recently announced that local authorities will begin distributing potassium iodine (KI) tablets to approximately 600,000 people living within 10 km of 24 nuclear installations, including France's 20 nuclear power facilities. In the event of a nuclear accident, these tablets will be used by people to prevent thyroid overexposure by iodine radionuclides, which could cause thyroid cancer (10). There are still many uncertainties, however, about strategies for prevention of radiation-induced thyroid cancer. Not all specialists agree on the approach of distributing stable iodine tablets among the population under normal conditions.

The WHO has also been developing a strategy to integrate the psychosocial dimension of radiation emergencies into emergency preparedness plans at local and national levels.

Conclusion

Because of world socioeconomic development and political stability, the need has increased dramatically for local and national capacities to avert and respond to major radiological accidents that have significant impact on health. The international capability to provide emergency assistance is also needed, particularly in situations for which national resources are inadequate. In response to these needs, the WHO has established an international infrastructure for better preparedness, response, and assistance in case of a radiological disaster. Plans to strengthen this infrastructure are aimed at three areas of a great concern: medical actions, public health actions, and follow-up studies of affected populations. Worldwide cooperation and financial support is needed to carry out these activities.

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