OVERVIEW OF LARGE-SCALE DISASTERS: CONSEQUENCES, SOCIAL AND OTHER PROBLEMS, SPECIAL CHARACTERISTICS

A Health Study of the Population Around Chernobyl

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The suspected health effects of the Chernobyl accident have been a matter of overriding concern for the people of the three Soviet Republics involved. A significant part of the International Chernobyl Project was devoted to an assessment of reported increases in illness attributed to the accident, and an evaluation of the health impact on the population residing in the contaminated areas.

The accident at the Chernobyl Nuclear Power Plant was one of the world's largest technological disasters. Although the immediate large releases of radioactivity were relatively well-contained within a matter of weeks, five years later, thousands of square kilometers remain heavily contaminated by radioactive material, and there are over 100,000 persons who have been living continuously in these contaminated regions. The objective of this study was to determine the health effects related to this accident.

Methods

The first step in determining the health effects of this accident was to categorize people by the duration and degree of their exposure to radiation. Four major populations were identified by the duration and degree of their exposure:

1) Workers and firemen involved in the immediate stages;
2) Decontamination workers (liquidators)—Estimates of the number of persons involved in the many clean-up phases of the accident vary from 100,000 to as many as 650,000. Most of the individuals have returned to their homes located all over the Soviet Union. It is possible that as a group, this population may incur the largest number of long-term health effects;
3) People living near the reactor and who were evacuated or relocated to other areas; and
4) People who have continued to live and work in areas of radioactive contamination, but are outside the 30 km zone immediately surrounding the accident site. While this group may not have received the highest radiation doses, they are of particular interest because they are continuing to receive radiation exposure. Those in the first three groups may have received higher doses, but their exposures have terminated.

A multinational team was formed in 1989, to carry out an international experts' assessment of the concept that the Russian Republic has evolved to enable the population to live safely in areas affected by radioactive contamination following the Chernobyl accident, and the evaluation of the effectiveness of the steps taken in these areas to safeguard the health of the population in the then Ukrainian Soviet Socialist Republic, the Byelorussian Soviet Socialist Republic, and the Russian Soviet Federated Socialist Republic.

The Project consisted of assessments made by international experts in five tasks:

1) Chronology of radiological events from the time of the accident to the present;
2) Environmental effects;
3) Radiation doses;
4) Health effects (Task 4 team); and
5) Possible counter-measures for the future.

The goal of Task 4 was to answer three basic questions about the population living in contaminated villages:

1) What health problems seen in these people might be related to Chernobyl?;
2) What health problems might be the direct result of exposure to radiation?; and
3) What can we expect?

Technological accidents are enormously complex. Therefore, assessing the effects of a technological disaster is complicated. Confounding variables must be considered at every level of analysis.

Individual "Missions"

Task 4 required multiple, separate journeys or missions to the Soviet Union. An initial 10-day, fact-finding trip was conducted to villages throughout the regions of interest and during which meetings were held with local townspeople, administrators, and physicians. The purpose of these visits was to determine the concerns of the population as well as to initially assess levels or effects. Next, a two-week, fact-finding trip was conducted to visit scientists in the major cities, including Kiev, Minsk, and Moscow. Soviet scientists were interviewed to determine what studies they had performed as well as to analyze their methodology and results. A third two-week visit was made, this time including experts in selected fields, to review Soviet data in more detail and depth.

Finally, the most difficult portion of the project was performed. This consisted of three, two-week field trips, one each to the Ukraine, Byelorussia, and the Russian Federation. The purpose of these trips was to conduct an epidemiological study of selected settlements by examining village residents. Each team included a physician who was an expert in one of the following fields: radiation effects, haematology, cancer, endocrinology, ultrasound, psychiatry or psychology, or general internal medicine. Representatives were present from the

World Health Organization during most of the trips.

Since there was only limited useful baseline data pre-event, it was necessary to identify and visit both control (uncontaminated) and contaminated villages, so that comparisons could be made. The primary source of exposure in the villages studied was fallout containing cesium that had contaminated the soil and food. A total of 13 villages were visited (seven contaminated and six control).

All questionnaires were filled-out by the patients with the guidance of the same interpreters. Analysis of the data was performed independently of the teams which collected the data.

Sixty percent of villagers included were children. Specific age groups were chosen for screening for specific medical reasons; for example, 2-year-old children were examined, because of concerns relative to lead poisoning and anaemia. In all, five groups were examined: 1) 2–5 years old; 2) 10-year-old children; 3) 40-year-old; and 4) 60-year-old adults. Participants were chosen by birth date and much care was taken to be sure representative samples from each village were obtained

Findings

Hematology and Immunology

Chernobyl firemen and plant workers demonstrated haematological changes. However, no such changes were identified in the village populations.

No pre-accident screening for anaemia was done of either children or adults who were not symptomatic. Thus, cases of anaemia could have been present and have gone undetected. Another possibility is that anaemias might have developed after Chernobyl even though they would be unlikely as a direct result of radiation exposure. Because of radioactive contamination of the food, governmental restrictions were placed on the consumption of milk, meat, and vegetables, possibly reducing the amounts of nutrients the people received. Also, people may have been so afraid of any amount of radioactivity in their food that they chose to eat very little and thus did not receive enough nutrients.

Low haemoglobin levels similar to those reported by Soviet physicians in some village children were detected. Haemoglobin levels and red cell size essentially were the same in those residing in the control and contaminated villages. A comparison of blood-cell size between US and Soviet children showed them to be the same, but the Soviet children's haemoglobin levels were slightly lower; adult US and Soviet levels were the same.

Lead in the diet may also cause low haemoglobin, and as large amounts of lead were poured into the reactor and probably vaporized and dispersed, the children's blood samples were tested for it. Food was also examined for lead. All reported lead levels were within normal ranges. Consequently, lead was excluded as a cause of low haemoglobin. Teams did not perform an analysis of either vitamin intake or of blood levels of vitamins.

Immune System

Available Soviet data did not imply that any significant changes in the immune system are present as a result of the Chernobyl disaster. Minor changes however, could not be excluded.

Thyroid Function and Nodules

There was no evidence found clinically or in blood hormone levels that changes have come about in thyroid function. Although studies of other populations have indicated that delayed hypothyroidism may be a problem, the same studies indicate that half of the cases should be apparent within five years. Thus, it is unlikely that hypothyroidism will be a major public health problem as a result of Chernobyl. The presence and frequency of enlarged thyroid glands (goiter) and nodules also were assessed by Task 4 teams. Ultrasound and physical examinations were conducted on the screened villagers. No differences were found between residents of the control and contaminated villages. Ultrasound measurements indicated slightly larger thyroid gland size when compared to measurements from other parts of the Soviet Union.

Cardiovascular Health

Many of the villagers from both the control and contaminated settlements suffered from hypertension, and most already were aware of their condition. The causes of the hypertension were not identified. All of these people have been experiencing increased stress from the accident as well as social, political, and economic disruption.

General Health

The teams compared the results of the physical examinations for age-matched people living in contaminated and control villages. Overall, 3 to 5% of the children and 10 to 20% of the adults needed medical care or supervision. The only difference found between control and contaminated villages was in the category of stomach disorders. These were more frequent in adults living in contaminated villages. No causes for these disorders were identified. Another common problem was poor dental hygiene.

The children were growing along US and Soviet standards. Overall, the people generally were healthy compared with similar populations in other countries, except for high incidences of hypertension, dental problems, and obesity.

Psychological Effects

The psychological effects go well beyond the direct biologic effects at this point in time. The primary acute health effects seen in these villages were not from radiation, but from anxiety and concern about the accident. Many of the people believed that radiation had made them ill. Many of the residents in both contaminated and uncontaminated villages also showed pessimism, depression, and fear, especially about the future.

Uncertainty about both what has happened to them and what will, definitely is a major factor influencing the mental health of everyone affected by Chernobyl. The uncertainty about the past and the present is very high because of the technological nature of the accident. The radiological phenomena involved are very complex and unseen. Objective information has done little to reduce the uncertainty of the population.

Uncertainty and anxiety about the future stems from the prospect of relocation. The lifestyle of many of the village people studied has been based on agricultural rhythms and practices for generations. Relocation poses a major possibility of disruption in their lives. Government interventions since the

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accident, as well as economic and political changes in the nation as a whole, also have raised levels of anxiety about the future.

Nutrition and Growth

Because food was the primary source of radiation exposure for most people, two areas of inquiry specifically concerned nutrition. First, the restricted diet that had been imposed by the Government to prevent people from eating contaminated food may have affected the people's general health, especially the children's. Second, were the Soviet people complying with these restrictions? The investigators could not find any evidence of problems from the new diet. Also whole-body radiation counts were performed by Task 2 and 3 investigators. It was surmised that most were complying with the prescribed diet.

Levels of food consumption were compared for control and contaminated villages and no differences were found. Comparisons of height and weight also showed no deficiency in nutrition in any of the age groups examined.

Cancer

Task 4 found no clear evidence of increases of either leukaemia or thyroid cancer in the village populations, as some Soviet physicians had reported. However, the Soviet tumour data collection system used a limited number of tumour categories; it was therefore not possible to exclude the possibility of small increases in these types of cancers.

The Task 4 researchers found no evidence to suggest an increase in congenital disease from radiation, but data received were limited, and future work needs to be done in this area.

Genetic Effects

No quantitative proof of effects on somatic mutation were identified. Many factors may have affected these findings. However, only small amounts of data were obtained and many samples degenerated during shipment. Future work is needed to better determine the genetic effects.

Summary

This study did not confirm many of the widely publicized media reports about the substantial health effects as the result of the Chernobyl accident to the general population residing in contaminated areas. This is not surprising because: 1) not enough time has elapsed since the accident for all potential radiological effects to be seen; and 2) The magnitude of the doses the population has received to date is lower than originally thought. The doses are somewhat lower than expected mostly due to the ability of the Soviet Government to bring clean food into the highly-contaminated region, and thus, limit the amount of radioactive material consumed.

None of the Project teams attempted to reach a conclusion as to what course of action should be taken in the future. This decision is properly the province of the respective governmental authorities based upon their economic realities and scientific and socio-political considerations. Recommendations were made relative to the need for more modern scientific and medical equipment, improved scientific methodology, quality assurance, and education. In addition, recommendations for follow-up monitoring of specific high risk groups were suggested.

The village population does face some risks in the future as a result of radiation exposure. There are other populations, such as the decontamination workers and the initial firemen and plant workers, some of whom already have experienced acute radiation effects, who may be at higher risk of long-term induction of tumours than is the general population. Future health studies have been planned involving both bilateral agreements between the Russian government and many individual governments and the World Health Organization.

Chernobyl represents a unique and gigantic problem in terms of health issues. Much useful data has been collected on the many health aspects of the accident. However, some information about the ultimate consequences never may be obtainable. This primarily is due to the complexity and scope of the accident and its effects.

Technological disasters have human consequences that are very different from those of natural disasters. At Chernobyl, there was a severe loss of expected control. This produced psychological consequences markedly different from those encountered after floods, earthquakes, and volcanic eruptions. No one expects to control such natural disasters. Another important psychological factor is that most natural disasters are observable to everyone: victims, relief workers, and authorities. Their effects also are relatively easy to see and understand, as are the measurements and directions of experts. By contrast, the ultimate effects of technological disasters may take years to emerge and their explanations and countermeasures to them are unfamiliar and mysterious.

However serious a natural disaster may be, recovery usually is steady and often rapid. Perhaps, Chernobyl's worst feature is its continuous threat, and the continuing fear it has generated in people. Their main fear is that the future will be blighted by cancer or genetic effects. These fears actually may have increased since the accident and show little sign of abating. Let us hope that some of these fears may be ameliorated by studies such as the one carried out by the Task 4 teams, other Project Task teams, and other objective scientific studies in the future.

Issues Related to the 1993 Mississippi Floods

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This presentation discussed the enormity and duration of the Great Mississippi Floods of 1993, the role of the American Red Cross, the differences from other disasters, and the emotional responses of victims.

Enormity and Duration

The Great Mississippi Floods of 1993 were among the worst floods in the history of the United States. In fact, the floods affected many rivers that feed the