Toxic Agent and Radiation Control: Progress Toward Objectives for the Nation for the Year 1990

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Synopsis

In 1980, the Department of Health and Human Services set national prevention objectives for 1990 in 15 health priority areas, 1 of which is the control of toxic agents and radiation. Ten objectives related to this area are priorities for the national control effort. Progress is reviewed on those priorities within the responsibilities of the Public Health Service.

Six key program elements, or types of support activities, are deemed essential to preventing, identifying, and controlling toxic agent and radiation threats. Significant progress has been made toward achieving objectives for which all key program elements have been successfully implemented to provide the requisite know-how, manpower, and tools.

Important advances have been made in reducing the blood lead levels of the population, reducing unnecessary exposure to medical X-rays, evaluating the toxicities of chemicals in toxic waste dumps, and improving the scientific and technical information base and its availability for prevention and control efforts.

The most important priority for the foreseeable future will be to expand our knowledge of potential health risks posed by toxic agents and radiation. Expanded surveillance systems and data bases are essential to determining the extent of the problems in terms of human health effects and for measuring the impact of prevention programs. Emphasis on the activities embodied in the key elements will encourage the expansion of the knowledge base and its effective application to prevention and control problems.

SOCIETY'S PERCEPTION of toxic agent and radiation control problems has changed dramatically in the last decade. While research has been carried out on adverse health effects of radiation for years, there had been little concern expressed until recently about chronic effects of exposure to chemicals and metals known collectively as toxic agents.

When major environmental laws were passed in the early 1960s, society was primarily concerned with pollutants released in large quantities, such as wastes into surface water and smoke and sulfur oxides into the air. Such pollutants stimulated both ecological and esthetic concerns, but their health risks were thought to be small, except at high concentrations. In the 1960s, the hazards posed by minute quantities of certain substances were demonstrated by the thalidomide episode and the mercury and PCB (polychlorinated biphenyls) poisonings in Japan.

As a result, scientists broadened their understanding of the extent to which environmental factors influence human health. Environmental factors were defined more widely to include such nonhereditary influences as air, water, and diet; the use of alcohol, tobacco, and drugs; occupation; and exposure to natural and medical chemicals and radiation. Public health officials were confronted with the fact that they had barely begun to address all the evident environmental health problems. Even today the scope and dimensions of the problems cannot be delineated precisely because of the complexity of the problems and insufficient scientific understanding of many of their aspects (*1*).

Increased regulatory attention was paid to toxic agents in the 1970s, but the Public Health Service (PHS) was not given a public health protection role outside the work place until 1980, under the Comprehensive Environmental Response, Compen-

sation, and Liability Act, which also created the Superfund Program. In 1980, PHS set specific, measureable national prevention objectives to be achieved by the year 1990 in 15 priority areas identified in "Promoting Health/Preventing Disease: Objectives for the Nation" (*2*). One of these priority areas is the control of toxic agents and radiation. Ten of the objectives related to this topic are priorities for the overall Federal effort (see box). This article surveys PHS progress toward the objectives pertaining to toxic agent and radiation control, as did an article in 1984 (*3*).

Environmental Health Program Key Elements

The process of developing the toxic agent and radiation control public health Objectives for the Nation for 1990 highlighted the importance of key program elements. The key elements bring to bear basic capabilities, knowledge, and activities essential to efforts to understand first how toxic agents and radiation affect human health, and second, how public health and environmental protection officials can institute programs to respond to environmental threats.

The six program elements required for effective toxic agent and radiation control follow:

- basic and applied research
- environmental monitoring
- health surveillance
- technical information and technology transfer
- intervention strategies
- program capabilities and scientific and technical manpower.

Each of the six elements has an essential role in efforts to analyze toxic agent and radiation control problems. Together they provide the requisite know-how, manpower, and tools needed to meet the problems in this scientifically complex area.

One of the more important elements, basic and applied research, is needed to increase our knowledge of the potential health risks posed by toxic chemicals. Clinical and epidemiologic studies of workers and others inadvertently exposed to toxic agents and radiation are necessary to complement the basic and applied laboratory-based research designed to demonstrate the effects of exposure. Basic science has produced improved methods of estimating human exposure levels, estimating and predicting potential health effects, and linking both into risk assessment procedures. Continued improvements are needed in methods of measuring, detecting, and identifying single chemicals and chemical mixtures in people and the environment.

The results of research need to be made available widely so that practical applications can be found and environmental programs updated and expanded. A critical need is the application of clinical, epidemiologic, and basic environmental health sciences research to the development of surveillance systems to identify persons who are exposed to toxic agents and radiations at levels which present a health risk. Once surveillance systems are established, the public and private health communities can cooperate in devising and implementing effective and resource-efficient intervention strategies for toxic agent and radiation control problems.

Progress Toward the Objectives

Some of the 10 high priority objectives will be met by 1990; some are not likely to be accomplished fully, largely because the support of certain key elements is lacking; for others, there is inadequate surveillance information to permit evaluation of progress. For each of those objectives that is likely to be met, it may be seen that all six of the program key elements have been brought to bear effectively.

Significant examples of progress on problems and issues related to the priority objectives are the following:

- Environmental levels of lead have been shown to be associated with elevated blood pressure, among other physiological and neurological effects. Technical assistance to State and local public health programs has supported regulations to reduce the amount of lead in gasoline, which contributed to a 37 percent decrease in the mean blood lead level of the general population (*4*).
- Educational programs on criteria for pelvic radiology in about 200 hospitals are credited by a multi-year study with a 50 percent reduction in the number of procedures, reducing unnecessary radiation exposure (*5*).
- Improved tests and procedures are being used to evaluate the toxicities of chemicals found in toxic waste dump sites. Benzene, frequently found at such sites and long recognized as a cause of human leukemia, has been shown to cause cancer in different organ and tissue sites in laboratory mice and rats, male and female (*6*).
- Studies of the health status of persons exposed to dioxin in surface soil at levels above 1 part per

Federal Priority Objectives for the Nation for 1990 for Toxic Agent and Radiation Control

Improving health status

1. By 1990, 80 percent of communities should experience a prevalence rate of lead toxicity of less than 500 per 100,000 among children 6 months to 5 years of age; at least 90 percent of all children identified with lead toxicity in the age group 1 to 5 years, especially those ages 1 to 3 years, should have been brought under medical and environmental management.

2. By 1990, significant progress should have been made toward preventing birth defects or miscarriages resulting from exposure to toxic substances through environmental interventions based on current information and expansion of the knowledge base related to hazardous substances and their reproductive effects.

Reducing risk factors

3. By 1990, the number of medically unnecessary diagnostic X-ray examinations should be reduced by some 50 million examinations annually.

Increasing public and professional awareness

4. By 1990, at least half of all adults should be able to report accurately an accessible source of information on toxic substances to which they may be exposed, including information on interactions with other factors such as smoking and medications.

5. By 1990, at least half of all people ages 15 years and older should be able to identify the major categories of environmental threats to health and note some of the health consequences of those threats.

6. By 1990, at least 70 percent of all primary care physicians should be alert when taking histories and making diagnoses to the role that environmental and occupational exposures can play in increasing the incidence of disease and health disorders, and be alert to how these exposures should be prevented or limited.

Improving services and protection

7. By 1990, every individual residing in an area of a population density greater than 20 per square mile, or in an area of particularly high risk, should be protected by an early warning system designed to detect the most serious environmental hazards posing imminent threats to health.

8. By 1990, every populated area of the country should be able to be reached within 6 hours by an emergency response team in the event of exposure to an environmental hazard posing acute threats to health from a toxic agent, chemical, and/or radiation.

Improving surveillance and evaluation systems

9. By 1990, a broad scale surveillance and monitoring system should have been planned to discern and measure known environmental hazards of a continuing nature as well as those resulting from isolated incidents. Such activities should be carried out continuously at both Federal and State levels.

10. By 1990, a central clearinghouse for observations of agent-disease relationships and host susceptibility should be fully operational, as well as a national environmental data registry to collect and catalog information on concentrations of hazardous agents in air, food, and water.

billion have not shown clinical illnesses attributable to the chemical exposure (*7*).

- Chemical information on 4,100 compounds likely to occur in chemical waste disposal sites, or in bulk transit, is being updated to improve online data retrieval services. This is expected to facilitate information gathering during responses to chemical emergencies and in disposal site cleanups (*8*).
- Federal legislation in 1980 created the Agency for Toxic Substances and Disease Registry (ATSDR), reporting to the Assistant Secretary for Health, to facilitate the evaluation of health risks and help prevent adverse health effects from toxic waste sites.

Improving Health Status

With regard to reducing the prevalence rate of lead toxicity, survey data show significant progress for particular population groups. Although the

prevalence rate of lead toxicity in children appears to have been reduced, inadequate surveillance techniques do not permit verification of the progress.

Four percent of all children in the United States between the ages of 6 months and 5 years of age showed blood lead levels in excess of the guidelines established by the Centers for Disease Control (CDC) in a survey from 1976 to 1980 (*9*). This estimate was obtained by the National Health and Nutrition Examination Survey (NHANES II, National Center for Health Statistics). When the blood level limit was lowered in 1985 from 30 milligrams per deciliter to 25, the proportion of the children exceeding the new level increased to 9 percent.

The importance of lowering blood lead levels is revealed by research findings that indicate that even very low levels in young children are associated with psychoneurological deficits and behavioral disorders (*10*). PHS is addressing the problem of lead exposure in children under block grant legislation, primarily through the Health Resources and Services Administration (HRSA) and CDC, which gives the States primary responsibility for lead-related prevention activities. Five of the six key elements are part of the lead poisoning prevention effort. The lacking element is a system to collect reliable and standardized national data on the prevalence of lead toxicity in children. Current data are collected by some States and communities, but they are not standardized and complete for all. No means exist for determining whether children found by screening programs to have elevated blood lead levels actually receive medical followup and successful treatment. Without this information, evaluation of the effects of intervention measures is not complete.

Between 1976 and 1980, the mean blood lead level in the U.S. population decreased 37 percent, paralleling a decrease in the use of leaded gasoline (*10*). The trend of reduced exposure is likely to continue until 1990 because of a proposal by the Environmental Protection Agency (EPA) to advance the total ban on lead in gasoline from 1995 to 1988 (*11*).

The problem of lead toxicity will not be resolved until the most significant sources of environmental lead are removed. About 37 million housing units in the country contain lead paint. A substantial number are likely to continue to do so for decades. Most housing codes do not provide States and localities with adequate mechanisms for dealing with this problem. Lead toxicity prevalence rates among children will continue to reflect the careless disposal of paint after its removal from buildings, the continued use of lead in gasoline, and the difficulty of removing lead from such sources as contaminated soil. If the lead toxicity objective is to come within reach, national, State, and local efforts must continue to limit children's exposure, educate the public about the adverse health effects, and identify and follow those children at risk for lead toxicity.

Reducing Risk Factors

With regard to reducing diagnostic X-ray exposure, program efforts have benefited from the effective use of all six key elements, permitting the development of successful intervention measures.

Medical radiation exposure can be reduced by eliminating unnecessary X-ray examinations and by reducing the total radiation dose in necessary examinations. Three sources of excess radiation exposure are faulty equipment, resulting in leakage and sometimes massive doses; improper techniques that result in higher levels of exposure than necessary, or to unshielded areas of the body receiving exposure; and clinical judgment about the number and kinds of radiographs needed. The Food and Drug Administration (FDA) has developed intervention strategies which include these:

- Setting performance standards for the manufacture of new X-ray equipment. The basics of equipment safety are now prescribed at the manufacturing stage under the Radiation Control for Health and Safety Act of 1974. Standards have been set for equipment collimation, filtration, maximum tube-housing leakage, and other factors.
- Developing training modules for radiology technicians
- Instituting educational programs to promote the use of techniques to produce optimum diagnostic images with minimum radiographic exposures
- Evaluating many of the mammography facilities
- Disseminating diagnostic radiology referral criteria in conjunction with the medical professions and under appropriate education protocols.

Additionally, HRSA has contracted for the production of self-paced training programs on radiological health. Self-teaching material has been prepared for dental assistants on techniques of low exposure dental radiology.

Current estimates suggest that five radiological procedures account for the majority of medically

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unnecessary X-ray exposures. They are pelvimetry, routine chest X-ray screening, presurgical chest X-rays, skull radiography after trauma, and dental radiographs. Referral criteria have been completed or are nearly completed for these procedures. Sufficiently broad acceptance of the criteria could avoid 50 million unnecessary examinations by 1990 to achieve the goal of this objective. FDA expects that, by monitoring the acceptance of the guidelines and by continuing surveillance of the practice of radiology, it will be able to confirm progress sufficient to meet the goal.

Improving Services and Protection

With regard to emergency response, the hazardous waste disposal issue has gained considerable attention since these objectives were established. Strong pressures resulted in legislation in 1980 to enable the Federal Government to clean up abandoned waste disposal sites and to deal with the release of hazardous substances in community settings. The main thrust of the act which created the superfund is cleanup, an EPA responsibility.

The law additionally recognizes the public health protection role of the Department of Health and Human Services (DHHS) through PHS and created the Agency for Toxic Substances and Disease Registry. ATSDR is required to establish disease and exposure registries; maintain an inventory of the literature on toxics, as well as a listing of areas closed or restricted due to environmental contamination; provide for medical care to exposed persons during public health emergencies; and conduct periodic survey and screening programs to determine relationships between exposure and illness.

Under an agreement with CDC, ATSDR provides support to develop methodologies for measuring the body burden of chemicals of interest, develop and perform epidemiologic studies of the potential human health effects of exposure to chemicals at cleanup sites, implement health and safety programs for workers involved in site cleanup, and establish appropriate registries. The agency has agreements with the National Library of Medicine (NLM) to establish and maintain the data base of health effects of toxic substances, and with the National Toxicology Program (NTP) to conduct toxicologic studies.

Experience with the Superfund Program has revealed deficiencies in the scientific and technological foundation which need to be addressed before effective interventions can be developed. The deficiencies call into question whether health and environmental threats can be eliminated in some cases, as for instance with contamination of ground water. At the time of the passage of the act, it was assumed that there was at hand virtually all the necessary science and technology, as well as the other elements of a broad environmental health program, to dispose of hazardous waste without harm to the public health. Experience has shown this not to be the case.

Recognizing this shortcoming, Congress enacted the Superfund Amendments and Reauthorization Act of 1986, which charges the National Institute of Environmental Health Sciences with responsibility for a university-based basic research program to develop fundamental information needed to respond to toxic waste disposal problems.

Improving Surveillance and Evaluation

With regard to a central clearinghouse for information on surveillance and evaluation systems, NLM has responsibility for these tasks:

- Establishing and maintaining an inventory of literature, research, and studies on the health effects of toxic substances
- Carrying out PHS information-related activities under the Superfund Program
- Developing a central clearinghouse for observations of agent-disease relationships and host susceptibility.

Unlike other objectives, the central clearinghouse objective is not directed toward a particular toxics problem, but at developing a resource for use in dealing with such problems. Its accomplishment depends, for example, on the availability of material in the scientific literature concerning the toxic agent and radiation control area. The material of interest derives from research, health surveillance, and environmental monitoring efforts. The clearinghouse function is making available the scientific and technical information essential to developing effective intervention strategies.

Many clearinghouse activities are supported by ATSDR, including maintenance and augmentation of NLM's online files and access systems. The clearinghouse will be fully functional and essentially synchronous with relevant publishing in 1990.

With regard to other objectives, work continues in developing the basis for intervention activities. Our foremost needs continue to be better understanding of the immediate problems and a centralized surveillance activity to provide morbidity and mortality data.

Achieving the Objectives

PHS is concentrating its resources on developing and providing the necessary framework for effective intervention in the prevention of toxics related problems. Progress in meeting the objectives for 1990 has been paced by the process of developing the six key program elements for each objective. Key elements are not fully developed in support of all objectives, all objectives will not be met, and progress is not measurable in all instances.

Setting Objectives for the Year 2000

As a means of furthering the development of key elements for each objective, DHHS and PHS are developing Objectives for the Year 2000 for toxic agent and radiation control. PHS will involve other environmental and public health organizations and individuals in the development process.

Among them are State and local health departments. These are already supporting pollution control and lead poisoning screening and treatment programs. Professional medical organizations are being encouraged to offer continuing education courses to primary care physicians on the health consequences of the major categories of environmental contaminants. A pluralistic process involving public and private participants from different backgrounds and sectors of the health community is necessary to achieve the objectives. DHHS's role continues to be to lead, encourage, and provide strategic support.

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