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Operations Research and Analytics Division

ENVIRONMENTAL HEALTH PLANNING

FOR POSTATTACK CONDITIONS:

SOME PROBLEMS, PROGRAMS, AND PRIORITIES

FINAL REPORT R-OU-197

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Prepared for

Office of Civil Defense
United States Department of the Army

under

U. S. Public Health Service
U. S. Department of Health, Education, and Welfare

Contract No. PH-86-65-16
OCD Work Unit 3412-B
RTI Project OU-197

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RESEARCH TRIANGLE INSTITUTE
Post Office Box 490
Durham, North Carolina

Environmental Health Planning for Postattack Conditions:

Some Problems, Programs, and Priorities

by

Raphael J. Salmon

April 1966

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April 1966

ABSTRACT

Conditions imposed by massive nuclear attack can be expected to disrupt normal environmental health services of communities throughout the United States, and to threaten the health of surviving population. This study develops a framework to help decision-makers evaluate postattack conditions relative to environmental health.

Review and analysis of existing information on probable postattack conditions as they might affect, and be affected by, personnel of local health departments, public health organizations, and resource management practices is presented. Anticipated postattack environmental health problems are identified, and priority judgments are made on a comparative basis in terms of level of gravity. Rationale supporting the judgments is included, and both action and research programs to improve preparedness are recommended.

Important sources of data prescribed for this study were the reports and working papers of an earlier U. S. Public Health Service Project, OCD-OS-62-254, "Environmental Health Problems in the Post Shelter Period." In addition, four city health departments were visited to assist in analysis of normal environmental health conditions relative to those expected in a postattack recovery period and of the ability of a local health agency to cope with projected conditions.

PREFACE

This study has been prepared to assist in evaluating postattack environmental health preparedness. It assesses, and provides guidance relative to, projected postattack environmental health problems; these are evaluated in terms of their seriousness and on a comparative priority basis. The rationale behind judgments made is pointed out, and action and research programs to improve environmental health preparedness are recommended.

Portions of the research completed under U. S. Public Health Service Contract No. PH 86-65-16, "Environmental Health Problems and Requirements under Postattack Conditions," are summarized in this report. Supporting information relative to effects of thermonuclear attack on environmental health conditions are provided in another study completed for this contract.^{1/} Together, these two reports supplement the engineering analysis and reevaluate the environmental health data gathered by the U. S. Public Health Service under Office of Civil Defense Contract OCD-OS-62-254, "Environmental Health Problems in the Post-Shelter Period."^{2/}

Consultants from the School of Public Health, University of North Carolina, have provided special assistance and advice in preparation of this study. The UNC consultant team consisted of Robert E. Coker, Jr., M.D., Charles M. Cameron, Jr., M.D., and William T. Herzog, M.S.P.H. Acknowledgement is also made of the cooperation of city health officers and their staffs in furnishing field data for the project, particularly C. A. Smith, M.D., M. V. Bradshaw, Jr., M.D., Peter Cupple, M.D., and Thomas L. Meador, M.D. Special recognition is given to the assistance and continuous support of Mr. Ernest Dubuque, Project Officer, and other associated staff of the U. S. Public Health Service and the Office of Civil Defense.

^{1/} Raphael J. Salmon, An Assessment of Selected Community Environmental Health Problems and Requirements under Postattack Conditions, Prepared under Contract No. PH-86-65-16, (Durham, North Carolina: Research Triangle Institute, January 31, 1966).

^{2/} "Environmental Health Problems in the Post-Shelter Period," Review Draft of Project No. OCD-OS-62-254, Research Branch, Division of Health Mobilization, Office of the Surgeon General, U. S. Public Health Service, Department of Health, Education and Welfare, (Washington: 1964).

TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT	i
PREFACE	ii
Chapter I: SUMMARY AND CONCLUSIONS	1
A. Objective of This Study	1
B. General Factors Affecting Postattack Environmental Health Conditions	1
C. Anticipated Problem Areas and Levels of Priority.	2
D. Recommendations	4
Chapter II: INTRODUCTION	17
A. Objective of This Study	17
B. Method of Approach.	18
C. Assumptions	18
D. Limitations	20
E. Content	22
Chapter III: ANTICIPATED BASIC COMMUNITY DEFICIENCIES.	25
A. Water Supply.	25
B. Food.	32
C. Housing	36
Chapter IV: EFFECTS OF DISPOSAL PROBLEMS ON HEALTH	41
A. Sewage Treatment and Disposal	41
B. Refuse Disposal	44
C. Disposition of the Dead	45
Chapter V: VECTOR CONTROL, GEOGRAPHIC AND TIME DISTRIBUTION OF DISEASE . .	47
A. Vector Control.	47
B. Geographic and Time Distribution of Disease	50
Chapter VI: ADMINISTRATION AND EMERGENCY PLANNING.	57
A. Disruption of Public Health Services.	57
B. Emergency Equipment and Supplies.	60
C. Scarcity of Personnel	60
D. Occupational Health Hazards	62
E. Training of Environmental Health Personnel.	63
F. Scope and Coordination of Local Public Health Services.	64
G. Records, Inventories and Plans.	66
H. Public Education.	66
BIBLIOGRAPHY.	69

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Exposure to Blast and Fallout: Hypothetical Heavy Attack on Military, Industrial and Population Targets	19

LIST OF TABLES

<u>Table</u>		<u>Page</u>
I	Action and Research Recommendations to Increase Postattack Environmental Health Preparedness	9

Chapter I

SUMMARY AND CONCLUSIONS

A. Objective of This Study

As a subtask of Project PH-86-65-16, "Environmental Health Problems and Requirements under Postattack Conditions," the objective of this study is to develop guideposts to assist in evaluating environmental health preparedness in terms of post-attack conditions. Relevant environmental health subjects are discussed, and guidance is provided relative to:

1. Anticipated postattack environmental health problems in terms of their seriousness and on a comparative priority basis with indication of the rationale behind such judgments; and
2. Both action and research programs to improve environmental health preparedness.

B. General Factors Affecting Postattack Environmental Health Conditions

Assessment of the postattack situation indicates three general factors which can be expected to have major impact on environmental health problems and conditions:

1. Temporary Regression to a Relatively Primitive Way of Life

Deterioration of the total environment and of environmental health services may require temporary regression to a more primitive way of life. This can be expected to pose major problems to the majority of twentieth century Americans who are accustomed to a high standard of living and adequate sanitary conditions. Much dependence is now placed on a variety of specialists and on services which may not be available in a postattack period. The adjust-

ments necessary to live under drastically changed conditions in many instances can be expected to pose problems more severe for this nation's urban population than for its rural population.

2. Increased Significance of Preattack Health Hazards

Accelerated deterioration of environmental health conditions may originate from, and be stimulated by, conditions which already exist in the preattack period. Thus, if a community is infested by rats, flies, or other vectors, it is safe to assume that the potentiality of an acute vector problem would be greater in that community under the deteriorating conditions expected in a postattack period than in another community which has eliminated many existing vectors and their feeding and breeding places.

3. Changes in Nature and Incidence of Health Hazards

The general deterioration of the health environment, together with the cumulative effects of stress and changed conditions, and possible lower resistance of the population to disease, may lead to increased incidence of infections seldom or never experienced in certain communities, regions, and the country as a whole under normal conditions. In the absence of controls, epidemics of some diseases could occur. Specific definitive projections are difficult to make. There is relatively limited knowledge of the cause and effect relationships between possible attack conditions, disease incidence, and the general postattack recovery environment.

C. Anticipated Problem Areas and Levels of Priority

The priorities assigned in this report are derived from judgments reflecting the gravity of the problems anticipated in a post-thermonuclear attack period relative to the feasibility of potential control and preparedness measures. Judgments and priority evaluations are based on study of the literature, field investigations, consultations, and general estimates of preparedness comparable

to the 1961-65 period. The priority judgments are provided for their value in determinations of costs and benefits of alternative environmental health research and action when total funds are limited, and are not meant to represent precise ratings. It should be recognized that factors such as the nature of threats, improvements in general and/or specific preparedness of communities, experience gained, and additional knowledge accumulated can affect priority levels. Three priority levels are utilized to facilitate evaluation. Subject to the above qualifications, priorities are assigned to the eight specific areas covered in this report as indicated below.

Priority I -- Local health department planning, provision for improved post-attack communications between public health personnel and with the public, together with general public education and training, would all be expected to play major roles in survival, recovery, and the level of performance of the postattack population. Preparedness of public health personnel and facilities and their flexibility in responding to postattack needs also would be important in this regard. Organizational preparedness in this field is complex, but its comparatively low cost and high potential warrant its high priority rating.

Water supply preparedness is of equally high priority. Safe water supplies must be assured not only for stark survival, but also because water plays a key role in utilization of other essential resources and services.

Vector populations and disease distribution have significant effects on the health of thermonuclear attack survivors. This area is also assigned the highest priority.

Priority II - Sewage treatment and disposal are projected as somewhat lower priority problems since with careful planning and relatively simple treatment methods, it is believed feasible to collect and disinfect domestic wastes adequately under postattack conditions. The probable low level of preparedness of the urban population for improvisation still would demand close attention from local health

department personnel, however, to assure safe sewage disposal under expected emergency conditions.

Although certain difficulty is expected in providing necessary services and proper sanitation, it is estimated that the quantity of housing remaining after attack would be sufficient for the surviving population. Housing is therefore accorded a second priority rating as a problem area.

Priority III -- Contaminated food supplies under the conditions studied, refuse disposal, and disposition of the dead are expected to pose relatively insignificant hazards in a postattack environment. They require comparatively simple operations and are considered third priority problems.

D. Recommendations

1. General Priorities

Table I, "Action and Research Recommendations to Increase Post-thermonuclear Attack Environmental Health Preparedness," summarizes the more significant activities which may assist communities to cope with potential post-attack environmental health problems. The table also lists associated research and specific study subjects in terms of the immediacy of their use to support national and community action programs. In addition to the action programs readily available and identified in the above table, in certain instances short-term research activities are recommended to facilitate such programs. Examples of research which are medium and long-range in nature are provided as well; these are aimed at development of additional knowledge expected to play a major role in postattack environmental health planning. Table I serves as a content summary in terms of identification of categories of recommended action. The areas covered in the table correspond to the order of their discussion in the text, thus facilitating reference to particular chapters of report.

It is interesting to note that recommended action programs differ in their relative need for preparedness activities, short and long-term research. In the area of administration and emergency planning for environmental health services, for example, emphasis is primarily on action programs aimed at increasing postattack preparedness and on short-term research aimed at implementing planning and action programs to cope with postattack conditions. The same situation seems to exist relative to housing and, although to a somewhat lesser degree, in the areas of refuse disposal and disposition of the dead. Vector control and distribution of disease, on the other hand, represent areas in which preparedness could benefit greatly from medium and long-range research activities aimed at developing knowledge relative to post-attack planning. This situation exists also in the areas of water supply and pollution control, and, to a lesser degree, relative to food and other anticipated deficiencies covered in this study.

Throughout the study, it is evident that comprehensive and systematic planning is greatly needed. Such planning would serve not only to overcome projected deficiencies and problems, but also to avoid acceleration and compounding effects in a postattack period, resulting from inadequate problem-solving activities prior to, or immediately following, thermonuclear attack. Extrapolation of requirements (evaluating each hazard or deficiency relative to other hazards or deficiencies), projection of available manpower and other resources, evaluation of present preparedness and training needs, as well as realistic stockpiling of identified deficient resources -- all would assist in development of inventories and detailed plans. Planning elements which seem to require special emphasis in each anticipated problem area or deficiency are specifically discussed and indicated in Table I. Preparedness, however, might require a specific community or region to adapt additional or different planning elements from the ones indicated in this study for preparation of

its plan, depending on its particular conditions and specific projected problem areas. Due to the heterogeneity of communities and regions, it is strongly recommended that assignment of priorities and planning guidelines to be applied on a national basis, be adjustable to regional and local conditions.

It is also recommended that evaluations, such as the one made in this study, continue to be undertaken at regular intervals. The different patterns of distribution of resources and environmental health conditions, the complex dynamic systems of interacting components and the ways they affect and are affected by change, the artificiality of singling out for study individual components or aspects of a complex ecological network, and the many equivalent, alternative, multi-pathway, multiple choice approaches to the same goal^{1/} -- all support the need for consistent and concerted attention to problems, programs, and priorities relative to comprehensive postattack environmental health evaluation. A systematic process of investigation, recording, and evaluation is mandatory for postattack planning in this field. By its nature, such a process would complement efforts being made directly by different levels of government and could provide valuable check-points, as well as additional input, for government programs. Thus, regular evaluation may assist in incorporating into postattack environmental health planning, current approaches and problems, recognized progress made, contributions of other studies, and elements which, by their nature, cross through different governmental agencies.

^{1/} Paul Weiss, Renewable Resources, A Report to the Committee on Natural Resources of the National Academy of Sciences-National Research Council, (Washington, D. C.: National Academy of Sciences-National Research Council, 1962), pp. 2-13.

2. Research Priorities

The highest priority research needs are listed below. These priorities are assigned in terms of immediate postattack environmental health requirements subject to reasonable budget levels.

- a. Evaluation and development of improved means of training public health personnel (including auxiliary personnel) to understand, and function effectively under, expected postattack conditions. Such training should be aimed to prepare personnel to respond with the speed needed for provision of essential health services. It should be geared to projected manpower requirements, availability of equipment and data, improvisation of operations, and the knowledge level of supporting agencies and the public.
- b. Study of the feasibility of developing area-wide plans for environmental health operations and development of one or more prototype plans in specific areas for demonstration purposes. Lines of authority and cooperation between agencies concerned with environmental health should be clarified. Techniques to be utilized by communities to survey available and projected resources, supplies, and needs, especially in the areas of water supply, medical supplies, emergency equipment, and food should be developed and improved.
- c. Exploration of disease distribution patterns and health status in selected communities as a basis for further research on specific post-attack health hazards. Limits of man's natural elasticity in ability to adjust and adapt to his environment should be considered relative to functions, organs, and systems and anticipated environmental postattack conditions.

- d. Assessment of means of increasing water supplies, utilizing techniques expected to remain functional under postattack conditions. Simultaneous evaluation should be undertaken of alternative water uses and procedures for development and management of water resources of a specific area.
- e. Evaluation of means of controlling large numbers of insects and rodents on an area-wide scale, utilizing equipment and materials expected to be available in a postattack period. Such evaluation should consider the spectrum of vector problems as related to the expected postattack environment.

It should be recognized that cost-effectiveness studies of recommended action and research alternatives should be undertaken relative to programs not presently in progress. Experience gained and new knowledge accumulated from ongoing research in relevant areas is expected to affect research priorities and costs of future programs.

Table I

ACTION AND RESEARCH RECOMMENDATIONS TO INCREASE
POSTATTACK ENVIRONMENTAL HEALTH PREPAREDNESS

(1) Anticipated Deficiencies and Problem Areas	(2) Estimated Level of Priority	(3) Action Programs Aimed at Postattack Preparedness	(4) Action Programs Requiring Short Term Research/Development for Postattack Planning	(5) Medium - Long Range Research Activities Aimed at Developing Knowledge Related to Postattack Planning
Water Supply and Pollu- tion. Control	I	<p>(a) Identify potential postattack hazards to water supplies.</p> <p>(b) Develop means of improving water supply protection.</p> <p>(c) Identify potential usable supplies.</p> <p>(d) Increase personnel preparedness for development and maintenance of safe water supplies.</p>	<p>(a) Assess means of increasing water supplies in each community, utilizing techniques expected to remain functional under postattack conditions.</p> <p>(b) Develop and utilize techniques that allow simultaneous evaluation of alternative uses and operating procedures for development and management of water resources of a specific area.</p> <p>(c) Assess factors affecting the relative safety and desirability of various existing water sources under postattack conditions.</p>	<p>(a) Improve understanding of ground water characteristics, movement, and the capacity of recharge areas.</p> <p>(b) Improve austere waste treatment techniques.</p> <p>(c) Investigate hazards of waterborne diseases in combination with radiation effects.</p>
Food	III	<p>(a) Survey available supplies and compare with projected needs.</p> <p>(b) Investigate means of overcoming identified food deficiencies.</p>	<p>(a) Develop and improve techniques to be utilized by communities to survey available and projected supplies and needs.</p> <p>(b) Evaluate foodborne disease occurrence in different parts of the country under various projected postattack conditions.</p>	<p>(a) Evaluate qualitatively and quantitatively the relationship between food supplies and prevalence of foodborne diseases to be anticipated following attack at different times of the year.</p>

(Continued)

(Continued)

(Continued)

1/ Since this table provides a content summary of the study, in order to facilitate reference to the chapters which follow, deficiencies and problem areas are presented in the order that they appear in the text.

Table I (Cont'd)

ACTION AND RESEARCH RECOMMENDATIONS TO INCREASE
POSTATTACK ENVIRONMENTAL HEALTH PREPAREDNESS

Anticipated Deficiencies and Problem Areas	Estimated Level of Priority	Action Programs Aimed at Postattack Preparedness	Action Programs Requiring Short Term Research/Development for Postattack Planning	Medium - Long Range Research Activities Aimed at Developing Knowledge Related to Postattack Planning
(1)	(2)	(3)	(4)	(5)
(c) Provide means of protecting and recovering food processing and distributing facilities.				
(d) Develop methods to project existing food stocks; consider possible substitutes for food items expected to be scarce.				
(e) Assess available facilities for mass feeding, and stock necessary equipment and supplies.				
Housing	II	(a) Assess community housing characteristics with regard to vulnerability of service facilities (such as fuel and electricity), and consequent effects on health. (b) Evaluate preparedness of community agencies responsible for meeting housing needs.	(a) Investigate consequences of crowding relative to disease spread and its reduction.	(b) Investigate postattack foodborne disease hazards for different population groups. (c) Consider effects of different diets, both quantitatively and qualitatively, on anticipated environmental health hazards. (d) Investigate hazards of foodborne diseases in combination with radiation effects.

(Continued)

Table I (Cont'd)

ACTION AND RESEARCH RECOMMENDATIONS TO INCREASE
POSTATTACK ENVIRONMENTAL HEALTH PREPAREDNESS

(1) Anticipated Deficiencies and Problem Areas	(2) Estimated Level of Priority	(3) Action Programs Aimed at Postattack Preparedness	(4) Action Programs Requiring Short Term Research/Development for Postattack Planning	(5) Medium - Long Range Research Activities Aimed at Developing Knowledge Related to Postattack Planning
Sewage Treatment and Disposal	II	(a) Develop community plans for effective emergency sewage collection and disposal methods, checking alternatives against anticipated manpower and other resources expected to be available. (b) Prepare diagrams and operating manuals for electric, collection, and treatment systems, as well as equipment necessary for repair and restoration of services.	(a) Evaluate alternative sewage disposal methods relative to characteristics of the waste, the community, and expected postattack conditions.	(a) Investigate means of forecasting effects of untreated wastes on receiving waters and of quantifying expected pollution hazards.
Refuse Disposal	III	(a) Develop specific plans for refuse disposal, considering available equipment and personnel needs.	(a) Evaluate effects of refuse on deterioration of community environmental health conditions.	(a) Investigate interdependent relationships of refuse to vectors and disease spread.

(Continued)

Table I (Cont'd)

ACTION AND RESEARCH RECOMMENDATIONS TO INCREASE
POSTATTACK ENVIRONMENTAL HEALTH PREPAREDNESS

(1) Anticipated Deficiencies and Problem Areas	(2) Estimated Level of Priority	(3) Action Programs Aimed at Postattack Preparedness	(4) Action Programs Requiring Short Term Research/Development for Postattack Planning	(5) Medium - Long Range Research Activities Aimed at Developing Knowledge Related to Postattack Planning
Disposition of the Dead	III	(a) Develop plans to provide necessary facilities, equipment, procedures, and manpower for disposition of the dead.	(a) Investigate effects of climate and other physical factors on disposition of the dead.	(a) Investigate environmental health effects of large numbers of undisposed corpses in various stages of putrefaction relative to vectors and disease spread.
Vector Control and Distribution of Disease	I	(a) Develop priorities and procedures for vector extermination utilizing supplies expected to be available. (b) Develop specific plans for refuse disposal, considering available equipment and personnel needs. (c) Provide training programs in vector control operations for in-service and auxiliary personnel. (d) Assess community patterns of health and disease distribution; determine statistically the probability of carriers of serious disease organisms occurring in crowded shelters.	(a) Analyze critically the relationship of given postattack conditions to vector development. (b) Evaluate means of mass control of insects and rodents on an area-wide scale using equipment and materials expected to be available. (c) Evaluate successful vector control techniques as an aid to effective planning.	(a) Investigate the relationships between vectors and spread of disease among different population groups. (b) Evaluate ecological effects of radiation exposure at moderate to severe levels and under different conditions on plant life, pathogenic, and/or nonpathogenic organisms. (c) Explore disease distribution patterns and health status in selected communities as a basis for further research on specific health hazards. (d) Investigate stress limits of man's elasticity in adaptation as they fluctuate in terms of functions, organs, and systems relative to anticipated environmental conditions.

(Continued)

Table I (Cont'd)

ACTION AND RESEARCH RECOMMENDATIONS TO INCREASE
POSTATTACK ENVIRONMENTAL HEALTH PREPAREDNESS

Anticipated Deficiencies and Problem Areas	Estimated Level of Priority	Action Programs Aimed at Postattack Preparedness	Action Programs Requiring Short Term Research/Development for Postattack Planning	Medium - Long Range Research Activities Aimed at Developing Knowledge Related to Postattack Planning
(1)	(2)	(3)	(4)	(5)

(e) Investigate effects of irradiation through external exposure or ingestion of contaminated substances on disease resistance and recuperation ability for those diseases anticipated.

Administration and Emergency Planning for Environmental Health Services

I

(a) Project available work force both for tasks requiring professional skills and for those related to maintenance of services and facilities but requiring unskilled labor.

(b) Develop locally-based training programs for persons to serve as auxiliary public health personnel in such specialties as sanitary engineer aides and sanitation aides.

(c) Prepare training manuals and guides which can be used by local personnel to train interested-

(a) Study communities and regions which have faced natural disasters in the past with consequent disruption of normal public health services, as an indication of the kinds of problems which may be anticipated.

(b) Ascertain the knowledge level of local agencies concerned with environmental health conditions and of the general population relative to cause and effect relationships of sanitation and other factors to disease.

(c) Strengthen and intensify efforts to develop improved measures for improvisation of equipment and operations important to maintenance of adequate environmental health conditions.

(Continued)

Table I (Cont'd)

ACTION AND RESEARCH RECOMMENDATIONS TO INCREASE
POSTATTACK ENVIRONMENTAL HEALTH PREPAREDNESS

(1) Anticipated Deficiencies and Problem Areas	(2) Estimated Level of Priority	(3) Action Programs Aimed at Postattack Preparedness	(4) Action Programs Requiring Short Term Research/Development for Postattack Planning	(5) Medium - Long Range Research Activities Aimed at Developing Knowledge Related to Postattack Planning
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ed persons as auxiliary public health personnel.

(d) Develop operational plans for close cooperation among agencies and public health personnel on local, regional, and state levels, and establish operational lines of authority.

(e) Assess potential effects on environmental health services of isolation of one part of the city from the main city body.

(f) Assess anticipated shortages of health personnel, equipment, facilities, and supplies.

(g) Identify items most likely to be needed under emergency conditions; stock items crucial to survival; restoration, and recovery functions;

(d) Estimate total manpower requirements with due regard to expected productivity; assess knowledge, capability, and preparedness of personnel to function effectively relative to the speed needed for provision of essential health services.

(e) Study feasibility of developing area-wide plans for environmental health operations; develop one or more prototype plans in specific areas for demonstration purposes.

(f) Develop methods to facilitate data collection relative to regional allocation of specific resources and services.

(g) Evaluate effectiveness of alternative means of developing public understanding and acceptance of planning and preparedness efforts.

(Continued)

Table I (Cont'd)

ACTION AND RESEARCH RECOMMENDATIONS TO INCREASE
POSTATTACK ENVIRONMENTAL HEALTH PREPAREDNESS

(1) Anticipated Deficiencies and Problem Areas	(2) Estimated Level of Priority	(3) Action Programs Aimed at Postattack Preparedness	(4) Action Programs Requiring Short Term Research/Development for Postattack Planning	(5) Medium - Long Range Research Activities Aimed at Developing Knowledge Related to Postattack Planning
familiarize personnel with supplies and equip- ment on hand, and with their location.				
(h) Train supervisory, operating, and repair personnel in elements of sanitation and in fallout protection measures.				
(i) Strengthen field training programs in environmental health disciplines; encourage interdisciplinary participation.				
(j) Develop comprehensive community plans to meet health contingencies and provide necessary services for survival; prepare and distribute such materials as resource inventories, supplies, and records.				
(k) Develop public educa- tion programs to gain acceptance of planning efforts.				

Chapter II
INTRODUCTION

The postattack environment in which survivors of a nuclear attack would find themselves would present a different picture in terms of health services and conditions from that which exists today. Uncertain quantities and qualities of food and water, crowded and generally reduced living standards, increased physical and mental stress, rapid increases in disease vectors, and damaged water supply and waste disposal systems may contribute to a high rate of communicable disease. Diagnoses cannot be expected to be as prompt and reliable as preattack, and drugs, medicines and other medical care requirements may exceed availabilities. The extent to which these interacting conditions would seriously affect population survival requires further assessment. If preventive action is to be taken and countermeasures formulated, priorities should be established in terms of the degree of seriousness these problems present.

A. Objective of This Study

The objective of this study is to develop a framework within which to evaluate and plan for the effects of immediate postattack conditions on environmental health. The task has been developed in such a way that guidance can be provided relative to:

1. Anticipated postattack environmental health problems on a comparative severity basis, with indication of the rationale behind such judgments;
and
2. Both action and research programs to improve environmental health preparedness.

B. Method of Approach

The primary approach employed herein was to review and analyze existing information on assumed postattack conditions as they might affect local communities, resource management, public health organization, and associated requirements for training levels and staffing patterns. Several tasks designed to develop health assessment procedures and data were specified by the U. S. Public Health Service. These tasks were:

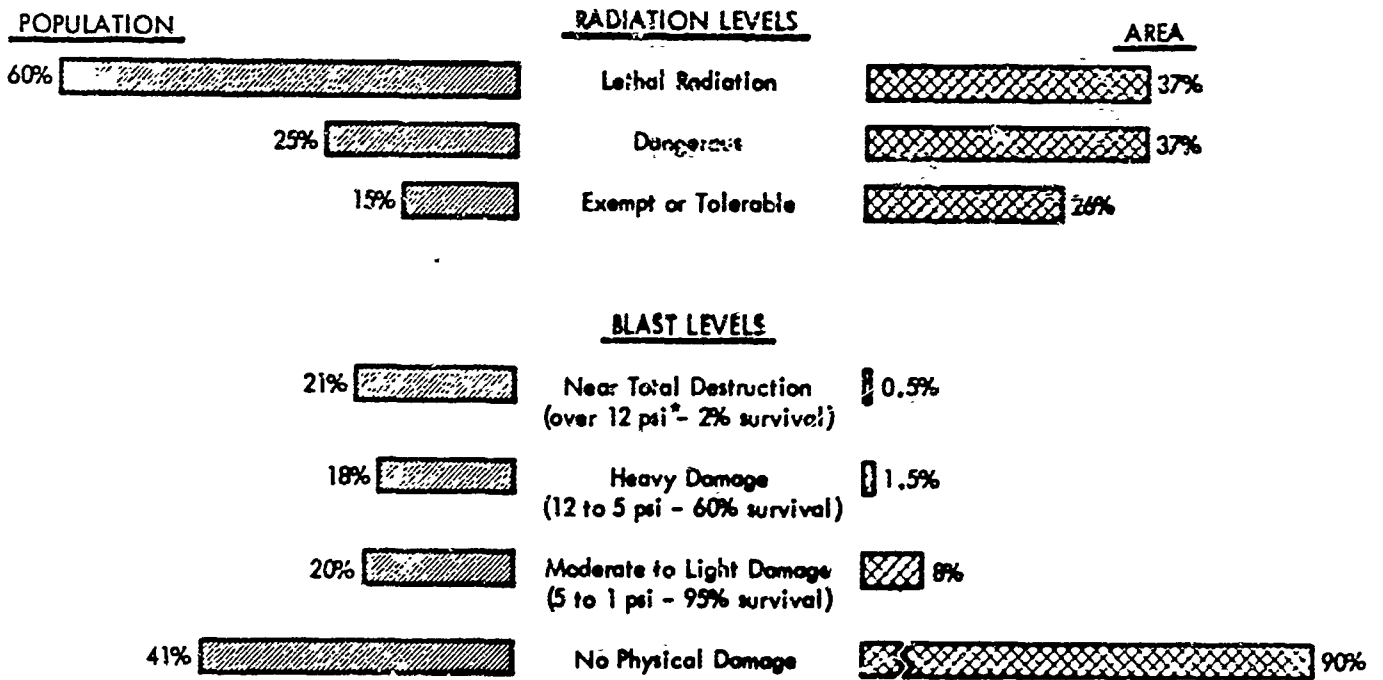
1. Completion of the engineering analysis and reevaluation of the environmental health data gathered under OCD Project OCD-OS-62-254;
2. Consideration of the knowledge and degree of preparedness of health department personnel from an additional four city health departments to cope with potential environmental health problems under post-nuclear war conditions; and
3. Analysis of local level problems associated with conversion of normal health control activities to those expected to be required in the postattack recovery period.

C. Assumptions

To define the task and provide reasonable boundaries for investigation, a number of assumptions have been made:

1. It is assumed that the thermonuclear attack under consideration for the purpose of this study is a mixed attack on military, industrial, and population targets, and results in dangerous radiation levels as indicated in Figure 1, "Exposure to Blast and Fallout: Hypothetical Heavy Attack on Military, Industrial and Population Targets."^{1/}
2. It is assumed in the priority determinations given that the United States could possess substantially greater civil defense fallout system preparedness than now exists. The priorities, in fact, are intended to support achievement of a balanced civil defense fallout shelter system.

^{1/} This assumption is for exemplification. The material presented in this report is not dependent on this specific example or its effects.



*Pounds per square inch of blast pressure

Figure 1

Exposure to Blast and Fallout; Hypothetical Heavy Attack
on Military, Industrial and Population Targets

POPULATION AND AREA AFFECTED BY HYPOTHETICAL HEAVY ATTACK

Figure 1 compares the effects of fallout and blast on the population and the land area of the country, using a series of attacks.

Blast levels. Under these assumptions, 90% of the land area and 41% of the population would not be subjected to damage or injury. Another 20% of the population would have an excellent probability of surviving the attack. Eighteen percent would have approximately a 60% chance for survival. Twenty-one percent of the population would be in the area of near total destruction.

Radiation levels. Although a large portion of the population would survive the blast effects, 85% would be subject to lethal or dangerous radiation levels which cover about 75% of the land area. Only 15% of the population would be in areas which are free of fallout or have a tolerable range of fallout.

SOURCE: Department of Defense Fallout Shelter Programs, Department of Defense, Office of Civil Defense, June, 1964 (Supersedes Nov. 1963 issue).

3. It is assumed that principal health agencies which would be involved in providing services during an immediate postattack period would be the local health departments.
4. It is assumed that public health personnel would survive an attack in approximately the same proportions as the population as a whole, and would participate in postattack recovery operations.
5. It is assumed that the professional training of persons in the different public health disciplines has been in accord with the recommendations of the Committee on Professional Education.^{1/ 2/} Training programs for public health personnel vary widely throughout the country. It is believed that existing variations in the curricula of professional and technical schools are not critical to the general findings of this study.

D. Limitations

The present project called for summary of the data gathered by a previous Public Health Service study as a major source of information on environmental health problems and their relationship to community planning for a postattack period. Thus, this study is based primarily upon findings and data assembled previously by the U. S. Public Health Service. Additional information was gathered from available research documents to assist in appraisal of the previous study. Within time and budget constraints, limited field work was undertaken in four selected communities.

1/

"Educational And Other Qualifications of Public Health Sanitarians," American Journal of Public Health, 46:9, (American Public Health Assoc., September 1956).

2/

"Educational Qualifications of Sanitary Engineers Engaged in the Field of Public Health," American Journal of Public Health, 45:4, (American Public Health Association, January, 1955).

It should be recognized that differences may exist between conditions observed in the few communities studied and those of the heterogeneous continental United States.^{3/} To accomplish the project purpose, many judgments were required. Since the world has not experienced a general nuclear attack condition, relatively few of these evaluations can be supported by direct observations or experience.

The postattack conditions considered for purposes of this study do not include attacks involving the use of chemical or biological warfare agents.

Although some military support may be made available to civil authorities, analysis of military capabilities has not been included in this study. Analysis of the more typical types of local health organizations has been the basis for many of the general action recommendations made. Implementing certain of these recommendations specifically for any given community would require certain adjustments and adaptations. Except for identifying critical problem areas related to public health preparedness, the details have not been pursued in this study. Further, the significance of psychological reactions and their relationship to health, recovery, and general functioning in a postattack period is recognized, but analysis has excluded these considerations. Economic feasibility of the recommended programs has not been specifically studied.

To make this complex research task manageable, certain environmental health factors have been isolated for study. It should be recognized, however, that often the magnitude of an environmental health problem may exceed the sum of its individual components, and a compounding effect may occur in terms of impact upon the total environment. A certain problem in sewage disposal, for example, may cause filth

^{3/}

It has been estimated that to evaluate only the problems associated with water supply and sewage treatment in a postattack period at a 95% confidence level would require a study of 384 randomly selected communities. (This estimate is based on the assumption that a "yes-no" type questionnaire would be administered to local health departments.) See Raphael J. Salmon and Robert C. Elston Methodology to Survey the Knowledge Level and Preparedness of Local Health Department Personnel to Cope with Thermonuclear Disaster, Prepared under Contract No. PH-86-65-16 (Extension), Durham, North Carolina: Research Triangle Institute, January, 1966.

conditions ecologically favorable to certain vectors. Due to other internal and/or external factors, such as available hosts, lower resistance of the population, and unavailability of drugs or proper medical services, an epidemic may begin. No one condition alone could be construed to be the prime responsible agent for such an epidemic, but the summation of circumstances project a foreseeable general result.

On the other hand, one condition may offset other conditions. In a postattack environment, for example, fallout may cause reduction of certain potential vector populations in an area. Due to the essential interrelationship of dynamic components, and the comparatively high degree of uncertainty in projection of some key environmental conditions, it is recommended that the evaluations which follow be used only as guideposts for planning purposes.

E. Content

The remainder of this study is divided into four chapters. These chapters represent the major functional aspects of environmental health operations in a peacetime environment, and also are appropriate to assessment of possible postattack situations. A summary analysis of certain problem areas is presented in each chapter, together with suggested priority ratings. Each section concludes with examples of possible action and research programs. Selected short-term research activities aimed at implementing action programs are discussed in order to increase the effectiveness of community planning. Examples of medium and long-range research programs are added to suggest areas where development of new knowledge may serve as a crucial element for effective planning.

Chapter III, "Anticipated Basic Community Deficiencies," deals with water supply, food, and housing. The relationship of sewage disposal, refuse disposal, and disposition of the dead to postattack environmental health is analyzed in Chapter IV, "Effects of Disposal Problems on Health." Chapter V, "Vector Control and Distribution of Disease," is divided into two parts: the first evaluates vector spread and control measures, while the second considers the geographic and time

distribution of disease expected during a postattack period. The last chapter, "Administration and Emergency Planning," discusses preparedness in terms of organizational factors, personnel and training needs, planning, and the role of public education.

Chapter III

ANTICIPATED BASIC COMMUNITY DEFICIENCIES

The United States possesses, at the present time, abundant quantities of food, water, and other basic resources necessary for a high standard of living. In a postattack environment, however, there is good reason to doubt the availability of certain critical resources of quantity and quality adequate for man to cope with changed conditions. Assessment of resource availability in an immediate postattack period depends upon methodical local, regional, and national evaluation of supply requirements balances and associated resource conservation and management practices. Appropriate analytical techniques have been developed, but they require further refinement and their findings are necessarily highly generalized. Continued improvements in systematic evaluation may indicate crucial deficiencies on a regional-community basis and eventually may assist in development of more precise projections relative to postattack conditions than are now possible.

This chapter considers the effects of water, food, and housing on environmental health. Particular attention is given to projected attack-imposed conditions.

A. Water Supply

1. Water Quantity

The total water supply of the continental United States is sufficient but not uniformly distributed. Some areas have an overabundance of surface and ground water, yet others face problems of scarcity. In peacetime, the problem of adjusting water resource supply to demand is largely fiscal in nature. Under disaster conditions, however, regional water scarcity could pose serious local problems, especially in view of the difficulty of transporting and distributing water over long distances. Many communities would

not have ground water available to replace deteriorated resources and provide essential services and functions.

In a postattack situation, the nature of water demand (and the availability of alternative supplies) would determine measures necessary to secure adequate supply. In an immediate postattack period, the quantity of water required per capita for drinking may be reduced to as little as two pints daily. Over a longer time period, water demand would be expected to increase in order to maintain adequate public health standards, and to perform functions reasonably expected under postattack conditions, such as fire fighting, flushing of sewage, and decontamination. Of all the renewable natural resources, water is most frequently the limiting factor for man's beneficial utilization of other resources and services.

A high priority rating should be given to evaluation of water supply and demand at the community level in order to assure sufficient safe supplies in a postattack condition.

Recommendations

- a. Community programs to increase preparedness to cope with projected postattack conditions in this area should include protection of presently available water supplies. Both action and data-gathering operations would be involved in order to:
 - (1) Identify potential hazards to existing supplies; and
 - (2) Identify and develop feasible new supplies which could be utilized under postattack conditions.

Attention should be given also to available brackish and saline water which could be used during a postattack period for functions other than human consumption. Potential development of ground water supplies for postattack use should be investigated.

b. Land surface and subsurface areas seem to be segments of the water cycle most suitable for research which may lead to substantial increases in water availability during a postattack period. Programs in this category would require medium and long-range investigation of certain critical aspects of the water cycle which are not sufficiently understood at present, relative to postattack conditions and projected needs. Included should be studies to:

- (1) Improve understanding of means of discovery, measurement and chemical analysis of ground water under postattack laboratory conditions, the characteristics of water movement through the earth, and the capacity of recharge areas, in order to assist in assessing ground water characteristics which may assume importance in a postattack period; and
- (2) Improve waste treatment techniques to deal with persistent organic and other pollutants. Frequently archaic treatment processes require vast quantities of water which may not be so readily available in a postattack period for flushing and storage facilities. To provide a sound basis for applied technology, fundamental investigation into physical, chemical, and biological aspects of water treatment would be of value. Such efforts also should encourage evaluation of safe waste disposal under postattack conditions to enable adaptation, or alteration, to fit specific community conditions.

2. Water Quality

Attack damage to sewers, sewage treatment plants, or industrial facilities within a watershed area may lead to increased biological and chemical contamination. Open distribution reservoirs and decreased pressures in

the distribution system, together with cross-connections, may also increase the danger of bacterial or viral pollution. Many communities presently depend, at least partially, upon outside agencies for supplying and/or testing of their water supplies. Expected shortage of chemicals such as chlorine, coupled with reliance on laboratories and laboratory techniques which may not be usable in a postattack period, and unfamiliarity of personnel with field laboratory methods, could contribute to hazardous postattack water quality.

Where fallout occurs, radioactive contamination of water supplies may result through the natural processes of the water cycle. Water drawn from open sources would be particularly subject to contamination. In an immediate postattack period, ground water is likely to be relatively free from contamination (provided that it is adequately protected in its movement from source to distribution point). Although consumption of contaminated water would cause an internal radiation hazard, data support the contention that within the first few months of a postattack period, biological effects generally would be insignificant when compared with other hazards.^{1/2/3/} The time at which internal hazards would become relatively more significant than external hazards would vary, depending upon the initial intensity water decontamination efficiency, and the degree of protection provided against external radiation.

^{1/} A Prototype Manual on Civil Defense Aspects of Waterworks Operations, Prepared for OCD Contract No. OCD-OS-62-106, (Arcadia, California: Engineering Science, Inc., August, 1964), p. 14.

^{2/} Hong Lee, Vulnerability of Municipal Water Facilities to Radioactive Contamination from Nuclear Attacks, SRI Project No. IM-4536, (Menlo Park, California: Stanford Research Institute, March, 1964), p. 97.

^{3/} Reducing the Vulnerability of Water Supply Systems, PF 80-24, (Washington: Department of the Army, Office of Civil Defense, March, 1965), p. 31.

The fact that most personnel within local health departments are not trained in radiological monitoring -- together with the relatively limited number of known emergency techniques for decontamination -- may hinder effective control measures. Lack of decontamination equipment, uncertainty relative to emergency standards for ingestion of radioactively contaminated water supplies, and public ignorance of safe water use practices may constitute other problem areas.

Recommendations

- a. Community action programs should include measures to increase preparedness of local environmental health personnel to assist in development, maintenance, and utilization of safe water supplies under postattack conditions. Particular attention should be given to accessibility of ground water supplies in this regard since they may be relatively free from radioactive contamination. The possibility of developing and utilizing safe private water supplies available to the community should be investigated. Potential storage facilities which provide protection for reserves should be appraised with an eye towards improving supply protection and distribution systems.
- b. Medium and long-range research programs should include:
 - (1) Further study of factors affecting the water cycle and of the relative safety and desirability of surface versus ground sources, and of various existing surface and ground sources, under postattack conditions. Such investigation would be helpful in providing guidelines for postattack preparedness to local environmental health personnel charged with inspection, monitoring, and approval of community water supplies; and

- (2) Research relative to the hazards of waterborne diseases in combination with radiation effects.

3. Water Management

When increasing numbers of people and services must rely on a largely unchanging resource base, such as water, they strive for optimum use of available supplies. The basis for realistic evaluation in this regard must begin with systematic assessment of elements, such as vulnerability and restoration time under possible attack conditions, of the water supply system for any given area.

Evaluation of the initial effects of radiation and blast make it evident that, in many areas, provision of total protection for existing water supply systems may not be feasible.^{1/} The vulnerability of any given system to attack damage is dependent upon a number of factors, among them the nature of the water source, treatment facilities and processes, storage, distribution facilities, structure, equipment, and power supply. The results of a specific detonation on a system may be estimated once data relative to the explosion are available. Severe and extensive damage due to blast overpressure is likely to occur in distribution facilities. Loss of power may mean inaccessibility of ground water supplies. Emergency sources, such as water stored in tanks, heating units, water pipes of buildings, and swimming pools, as well as emergency connections to water sources not normally used for domestic consumption, may be necessary. The increased reliance of the public, particularly in urban areas, on public supplies would mean that if supplies were inadequate, any available water probably would be tapped by the city or by individuals.

Lack of emergency equipment and supplies may handicap water system restoration in a postattack period. Where fallout is hazardous, any damage

^{1/} Reducing the Vulnerability of Water Supply Systems, FF 80-24, (Washington: Department of the Army, Office of Civil Defense, March, 1965), p. 1-1.

experienced may be difficult to repair due to danger of personnel exposure. If emergency generating facilities are not available, power failure caused by destruction of transmission lines may be the most critical single problem handicapping restoration efforts immediately after an attack. Public health hazards resulting from lack of adequate water supplies could be expected to continue, and perhaps increase, with longer delay times for restoration of services.

Other managerial problems would stem from lack of broad training and knowledge of critical elements of the water cycle and system on the part of operating personnel. This, coupled with lack of emergency standards, supplies, equipment and laboratory facilities, may distort realistic assessment of damage and alternative measures. Thus, for example, if a fire occurs, the tendency may exist to by-pass the water treatment plant if a greater volume is needed than the available treated water being supplied. This may occur even in situations where the raw water would be heavily polluted with fallout and/or other agents, and/or when dead ends exist within the immediate distribution area, and facilities for isolation of this part of the distribution system are inadequate.

Recommendations

- a. Community action programs to increase preparedness for effective water management under postattack conditions should include appraisal of means of improving community water supply protection and of structure and equipment hardening. The probability of postattack water supply availability could be increased by decreasing the vulnerability of system elements. Provision of facilities and supplies such as standby generators, emergency pipe supplies, and chemical stocks would improve preparedness for effective water management under postattack conditions.

b. Medium and long-range research should include efforts to further develop and utilize planning techniques that allow simultaneous evaluation of many combinations of alternative uses and operating procedures relative to development and management of the water resources of any given area under postattack conditions. Water management and planning for emergency contingencies is presently handicapped by the limited availability and application of sophisticated techniques for determining the best mix of action involving a variety of objectives. Means of improving water resource allocation and management, utilizing techniques expected to be functional in a postattack period, also require further study.

B. Food

1. Food Quantity

There is a close relationship between food quantity and quality as these pertain to environmental health. Where food supply is adequate, fewer sanitation problems would be expected since there would be no need to consume unsafe supplies. Uneven distribution of food supplies in kind and quantity in the majority of cases probably would pose primarily regional and/or local problems. Although food supplies may not have the same geographical distribution as attack survivors, in most states the total supply of processed foods would last from two to three months. Some regions, however, such as parts of New England, the southeast and the mountain areas, may experience shortages within the first month of a postattack period unless supplies can be imported.^{1/} In regions where processed food stocks may be unusable or

^{1/} Paul D. Marr, Food Supply and Production Following Massive Nuclear Attack, SRI Project IU-2234, Prepared for Office of Civil Defense Mobilization, (Menlo Park, California: Stanford Research Institute, October, 1958), p. 8.

unavailable, non-processed stocks and supplies meant for animals under peacetime conditions may be used for human consumption to a certain extent. Previous experiences in other countries during disaster situations and in the U. S. Armed Forces may provide limited assessment of the difficulty of changing food habits in the face of necessity.

Primary food problems would be likely to center around processing and distribution functions. Overall food shortage is not considered a major post-attack environmental health problem, with the possible exception of sustenance for infants who would not be able to utilize the variety of foodstuffs suitable for adult consumption. Close coordination of public health personnel with the organizations responsible for collection and distribution of food would be critical in this regard.

Recommendations

- a. Present community planning should include survey of available and projected supplies and needs under postattack conditions. Measures for protection and recovery of food processing and distribution facilities should be developed. Potentially food-short areas should investigate and plan for means of overcoming identified food deficiencies; consideration should be given to the possibility of substitution of nonprocessed food stocks and other edibles for food items expected to be scarce under postattack conditions. Methods of protecting existing food stocks from radioactive contamination should be evaluated; in many cases, such measures may be simpler and more effective than attempts to recover or utilize such supplies after attack.
- b. Medium and long-range research programs should include improvement and utilization by communities of techniques to project food needs and available food supplies in a postattack period. Quantitative and qualitative evaluation of the relationship between food supplies

and prevalence of foodborne diseases to be anticipated under attack conditions at different times of the year also should be undertaken.

2. Food Quality

In view of the increasing use of refrigerated foods, lack of electric power could mean that within a few days following attack, the only foods safe for consumption may be canned goods and non-perishables. Under structural damage conditions, nonperishable food supplies also may spoil. The proportion of nonperishables subject to spoilage after exposure to blast damage and weather would vary, depending upon the food item and existing conditions. The health hazards associated with food spoilage are reasonably well known and may be expected in a postattack period in varying degrees depending upon the local situation.

It is believed that food contamination by fallout would be a comparatively minor problem with most supplies which initially survive an attack. Foods packaged in almost any nonporous container would be relatively safe for use. Food animals surviving an attack also could be consumed with relative safety.^{1/}

The possible need for emergency mass feeding services may provide conditions conducive to insanitation and close personal contact which could result in development of secondary disease cases from primary foodborne infections. Damage to schools, restaurants, and other potential resources for mass feeding would complicate the process. Refrigeration, processing, and distribution systems, equipment, and supplies also may be lacking. Under such conditions, public health personnel may be required to monitor and supervise existing transportation, refrigeration, processing, and distribution systems operated largely by untrained persons. The effectiveness of public health personnel

^{1/} Stanley I. Auerbach, et al., "Food and Water Recovery," in Postattack Recovery Program, ("Project Harbor," Appendix D, Woods Hole, Massachusetts: National Academy of Sciences-National Research Council), pp. 130-137.

may be further limited by lack of close coordination with organizations responsible for collection and distribution of food supplies. If radiological contamination of food and milk occurs, functions such as monitoring and approval of relatively safe food supplies, and development of plans for decontamination of food when feasible also may be necessary. Again, the inadequacy of previous training in radiological monitoring may provide additional handicaps to effective guidance. Bacteriological contamination of food and milk due to improper processing, distribution, and preparation also might pose hazards to expedient systems. Public education relative to safe use of food products would be of major importance in the face of possible quality problems.

During an immediate postattack period, usable food supplies may survive in greater quantity than people. In view of the comparatively simple nature of sanitation control measures, it is thought that food quality generally would not represent a high priority problem.

Recommendations

- a. Community action programs should include planning for protection of existing food stocks. Assessment also should be made of available facilities for emergency mass feeding services. Necessary equipment and supplies should be stocked so that emergency feeding operations can be simplified and adequate sanitation controls applied insofar as possible under postattack conditions.
- b. Research programs probably should be focused on the following:
 - (1) Foodborne disease occurrence in different parts of the country under various postattack conditions should be estimated. Investigation of the hazards of foodborne diseases for different population groups also may be of importance.

- (2) Medium and long-range research should include consideration of the effects of different diets, both quantitatively and qualitatively, on the environmental health hazards anticipated in postattack period. Foodborne disease hazards in combination with radiation effects also require study.

C. Housing

1. Housing Quantity

In general, it can be stated that attacks of a nature that provide life preserving justification for a fallout shelter system are more likely to destroy population than housing.^{1/} From one perspective, therefore, the greater the number of lives saved by fallout protection measures, the more critical the postattack housing problem, and therefore the more vital the need for public health controls if postattack recovery objectives are to be met. Crowding may be expected to occur in shelters, at evacuation points, or in relatively undamaged areas of communities as persons whose homes have been destroyed seek accommodation. Lack of fuel and damage to service facilities, such as those providing heat and water, again may encourage concentrations of population in relatively intact structures. Congregate housing would be likely to enhance spread of respiratory and gastrointestinal diseases. The presence of persons with communicable disease organisms in crowded shelters would insure exposure of practically every occupant. Development of disease would then depend to a large extent upon the level of immunity.

^{1/} Current reviews indicate that dwellings in the United States may be more vulnerable than previously assumed in damage assessment programs. The assumption is made, however, that without full fallout protection throughout the country, (1) needed housing in direct effects areas will be more than counterbalanced by undamaged houses in nearby areas where the population is severely reduced by fallout; and (2) it is practical to increase greatly the number of people per house in a postattack period over the number per house in more normal times. National Resource Evaluation Center, Manual Procedures for Resource Evaluation, (Undistributed report, Washington, D. C.: Executive Office of the President, Office of Emergency Planning, July 1, 1965), Section III.

In cases of destruction of houses, or their denial due to indirect attack effects, it is expected that public health personnel would assist in evaluating and inspecting mass shelters, usable structures, and evacuation centers. Major problems may be lack of construction materials, skilled personnel, and plans and equipment for restoration of existing housing and/or construction of evacuation camps. Acceptable alternatives to concentrations of population in shelters and evacuation areas may be lacking. Understanding by local health department personnel of the probable consequences of crowding and of feasible measures to reduce disease spread under such extensively abnormal conditions also may be limited.

The degree of priority assigned to planning for provision of housing is directly related to the life-protecting efficiency of civil defense shelter systems; the higher the ratio of population to housing, the higher the priority. At present, housing planning is believed to be of relatively low priority. It is nevertheless important in that provision of adequate housing in a postattack period could be of significant value in alleviating some of the health hazards cited above.

Recommendations

Action and short-term research programs recommended for communities should include:

- a. Evaluation of the preparedness of responsible community agencies to meet housing needs and development of plans to provide adequate housing under postattack conditions; and
- b. Assessment of community housing characteristics in order to improve knowledge and analytical perspective relative to housing concentrations, population densities, structural vulnerability, and vulnerability of service facilities as these affect projections of housing to population ratios under postattack conditions.

2. Housing Quality

The propensity of persons to return to their homes as soon as possible despite large-scale destruction, may mean that part of the population may be living in insanitary surroundings lacking important services and facilities. Such conditions would be conducive to increases in upper respiratory infections and sanitation diseases. During winter in northern climates, where power and fuel shortages prevent house heating, survival could be threatened by exposure. Lack of water, sewage, and other essential services, together with crowding, would be expected to contribute again to generally insanitary conditions conducive to disease spread.

Fallout contamination may limit the usefulness of surviving structures. Lack of equipment, supplies, facilities, and knowledgeable personnel may handicap necessary decontamination procedures. Although not the immediate concern of this study, it should be noted that where fallout results from attack, with or without blast and fire, fallout shelter protection may be of far greater significance to survival than environmental health controls or any other single factor. In many communities, without adequate shelter provision there may be little point in planning for survival needs since the proportion of the population left alive would be insignificant.

The major problem which would confront large segments of the population, especially in urbanized areas, would be the need to adapt to a more primitive way of life without the multitude of services to which people have become accustomed and upon which they depend. A higher order of communication between people and public officials than that which exists today may facilitate this adjustment.

Recommendations

- a. Community action programs should include assessment and provision of means to assure the availability of services, such as heating, which may be essential for adequate shelter protection under post-attack conditions.
- b. Medium and long-range research should include further investigation of the probable consequences of crowding relative to disease spread, and analysis of feasible measures of reducing spread of disease under such conditions.

Chapter IV

EFFECTS OF DISPOSAL PROBLEMS ON HEALTH

Waste disposal usually has two major objectives: avoidance of direct or indirect hazardous effects to man, and elimination of conditions by which waste may curtail the usefulness of existing resources. In an immediate postattack period, both objectives may be important for survival and health. This chapter deals with sewage treatment and disposal, refuse disposal, and disposition of the dead.

A. Sewage Treatment and Disposal

Analysis of the vulnerability of sewage systems to attack damage must be made in terms of specific systems, plants, and processes. Sewage collection systems would be vulnerable to effects of blast and thermal radiation, and damage to plant facilities could disrupt treatment processes. Cross connections between potable water supplies and nonpotable sources, and back-siphonages from zero or negative pressures within a system, might cause contamination which sometimes would be difficult to detect. Destruction of chlorine and methane gas tanks, where these exist, could cause a gas hazard. Damage to water and power supply systems may render sewerage systems inoperable until these units are restored. Where bypassing is necessary, the quality of water downstream may be adversely affected. Disruption of sewerage systems would lead to generally insanitary conditions; the chances for growth of vector populations and for waterborne disease spread consequently could be expected to increase. Illness could occur if water supplies were not treated prior to use. Particularly where flies have access to fecal matter, undisposed sewage would provide sources of infection for filth diseases hazardous to the

population. Restoration would depend upon availability of equipment, facilities, supplies, and personnel, and the degree and nature of damage.

Damage or incapacitation of public sewerage services may demand increased dependence upon individual sewage disposal systems such as septic tanks and cesspools. Although representing an advance in public health, the increasing replacement of individual systems by public collection and treatment facilities, especially in urban areas, may be unfortunate in terms of projected postattack needs. In situations where emergency construction of privies is necessary, it may be complicated by the unavailability of persons with sufficient technical knowledge to assess safe location and construction techniques. With general dependence on communal systems, the public may be largely unfamiliar with emergency disposal methods and treatment techniques. Expedient, improvised emergency measures for collecting and disposing of fecal matter may have to be devised.

If fallout necessitates shelter confinement, and chemical toilets are not available, the problem of waste disposal may well be intensified. Human wastes disposed outside shelters would attract flies and support their reproduction. Transmission of enteric diseases through transmission of fecal matter by flies could be a significant factor in the presence of large numbers of persons already ill and weakened by radiation sickness.

In such situations, the role of local public health personnel would include provision of assistance in development of plans for expedient sewage collection and disposal systems. Monitoring and supervision of collection and disposal and of field disposal facilities would be required, in addition to public education on expedient, sanitary, disposal techniques. Inadequate plans and equipment for

collection and disposal of sewage when water and sewerage systems are not functioning may limit the potential effectiveness of public health personnel. Lack of equipment, supplies, and manpower for repair and reconstruction of sewerage systems may increase sewage problems under postattack conditions.

The use of simple precautions and procedures to treat water before use would do much to alleviate the dangers of water pollution. With minimum preattack planning, sewage treatment and disposal are not expected to present high priority problems in most postattack situations.

Recommendations

1. Community action programs should include development of plans for effective, expedient sewage collection and disposal under emergency conditions. Such planning should consider emergency sewerage systems for families, neighborhoods, and communities. Alternative methods should be checked against manpower and other resources expected to be available for such tasks, in line with the overall plan of the community. Communities should prepare and have available equipment necessary for repair and restoration of services as well as diagrams of electric, collection, and treatment systems.
2. Research programs should include:
 - a. Exploration of alternative sewage disposal methods relative to the characteristics of the waste, the community, and expected postattack conditions; and
 - b. Investigation of means of improving forecasting of the effects of untreated wastes on receiving waters and of quantifying expected pollution hazards.

B. Refuse Disposal

Loss of equipment, fuel, and trained personnel may be expected to disrupt organized disposal services. Large quantities of debris would result from nuclear attack. Garbage would be generated at a level commensurate with the decreased level of food availability and the number of survivors. Refuse laden areas could serve as breeding locations for filth flies and as feeding areas for other surviving vectors and would contribute to the generally insanitary conditions expected.

Local public health personnel would be expected to assume an active role in development and supervision of expedient programs for collection and disposal of refuse and waste which may pose a relatively direct threat to public health. They would also be concerned with public education on proper disposal techniques. If public and official demands overemphasize the importance of non-health related measures, effective functioning would be handicapped by inefficient utilization of personnel for non-crucial tasks. Lack of equipment for collection, storage, and disposal also may hinder services.

In light of evidence presented by past prolonged disaster periods, it appears, however, that undisposed garbage and refuse do not pose serious direct environmental health threats that cannot be overcome with relative ease. Refuse disposal therefore is not considered to be of high priority relative to other postattack environmental health problems.

Recommendations

1. Community action programs to increase postattack preparedness should include formulation of specific plans for refuse disposal under given emergency conditions. Personnel needs for garbage and refuse disposal functions should be assessed in terms of problems anticipated in a post-attack period. Equipment expected to be available for collection, storage,

and disposal of garbage following thermonuclear attack should be identified and appraised. Plans should be made to supplement available equipment where necessary.

2. Research activities should include:

- a. Evaluation of the effects of refuse on deterioration of environmental health conditions in a postattack period; and
- b. Medium and long-range investigation of effects of refuse on vector and disease spread under postattack conditions.

C. Disposition of the Dead

Under the best assumed postattack conditions, it is highly unlikely that mortuaries could handle even their yearly number of dead within a period of only a few days. Proportionate numbers of deceased professional personnel trained in disposal of the dead probably would be among the tremendous number of immediate dead resulting from thermonuclear attack. Heavy reliance therefore would have to be placed on persons not trained in this function. Due to emotional aversions and the generally distasteful sight and smell of bodies in various stages of decomposition, it is likely that people would tend to avoid such work. Injuries among the surviving population would further curtail recruitment of workers. Damage to equipment also could be expected to inhibit disposal activities. Disposition of the dead probably would be regarded by environmental health personnel as less important than other activities necessary for survival, such as caring for the injured and supplying food. Altogether, it is likely that there would be considerable delay-time before complete disposition of all dead bodies could take place.

Local public health personnel would be expected to assist in developing plans for, and in supervising, mass collection and disposal procedures in a postattack situation. The ready availability of fuel and the fact that relatively little movement of bodies would be required make cremation an obvious means of disposal,

however, most public health personnel are completely unfamiliar with this type of activity. Administrative and executive procedures associated with disposition of the dead, such as the usual identification of corpses, may have to be foregone or drastically changed under emergency conditions.

The threat to environmental health from corpses in some stage of decay has not been well studied. It is thought that a decomposed body is not a disease carrier since putrefaction destroys any pathogen which may have been present.^{1/} Corpses may serve as food sources for small rodents. Usually, however, they would be second choice to other foods, which would be readily available as a consequence of attack damage. The worst threat posed by undisposed bodies would appear to be the excrements voided by the deceased and the possibility of bodies serving as breeding places and food sources for flies and other insects. With reasonable mortuary precautions, it is expected that any such environmental health threats associated with disposal of the dead could be mitigated; thus this function is viewed as third priority relative to other problem areas essential to survival.

Recommendations

1. Community action programs should include development of standby plans based on facilities, equipment, procedures, and manpower projected to be available for disposition of the dead under postattack conditions.
2. Research programs to increase preparedness in this area would benefit from:
 - a. Investigation of the effects of climate and other physical factors on disposition of the dead under postattack conditions; and
 - b. Medium and long-range study of the possible environmental health effects under stipulated postattack conditions of large numbers of undisposed corpses in various stages of putrefaction.

^{1/} U. S. Strategic Bombing Survey, Effects of Bombing on Health and Medical Care in Germany, (Washington, D. C.: U. S. Government Printing Office, 1947), p. 262.

Chapter V

VECTOR CONTROL, GEOGRAPHIC AND TIME DISTRIBUTION OF DISEASE

Perhaps the most important, and often ignored, environmental health investigation is examination of the environment in its totality. The ability of man to understand the processes of nature and to manipulate them to meet his basic needs is increasing at an unprecedented rate. Evaluation of cause-and-effect relationships of the "natural" environment to man and of positive and negative effects of man's modifications of that environment requires better understanding of the interactions of biological species among themselves and with the inanimate forces of nature.

Assessment of vector control and of geographic and time distribution of disease cannot be undertaken effectively without more knowledge of the responses of organisms as a whole, including man, to given environmental changes. Unfortunately, the trend today is rather to focus attention on subjects which are regarded as more fundamental -- namely, on detailed analysis of structures and reactions in isolation from the living organism. Recognizing the difficulty of pursuing the tasks indicated above with today's tools and level of knowledge, general suggestions relative to expected problem areas in these categories are posited in line with past experiences and stipulated postattack conditions.

A. Vector Control

Effects which thermonuclear disaster may have on vector populations are not well understood. Differential radiation sensitivity may lead to increases in insect populations, since birds which normally control these populations are more sensitive than insects to radiation.^{1/}, ^{2/} In the absence of controls, generally poor sanitary conditions during a postattack period could

^{1/} John Walsh, "Scientists and Civil Defense: Dialogue at Berkeley," Science, Vol. 15, No. 3706, (January 7, 1966), p. 56.

^{2/} R. F. Reitemeuer, U. S. Atomic Energy Commission and Department of Agriculture, in U. S. Congress, House, Biological and Environmental Effects of Nuclear War, Hearings before the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy, 86 Congress, 1st Session, 1959, p. 791.

lead to buildup of vector populations. Concentrations of people, improper waste disposal in shelters and evacuation areas, and the large amounts of debris in abandoned areas may contribute to growth and spread of insect and rodent populations. The rapidity of vector buildup and the extent of the problem in all areas would be dependent, in part, upon the initial vector population level and their reproduction rate under postattack conditions.

Effects of radiation on vector populations in situ are largely unknown. The possibility of increases in insect and rodent populations due to ecological factors, differential radiation sensitivity, and destruction of natural predators poses real problems in forecasting vector distribution in a postattack environment. Uncontrolled, the effects of vectorborne diseases on community survival and recovery efforts could be significant.

The potential role of local health personnel in curbing vector populations would be twofold: (1) development of plans for, and supervision of, vector control measures such as spraying operations, delousing, and rodent poisoning activities, and (2) development and supervision of expedient programs for collection and disposal of refuse and waste (limited to situations in which these pose direct threats to human health). In many communities, vector control programs are normally handled by private companies. The effectiveness of public health personnel therefore may be limited by their lack of familiarity with the use of insecticides and rodenticides. Inadequate emergency plans for large-scale operations, together with lack of equipment and supplies, may further handicap efforts at vector control. Restricting the probable growth and spread of insect and rodent populations in abandoned areas would require development of plans by public health personnel for mass eradication programs in such areas, together with supervision of disposition of human wastes, animal wastes, refuse, and garbage. Establishment of community priorities and procedures for extermination of vectors would require medical evaluation in terms of the relationship of certain vectors to disease spread and to specific environmental health conditions.

Growth and spread of vector populations do pose potential environmental health threats under postattack conditions. Anticipated problems of public health personnel in supervising projected vector control operations lend additional weight to assignment of a high priority rating to this area.

Recommendations

1. Community action programs should include:
 - a. Development of priorities and procedures for vector extermination, utilizing supplies which could be stockpiled so as to be available under postattack conditions. Study of successful techniques for mass control of insects and rodents, especially those used in developing countries, should provide useful input for formulation of effective contingency plans. Alternative emergency equipment and supplies needed for vector control operations should be identified in terms of both effectiveness and accessibility;
 - b. Development of expedient programs for collection and disposal of refuse and waste which provide vector breeding grounds, and identification of emergency equipment and supplies needed for such efforts; and
 - c. Training programs for in-service and auxiliary personnel to supplement the limited experience which many public health personnel have in actual implementation of vector control programs.
2. Research efforts should focus upon:
 - a. Critical analysis of the relationship of projected postattack conditions to development of vectors and of the relationship of the anticipated spectrum of vector problems under stipulated post-attack conditions to planning which may limit disease spread among a population group,

- b. Further study and development of effective techniques for mass control of insects and rodents on an area-wide scale, using equipment and materials expected to be available during a postattack period; and
- c. Evaluation of effects of radiation exposure at moderate to severe levels, and under different conditions, on plant life, and on pathogenic, and/or nonpathogenic organisms (including known and potential disease vectors). Without such ecological analysis, projections of postattack environmental health problems are severely limited.

B. Geographic and Time Distribution of Disease

Some mechanisms of linkage with respect to disease hazards constantly faced in the present environment are still poorly understood. Little is known, for example, of the short and long-range effects of various pollutants on man, or of his adaptability to such substances. Thermonuclear war would bring about radical and abrupt changes in man's environment and require from him more rapid adjustments than were ever necessary before. Such conditions undoubtedly would result in significant biological, physiological, and psychological reactions, the causes and results of which are yet unclear.

In the absence of environmental health controls and in view of other factors discussed in previous chapters, it is estimated that increases particularly in enteric and respiratory infections could be expected in a postattack situation. Some infections might reach epidemic proportions. Projected disease hazards would vary from one area to another in accordance with the environmental health conditions which develop, the reservoir of infection present, and, of course, the consequences of thermonuclear attack. The combined effects of radiation exposure and the less virulent types of organisms are unknown, but probably would be more serious than either separately.

Limitations on services, such as refrigeration, and deterioration of personal and general hygiene could be expected to lead to increases in zoonoses such as brucellosis and salmonellosis (although those foods which contribute to spread of salmonellosis may not be readily available in a postattack period.^{1/} Flies, and the presence of an active case or a carrier working at a central distribution point, could cause rapid disease spread. Disturbed conditions resulting from nuclear attack may lead to closer contact between domestic rats and infected fleas and to consequent increases in murine typhus. Incidence of infection would be limited in geographic area and may not constitute a significant hazard in urban areas. Minor incidence of plague, ratbite fever, lymphocytic choriomeningitis, and leptospirosis also could be expected, due to the possibly closer contact between man and rodent. Incidence of encephalitis would vary depending upon the habitat of the types of mosquito involved. Western and St. Louis encephalitis are more commonly found in polluted water which would be expected under blast conditions; they may pose the greatest potential hazard in California.^{2/} Human encephalitis could occur in both rural and urban areas. With increased stray dog populations and the absence of vaccine, an increased rabies hazard also may be expected.

Of those diseases not transmitted directly from man to man, (although they are primarily pathogenic to man), endemic typhus could be expected to increase as a result of pediculosis. Since typhus requires a longer incubation period for manifestation of clinical symptoms, conditions during the early postattack phases

^{1/} Environmental Health Problems in the Post-Shelter Period, Review Draft of Project No. OCD-OS-62-254, (Washington, D. C.: Research Branch, Division of Health Mobilization, Office of the Surgeon General, Public Health Service, U.S. Dept. of Health, Education and Welfare, 1964).

^{2/} Postattack Sanitation, Waste Disposal, Pest and Vector Control Requirements and Procedures, Prepared for the Office of Civil Defense under Contract No. OCD-PS-64-9, Subtask 3441A, (Arcadia, California: Engineering Science, Inc., February, 1965), pp. 10-11.

could lead later to wider spread of the disease. Although the possibility of increases in malaria, yellow fever, and dengue fever exists, in the past decade, and despite periodic importation, neither malaria nor dengue fever have become reestablished endemically or epidemically by this route.^{1/} Recently, however, cases of quinine resistant falciparum malaria have been discovered among troops returning from Indochina.^{2/} This means that there is at present no therapeutic agent available for this disease, and its occurrence in the civilian population of the United States is a possibility. If this should occur, it would most certainly become a problem if mosquito control programs were disrupted during a postattack period. It is doubtful that environmental changes in urban areas would cause significant increases in human tickborne hazards, although Rocky Mountain Spotted Fever is widespread in the western part of the country.

Bacteria and viruses that generally result in enteric infections are among those agents transmissible from man to man and capable of survival in the environment for long periods of time. Shigellosis is one of the most likely infections in the early postattack phases; incidence in individual cities might reach as high as 90 percent depending upon conditions.^{3/} Without countermeasures, and in the presence of insanitary and crowded conditions, the large numbers of active cases and carriers in the population could provide foci for more rapid spread than might be expected of other less common conditions. In crowded conditions, typhoid could be a serious threat since most of the United States population has little immunity to this disease. If public health measures should break down in a postattack situation, the opportunity for a carrier to infect large numbers of persons could result in a severe epidemic. Increases in staphylococcal and streptococcal infections also could be expected within the first few days of a postattack period.

^{1/} Ibid., p. 12.

^{2/} "Tropical Diseases: Malaria in Viet Nam," Time, LXXVI, No. 8, (August 20, 1965), p. 43.

^{3/} Postattack Sanitation, Waste Disposal, Pest and Vector Control Requirements and Procedures, op. cit., p. 62.

Lack of refrigeration and careless food handling may lead to increased incidence of staphylococcal food poisoning, an infection caused by microbial products without true infection of the host. The total disability produced by this disease, although brief, could develop into a serious threat if the persons involved hold key positions or are needed for essential undertakings. Clostridiums also are generally prevalent and should be expected under postattack conditions.

Of those diseases which are perpetuated by direct transmission of their infectious agents from man to man, respiratory diseases are perhaps the most common and troublesome. Normally mild respiratory infections may have serious or even fatal complications in a postattack period due to lack of medical care and increased stress. The likelihood of infection from more serious pathogens such as pneumococcus, diphtheria bacillus and meningococcus would also exist, particularly in crowded conditions. Due to the prevalence of these organisms in the general population^{1/} epidemics may develop. Crowded conditions and shelter living may encourage spread of tuberculosis and/or activate previously inactive cases. Enteric infections, which are basically filth-borne diseases, also could be expected to cause problems during a postattack period. During the latter part of the D to D+15 phase and well into the D+90 to D+180 phase, flies^{2/} and other surviving carriers would tend to increase exposure to fecal-oral route diseases. Limited food and water, crowding, and possibly shelter living, together with the carriers known to exist in the general population, may well contribute to

^{1/}William Herzog, Emergency Health Problems Study, Office of Civil Defense Contract OCD-OS-62-250, (Durham, N. C.: Research Triangle Institute, July 31, 1963), p. 19.

^{2/}A recent U. S. Public Health Service study ("Environmental Health Problems in the Post-Shelter Period," op. cit.) raised a question regarding the possibility of fly populations being limited by radiation. On the other hand another study has indicated that proper garbage disposal methods would be of importance in controlling flies under postattack conditions and has attached significance to fly borne diseases. Postattack Sanitation, Waste Disposal, Pest and Vector Control Requirements and Procedures, op. cit., p. 62.

spread of the infectious hepatitis virus. Due to its longer incubation period, the effects of this disease probably would not be manifest until late into the D to D+30 phase. Coxsackie and ECHO^{1/} viruses also may spread by contact and may be distributed widely throughout the general population. In addition, many geographic areas would experience problems of scabies, impetigo, and pediculosis.

Although focal points of infection for many serious diseases obviously exist at the present time in the United States, they are quite rare.^{2/} This might indicate that even if epidemics such as those suggested above should begin in a postattack period, it would take some time for them to become established, thus providing a period for enforcement of precautionary measures. Moreover, the influence of poor nutrition, fatigue, and similar adverse conditions would not be immediate or simultaneous. The role which mass population movements have played in epidemics and pandemics is well known. Postattack conditions may increase the opportunity for spread of disease from its endemic foci. If the population were confined to shelters and limited in their range of movement, then incidence of disease spread and the number of secondary cases may be more limited in both quantity and geographic distribution. Large dislocations with mass movements of population, on the other hand, may be conducive to spread of disease to a large number of susceptibles.

Altered environmental health problems caused by attack may seriously limit the ability of public health personnel to diagnose, treat, and/or prevent spread of disease. Hospitals themselves may serve as endemic sources of infection, especially when overcrowded. There is no question that the potential environmental health hazards discussed above deserve a high rating in terms of priority and urgency.

^{1/}This designation refers to Enteric Cytopathogenic Human Orphan (ECHO).

^{2/}Robert U. Ayres, Special Aspects of the Environment Resulting from Various Kinds of Nuclear Wars, (Harmon-on Hudson, New York: Hudson Institute, Inc., June 5, 1963), p. 2.

Recommendations

1. Action programs should include community assessment of health and disease distribution patterns. Statistical determination of the probability of carriers of serious disease organisms, such as salmonella typhi, shigellia, the virus of infectious hepatitis, rickettsia prowazeki, and salmonellas A, B, and C, occurring in crowded shelter areas following attack should be included.
2. Medium and long-range research efforts should consider:
 - a. Factors affecting disease incidence and spread under anticipated post-attack conditions. Exploration of disease distribution patterns and health status in selected communities as recommended above may provide models for further study of specific health hazards with application to more complex geographical and biological systems.
 - b. Investigation of the limits of man's natural elasticity in ability to adjust and adapt to his environment relative to functions, organs, and systems and anticipated stresses imposed by a postattack environment; and
 - c. Further study of the effects of irradiation through external exposure and/or ingestion of contaminated substances on disease resistance and recuperative ability for those diseases which may be expected during a postattack period.

Chapter VI

ADMINISTRATION AND EMERGENCY PLANNING

Management, direction, and other administrative aspects of environmental health services should receive high priority, especially with respect to development of detailed plans, lines of authority, and communications within and between agencies and with the general public. Efforts to acquaint the public with projected postattack conditions and to develop preparedness for improvisation to meet basic health needs are needed. Realistic assessment of the number, competence, and training of professional and auxiliary public health personnel in specific communities also may be of great importance.

A. Disruption of Public Health Services

The postattack environment in which survivors of a nuclear attack would find themselves would present a changed picture in terms of health services. The present system of public health administration and medical care undoubtedly would be severely disrupted and dislocated. In communities where hospitals and other environmental health or medical care facilities are located close to one another, thermonuclear explosion could mean complete destruction of structures and equipment as well as a high percentage of personnel. Assuming that the nation's large urban concentrations may be primary target areas, some suburban or peripheral areas may find themselves relatively isolated from municipalities upon which they previously depended for a variety of services.

Provision of adequate medical care in the face of large numbers of persons suffering from injuries, radiation sickness, and other illnesses would present a serious problem. Even if the ratio of physicians to population remained the same, the ratio of physicians to the ill would be in the range of from 1:300 to 1:500

depending upon the specific geographic location.^{1/} Although this ratio might improve after the D+15 to D+30 phase due to recovery or death of the diseased and injured, in the early phases self- and neighbor care in the absence of facilities, equipment, and supplies would be required. Decreases in the number of environmental health personnel at least proportionate to total population reduction also should be expected.

Much of the resistance of the United States population to a variety of diseases is a partial outgrowth of the use of medicines, antibiotics, anti-toxins, vaccines, and similar drugs or other supplies which provide protection or cure. Although the need for such substances may increase following attack, supplies would be far more limited and perhaps unavailable. Reserves may be destroyed, and manufacturing and distributing capability temporarily halted or severely limited. Persons with chronic diseases able to live fairly "normal" lives under peacetime conditions might face a severe threat during a postattack period when adverse conditions exist and routine medications, appliances, and medical care would be scarce. Large portions of the American population are not accustomed to primitive conditions of self-care and limited medical services common in other nations of the world; on the contrary, great dependence is often placed on the services of specialists and availability of aids to treat disease and injury. In this regard, previous studies have indicated that geographic areas frequented by natural disaster may be somewhat better prepared to deal with postattack environmental health problems, including disruption of normal health services, than those areas in which environmental factors pose little or no threat.^{2/} Rural communities also may be better prepared in some respects than urban areas.

^{1/}William Harzog, Emergency Health Problems Study, op. cit., p. 7.

^{2/}"Environmental Health Problems in the Post-Shelter Period," op. cit., p. 087.

The unfamiliar conditions caused by thermonuclear attack may present both ethical and technical problems to surviving medical personnel. The philosophy of medical practice and the ethical code accepted during peacetime relative to what conditions should be treated, how and when, and priorities to be assigned to them, may have to undergo radical alternation in the face of postattack contingencies. Health personnel may not be familiar with diseases and hazards to be expected in the postattack environment. Practical first-hand experience with effects of radiation overexposure, for example, is rare. Moreover, most physicians and public health personnel may have had no more than isolated experiences with infectious diseases which could reach epidemic proportions in a postattack period under certain conditions. With the infrequency of severe malnutrition in this country today, nutrition training in United States medical schools is so meager as to be virtually nonexistent.^{1/} It is evident that such problems would constitute additional handicaps to provision of adequate medical care in a postattack situation. Overall shortage of medical personnel, equipment, facilities, and supplies leading to interruption, alteration, and in some cases destruction, of normal public health services would constitute first priority problems under projected postattack conditions.

Recommendations

1. Community action programs should include:
 - a. Assessment of anticipated shortages of health personnel, equipment, facilities, and supplies together with identification of medical care items most likely to be needed under emergency conditions. Environmental health and medical personnel should be familiar with supplies and equipment on hand and with their location; and
 - b. Assessment of potential effects of isolation from the main city body on environmental health services of suburban and rural areas.

^{1/} Paul Weiss, Renewable Resources, op. cit., p. 81.

2. Research programs should focus upon:

- a. Study of communities and regions which have faced natural disasters in the past, with consequent disruption of normal public health services, to obtain indications of the kinds of problems which may be anticipated in a postattack situation; and
- b. Assessment of the knowledge level of local agencies concerned with community environmental health conditions and of the general population relative to cause and effect relationships of insanitation and other factors to disease.

B. Emergency Equipment and Supplies

Lack of emergency equipment and supplies to cope effectively with projected postattack environmental health conditions would be a problem facing many communities. Materials needed for essential services (such as heating, sewage and waste disposal) also may not be available.

Recommendations

1. Community action programs should include identification of items most likely to be needed under emergency conditions. Personnel should be familiar with available supplies and equipment and with their locations.
2. Research efforts should be continued and intensified to:
 - a. Develop improved measures for improvisation of equipment and operations important to maintenance of adequate environmental health conditions; and
 - b. Design multipurpose emergency supplies, and equipment which is portable and simple to operate under postattack conditions.

C. Scarcity of Personnel

Variations in absolute and proportional numbers of public health personnel throughout the country generally tend to favor more urbanized and industrialized

areas. The overall peacetime shortage of qualified personnel in many communities is such that critical scarcity of such persons should be expected during a post-attack period. The majority of operating public health personnel are employed by local political units which may not necessarily coincide with the most efficient and effective resource units. Attack effects also are not likely to follow political boundaries. Hence some predetermined plan for exchange of personnel would be necessary if surviving personnel are to be utilized effectively.

The four categories of public health personnel most directly concerned with environmental health are sanitary engineers, professional sanitarians, other sanitarian personnel, and veterinarians. Among these four categories, sanitary engineers provide the majority of local leadership and sanitarians constitute the largest group of environmental health workers. In addition, public health physicians generally have final approval of the nature and extent of tasks undertaken by local environmental health personnel. Laboratory personnel perform many of the services necessary to effective environmental health monitoring and sampling procedures. Extreme shortages of environmental health personnel in all categories are expected.

Recommendations

1. Community action programs should include the following:
 - a. Development of operational plans to provide for close coordination among environmental health personnel and respective parent agencies (including standby provisions for personnel transfer) during a post-attack period; and
 - b. Assessment of projected available work forces for tasks requiring professional skills and for those requiring unskilled labor but related to maintenance of services and facilities (such as garbage disposal or disposition of the dead). Estimation of the total daily

man-hours required for environmental health activities in a postattack period should provide useful input for determination of approximate numbers of supplementary personnel needed.

2. Short-term research should focus on:

- a. Feasibility studies relative to development of locally-based training programs for persons to serve as auxiliary environmental health personnel in such specialities as sanitary engineer and sanitarian aides.

A corollary effort should be development of training manuals and guides which could be used by local personnel for training of interested persons, and

- b. Estimation of total manpower requirements with due regard to post-attack productivity aspects, relative to execution of environmental health tasks. The limiting effects of radiation exposure and disease incidence should be considered in assessment of projected needed and available manpower.

D. Radiological Health Hazards

Radiological contamination may limit the accessibility of some areas. Without competent operation and maintenance crews, a water supply system, for example, may be put out of service even though it remains structurally intact following attack. Some units, such as coagulation, settling basins, and filters, may be especially hazardous because of fallout concentrations, and therefore inoperable. At the same time, work teams supporting services and restoration may themselves take inadequate health precautions. Without supervision of environmental health conditions among work teams, personnel may face serious health hazards. Incapacitation or inability of personnel to perform needed health-related functions may have a compounding effect upon the health, and indeed the survival, of large segments of the population. Moreover, without adequate supervision, personnel unknowingly may serve as foci for disease spread. The presence of an active mild

case of salmonellosis, or of a carrier working at a food distribution point, for example, could lead to rapid spread of the disease. Protection and preparedness of personnel to work under postattack conditions would affect the speed and effectiveness of restoration of essential services.

Recommendations

Community action programs should plan for education of supervisory, operating, and repair personnel in the elements of sanitation as well as in means of fallout protection.

E. Training of Environmental Health Personnel

Environmental health personnel generally function in a supervisory capacity. Therefore, they are expected to have relatively limited capability for personally implementing most environmental health measures even under peacetime conditions. The level of training of qualified sanitary engineers, professional sanitarians and other sanitarian personnel generally seems sufficient, however, to enable them to adapt to most of the technical requirements of a postattack situation. The expected ability of local health department personnel to perform radiological monitoring functions and to operate field laboratories are two serious exceptions in this regard. Postattack requirements would involve much higher levels of radiation than those for which even trained personnel are prepared. In many cases, personnel are not familiar with effective emergency techniques for vector control, field sewage disposal, monitoring and supervision of mass feeding operations, disposition of the dead, and other similar functions which may be necessitated by thermonuclear disaster.

Recommendations

1. Community action programs should include strengthening of field training programs in the disciplines involved in maintenance of environmental

health controls. The frequent interdependence of environmental health problems would require cooperative efforts of the social, biological, and engineering sciences together with utilization of modern methods of research and analysis.

2. Short-term research should include evaluation and development of alternative training programs to improve community environmental health personnel's level of:

- a. Understanding of the nature of the postattack situation and the probable role of environmental health,
- b. Capability to perform routine radiological monitoring activities to the degree expected in the postattack period, and
- c. Capability to function effectively without access to laboratory analysis, and consequent capability to perform routine tests using field laboratory equipment.

F. Scope and Coordination of Local Public Health Services

Although the scope of services of local health units varies widely, most agencies accept general responsibility for community action to prevent illness and maintain adequate health conditions for the population served. By and large, however, the local public health agency serves primarily as the central monitoring, controlling, and planning unit rather than as the actual provider of health services and resources. As a result, a specific public health agency may have little operational capability for implementing activities necessary to maintenance of community health.

Public health services are generally dependent upon a number of governmental, voluntary, and commercial organizations. This dependence requires smooth coordination and cooperation between the various units responsible for providing services to the population. In practice, however, local situations vary. Some communities have difficulties of long standing in coordination and cooperation between local units, as well as between local, state, and federal agencies.

Communities and departments often tend to function as small, isolated units. Such negative traditions may well serve to impede constructive action under the additional stresses imposed by a postattack period. Communities studied to date have indicated justified concern over the inadequacy of communications and designations of authority between and within agencies (particularly where different departments are involved), as well as with the general public.

Recommendations

1. High priority should be given to community action programs for:
 - a. Development of postattack environmental health plans which include agreements between local health units, as well as community-regional-state agencies, for mutual support during a postattack period; and
 - b. Establishment of operational lines of authority to facilitate execution of environmental health activities in a postattack period. Close coordination should be assured with public and/or private organizations which actually provide for such essential resources and services as water, food, waste disposal, sewage disposal, and vector control, on local, state, or national levels.
2. Short-term research should include feasibility studies for development of area-wide plans for environmental health operations in a postattack period. Plans should encourage cooperative agreements and contingency arrangements with related service and commercial organizations. Local operational civil defense plans of the political units involved, as well as relevant plans of active and reserve military units in the area, should be utilized. Authority lines between different agencies and departments concerned should be clearly identified, questionable features resolved, and implementation responsibility under emergency conditions clarified. One or more prototype plans in specific areas should be developed for demonstration purposes.

G. Records, Inventories and Plans

Communities studied to date have indicated lack of detailed standards and plans for specific postattack situations. In some cases, health department personnel do not seem to be familiar with plans made by civil defense authorities. Records and operating procedures often are not available in complete form in alternative storage places so that, under emergency conditions, persons other than the present managerial and operating personnel would be able to provide essential services.

An important corollary to this problem is the frequent lack of basic data necessary for effective community resource planning and development in a post-attack period. Policy decisions should not be made on the basis of inadequate information or loose estimates; otherwise, they may be expected to suffer consequent limitations.

Recommendations

1. Comprehensive inventories and operating manuals for essential services, emergency organizational structures, communications systems, and records indicating the location of auxiliary resources and equipment should be developed. Preparation of such materials should involve key health personnel, and several copies should be filed at different places within the community.
2. Research should be focused on identification of data needed for effective postattack planning and assessment of methods to facilitate data collection relative to regional allocation of specific resources and services.

H. Public Education

As the public health standards of this country have risen, the population has become less experienced in coping with primitive environmental conditions. In a

postattack period, many services and facilities which normally safeguard community health may be disrupted. It may be necessary to return to a more rudimentary form of life, at least until essential services can be restored. For example, public ignorance of simple techniques of sewage disposal, or for provision of safe water, which may be improvised with relative ease would be a handicap under emergency conditions. Uninformed construction of privies could, in fact, add to postattack environmental health hazards, for unless proper precautions were taken, pollution of ground sources could occur. It is unlikely that there would be enough trained people available when and where needed to supervise such emergency practices. The problem of providing environmental health supervision of a mass feeding station, for example, would not present extreme technical difficulties to a sanitarian. The fact that persons operating these stations may be for the most part untrained, and the equipment inadequate, would mean that almost constant supervision and control would be necessary.

Furthermore, leadership components of the general public are likely to be ignorant of many of the health hazards peculiar to thermonuclear warfare. Knowledge of the effects of radiation, (for example, of the point at which ingestion and/or external exposure could reach the danger level), of simple means of decontamination, and similar essentials would be the exception rather than the rule. With the physical and psychological stresses caused by nuclear disaster, instruction of survivors in simple procedures of disinfection and/or decontamination necessary to treat water during the interim period before water supply services were restored might prove a serious problem.

It is one thing to decide objectively what would be most desirable for post-attack environmental health planning but it is another thing to obtain needed public understanding and acceptance. There is a widespread tendency to view the problem of resources and services as primarily planning to avert shortage of fixed acceptable supplies for a given area. The fields of environmental health

and civil defense offer numerous examples of the interconnectedness of individuals and groups with the environment within which they live. Introduction of the citizenry to some of the key issues identified by planners in the field could have significant effect in preparing them to face potential environmental health problems realistically and effectively. Public education as to anticipated postattack environmental health problems and means of mitigating some of their effects would seem to be a high priority item for increasing preparedness. Without extensive efforts along this line, postattack environmental health planning can never be fully effective.

Recommendations

1. Public education in primitive sanitation methods is one specific area of concern which should receive high priority. Efforts in community leadership education generally should be directed towards anticipated post-attack environmental health conditions and means of coping with projected problems. Measures to facilitate individual and group understanding and participation in community planning should be developed and utilized.
2. Medium and long-range research programs should focus on study of information spread before, during, and after a crisis period. The functioning and malfunctioning of the social systems which determine the way in which available resources are utilized and contingencies met also should be carefully evaluated.

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Raphael J. Salmon. 31 January 1966 (Unclassified) 73 pp.

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