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Memorandum

August 10, 1979



TO: Members of the Nutrition Committee

FROM: Mary Winston *M. Winston*

You will recall that at our meeting in April Dr. Bray suggested to us that we familiarize ourselves with the three recent nutrition reports coming from Washington from OTA, GAO, and OST. I have been successful in obtaining this one from OST which is enclosed. The other two are on order and I will send them as soon as they become available. Perhaps this is something we should discuss at our November meeting.

I am also enclosing a copy of a list of low sodium medications published by the American Druggist magazine. They have offered to reprint this article for us at no cost. Do you see this as a useful piece? Please send me your comments.

Thank you again.

/ls

Enclosures

New Directions in Federally-Supported Human Nutrition Research

Prepared by
NUTRITION RESEARCH INTERAGENCY WORKING GROUP
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT

Washington, D.C.

December 1977

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EXECUTIVE SUMMARY
and
ACTION PLAN

The Administration is focusing attention on the relationships between nutrition and health and between nutrition and food policies both here and abroad. An initiative to overcome world hunger is being organized by Secretary of Agriculture Bergland and White House Assistant Peter Bourne. A prominent place for nutrition has been highlighted in the Child Health Initiative and health promotion and disease prevention programs undertaken by Secretary of Health, Education, and Welfare Califano and Assistant Secretary Richmond. The organizational aspects of food and nutrition policies and programs are under detailed review by the President's Reorganization Project. Research on the many aspects of human nutrition represents an important component of Federal nutrition policy.

Human Nutrition Research encompasses investigations of the effects of food ingredients on human development and health, the nutrient composition of foods, food consumption patterns, and methods for educating the public about dietary practices. Federal expenditures in FY 1977 for nutrition research as defined in this study were approximately \$117 million. Most of the research is conducted by the National Institutes of Health (\$80 million), the Agricultural Research Service (\$14 million), Cooperative State Research Service (\$8 million), and the Food and Drug Administration (\$4 million). There is little formal coordination of research planning or joint conduct of nutrition research by Federal agencies. There are substantial gaps in the overall Federal research program despite the facts that good nutrition is essential for normal development and optimal performance and that many Americans suffer from nutrition-related health problems.

The Office of Management and Budget requested the Office of Science and Technology Policy (OSTP) to examine federally supported human nutrition research efforts and to identify high priority activities in time for preparation of the FY 1979 budget. The Director of OSTP established the Human Nutrition Research Working Group. This group, consisting of representatives from five Federal agencies with major human nutrition research programs, has:

- Defined the scope of human nutrition research
- Described and assessed existing Federal nutrition research programs
- Identified research areas requiring increased attention
- Suggested mechanisms for enhancing coordination and improving the scientific quality of Federal research activities

In the course of the study, OSTP staff and consultants visited nutrition research laboratories of the National Institutes of Health (NIH), the Agricultural Research Service (ARS), and the Food and Drug Administration (FDA). The staff met with representatives from academic research departments, food industries, professional nutrition organizations and consumer organizations.

Human nutrition research was classified into four essential areas which are listed below (with estimated 1977 expenditures):

- Effects of Nutrition on Human Health and Performance: Studies of human nutrient needs and the role of food ingredients in health status, in growth and development, and in the care, treatment, and prevention of specific diseases (\$95 million)
- Food Sciences: Studies of nutrient composition of foods and biological availability of nutrients in foods when they are consumed (\$9 million)
- Nutrition Education Research: Determination of the influence of income attitudes and knowledge on dietary practices and delineation of the most effective mechanisms for reaching consumers with nutrition information (negligible funding)
- Surveillance of Diet and Nutrition-related Health Status: Determination of the food consumption patterns and nutrition-related health status of the U.S. population and of various population subgroups, e.g., elderly, economically disadvantaged (\$13 million)

RECOMMENDATIONS

1. Using the criteria of potential impact of research, magnitude of the knowledge gap, and researchability of the topic, the Working Group identified 17 high-priority research activities listed in Exhibit 1. Nutrition research should still be conducted in many other areas, of course. Measures of performance and health status and recognition of individual differences in absorption and utilization of nutrients are essential for many of these research activities.

2. The Department of Health, Education, and Welfare (DHEW) and the Department of Agriculture (USDA) need to establish clear and, wherever possible, distinct missions for human nutrition research. Nutrition research activities within each agency should be defined more explicitly. Actions need to be taken to improve coordination of research in the many areas of overlapping responsibilities among the agencies. Food scientists, physiologists, clinicians and other research specialists from the various agencies need to work more closely together to plan, fund, conduct, and evaluate human nutrition research. Two mechanisms are recommended for such coordination to strengthen research efforts:

- (a) In-depth external reviews of the intramural research programs of NIH, ARS, FDA, National Center for Health Statistics (NCHS), and Department of Defense (DOD) with participation from both biomedical and food sciences specialists.

- (b) An expanded extramural competitive grants process in both NIH and USDA with joint participation of Federal agencies in developing requests for proposals and in reviewing research in progress.

3. Improved communication and coordination is required within DHEW and within USDA:

- (a) In DHEW, the programs of FDA, NCHS, Center for Disease Control (CDC), and NIH must be coordinated in the high priority activities identified in Exhibit 1. At NIH, it is essential for the NIH Director and for the Nutrition Coordinating Committee under his direction to have the authority to prioritize nutrition research needs. The Director, NIH, has a relationship to the several Institutes which permits allocation of funds for nutrition research in the absence of specific statutory authorities for reprogramming between Institute appropriations.
- (b) In USDA, it is essential that the nutrition research activities of the Agricultural Research Service (ARS), the Cooperative State Research Service (CSRS), the Food and Nutrition Service (FNS), and the Economic Research Service (ERS) be coordinated through the Secretary of Agriculture.

BUDGET IMPLICATIONS

The objectives of the Working Group may be met at least in part by reallocation of resources from existing programs to the higher priority areas identified here. The Working Group decided to recommend no specific funding levels. Funding levels should be developed in the context of the budget process. OSTP will participate with the agencies, with OMB, and with other units in the Executive Office of the President to help develop appropriate budget requests for human nutrition research.

EXHIBIT 1

PRIORITY RESEARCH ACTIVITIES

EFFECTS OF NUTRITION ON HUMAN HEALTH
AND PERFORMANCE

Pregnancy
Infancy and Early Childhood
Elderly
Obesity
Iron Deficiency
Nutrient Toxicity and Interactions

FOOD SCIENCES

Methodology for Analyzing Food Composition
Nutrient Bioavailability in Foods
Updating National Nutrient Data Bank
Expanding Food Composition Measurements

NUTRITION EDUCATION RESEARCH

Factors Determining Dietary Practices
Identification of Good Nutritional Practices
Ad Hoc Education Research Planning Committee

DIET AND NUTRITIONAL STATUS SURVEILLANCE

Food Consumption Survey Methodology
Measurements of Nutritional Status
Analysis of HANES Data
Epidemiological Studies

CHAPTER I

INTRODUCTION and OVERVIEW
of
FEDERALLY-SUPPORTED HUMAN NUTRITION RESEARCH

Nutrition research provides essential knowledge, which -- when used to help shape or modify consumer dietary practices, health care services and practices, food production and processing, and Federal nutrition and agriculture policies -- can lead to a healthier, more productive society.

Both the Department of Agriculture (USDA) and the Department of Health, Education, and Welfare (DHEW) have major roles in human nutrition research, since scientific knowledge about nutrition is basic to food and agriculture policy and to national health policy. Consequently, there are overlapping research activities. The Food and Agriculture Act of 1977 recognizes the dual role, by directing the Secretary of Agriculture to coordinate with the Secretary of Health, Education, and Welfare in areas of nutrition research that are of mutual interest. Both Departments have prepared very recently extensive plans for expansion of their respective programs in many aspects of nutrition. This report examines nutrition research and leaves broader issues of provision of food and nutrition services, food safety and consumer protection, manpower training, regulations, and nutrition education to the agencies. The organizational aspects of food and nutrition policies and programs are under detailed review by the President's Reorganization Project.

FORMATION OF THE WORKING GROUP

In January 1977, the Energy and Food Division of the Office of Management and Budget (OMB) asked the Office of Science and Technology Policy (OSTP) to examine Federally-supported human nutrition research efforts and to make recommendations for improvements to be considered in developing the FY 79 Administration budget.

An interagency working group, chaired by the OSTP Assistant Director for Human Resources, was established in April 1977 with senior research staff representing the Department of Agriculture (USDA), the Department of Health Education and Welfare (DHEW), the Department of Defense (DOD), the Agency for International Development (AID), OSTP, and OMB. The full working group met eight times. Assignments were carried out by agency representatives and OSTP personnel working individually and in small task groups. 1/

1/ Participants are identified in Appendix A.

WORKING GROUP OBJECTIVES

The principal objectives of the working group were to:

- Define the scope of human nutrition research
- Describe and assess existing Federal nutrition research programs
- Identify research areas requiring increased attention
- Determine how the coordination of research activities and the sharing of human nutrition research information throughout the Federal government might be enhanced

Emphasis was placed on human nutrition research for domestic objectives. The study paralleled an OSTP review of international nutrition research objectives proposed in June 1977 in the National Academy of Sciences' World Food and Nutrition Study. Of the 22 high-priority research areas identified in the NAS study, three represented nutrition research; all of the others were agricultural research on food production and food marketing and policy analyses. The three nutrition research areas were nutrition-performance relations, role of dietary components, and nutrition intervention programs.

This Working Group report emphasizes studies on human health effects of specific nutrients and foods and research to improve the capability for assessing and enhancing the impacts of dietary programs and practices on health and performance. Thus, the Working Group recommendations support the international priorities. In the international setting and in the United States, as well, one must recognize that nutritional status is affected by income, availability of foods, cultural practices, and endemic diseases. Some of these factors affecting health and nutritional status in the less-developed countries are beyond the scope of this nutrition research report. However, these broader policy issues are being addressed under a Presidential directive by a Cabinet-level working group on world hunger.

CRITERIA FOR PROGRAM RECOMMENDATIONS

The following three criteria developed by the Working Group were used in reviewing nutrition research activities and in selecting specific research areas for increased attention:

- Impact: Research findings are expected to have major influence on human health or dietary practices.
- Substantial Existing Knowledge Gap: There is insufficient knowledge in a specific area either because little relevant research has been carried out or because the research has not yielded conclusive results.

- Researchability: An adequate research capability -- knowledge base, skilled personnel, and research techniques -- exists to address the problem so that research is likely to result in a significant breakthrough in knowledge. This criterion depends upon scientific judgment about the methods available to operationalize research questions.

THE SCOPE OF HUMAN NUTRITION RESEARCH

Human nutrition research encompasses investigations of:

- Basic physiological and biochemical mechanisms for the digestion, absorption, metabolism, and transport of nutrients; the role of food ingredients in human health and performance and in the prevention and treatment of disease.
- Nutrient composition of foods; the effects of storage, processing and packaging; and the biological availability of nutrients in the foods at the time of consumption.
- Determinants of dietary practices and methods for educating the public about dietary practices.
- Food consumption patterns and nutritional status of the general population and of special high-risk subgroups within the population; evaluation of the nutritional impacts of various intervention strategies and public policies.

Comprehensive nutrition research demands a wide range of disciplines including: physiology, developmental biochemistry, food and plant sciences, cell biology, pharmacology, epidemiology, clinical medicine, behavioral sciences, education, and economics.

AN OVERVIEW OF CURRENT FEDERAL NUTRITION RESEARCH PROGRAMS

Human nutrition research is conducted primarily by the National Institutes of Health (NIH) and the Food and Drug Administration (FDA) in DHEW and by the Agricultural Research Service (ARS) the Cooperative State Research Service (CSRS) in USDA. Significant additional contributions are made by the National Center for Health Statistics (NCHS) of the Health Resources Administration (HRA), and the Alcohol, Drug Abuse and Mental Health Administration (ADAMHA) in DHEW; Agency for International Development (AID); the Office of the Surgeon General of the Army which conducts nutrition research for the Department of Defense (DOD); the Veterans Administration (VA); and the National Science Foundation (NSF).

In FY 1977, an estimated \$117 million in Federal funds were spent on human nutrition research, an increase of about 8 percent in constant dollars over FY 1975 expenditures of approximately \$93 million. Exhibit 2 shows FY 1977 estimated expenditures in millions of dollars with major breakouts the spending by various units within the agencies. 2/

NIH human nutrition research consists of studies of the mechanisms and consequences of food or nutrient intake in the intact organism, effects of nutrient variables at the cellular or sub-cellular level, genetic-nutrient-environmental interactions, and dietary manipulations expected to produce significant changes in health status. NIH supports research on the role of nutrients in cancer, hypertension, atherosclerosis, diabetes, obesity, and gastrointestinal disorders.

ARS research activities include determining normal human nutrient requirements, the nutrient composition of foods, and the food consumption and dietary practices of the public. Investigations range from basic research on trace mineral absorption and metabolism to research on household food economics. FY 77 expenditures include \$3 million for the Nationwide Food Consumption survey performed once every 10 years. In FY 1978, a \$5 million extramural competitive grant program in nutrition research will be initiated to support ARS research responsibilities.

The Cooperative State Research Service (CSRS) provides support to State Agricultural Experiment Stations and other designated state institutions for research on nutrient requirements, sources of nutrients, and dietary practices. USDA has little control over the research areas selected for investigation by recipients of these funds.

FDA conducts research to support its regulatory authority to control food fortification practices; to regulate the composition of foods recommended for special dietary purposes and drugs containing nutrients; to establish nutritional requirements for substitute foods; to develop analytic techniques for food composition measurement; to prevent or minimize the presence of injurious substances in foods; and to operate a nutrition-labeling program.

2/ Estimates of expenditures vary greatly, depending upon the breadth of the definition of human nutrition research. We have used an estimate prepared by NIH which considers the nutrient component of multiple risk-factor studies as nutrition research. In a recent exchange before the Senate Select Committee on Nutrition and Human Needs, the Director of NIH agreed with an estimate by the Chairman of the Committee based on a relatively narrow definition that about \$20 million is spent by NIH on research that has direct implications for dietary prescription. In our view, the broader definition and larger expenditure should be used. Our broader definition and expenditure estimate are consistent with the ones provided for and accepted by the Congressional Research Service and the Government Accounting Office in summarizing FY 75 expenditures. Similar definitional difficulties exist in other agencies where overlaps occur among nutrition research, policy analysis, and basic food sciences research.

EXHIBIT 2

FEDERAL EXPENDITURES FOR HUMAN NUTRITION RESEARCH

An Approximation of FY 77 Expenditures
(millions of dollars)

		Agency Total
Department of Health, Education & Welfare		
National Institutes of Health	\$80.4	
Food and Drug Administration	3.9	
National Center for Health Statistics	2.4	
Alcohol, Drug Abuse and Mental Health Administration*	1.1	
Health Services Administration*	0.5	
Center for Disease Control*	0.3	\$88.6
Department of Agriculture		
Agricultural Research Service	14.0	
Cooperative State Research Service	7.5	
Economic Research Service	0.5	22.0
Agency for International Development		2.9
Department of Defense*		2.3
Veterans Administration*		0.5
National Science Foundation*		0.3
	Grand Total -----	\$116.6

Expenditures based on agency submission to Working Group except as noted.

* Estimates of FY 76 expenditures provided by draft Government Accounting Office report Human Nutrition Research -- Need For A Coordinated Approach To Advance Our Knowledge, 1977

AID is sponsoring research with emphasis on meeting the needs of the less developed countries in the following areas: nutritional analysis and planning, nutrition surveys, nutrition health systems, iron deficiency anemia, vitamin A deficiency, nutritional requirements, and food technology. AID research is conducted only on an extramural basis. AID contracts with USDA for food and nutrition technical services to develop new food products and food processing techniques to meet specific nutritional deficiencies. The Economic Research Service of USDA is also helping AID conduct research to develop methods for quantifying the effects of agricultural prices, land use and trade policies on food consumption.

The National Center for Health Statistics (NCHS) in the Health Resources Administration, DHEW, conducts the Health and Nutrition Examination Survey (HANES) and collects data by interview and by physical examination to assess and monitor the health and nutrition status of the U. S. population.

The Center for Disease Control (CDC) helps NCHS with HANES and conducts epidemiological studies under contract from State agencies and from AID. CDC has very little funds of its own for nutrition-related research and conducts its nutrition-related research on a reimbursable basis.

DOD conducts research designed to meet the nutritional needs of combat and support forces including the nutrient composition of military rations and individual food items under extreme storage and field use conditions. Practically all DOD nutrition research is conducted through the Office of the Surgeon General of the U. S. Army. The planned termination of the nutrition research program at the Letterman Army Institute for Research in San Francisco will substantially reduce the size of the DOD effort. The U. S. Army Natick (Mass) Laboratory conducts research on food engineering and food processing with potential applications to civilian needs.

ADAMHA research focuses on the effects of alcohol consumption on nutrient metabolism and nutrition deficiencies.

NSF supports basic research in agricultural sciences, applied research in food technology, and basic behavioral, educational and social science research in areas that are applicable to food and nutrition.

The VA conducts clinical and experimental research in nutrition, with emphasis on trace minerals.

The Federal Trade Commission (FTC) does not conduct any nutrition research but it exercises regulatory control over all food and nutrition advertising and can have an important role in nutrition education.

The Food and Nutrition Service (FNS), USDA, which administers food stamp, school lunch, and other food assistance programs, conducts evaluations of their effectiveness in delivering nutrition benefits to target populations.

The Food Safety and Quality Service (FSQS), USDA, is responsible for inspection of meat and poultry, and for the standardization and grading of foods. FSQS develops methods of improving the operations of its regulatory systems and for conducting extensive laboratory analyses of food products, including tests to detect chemical residues, antibiotics, and other additives.

A BRIEF HISTORY OF FEDERAL GOVERNMENT NUTRITION RESEARCH ACTIVITIES

Federal government involvement in nutrition research studies began in 1893 with USDA determining the energy values of common foods. In 1912, the Hygienic Laboratory of the Public Health Service was established to conduct human nutrition research on vitamin deficiency and on optimal diets for the prevention of diseases. In 1930, the Hygienic Laboratory was renamed the National Institutes of Health.

With World Wars I and II came substantial growth in nutrition research. A number of vitamins were discovered, and considerable attention was given to the effects of diet on soldiers' performance. Pellagra and beriberi were recognized as nutrition-related disorders and soon after were virtually eradicated in the U. S. by improved nutritional practices.

A widespread perception followed WWII that there was comparatively little more to learn about meeting human nutritional needs in the United States. Attention was focused on nutrition research needs of livestock of domestic importance and of populations living in less developed countries. Meanwhile, basic biochemical and genetic research revealed physiological complexities and individual variability which have great significance for the absorption, metabolism, and health effects of many nutrients.

In the last ten years, there has been increased interest in human nutrition manifested in part by:

- The 1969 White House Conference on Food, Nutrition and Health
- Hearings and reports of the Senate Select Committee on Nutrition and Human Needs
- General recognition that improved nutrition can favorably influence human performance, development, and health
- Widespread use of "health foods," megavitamins, and weight reduction approaches
- Increased awareness of the detrimental effects of malnutrition in developing countries and among disadvantaged groups in the United States
- Greatly increased Federal expenditures for food intervention programs (over \$8 billion annually)

IMPEDIMENTS TO CONDUCTING HUMAN NUTRITION RESEARCH

Problems confronting Federal human nutrition research efforts can be summarized as follows:

- Intrinsic Limitations on Researchability: In some areas of human nutrition research, there are certain intrinsic limitations on the effectiveness of research. Studies in the area of nutrient requirements call for very precise and costly measurements of the balance between food intake and body losses. However, interactions among specific nutrients and variability in requirements among different individuals and variability in requirements over time for individuals greatly complicate any research protocol, undercutting research that focuses on any one nutrient and tries to "keep other factors constant." The bio-availability of specific nutrients in different processed and unprocessed foods, taken by different individuals under different conditions of health and stress, varies significantly. Such variation may be greater than the present uncertainties about exact requirements for many specific nutrients.

Many experimental approaches would involve prohibitively expensive large-scale clinical trials. Volunteer subjects must participate for long periods of time, and the variability in requirements among individuals means that large numbers of subjects have to be studied. Consequently, research in such areas is likely to have a relatively low pay-off compared to research on other aspects of nutrition.

- Limitations on the Use of Human Subjects: In recent years, ethical considerations have restricted the use of human volunteers in biological research. Ethical considerations have also virtually eliminated studies to determine possible harmful effects of food excesses or imbalances on such critical groups as infants, children, and pregnant women. Special efforts must be made to recognize the individual's right to privacy and society's needs for knowledge by assuring anonymity rather than by suppressing existing data or prohibiting future data collection.
- Lack of Central Coordination and Planning: Many areas of nutrition research require involvement by more than one agency. No mechanism exists to regularly identify, prioritize, and plan for overall research needs so that total resources can be most efficiently and effectively employed to meet common goals. Undesirable duplication of research appears to be minimal because of the ability of individuals at the operating level to work together on an informal basis and because of the informal "Committee on Federal Information and Communications in Nutrition" which has met quarterly for three years. Most of the information, however, is exchanged after the fact, instead of in the planning stage, and the effort has had little influence on the setting of priorities.

- Environmental Control of Laboratory Practices: The Occupational Safety and Health Act (OSHA) regulations, when implemented in laboratories conducting nutritional research, can be anticipated to have significant financial implications. Many government and university facilities will undoubtedly need to be renovated or rebuilt.

CHAPTER II
RESEARCH PRIORITIES

The Working Group organized the review of human nutrition research into four areas of:

- Effects of nutrition on human health and performance
- Food sciences
- Nutrition education research
- Diet and nutrition-related health status surveillance.

The criteria of impact, gaps, and researchability (page 3) were applied to identify targets for increased research efforts within each area.

A. EFFECTS OF NUTRITION ON HUMAN HEALTH AND PERFORMANCE

Studies of the effects of nutrition on human health and performance seek knowledge to permit the design of nutrition practices and policies that:

- Optimize physical and mental growth and individual performance
- Maintain human health and prevent nutritionally-related diseases
- Provide the most favorable nutritional conditions for recovery from disease.

Research gaps in this area are profound. Recommended Dietary Allowances have been published for only 16 of the 40 or more known essential nutrients. Many of these allowances are based on limited data and may need to be modified in the future. Biochemical, genetic, health status, activity, levels of stress, and life-style differences among individuals, as well as within a single individual during a lifetime, can significantly alter nutritional needs. Thus, increased attention needs to be placed on individual variability in nutrient requirements.

The biochemical reactions and metabolic competition that occur within the body -- between nutrients, nutrients and drugs, nutrients and food additives, nutrients and environmental contaminants -- have not been extensively studied. Yet these interactions are important in accurately determining nutrient requirements. Methods must be developed to assess simply and accurately the biochemical status of individuals and to define acceptable dietary intake based on individual needs. Such research is essential to the development of appropriate strategies for intervention, education, and monitoring. The payoff in terms of maximizing physical and mental development and performance and preventing or ameliorating disease could be large, both in terms of alleviating human suffering and reducing societal costs.

Progress in gaining knowledge about what nutrients persons need has given us control over major nutritional deficiency diseases in the U. S. Knowledge is now needed about the effects of nutrition on optimal growth and functional performance and the prevention of common diseases thought to be related, at least in part, to nutritional factors; these diseases include atherosclerosis, cancers, hypertension, and diabetes.

Approximately \$95 million of Federal funds were expended in FY 1977 on research in this area. Major research activities, including recommended priority research efforts, are summarized in Exhibit 3.

On the basis of the previously discussed criteria for setting research priorities, six of these major study areas are recommended as having greatest priority for expanded research. Other study areas are considered appropriate for continued effort without expansion or possibly with some reduction in resources on the basis that progress seems to have plateaued in the absence of new methodology. Specific priority areas are discussed briefly below.

In all research undertaken in determining nutrient needs, emphasis should be placed on elucidating:

- "Living cycle" (e.g., physical and mental demands, stress, general health status) variability
- Basic biochemical mechanisms
- Individual genetic variability
- Life cycle (e.g., childhood, old age) variability

(1) PREGNANCY

Pregnancy compresses and magnifies processes of growth and differentiation, making the fetus and placenta very sensitive to nutrient deficiencies and excesses. Roughly, 10 percent of the three million babies born each year in the United States weigh less than 5-1/2 pounds, and 50 percent of these babies show evidence of intrauterine growth retardation. The nutritional state of the pregnant mother is a critical variable in determining the long-term outcome for these low-birth-weight babies. Although something is known of protein and caloric requirements during pregnancy, much less is known about the need for minerals and vitamins. Both women and physicians are frustrated by this lack of knowledge.

CURRENT RESEARCH EFFORTS
IN HUMAN NUTRITION
(With FY 77 Estimated Expenditures)

I EFFECTS OF NUTRITION ON HUMAN
HEALTH AND PERFORMANCE
(\$95 mil)

II FOOD SCIENCES
(\$9 mil)

1. Normal Development and
Performance

Pregnancy
Infant Feeding
Immune Competence
Nutrition & Behavior
Reproduction
Adults & The Elderly

Consumer Information
Food Composition Analysis
Nutrient Data Bank
Development of Automated
Analysis Techniques
Monitoring the Quality of
Processed Foods

2. Disease Prevention

Obesity
Iron Deficiency
Arteriosclerosis
Hypertension
Cancer
Inherited Metabolic
Disorders and
Mental Disease
Osteoporosis
Diabetes
Caries and Periodontal
Diseases

III NUTRITION EDUCATION RESEARCH
(Negligible Funding)

No Major Activities

3. Treatment of Disease

General Nutritional Support
Cancer
Congenital Malformations
Diseases of the Central *NERVOUS*
System

IV DIET AND NUTRITIONAL STATUS
SURVEILLANCE
(\$13 mil)

Nationwide Food
Consumption Surveys
Health and Nutrition
Examination Survey
Nutrition Status
Monitoring
Regional Food Consumption
Surveys

4. Basic Biochemistry, Physiology
and Pathology of Nutrients

General Dietary Requirements
Nutrient Toxicity and Nutrient
Interactions

Animal studies have shown that deficiencies of certain minerals during pregnancy can produce neurologic and other congenital abnormalities in the offspring which mimic various genetic diseases of man. The effects of these hereditary disorders can be ameliorated by supplementing the mother's diet with the appropriate minerals. Such findings represent a major research advance, because they show that the expression of some congenital abnormalities in animals depends on the mother's nutritional status during pregnancy.

The major research tasks now are to develop accurate methods of quantifying a pregnant woman's nutritional status, to discover more nutrient/genetic interactions in both laboratory animals and humans, and to develop nutrition intervention approaches to prevent the birth of physically or mentally damaged offspring.

(2) INFANCY AND EARLY CHILDHOOD

Advances in our understanding of intermediary metabolism in low-birth-weight infants have made it necessary to consider decreasing the protein and electrolyte concentration of infant formulas. More information is needed on the nature and quantity of certain components of human milk and how these function biologically, especially in the growth of low-birth-weight and sick infants. Such research will pave the way for the improvement of proprietary formulas in general and for the development of special formulas to meet the specific nutrient requirements of low-birth-weight infants. There is a particular need for knowledge of the nutrient requirements for optimal growth and subsequent mental and physical performance of children during the critical period of development from birth to 24 months of age. It is likely that eating patterns and health status are molded in the early years of life.

(3) THE ELDERLY

Despite the fact that persons over 65 years of age represent more than 10 percent of the United States population, little is known about their nutritional requirements or the relationship of nutritional status at different stages of the life span to longevity. Age-related changes, if any, in the specific metabolic pathways by which certain nutrients are handled in the elderly must be identified. Studies are needed on the level of nutrient intake in relation to the prevention and moderation of degenerative processes and the specific effects of vitamin and trace element supplementation on the physiologic performance, health, and well-being of this population group which tends to have more diseases and illnesses than any other life-cycle group. The extramural grants program of the National Institute on Aging of the NIH and the hospital-based geriatric research centers of the VA should give much greater attention to nutritional needs, disease-related nutritional deficiencies, and dietary practices of the elderly.

The National Institute for Child Health and Human Development and the National Institute on Aging have jointly formulated a plan for nutritional studies of normal growth and development throughout the life cycle. Such a plan could fit well into the priorities established by this Working Group. Scientists from other Federal agencies should participate in the development of the plan to assure coordination.

(4) OBESITY

Obesity, the most widespread nutritional disorder in the United States, is a primary risk factor for diabetes and cardiovascular disease. Currently, about 30 percent of middle-aged American males and 40 percent of the females are considered obese. Despite the magnitude of this problem, the fundamental causes remain obscure. Before effective therapy can be offered, the various types of obesity must be elucidated and contributing variables clarified. Standards for diagnosing obesity must be developed so that the desirable body weights recommended to the public are supported by valid scientific data.

Research is needed on the role of genetic, environmental, and cultural factors in the development of eating patterns. Current evidence indicates that eating behavior may be determined very early in life -- possibly by the imprinting of nerve centers in the hypothalamus. Precisely how the composition and quantity of dietary intake in infancy may affect the setting of these centers is an area of investigation that holds great promise for understanding the drive to eat and, in many, the drive to over-eat. The interactions between these internal regulatory mechanisms and external psychological/environmental/cultural factors which may over-ride such internal mechanisms need to be clarified.

Further studies on the kinetics and metabolism of fat cells and the role of overfeeding in infancy and childhood on adult obesity are needed in order to justify appropriate dietary modifications.

(5) IRON DEFICIENCY

Next to obesity, iron deficiency is the most common known nutritional disorder in the United States, yet the effects of iron deficiency on physical and mental performance, ability to resist infection, and long-term survival are poorly understood.

The extent to which iron-deficiency anemia can be prevented through better knowledge of the bio-availability of iron in foods and through supplementation of food with iron must be elucidated. These issues are now amenable to study as new laboratory methods permit a more effective determination of iron absorption, of iron stores in humans, and of the biological availability of iron in food.

(6) NUTRIENT TOXICITY AND NUTRIENT INTERACTIONS

In recent years, quantities of vitamins and minerals purchased by the public for self-medication or insurance against presumed dietary insufficiency have increased substantially. There is a mistaken belief that excessive intake of nutrients poses no health problem.

Some of the nutrients that have been identified as essential for human health and development are also known to be toxic at levels above recognized requirements. The levels at which acute toxicity occurs have not been determined for most essential vitamins and minerals. For those where data are available, the margin of safety is sometimes small -- for vitamin D, only five times the recommended daily intake is toxic in some individuals. This margin is substantially less than the 100-fold safety factor required for the approval of new food additives. Understanding chronic toxicity is also important to human health. A continued lack of toxicity data will preclude effective education and regulation and may well result in adverse health effects for significant numbers of the unsuspecting public.

Dietary levels of nutrients required to meet human needs are known to be influenced by interactions with other nutrients, with drugs (e.g., antacids, analgesics, sleep medications, birth control pills), with food additives and dietary supplements, with environmental contaminants (e.g., lead, arsenic, cadmium), and with various chemicals that occur as a natural component of foods. The elucidation of such nutrient interactions is becoming increasingly important with the ever-increasing exposure of our population to such compounds. Current research is insufficient to maintain pace with newly discovered problem areas. The few relationships that have been studied in animals (calcium/potassium; zinc/copper; calcium/iron; calcium/lead) must be investigated in humans and translated into practical dietary guidelines. More work is needed on the role of fiber in inducing zinc and copper deficiency. Special nutrient interactions that may occur in the intravenous feeding of patients when the body's normal absorptive mechanisms are by-passed also require attention.

Techniques for conducting research on toxicity and nutrient interactions have been improved. The major portion of these studies can be accomplished using animals, including sub-human primates. Because of ethical considerations, human studies generally must be limited to retrospective or epidemiological evaluation of incidentally occurring problems.

B. FOOD SCIENCES

Informed choices by people of the food that they eat and the design of food intervention programs depends on basic knowledge of the nutritional composition of foods. Data are lacking on the amounts and biological availability of important nutrient forms that occur in various foods. Much of the information currently available is either obsolete because of the introduction of new varieties or processing methods, or incomplete because many of the nutrients which are now considered important were not included in earlier food composition measurements.

Food sciences research is still in its infancy. Support has lagged well behind the extensive changes in food production, technology, processing, packaging, and advertising that have revolutionized the food industry since World War II. The result is that we understand little about the real effects of these changes on human diets and health. The Working Group has made recommendations for enhancing the knowledge base in food sciences for improved nutrition. This research should lead to the development of foods with high nutritional values. USDA should work with industry to bring about the development and marketing of such foods.

Specific priorities for strengthened research efforts are:

(1) Development of improved methods for food composition analysis.

The methods currently available for analysis of many of the known nutrients and other food ingredients of concern (fibers, food additives, environmental contaminants, etc.) are slow and imprecise. For some nutrients, no standard analytical methods exist. Standard measurement procedures and reference materials must be developed so that tests can be accurately performed and readily validated.

Particular areas that need to be addressed include the development of:

- More rapid analytical procedures
- Methods that will distinguish among chemical forms of a nutrient with differing degrees of bioavailability -- e.g., vitamin D.
- Extraction techniques for the measurement of the contents of compound or complex foods -- stews, baked goods, etc.
- Automated or semi-automated food composition measurements allowing for rapid measurement of many nutrients and other food ingredients.

(2) Studies on the bioavailability of nutrients in foods as consumed.

Recent growth and changes in food fortification, processing, storage, packaging, and preparation methods demand that increased attention be devoted to studying the bioavailability of nutrients in foods at the time such foods are actually consumed. Interactions among several nutrients,

between nutrients and food additives, between nutrients and packaging materials, as well as changes that may occur with various processing methods, such as flash-freezing and freeze-drying, can affect substantially the quantity and/or availability of nutrients in food.

(3) Updating food composition information in the National Nutrient Data Bank.

The National Nutrient Data Bank is intended to be the central repository for nutrient composition data, providing detailed information on individual food products and aggregated data on classes of food products. These data are important for planning diets to meet nutritional requirements and for determining nutrient intakes and nutritional deficiencies of selected populations when used in conjunction with food consumption data collected through surveys. The Consumer and Food Economics Institute of USDA operates the Data Bank.

Data on virtually all of the food groups are out-of-date. Substantial gaps exist in the data tapes so that the tapes are virtually useless to some potential users. No data are available for many of the newer processed foods. Substantially increased efforts need to be applied to bring the data bank up-to-date quickly and to make such information available to consumers, to institutions providing meals, and to the food processing and nutrition research communities.

(4) Expansion of Federal food composition measurement capabilities.

The bulk of food composition measurements will continue to be conducted by industry, but certain types of information are needed for which industry is unlikely to have the data. These include:

- Variations in the nutrient content of foods according to seasons, storage times, and production processing and handling methods. Most of the emphasis has been on avoiding spoilage rather than on maximizing the nutritional contents. This research should tie in to the development with industry participation of food production and processing techniques that enhance nutrient values of foods.
- Safety of the nation's food supply and changes over time with particular emphasis on the amounts of particular food ingredients in the total food supply which at certain levels may constitute a public health hazard.

Some food composition measurements are conducted by ARS (Nutrient Composition Lab), by FDA ("Market Basket" Survey of foods for both environmental contaminants and nutrients), and by CSRS. However, current USDA and FDA laboratory capacity, both in government and contract facilities, is too small for the food composition measurements that should be performed. Laboratory capabilities need to be increased or provision for contract services expanded so that necessary measurements can be made, particularly of food additives, environmental contaminants, and fatty acids.

C. NUTRITION EDUCATION RESEARCH

Nutrition education programs, by transmitting knowledge gained from nutrition research, can lead to improvements in dietary practices and ultimately in the health of the public. However, it must be recognized that income, attitude and cultural practices may be even more important than knowledge in determining dietary practices. The complex relationships of these factors need to be investigated.

The Federal government supports a large number of nutrition education programs. A recent Congressional Research Service study identified 30 Federal programs (mostly in DHEW and USDA). Expenditures by USDA alone were over \$64 million. Despite its prominent role in nutrition education, the Federal government has almost no involvement in determining the best methods of educating consumers and health care professionals about good nutritional practices and important areas of unresolved scientific controversy. The Working Group could not identify any Federal expenditures in FY 1977 specifically earmarked for nutrition education research.

Priority should be given to:

(1) Identification of basic factors influencing consumer dietary practices. Efforts to formulate effective education and intervention program as part of a national nutrition policy need to be based on knowledge of the factors influencing consumer dietary practices. These factors include price, income, education, individual and family attitudes, life style, and cultural practices. Emphasis should be placed on determining which factors are most readily influenced by education and information. Research should focus initially on determinants of food consumption behavior and barriers to dietary adequacy in such vulnerable groups as pregnant women, infants, the elderly, and certain culturally defined population subgroups which may have poor dietary practices. The effort should draw on findings from such diverse areas as anthropology, sociology, market and communications research, general education research and basic medical and food science studies, including studies on taste preferences. Support for these areas of behavioral and social sciences research should be sought from the National Science Foundation, as well as other agencies. These research findings would be useful for developing a wide range of Federal intervention strategies.

(2) Identification of "good" nutritional practices and clear delineation of unresolved nutrition controversies. The Federal government has supported a great deal of human nutrition research. Yet, research findings generally have not been presented in ways to help consumers choose diets advantageous to health or to help the government develop nutrition intervention strategies. USDA, DHEW, DOD, and AID should support the development of dietary goals and practices that are likely to lead to good health. These goals must be based on a careful analysis of knowledge gained from research findings. In those areas of nutrition where research findings are not yet sufficient to make categorical statements, provisional goals should be established where possible, with a clear statement of the central issues

in any major unresolved controversies. The presentation of "good" nutritional practices and unresolved controversies should be made in a way that can be readily understood and translated into everyday dietary decisions by consumers.

The Senate Select Committee on Nutrition and Human Needs has published a list of dietary instructions under the title of Dietary Goals for the United States (pp.3-5). These goals are directed specifically at reducing certain common degenerative diseases, especially atherosclerosis, hypertension, diabetes, and dental caries. An assessment of these recommended dietary goals is overdue; an interagency working group, headed by the Assistant Secretary of Health, DHEW, and including representatives of USDA, NIH, FDA, and AID, should evaluate these goals and other goals that have been put forward to determine their scientific validity and their applicability. If deficiencies are found, the group should identify the next steps that should be taken to develop more definitive dietary goals.

(3) The establishment of an ad hoc interagency nutrition education research committee. Such a committee would have participation by research and program personnel from those Federal agencies conducting nutrition education and nutrition research programs. Its purposes would be to:

- Identify and summarize past and current findings related to nutrition education research and the determinants of food selection and general dietary behavior -- including data from industry sources.
- Identify and summarize pertinent findings from other areas of education research that should be translatable to nutrition education.
- Establish priorities for nutrition education research.
- Develop a plan for conducting nutrition education research.

The Committee should have a full-time chairperson from HEW (probably the Office of Education) and at least one full-time staff member from USDA. The Committee should be relatively small but able to draw as required on staff from the numerous Federal agencies concerned with nutrition education. Participants would likely come from USDA (FNS, ARS, CSRS, ES); DHEW (OE, HSA, NIH, HRA, FDA, OCD); AID; DOD; FTC; NSF; and VA. The committee should report to the Secretaries of USDA and DHEW and to the Director of OSTP by June 30, 1978, and disband shortly thereafter. It should systematically obtain input from the public including consumers and public interest groups, food producers and the food-marketing community, and educational specialists, anthropologists, economists, and psychologists. The Committee should relate nutrition education approaches to broader health education programs.

D. DIET AND NUTRITION-RELATED HEALTH STATUS SURVEILLANCE

The fourth priority area of human nutrition research is devoted to improving surveillance of dietary intake and nutritional status of the general population and of certain high-risk population subgroups. Such knowledge is essential to:

- Identify nutrition-related health problems.
- Design and evaluate food intervention programs, fortification strategies, distribution activities, and regulatory programs concerned with nutritional quality.

The Federal government uses two principal means of monitoring American diets. First is the National Food Consumption Survey conducted once every 10 years by the Department of Agriculture to assess the eating patterns of a sample of 40,000 people, based on their food intake over a 3-day period. The second principal method of monitoring diets and nutrition is the Health and Nutrition Examination Survey (HANES), conducted by DHEW's National Center for Health Statistics with help from the Center for Disease Control. It provides historical, laboratory, and clinical data on the health and nutrition status of a sample of 30,000 individuals.

There are serious limitations in both the methods and the timing of the surveys. A 10-year interval between USDA's food consumption surveys is too long to keep up with today's rapid changes in foods and eating habits. It also means the survey does not mesh with the more current nutrition data of the HANES survey.

The most common survey technique -- the dietary recall system -- has built-in potential for error. The participant is asked to recall the kinds and quantities of foods that he or she ate over a 24-hour period. Doing that with any degree of accuracy is exceedingly difficult, especially with the variety of processed foods on the market today.

Clinical and laboratory tests have problems too. Those presently in use are slow, cumbersome to administer in the field, and difficult to analyze. NCHS has not had the resources to complete analysis of a good deal of the nutrition-related data it has collected through the HANES studies.

Considering these problems, the most urgent research needs are as follows:

(1) To develop fast and relatively inexpensive methods of collecting food consumption information. Such a development will enable the Departments of Agriculture and Health, Education, and Welfare to get information that will accurately portray changing dietary habits. It will also facilitate studies of certain high-risk groups that we need to know more about -- especially the poor, infants, and the elderly. In addition, a coordinated and reliable system is needed to measure trends in consumer buying patterns. New techniques are needed to monitor individual food consumption. Consideration should be given to developing ways to use food consumption data already

being collected through automatic check out systems in grocery stores and perpetual inventory systems in commercial food establishments to provide continuous food consumption data.

(2) To develop more precise methods for field measurements of changes in nutritional status. Breakthroughs will depend upon basic physiological, biochemical, and genetic studies as well as on epidemiological research. Research is needed to develop simple, rapid screening methods that are more sensitive, specific, and reliable than those currently available for application in the field.

Reliable assessments of how a wide range of government intervention and nutrition education programs affect health, nutritional status, and performance of the people they are intended for is also needed. The assessments cannot be conducted until these measurement techniques can be developed. Such measures should cover not only nutritional values, but also the results such programs achieve in behavior changes, social and economic benefits, and public acceptability.

(3) Analysis of HANES data. There is obvious need for better correlation of the clinical and laboratory data already collected in the HANES study conducted by DHEW and the information collected in USDA's Household Food Consumption Surveys. The two Departments are working on that now, but without new survey and analytical methods, complete coordination will be difficult. Resources are needed to complete analysis and indexing of the nutrition data already collected in the HANES studies. For example, tabulations are yet to be completed on nutritional biochemistry and food consumption information collected in past years. Tapes of data should be indexed so that other agencies can draw upon them.

(4) Expansion of nutrition-related investigative epidemiological studies to get as much information as possible on toxic reactions to foods, as well as on results of nutritional deficiencies when they occur at home and abroad.

USDA and DHEW have been cooperating in surveillance activities. A working group with eleven participants from a number of agencies within USDA and DHEW identified ways in which collaboration between the two Departments could be increased. As a result of the Food and Agriculture Act of 1977, representatives from these two agencies are formulating a proposal for a comprehensive monitoring system.

CHAPTER III

GENERAL RECOMMENDATIONS

All four major areas of human nutrition research identified in this review require input from more than one Federal agency. Informal interchange between agencies does occur. But there are no coordination mechanisms in place to assure joint agency participation to identify, prioritize, and plan for overall research needs and to insure that activities are coordinated most effectively to meet stated goals. The need for such interchange is most acute in the research area with greatest expenditures -- studies of the effects of nutrition on human health and performance.

There are opportunities for very effective interplay between the biomedical and food sciences disciplines -- specific areas where NIH, ARS, and FDA should be involved together in planning and implementation of research programs. A significant step in developing such opportunities was the July 19, 1977, agreement between DHEW and USDA regarding their lead roles in human nutrition research.

A. Interagency Nutrition Research Planning Committee

The participants in the Working Group requested OSTP to continue to take a lead role in coordinating and monitoring nutrition research activities.

Although OSTP is not a management agency, it can conduct periodic follow-ups on nutrition research and can provide a mechanism for inter-agency planning through the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), chaired by the Director of OSTP. The Committees can draw upon additional government and outside experts as needed. It is important that a broad array of disciplines relevant to modern nutrition research be considered, including physiology, developmental biochemistry, cell biology, pharmacology, epidemiology, education, clinical medicine, and food sciences. The Committees also provide a vehicle for enlisting cooperation from universities, industry, and consumer groups for priority setting and research planning. Individual agencies should also develop or strengthen mechanisms for coordinating Federal research activities with those sponsored by universities, State governments, and private industry.

B. Extramural Grants Program

USDA sought Administration support for an extramural competitive grants program for FY 1978 in agricultural and nutritional research. OSTP and OMB supported the competitive research grants program for agricultural research, and OSTP helped obtain funding from the Congress. An extramural competitive research grants program in nutrition was deferred until a review of current Federal nutrition research activities could be conducted by OSTP. The Congressional Conference Committee on the Agricultural

Appropriations Bill for FY 1978, however, provided \$10 million for agricultural research and \$5 million for nutrition research. The establishment of an effective peer review mechanism and the award of grants to recipients with considerable research promise are an essential part of this program. In future years it may be appropriate for USDA to increase the proportion of its funds that go to extramural support. Extramural grants, of course, have been the hallmark of the NIH for many years. Some 90 percent of NIH funds goes to researchers outside the NIH laboratories in Bethesda.

Extramural grants programs in the high priority areas identified in Chapter II of this Report offer excellent opportunities for effective coordination and for assurance that proposed research is not duplicative. Mechanisms for cross-agency cooperation on specific research areas include:

- Joint agency participation in the development of Requests for Proposals (RFP's) for human nutrition research
- Joint agency participation in review of proposals submitted
- Joint agency monitoring of Federally supported nutrition research

A collaborative group, perhaps representing a university medical school and a food sciences school, or a Federal lab in combination with a university or private research organization, could be selected as a specialized research center in response to a Request for Proposal developed jointly by the Federal Agencies funding the research.

C. External Reviews of Intramural Research Programs

The close scrutiny by leading scientists of research proposals and of research in progress has contributed to the high quality of extramural research. Intramural research programs often do not have the benefit of such scrutiny. Most of the USDA, FDA, and DOD human nutrition research and about \$4 million of NIH human nutrition research is conducted in intramural programs. The on-going intramural human nutrition research programs of NIH, USDA, FDA, NCHS, and DOD should be examined in depth within the next 12 months by teams of non-agency scientists to determine:

- Appropriateness of methods and strategies
- Researchability
- Quality
- Priority
- If research is adequately coordinated with related projects supported by other Federal or State agencies or by private industry

Because nutrition research is multi-disciplinary, each team should consist of persons with biomedical and food science expertise. Scientists from other Federal agencies conducting nutrition research should take part in the review, thus increasing communication and understanding of the Federal programs. Findings from the reviews should be submitted with requests for the next year's funding.

D. Budgetary Implications

The Working Group took the approach of establishing criteria for prioritizing research and of identifying high priority research areas, rather than recommending specific funding levels. The mechanisms recommended in this study for coordinating planning, funding, and evaluation of research should do much to assure quality control and cost-effectiveness of Federal human nutrition research activities. The scientific review of current researchability of a number of important topics suggests that some fields with considerable current research effort have reached a plateau from which new methodological breakthroughs are essential if major progress is to be achieved. In the interim, work should continue, but some reallocation of resources may be indicated.

An active role for the Nutrition Coordinating Committee of the NIH is essential to integrate priorities in nutrition research across the institutes of the NIH and to achieve greater effort in the research areas identified under the effects of nutrients. The joint planning of the National Institute for Child Health and Human Development and the National Institute on Aging for a major research program on the roles of nutrients and good dietary practices in normal growth and promotion throughout the life cycle will need support from the Office of the NIH Director. Further investigation will be required to determine whether reallocation of existing resources at NIH will suffice or if increased funding, directed to the priority areas, is needed.

The USDA has received \$15 million for new extramural competitive grants programs in agricultural and nutritional research for FY 1978. Of this amount, some \$5 million was directed by the Congressional Conference Committee for use in nutrition research. Tentative program plans have already been developed by USDA for these extramural research funds to be used in the areas of nutritional status monitoring, nutrient composition, and nutrition education research. More resources will be needed to carry out the larger mandate for increased research in the food sciences recommended in this report.

The effectiveness of USDA extramural programs in Nutrition Education Research and Status Surveillance could be enhanced by developing the specific supporting and coordination mechanisms outlined in this report.

The role of the FDA in nutrient toxicity will require upgrading FDA laboratory capability and increased cooperative planning of research across the agencies, especially between FDA and NIH. The enhancement of the FDA roles in iron deficiency and in surveys of food consumption and analysis of epidemiological and survey data will require modest increases in support.

AID funding is based upon international development objectives. The agency's research needs are generally of an applied nature and extend from straightforward and technically simple food fortification programs to developing the most effective means of integrating nutritional considerations into national development planning. AID already provides over \$1 million per year in contract support for studies by two divisions of USDA. AID also provides \$200,000 to the Office of International Health, DHEW, for assistance in incorporating nutritional guidelines into low-cost health delivery programs abroad. Decisions in the near future by the Administration and the Congress about the overall strategy for the United States in bilateral development assistance programs will determine the extent to which AID can increase its participation in these activities. Nevertheless, each of the other agencies should be encouraged to assess the potential international pay-off from current and projected research projects which are designed primarily to meet domestic needs. AID, in turn, can provide through its overseas programs in response to host country requests a unique milieu for determining human nutrient requirements, assessing the results of nutrition intervention efforts, and evaluating the effectiveness of approaches designed to modify detrimental food habits.

The AID nutrition program can also serve as a bridge between the domestic program and the research recommendations set forth in the recent NAS/NRC World Food and Nutrition Study. To the extent that research programs and methods development can serve both domestic and international objectives, the participation of AID in the research planning exercises called for by the Working Group should increase the yield of internationally relevant results. USDA is expected to expand its agricultural research for international objectives, as well.

The Department of Defense has a long history of interest and leadership in certain aspects of nutrition research. There is concern that nutrition research now has a very low priority in DOD, despite the special research needs regarding transport and storage of foods and the stressful circumstances to which military personnel may be exposed. Any policy that restricts DOD research to those topics which are not or cannot be investigated under the aegis of other agencies seems to take a narrow view of the relevance of nutrition to the needs of the military.

As previously noted, the Veterans Administration has established a number of gerontology research centers at VA hospitals. Research on the physiological, cultural, and disease-related nutrition problems of the elderly should be emphasized in these centers.

Finally, the National Center for Health Statistics will need additional support to index data tapes, to analyze more of the HANES data, and to work with NIH and CDC in developing better measures of nutrition-related health status and in conducting expanded epidemiological activities. The NCHS and the FDA should work together with the Center for Disease Control to develop investigative approaches to unusual nutritional situations that could provide clues of general value for research and for public education about nutrition.

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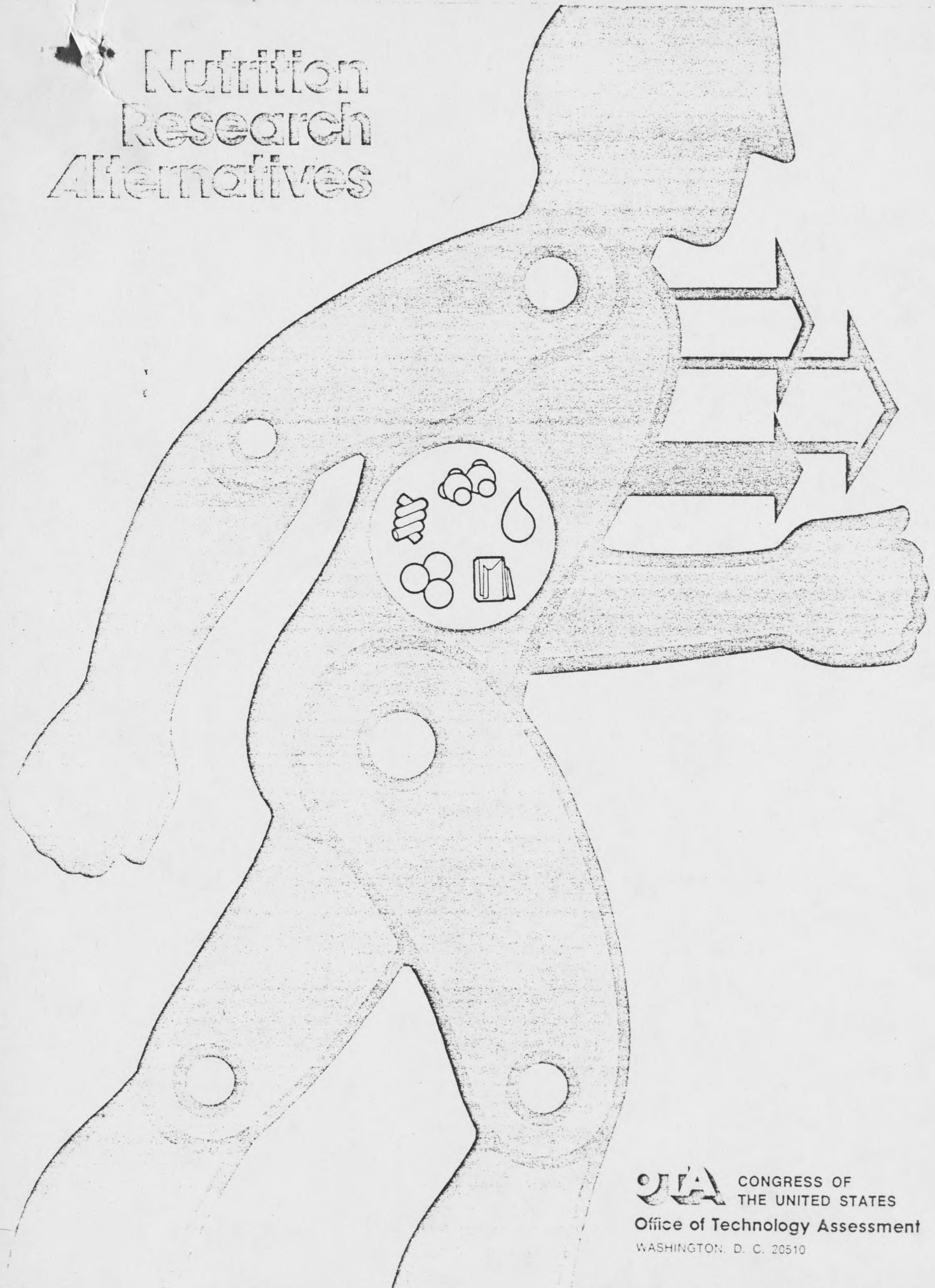
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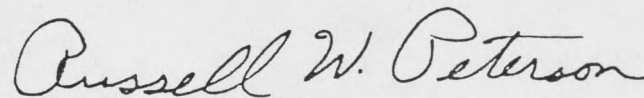
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FOREWORD

This assessment is an analysis of nutrition research alternatives—alternative goals and priorities, alternative definitions and funding, and alternative research personnel requirements. Its principal finding is that Federal human nutrition research programs have failed to deal with the changing health problems of the American people. Possibly the most productive and important area of nutrition research will be the identification of specific dietary links to chronic diseases, leading to methods for prevention.

The late Senator Hubert H. Humphrey, member of the Technology Assessment Board, requested the assessment to provide guidance to Congress in oversight of the executive agencies conducting human nutrition research.

The study was conducted by the staff of the OTA food program with the assistance of the OTA Food Advisory Committee and the Advisory Panel on Human Nutrition Research. The resulting report is a synthesis and does not necessarily reflect the position of any individual.



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EXECUTIVE SUMMARY



vitamins



fats



minerals



carbohydrates



proteins

EXECUTIVE SUMMARY

During this century, particularly since World War II, Americans have markedly altered their eating habits and lifestyles. Simultaneously there has been an equally significant change in the major causes of death.

Fifty to seventy-five years ago illnesses during infancy and infectious diseases, such as tuberculosis and pneumonia, dominated the mortality tables. Nutrient deficiency diseases, such as rickets and pellagra, were also significant public health concerns.

Today we find that most Americans die from degenerative illnesses such as heart disease and cancer. At the same time few Americans show any overt evidence of nutritional deficiency.

Unlike the infectious diseases, degenerative illness appears to result from the complex interaction of multiple factors. Although diet is one of the factors involved, to date there has been relatively little research into the direct relationship of diet to chronic disease. However, epidemiological studies indicate that overconsumption of food, especially certain kinds of foods, contributes to the incidence of and mortality from degenerative diseases such as heart disease, some cancers, stroke, hypertension, and diabetes.

The United States has gradually shifted its nutrition research focus away from domestic nutrient deficiency questions, and toward biochemical functions of nutrients and undernutrition in developing countries. This shift has left a vacuum in domestic human nutrition research. Today we need to know the answers to several key questions, such as: What specific elements in the American diet contribute to the physiological or biochemical changes which lead to the development of degenerative illnesses? By reorienting Federal nutrition research efforts, the links between diet and these diseases may soon be discovered. Obtaining better knowledge, and conveying it to the public, could reduce or delay the incidence of a number of major ailments.

Research on the links between diet and heart disease has brought widely publicized recommendations to reduce consumption of cholesterol and saturated animal fats. These recommendations have changed the eating habits of many Americans. We are eating more polyunsaturated fats and less saturated fat and cholesterol. In the last 10 years, the mortality rate from coronary heart disease has gone down over 20 percent, although heart disease still remains the leading cause of death. No conclusive cause and effect have been established, but diet, along with exercise and improved medical care, is considered a factor in this decline.

Most human nutrition research in the United States is conducted or sponsored by the Federal Government, primarily through the Department of Agriculture (USDA), the State agriculture experiment stations, and the Department of Health, Education, and Welfare (HEW). Alternatives for redefining and refocusing Government nutrition research have been put forward in recent legislation and several studies. This report assesses these alternatives, along with the state of Federal nutrition research.

The principal finding of this OTA assessment report is that the Federal Government has failed to adjust the emphasis of its human nutrition research activities to deal with the changing health problems of the people of the United States. The consequences of continuing to pursue the present preoccupation with nutritional deficiency diseases will seriously affect the quality of life of present and future generations into the 21st century.

OTA's assessment explores several optional paths that the U.S. Congress might consider to deal with this finding. Each of these options are discussed from the perspective of the three issue areas critical to the assessment's principal finding. These are:

- 1) Goals and priorities of human nutrition research,
- 2) Definition and funding of human nutrition research, and
- 3) Personnel resource requirements.

CONGRESSIONAL OPTIONS

Congress can elect to maintain the status quo with or without minor shifts or choose among the strategies and options offered by OTA, the General Accounting Office (GAO), and the Office of Science & Technology Policy (OSTP). These alternatives are outlined in table 1. Either alternative has economic, institutional, and health implications.

Congress could choose to maintain the overall status quo by refraining from any action, awaiting the recommendations of the President's Reorganization Project.

Congress could also choose to make small alterations to the existing system without changing its overall priorities and structure. This could be accomplished by amending the Food and Agriculture Act of 1977 to clarify the designation of lead agency for human nutrition research, by developing nutrition research goals and priorities for HEW that complement the goals and priorities outlined for USDA in the Food and Agriculture Act of 1977, by enacting legislation establishing a coordinating mechanism for Federal human nutrition research activities, or by considering legislation to improve data storage and retrieval systems currently in use.

If Congress chooses to change the emphasis of federally funded nutrition research, such change could be based on the strategies and options put forward by OSTP, GAO, or OTA. Before any path is chosen, however, more information is required on Federal expenditures and nutrition research personnel. This could be gained through a GAO audit of Federal expenditures for human nutrition research and a census of research personnel. Based on these findings, Congress could consider increased training grants and fellowships to fill any existing gaps in research personnel.

Table 1.—Alternative Human Nutrition Research Strategies

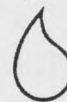
Components of strategy	Office of Technology Assessment	General Accounting Office	Office of Science and Technology Policy
Research priorities	<ul style="list-style-type: none"> • Role of diet in prevention of chronic disease and obesity • Role of nutrition in treatment of disease and support of therapy • Requirements for essential nutrients • Nutrition education and consumer information • Nutritional aspects of food science and food safety • Monitoring nutritional status • Nutrition policy and management 	<p>Research gaps:</p> <ul style="list-style-type: none"> • Knowledge of dietary nutrients required to promote or maintain growth or well-being at various stages and conditions of life • Information on the composition of the current U.S. food supply and the extent that nutrients are biologically available • Evaluation of long-term health consequences of the modern diet • Assessment of the Nation's current nutritional status in terms of dietary excesses and imbalances, as well as deficiencies <p>Research needs:</p> <ul style="list-style-type: none"> • Long-term studies of human subjects across the full range of both health and disease • Comparative studies of populations of differing geographic, cultural, and genetic backgrounds • Basic investigations of the functions and interactions of dietary components • Updated and expanded food composition data • Improved techniques for assessing long-term toxicological risks 	<ul style="list-style-type: none"> • Effects of nutrition on human health and performance • Food sciences • Nutrition education research • Diet and nutritional status surveillance
Definition and funding	<p>Definition should recognize degree of relationship to stated goals. Before Congress considers appropriations for nutrition research, an audit of Federal expenditures should be performed using a constant definition.</p>	<p>Does not define nutrition research. Instability of federally funded extramural research is a barrier to progress. Endorses development of federally funded regional research centers in conjunction with universities.</p>	<p>Definition includes basic physiological and biochemical research. Establishes FY 1977 research spending at \$116.6 million. Recommends no increases in funding with reallocation of resources to the higher priority areas.</p>
Personnel requirements	<p>No reliable figures are available for numbers of nutrition research scientists in the laboratory or in training. Before a comprehensive research program is established, must consider ability of the field to implement and sustain a program.</p>	<p>There is a shortage of nutrition research scientists.</p>	<p>Not considered.</p>
Research organization	<ul style="list-style-type: none"> • Maintain pluralistic approach with well-defined agency responsibilities • Initiate an interagency committee with rotating chairmanship • Implement a uniform data storage and retrieval system • Improve congressional oversight through joint planning and hearings 	<ul style="list-style-type: none"> • Assign each area to a lead Federal agency • Eliminate unnecessary research • Promote Government-wide research planning, coordination, and reporting 	<ul style="list-style-type: none"> • Coordinate agency activities through the Federal Coordinating Council on Science, Engineering, & Technology • Conduct external reviews of intramural programs • Improve intra-agency coordination • Establish an ad hoc interagency nutrition education research committee

Chapter I

OVERVIEW



vitamins



fats



minerals



carbohydrates



proteins

OVERVIEW

Modern nutrition science dates from the turn of the century when vitamins were first discovered. Since that time, nearly all elements in foods essential for health have been identified—vitamins, amino acids, minerals, and fatty acids. Indeed, a patient can be maintained for a long period by intravenous feeding with a purified diet that contains the known necessary nutrients. This indicates that few essential nutrients remain to be found.

Early nutrition research was spurred by the finding that many severe diseases such as rickets, pellagra, beriberi, and scurvy were caused by vitamin deficiencies. These nutrition deficiency diseases were practically eliminated in the United States by the 1940's as a result of better nutritional knowledge, food enrichment, agricultural advances, and socioeconomic changes. Consequently, a belief spread among scientists that little of practical importance for the United States would result from further research in human nutrition. Attention was instead shifted increasingly to the biochemical functions of essential nutrients and infant and childhood malnutrition in developing nations.

Over the past 50 years, the basic goal of nutrition strategy in the United States has been to ensure an adequate intake of all essential nutrients for the population. Nutritional advice to the public has consistently stressed a balanced diet that provides necessary protein, minerals, and vitamins. This strategy has been largely successful. However, it was developed and carried out with little understanding of the long-term effects of the abundant diet currently consumed by the majority of Americans.

Studies during the past decade have indicated that overconsumption of food and relative overconsumption of certain kinds of food are important contributing factors in heart disease, stroke, hypertension, cancer, diabetes, osteoporosis, and dental disease. Increased research into the role of diet in causing and preventing such major chronic diseases may lead to findings which could reduce their incidence or delay their onset.

These diet-related diseases take a heavy toll in the United States. For example, cardiovascular disease, diabetes, and hyperten-

sion share the common risk factor of obesity, which is caused by overeating and lack of exercise. About 30 percent of men and 40 percent of women in the United States between the ages of 40 and 49 are overweight. Many are technically "obese"—more than 20 percent above desirable weight. This fact is reflected in disease statistics. Some 23 million Americans suffer from hypertension and 10 million from diabetes. Diabetics are twice as prone to heart disease and stroke. Every year, 850,000 Americans suffer fatal heart attacks.

Five of the leading causes of death are believed to be diet-related. These are heart disease, cancer, stroke, diabetes, and cirrhosis of the liver. The mortality statistics for these diseases are shown in table 2. The impact of chronic diseases extends beyond the obvious mortality figures. Chronic diseases account for many days of work lost, major hospitalization costs, and personal suffering because of activity limitation.

The links between diet and these diseases are based on epidemiological studies, and

Table 2.—Death Rates Per 100,000 Population for Leading Causes, by Sex and Age: 1974
(Excludes deaths of nonresidents of the United States)

Sex and age group (in years)	Heart disease	Cancer	Stroke	Accidents	Pneumonia ^a	Homicide	Suicide	Diabetes	Cirrhosis of liver	Emphysema
Male.....	400	191	87.8	71.1	28.9	16.3	18.1	14.7	21.2	15.3
15-24	3	8	1.5	99.1	1.9	22.1	17.1	0.5	0.5	0.1
25-44	44	29	7.7	69.6	4.8	29.5	23.1	3.2	13.7	0.5
45-64	591	338	73.1	71.0	24.9	16.9	28.2	20.8	60.9	18.4
65 and over ..	3,081	1,293	810.7	144.2	233.7	8.9	36.7	110.4	61.9	131.8
Female.....	301	151	107.9	29.0	23.0	4.4	6.5	20.5	10.6	3.8
15-24	2	5	1.3	23.9	1.5	6.3	4.6	0.6	0.3	0
25-44	15	35	7.9	17.4	3.1	7.0	9.5	2.7	7.4	0.2
45-64	195	261	56.2	24.9	12.5	3.7	11.8	20.3	28.8	5.7
65 and over ..	2,159	723	791.8	94.6	150.7	3.2	7.3	130.1	22.7	21.4

^aIncludes influenza.

Source: U.S. National Center for Health Statistics, *Vital Statistics of the United States*, annual.

direct cause-and-effect relationships have not been established. It is therefore impossible to estimate the economic benefits to be derived from funding research in this area. This does not imply that attention should not be directed to this research. Clearly, reducing the incidence and severity of these diseases or preventing the early expression of them would reap large economic and social benefits.

There is evidence that nutrition research can make an impact on chronic diseases. Intensive studies on the relationship of diet to heart disease, the greatest cause of death in the United States, have yielded results. As the connections have become clearer, at least 16 national and international groups have developed similar dietary recommendations to combat cardiovascular disease. With varying degrees of emphasis, these recommendations have urged reduced intake of cholesterol and fats, especially saturated animal fats. In addition, they have stressed weight control, more physical activity, and a halt to smoking.

These recommendations, widely and repeatedly publicized, have had an impact on Americans. Recent reports indicate that while the age adjusted mortality rate from coronary heart disease rose 19 percent between 1950 and 1963, the rate has declined more than 20 percent during the past

decade. The causes of this favorable trend are not conclusively known, but better nutrition education, changes in formulation of processed food, and changing eating habits appear to have played an important role. The statistics are consistent with reported per capita reductions in the consumption of saturated animal fats and cholesterol, increases in the consumption of vegetable oils, alterations of the ratio of polyunsaturated to saturated fats in the diet, a decrease in smoking, and the attention of many Americans to exercise. These shifts belie the widespread assumption that it is impossible to change American habits, including eating habits, for the better. They also indicate that a major chronic disease can be combated by modifying dietary behavior.

These findings are significant to future nutrition research in light of growing epidemiological evidence linking diet to other chronic and degenerative diseases such as cancer, diabetes, hypertension, and osteoporosis. There has been little direct research, however, into the dietary factors involved in these diseases. Specific aspects of diet that contribute to physical or biochemical changes leading to the onset of such diseases are still unknown. Current knowledge is now at the point where knowledge of diet and heart disease was in the late 1950's, when intense research began to establish the relationship. Possibly the most

productive and important area of nutrition research will be the identification of specific dietary links to other chronic diseases. Such research will inevitably require the development of new techniques and approaches.

There are other areas where more nutrition research is needed. While severe malnutrition is now relatively rare in the United States, moderate degrees of iron deficiency, folic acid deficiency, and possibly other deficiencies remain relatively common. For a variety of social, economic, or physiological reasons, some groups in the population are particularly prone to nutritional deficiencies. These groups include the poor, the elderly, pregnant women, alcoholics, and

patients with chronic diseases or special metabolic problems of genetic origin.

The identification of all or nearly all of the essential nutrients has opened up new areas of clinical patient care. The development of purified diets allows complete nutrition by intravenous feeding. Diets can now be tailored to meet the needs of a wide variety of patients. It is clear that many patients—those with chronic disease, trauma, genetic defects, and others—have not received adequate nutrition in the past. Since developments in this field are still in their infancy, further research support will be needed to ensure continued improvements in patient care.

WHAT RESEARCH CANNOT DO TO SOLVE NUTRITION PROBLEMS

Increased nutrition research can help solve some of the nutrition problems of American society. Research, however, cannot solve all such problems. Some of our most pressing needs involve the application of existing knowledge rather than the search for new knowledge. If it is unclear how to make use of existing knowledge, research indeed can help. If both the knowledge and means are available but are not

utilized, the failure may lie in the inadequate design and administration of public nutrition education and food programs. People may fail to respond to existing programs. They may be confused by the profusion of sometimes contradictory recommendations and urgings from various experts and authorities. It is the Government's challenge to remedy such problems and reach people with needed nutrition services.

Chapter II

KEY ISSUES



vitamins



fats



minerals



carbohydrates



proteins

KEY ISSUES

An appreciation of three key issues that underlie the basic findings of this assessment can aid Congress in better judging appropriate options. These issues are:

- 1) Goals and priorities of human nutrition research,
- 2) Definition and funding of human nutrition research, and
- 3) Personnel resource requirements.

ISSUE 1—Goals and Priorities of Human Nutrition Research

The problems of setting goals and priorities for Federal human nutrition research are inseparable from the organizational structure of current research efforts. Such efforts are now fragmented. Fourteen Federal agencies (under seven departments) are involved in human nutrition research. Each department has independently established its own nutrition research goals and priorities—in line with how it interprets its own particular legislative mandates. The result is a piecemeal approach to nutrition research.

Although most nutrition experts agree that the main goals of nutrition research include the promotion of optimum health and performance, and the treatment of disease through diet therapy and support of other medical therapies, the Federal Government's activities lack such specific unifying goals. They are still guided by the traditional nutrient deficiency disease approach. This fails to meet the changing needs of the American people.

Indeed, nutrition research activities in Federal agencies are generally without focus. This confusion was pointed out by the National Institutes of Health (NIH) Director Dr. Donald Fredrickson's March 15, 1977 testimony before the Senate Committee on Appropriations: "...research on nutrition is as yet, at NIH and elsewhere, a vast, diverse, and essentially unstructured set of activities."

This lack of overall focus is reflected in the poor coordination of research efforts among Federal agencies involved in such activities. Past attempts at coordination between the Departments of Agriculture (USDA) and Health, Education, and Welfare (HEW), the two principal funders of nutrition research, have usually been of short duration and little impact. International nutrition research, supported primarily through the Agency for International Development (AID), is essentially independent of domestic nutrition research.

The result of this absence of coordination is duplication—not only in the missions of some Government agencies but also in their research and other activities. For example, both NIH and USDA's Science Education Administration have similar research programs on protein, carbohydrates, lipids, vitamins, and minerals.

The Office of Technology Assessment also found a need in Federal nutrition research programs for better integration of data storage and retrieval. Collecting such data is necessary at all levels of nutrition research so that findings can be better utilized. However, various agencies now use different types of indexing, data storage, and retrieval systems. Thus they find it difficult to report results of research projects. Moreover, no agency has an efficient system of evaluating and col-

lating research findings. Because of a general lack of accessibility, it is often extremely difficult for agencies to communicate research information to the public or Congress.

Of course, some overlap in interests is inevitable in similar areas of research, and duplication of research results is a necessary part of scientific research. But unnecessary duplication should be avoided. Minimizing duplication by developing more efficient means of sharing information on planned, ongoing, and completed research is an achievable goal.

In the same sense that some duplication is a necessary part of scientific research, healthy competition among agencies may stimulate greater effort and ultimately benefit the public. But the proprietary stance taken by some agencies is wasteful and inhibits joint planning. Internecine struggles at higher levels of Government apparently foster such attitudes. However, career civil servants and the public, as well as the overall Federal research effort, suffer as a result. The turf battles that lead agencies to work at cross purposes should be eliminated. Agencies involved in nutrition research should demonstrate a commitment to coordination and the avoidance of unnecessary duplication. This commitment needs to be built in, not only at the "political" level of the higher echelons of Government but also in the career civil service.

The establishment at USDA of the Human Nutrition Center and the Human Nutrition Policy Committee and at HEW of the Nutrition Coordinating Committee are two positive steps toward intra-agency coordination. They not only indicate a commitment to nutrition research but also can serve as mechanisms for interagency coordination and information exchange.

The Food and Agriculture Act of 1977 specifies that the Secretary of Agriculture shall "periodically consult with the administrators of other Federal departments and agencies that have responsibility for coordinating Federal nutrition research activities." However without the support and involvement of the Secretary of HEW, unilateral USDA efforts to coordinate research may not be effective. Likewise, it should be

noted that this language is ambiguous. It does not specify "lead," and it leaves cooperation to the goodwill of HEW.

The need for improved coordination in nutrition research extends beyond the executive agencies to Congress. At present 14 congressional committees and 20 subcommittees are concerned with nutrition matters. The principals include the Senate Committees on Agriculture, Nutrition, and Forestry (Subcommittee on Nutrition); Appropriations (Subcommittees on Labor-Health, Education and Welfare, and Agriculture); the House Agriculture Committee (Subcommittee on Domestic Marketing, Consumer Relations, and Nutrition); the House Appropriations Committee (Subcommittees on Agriculture and Labor-Health, Education, and Welfare); House Interstate and Foreign Commerce Committee (Subcommittees on Oversight and Investigations, and Health and Environment); and the House Science and Technology Committee (Subcommittee on Domestic and International Scientific Planning, Analysis, and Cooperation, and the Subcommittee on Science, Research, and Technology). Since some duplication of interest exists, joint sessions of relevant congressional subcommittees to consider plans and hearings for oversight purposes should be considered.

There is a strong relationship between human nutrition research conducted abroad and research needs in the United States. The research goals identified in this report can be best achieved if international and domestic research activities are tuned together.

Nutrition research in other countries may help in solving domestic nutrition problems. For example, epidemiological investigations of certain chronic diseases require good information about disease incidence. This may be obtained from studies of societies with lifestyles and food habits very different from our own. The high incidence of malnutrition in some developing nations also provides an opportunity to investigate relationships between the nutritional status and functional performance of individuals in a way that would be impossible in the United States. It may be possible to extrapolate the results of studies of severe malnutrition abroad to marginal nutritional areas in this country.

The study of worldwide populations and food patterns is essential to the better understanding of some of the priority research areas of nutrition. Thus any effort to increase international nutrition research capabilities

will have a dual reward—assistance to malnourished peoples abroad and increased knowledge of human nutrient needs and health status under changing environmental conditions.

ISSUE 2—Definition and Funding of Human Nutrition Research

If one accepts that the goals of human nutrition research are twofold—(1) the promotion of optimum health and performance, and (2) the treatment of diseases through diet therapy and the support of other medical therapies—then definition of human nutrition research flows from these stated goals. If all the research areas involving nutrition are listed, from basic studies on the metabolism of nutrients to genetic studies on the development of foods with specific nutrient characteristics, it is clear that some areas of research are more closely related to these stated goals than others. Accordingly, the definition of human nutrition research must take into account these relationships to stated goals.

In terms of this assessment, nutrition research falls into three broad categories. Most closely related to the stated goals is research into the biochemical and physiological effects of food on the body in health and disease. This category includes research on nutritional management of disease, nutrient needs and interactions, and research which promotes optimum health and disease prevention through diet.

Research on food and nutrition quality determinants is also related to the stated goals, but less directly so than the previous category. Under this heading would be research into food composition, especially the nutritive components and changes in nutrient composition that occur from point of origin to point of consumption; food safety; social, cultural, and economic aspects of food habits; feeding programs; nutrition education; consumer information; and nutrition surveillance and monitoring.

The third category of research involves basic research on sources of human food and basic biochemistry. Research into animal

genetics, animal nutrition, plant nutrition, and plant genetics comes under this classification. While there is need to integrate such agricultural research with human nutrition concerns, these areas should not be considered human nutrition research. Similarly, basic research on metabolism of nutrients, if not directly applicable to people, should not be considered human nutrition research. Basic research on metabolism should be considered as basic research underlying all of the biomedical and life sciences. Human nutrition research builds upon this knowledge base, but the apparent commitment to and budget for human nutrition research should not be inflated by its inclusion.

Throughout this assessment, a recurrent problem has been that of definition of human nutrition research. Agencies report as human nutrition research studies that appear to have little to do with human nutrition. Examples are "Catalytic Functions and Metabolism of Vitamin B6 in Bacteria and Fungi," "Nutritional Imbalance and Metabolic Alterations in Fungi," or "Hepatoma Incidence in Trout on Dietary Aflatoxin and PCB." Such studies are worthwhile and contribute to our understanding of basic biochemistry but are not directly applicable to humans.

The almost unanimous consensus of the participants in the OTA study was that attribution of these Federal expenditures to "human nutrition research" was improper.

Fourteen different Federal agencies are engaged in some sort of nutrition research. Each agency has developed its own definition of human nutrition research and set priorities on the basis of how it interprets its legislation mandate. The agencies and their priorities are shown in table 3.

Federal expenditures for human nutrition research in FY 1977 (shown in table 4) were

Table 3.—Federal Government Agencies Active in Food and Nutrition Programs and Their Nutrition Research Priorities

Department	Agency	Food and nutrition programs	Research priorities
Health, Education, & Welfare	National Institutes of Health		<i>National Institute of Arthritis, Metabolism, and Digestive Diseases (NIAMDD).</i> Basic physiological studies of nutrients; basic metabolism studies; obesity; trace elements nutrition support of patients; fiber; anemias.
			<i>National Institute of Child Health and Human Development (NICHD).</i> Nutrition and fetal development; metabolic capacities of normal, low-birthweight, and premature infants; diet modification for low-birthweight and premature infants; optimum nutrition in developmental years; nutrition and reproductive potential; genetic variability—nutritional interaction; prevention—metabolic antecedents of adult disease.
			<i>National Cancer Institute (NCI).</i> Nutrition support of cancer patient; nutrition in cancer etiology; host-tumor interactions and competition for nutrients; prevention strategies based on nutrition; diet and nutrition in the rehabilitation of cancer patients.
			<i>National Heart, Lung, and Blood Institute (NHLBI).</i> Nutrition in etiology of arteriosclerosis and hypertension; achieving and maintaining dietary change; development of food composition tables; methodology—collecting, recording, and evaluating dietary data.
			<i>National Institute of General Medical Sciences (NIGMS).</i> Traumatized/burned patients and nutrition.
			<i>National Institute of Environmental Health Sciences (NIEHS).</i> Neurotoxicity; mutagenesis; teratology; environmental contaminants in food.
			<i>National Institute of Neurological and Communicative Disorders and Stroke (NINCDS).</i> Protein-calorie malnutrition, B-vitamin deficiencies and the nervous system; genetic disorders and the nervous system; specific nutritional problems in the central nervous system; stroke.
			<i>National Institute of Dental Research (NIDR).</i> Sucrose and caries; poor nutrition and periodontal disease; poor nutrition and oral mucus membranes; nutrition in craniofacial malformations and oral-facial structures; nutrition and salivary gland development.
			<i>National Institute of Allergy and Infectious Disease (NIAID).</i> Interrelated factors hearing on malnutrition, infection, and the immune system.
			<i>National Eye Institute (NEI).</i> Vitamins A, B-12, and other nutrients in visual processes; diseases of visual system, e.g., keratomalacia; metabolism of visual cells; protein changes in the lens.
	<i>National Institute on Aging (NIA).</i> Nutritional status of the elderly; aspects of increase in life span including dietary manipulations; vitamin supplementation in elderly; nutrient intake as a consequence of economic status in elderly; relationship among nutrition, cellular structure, and function in elderly.		
	<i>Division of Research Resources (DRR).</i> Nutrient requirements for growth, gestation, lactation in primates and laboratory rodents; standard diets for specific objectives; interaction of various nutrients on physiological function in laboratory animals; differences in nutrient requirements among strains of animals within a species.		
Food & Drug Administration	Regulatory activities related to: nutrition labeling, ingredient labeling, food for special dietary use, food advertising, nutrition quality of foods	Nutrient efficacy and safety; nutrient interrelationships as concerned with disease prevention; nutrient bioavailability for food fortification purposes; nutrient quality assessment of processed foods; medical food assessment; food composition and nutrient analysis as related to FDA mission; and consumer studies of perceptions about food values and nutritional quality and educational models to help correct misconceptions about them.	
Health Resources Administration	Health and Nutrition Examination Survey	Assessment of the nutritional status of the American people.	

Table 3—continued

Department	Agency	Food and nutrition programs	Research priorities
	Center for Disease Control		Epidemiological surveillance studies in cooperation with State agencies assistance to AID in similar international areas.
	Health Services Administration		Collaborative research and screening program for phenylketonuria.
	Alcohol, Drug Abuse, & Mental Health Administration		Effects of alcohol consumption on nutrient metabolism and nutritional deficiencies; study of food additive consumption and hyperactivity in children.
Agriculture	Agricultural Research Service*		<p>Human Requirements for Nutrients</p> <p>Determine the requirements for lipid intake and identification of the forms of these nutrients in foods that may be useful in meeting these requirements.</p> <p>Determine the requirements for mineral intake by humans and identification of the forms of these nutrients in foods that may be useful in meeting these requirements.</p> <p>Determine the requirements for vitamin intake by humans and identification of the forms of these nutrients in foods that may be useful in meeting these requirements.</p> <p>Determine the requirements for protein and amino acid intake by humans and identification of the forms of these nutrients in foods that may be useful in meeting these requirements.</p> <p>Determine the requirements for carbohydrate and energy intake by humans and identification of the forms of these nutrients in foods that may be useful in meeting these requirements.</p> <p>Food Composition and Improvement</p> <p>To provide accurate, up-to-date, and comprehensive information in a readily usable form on the composition of all important foods for those nutrients required by and biologically useful to man.</p> <p>To provide the technology for the nutritional improvement of foods when enhanced levels of certain nutrients in the diet are needed to correct possible dietary faults.</p> <p>Food Consumption and Use</p> <p>To provide accurate, up-to-date, and comprehensive information in a readily usable form on food consumption and dietary levels.</p> <p>To provide consultative assistance on food and nutrition problems and provide sound guidance materials on nutrition for the consumer and for nutrition educators, program leaders, and food program managers; to identify techniques which will assist people in selecting nutritionally adequate diets within different budget limitations; to identify means to modify undesirable food habits; to strengthen nutritionally desirable food choice.</p> <p>To identify and develop suitable and safe procedures for food management and preparation for home and institutional consumers, for best retention of both nutritional and eating qualities and to avoid food-borne illness.</p>
	Cooperative State Research Service**		Nutrient requirements; nutritional status of special population groups including children, low income, and aging; metabolic function of nutrients in the diet and their interactions; nutrient content of foods; effects of processing on nutrients; food delivery systems; food habits and use); dietary patterns.

Table 3—continued

Department	Agency	Food and nutrition programs	Research priorities
	Economic Research Service***		Economic and social research relating to domestic food programs; nutrition policy in LDCs; food choices (demand); nutritional programs for the elderly.
Defense			Determination of nutritional and dietary standards for Armed Forces personnel subsisted under normal and special operating conditions; evaluation of nutritional adequacy of food as consumed; evaluation of the nutritional status of Armed Forces personnel; establishment of sanitary and food hygiene standards for all food program activities; food aspects of preventive medicine.
National Aeronautics & Space Administration			Nutritional control of neurotransmitters; role of dietary protein and specific amino acids in optimizing human performance under stress.
Veterans Administration	Department of Medicine & Surgery		Research in disease and diet: nutrition and disease or clinical nutrition, dietary therapy; effect of disease on nutrition; environmental toxicants, alcohol, and nutrition; nutrition and cancer; nutrition and vision research; nutrition-related therapy. Metabolic effects: Investigations on or related to malabsorption syndromes, inborn errors of metabolism, and familial or inherited nutritional defects. Nutrition requirements: Studies of nutrient metabolism, malnutrition, neuroendocrine nutrient interactions, fundamental intermediary metabolism involving the role of one or more nutrients.
State	Agency for International Development		Development of new low-cost nutritious foods; development and dissemination of new appropriate technologies; understanding nutritional needs and requirements; testing and evaluation of nutrition program alternatives; research on methodologies for improving national nutrition planning and programing.
National Science Foundation			Basic research in the behavioral, education, and social sciences in areas applicable to foods and nutrition.

*Under USDA's recent reorganization, ARS is now called Federal Research, and is housed within the Science and Education Administration.
 **Under USDA's recent reorganization, CRS is called Cooperative Research and is housed within the Science and Education Administration.
 ***Under USDA's recent reorganization, ERS is called Economics and is housed within the Economics, Statistics, and Cooperatives Service.
 ****Under USDA's recent reorganization, ES is called Extension and is housed within the Science and Education Administration.

estimated at between \$50 million and \$117 million, depending on how "nutrition research" was defined. If for example, the NIH definition is used, NIH appears to be spending \$80 million for human nutrition research. This broad definition takes in studies of basic biochemistry, studies which are not focused on nutrition but have a nutrition aspect, as well as studies of primary nutrition. If a narrow definition is used, one encompassing only those studies of direct clinical applications and disease prevention, the NIH nutrition research funding falls in the annual range of \$20 million. Even the higher \$80 million figure, incidentally, amounts to less than 3 percent of the NIH research budget.

HEW and USDA are responsible for the majority of federally supported human nutri-

tion research. Seventy-five percent of Federal nutrition research is conducted outside of the two departments through competitive grants and contracts. Using the more realistic funding figure of \$50 million for FY 1977, NIH at HEW funded 44 percent of the total, and the Science and Education Administration (SEA) at USDA funded 43 percent of the total. The Science and Education Administration encompasses what were formerly known as the Agricultural Research Service and the Cooperative State Research Service. Under USDA's new reorganization, most human nutrition research will be coordinated by SEA's Human Nutrition Center.

The Science and Education Administration Cooperative Research (SEA-CR) of USDA is unique among Federal agencies in that it links

Table 4.—Federal Expenditures for Human Nutrition Research
An Approximation of FY '77 Expenditures (millions of dollars)

Agency	Office of Science & Technology Policy ^a	Office of Management & Budget ^b
Department of Health, Education, & Welfare.....	\$ 88.6	\$22.0
National Institutes of Health.....	80.4 ^c	22.0 ^d
Food and Drug Administration.....	3.9	
National Center for Health Statistics.....	2.4	
Alcohol, Drug Abuse, and Mental Health Administration.....	1.1*	
Health Services Administration.....	0.5*	
Center for Disease Control.....	0.3*	
Department of Agriculture.....	22.0	21.8
Agricultural Research Service.....	14.0	13.2
Cooperative State Research Service.....	7.5	8.1
Economic Research Service.....	0.5	0.5
Agency for International Development.....	2.9	0
Department of Defense.....	2.3*	2.2
Veterans Administration.....	0.5*	4.1
National Science Foundation.....	0.3*	0
Grand total.....	\$116.6	\$50.2

^aOffice of Science and Technology Policy, *New Directions in Federally Supported Human Nutrition Research*, December 1977.

^bOffice of Management and Budget, *Special Analyses—Budget of the U.S. Government FY 1979*.

^cThis figure includes studies designed to assess the mechanisms and the consequences of food or nutrient intake in the intact organism, particularly man; investigations involving nutrient variables at the cellular or subcellular level, including metabolic studies in animals and man; research designed to elucidate the metabolic role or function of an essential nutrient in both animal models and man, as appropriate; all studies concerned with genetic-nutrient-environmental interactions; dietary studies expected to produce changes in health status, including the maintenance of health and the treatment of disease in man.

^dThis figure includes biochemical, physiological, and clinical studies of nutritional needs for normal growth, development, and health; nutritional needs of patients with specific common diseases; and experimental assessments of feeding programs.

*Estimates of FY 1976 expenditures provided by draft Government Accounting Office report, *Human Nutrition Research—Need for a Coordinated Approach to Advance Our Knowledge*, 1977.

Federal and State research efforts. SEA-CR administers funds that Congress appropriates to the States for agricultural research. This work is conducted at the State agricultural experiment stations, land-grant colleges and universities, approved schools of forestry, colleges of 1890, and Tuskegee Institute. In FY 1977, the States used \$7.5 million of the Federal money available to them for human nutrition research. The States themselves provided \$11.7 million for human nutrition research in 1976. Most of the Federal money came from funds authorized by the Hatch Act, as amended, and P.L. 89-106 (an act to amend the Agriculture Act of 1954). The funds are accounted for under the Hatch Act research program called People, Communities, and Institutions, which comprised 12 percent of total Hatch Act research funds in 1977.

Federal human nutrition research may be financially undernourished. However, no analysis of the adequacy of present funding

levels could be made since current estimates of Federal spending for human nutrition research are questionable. Estimates for FY 1977 range from \$50 million to \$117 million (table 4). The lower figure, based on agency responses to a standard questionnaire, was developed by the Office of Management and Budget (OMB) for the FY 1979 budget. The higher figure came from an OSTP working group and appeared in the December 1977 report "New Directions in Human Nutrition Research."

Neither is reliable. The \$50 million, for example, fails to include certain nutrition research activities within HEW, AID, and the National Science Foundation. The \$117 million, on the other hand, includes \$80.4 million of NIH spending—much of it of tenuous connection to human nutrition research. In testimony before the Senate Select Committee on Nutrition and Human Needs on October 17, 1977, NIH Director Dr. Donald Fredrickson conceded that, based on a strict definition,

his agency devoted only around \$20 million to human nutrition research in FY 1977 (a figure reported to OMB).

Another statistic which raised questions came from the Veterans Administration (VA). GAO put the VA's FY 1976 nutrition research spending at \$0.5 million. In FY 1977, the VA reported sharply increased expenditures of \$4.1 million, even though nutrition research was not recognized as a high priority by the agency.

In some cases, it was difficult to determine how much (if any) money was being spent for certain types of important nutrition research. For instance, the Federal Government is now annually spending about \$70 million on nutrition education programs. It is unclear

whether any of these funds are devoted to research on which methods are most effective for reaching people.

OTA concluded that most estimates of human nutrition research funding were questionable and that total funding fell considerably short of the reported \$117 million level. Regardless of which overall figure is more nearly accurate, certain areas identified by OTA are not now receiving sufficient Federal support, the result of a lack of recognition of their importance and zero or almost no funds. Those areas most in need of increased funding are the role of diet in the prevention of chronic disease and obesity, nutrition education and consumer information, monitoring nutritional status, and nutrition policy and management.

ISSUE 3—Personnel Resource Requirements

Estimates of the number of scientists engaged in human nutrition research also proved elusive.

In an attempt to determine the current number of scientists engaged in human-nutrition research and the numbers of research scientists being trained, OTA contacted five professional societies and six Government agencies. Of the professional societies, the American Public Health Association, Institute of Food Technologists, and American Chemical Society make no attempt to distinguish between members engaged in research versus other career orientations and therefore could not supply information on the proportion of their membership engaged in human nutrition research or training of nutrition research scientists. Membership in the American Institute of Nutrition (AIN) is limited to those who have made significant contributions to the field of nutrition research. By definition, all of AIN's 1,730 members are nutrition research scientists. This number seriously underestimates the total number of scientists in the field, since junior people are not eligible for membership and very few behavior and education researchers are included. AIN does not keep any figures on training. Of the American Dietetic Association's 21,751 members in 1977, 764 state

they are engaged in research activities. This does not indicate the degree of involvement and, of course, neglects those outside of dietetics engaged in nutrition research.

The two Government agencies that fund the largest portion of nutrition research, HEW and USDA, do maintain figures on scientist-years devoted to nutrition research and 5-year projections of personnel needs. At USDA in FY 1976, 193.5 scientist years were devoted to human nutrition research as defined by the agency. The 5-year projection of need for nutrition research scientists at USDA is for 260.7 scientist years, a 20-percent increase.

In a written response to an OTA questionnaire, NIH informed OTA that 70 scientists were employed in human nutrition research in 1977. But NIH Director Fredrickson submitted a written statement to the Senate Select Committee on Nutrition and Human Needs that during that same time period 180 intramural investigators in NIH were directly involved in human nutrition research. Of that number, 20 were defined as "classical nutritionists" when nutrition research was defined as "the study of food and nutrients." In FY 1977, 20 lead scientists, those holding M.D., Ph.D., or D.V.M. degrees, and 50 junior scientists were conducting nutrition research

at Letterman Army Institute of Research of the Department of Defense.

Before a comprehensive nutrition research program is established, consideration must be given to the ability of the field to sustain such a program. No accurate figures exist on how many scientists are currently engaged in human nutrition research. Furthermore, few reports on nutrition research mention this aspect of planning.

Implementation of the research priority areas identified in this report may require changes of emphasis in existing graduate and

professional nutrition training programs as well as increased training support. For graduate students in nutrition and food science, such changes might include greater stress on nutritional pharmacology, food science principles, nutrition education, nutritional status evaluation, and nutrition-related diseases. Training would be further strengthened by postdoctoral research work with either humans or experimental animals. Greater emphasis on nutritional biochemistry and clinical nutrition in undergraduate medical education may help attract physicians to the field.

Chapter III

NUTRITION RESEARCH STRATEGIES



vitamins



fats



minerals



carbohydrates



proteins

NUTRITION RESEARCH STRATEGIES

Accumulating the fragmented research activities of the 14 Federal agencies supporting human nutrition research does not, as a whole, constitute a coherent strategy for the solution of current diet-related health problems. A good understanding of the status quo can be gained by analysis of the Food and Agriculture Act of 1977 which established research goals and priorities for the Department of Agriculture (USDA). The picture of the present situation can be completed by reviewing the research goals and priorities at the National Institutes of Health (NIH). Alternatives to the status quo can be found in the recently published reports of the Office of Science and Technology Policy (OSTP) and the General Accounting Office (GAO). These two alternatives, plus an alternative developed by OTA, are examined here and provide Congress with several alternative strategies that may be pursued. Each of the alternatives are examined from three perspectives: Do the stated goals and priorities adequately address current U.S. health problems? Is nutrition research defined clearly to permit realistic estimation of Federal expenditures? Is consideration given to the personnel requirements to fulfill proposed research priorities?

THE STATUS QUO: NUTRITION RESEARCH IN THE FEDERAL GOVERNMENT

Goals and Priorities

The Food and Agriculture Act of 1977 recognized the relationship between diet and the general health of the population. The legislation states "that there is increasing evidence of a relationship between diet and many of the leading causes of death in the United States; that improved nutrition is an integral component of preventive health care; that there is a serious need for research on the chronic effects of diet on degenerative diseases and related disorders; that nutrition and health considerations are important to U.S. agricultural policy; that there is insufficient knowledge concerning precise human nutritional requirements, the interaction of the various nutritional constituents of food, and differences in nutritional requirements among different population groups such as in-

fants, children, adolescents, elderly men and women, and pregnant women; and that there is a critical need for objective data concerning food safety, the potential of food enrichment, and means to encourage better nutritional practices."

The legislation declares that the Secretary of Agriculture shall develop and implement a national food and human nutrition research program that shall include, but not be limited to, five areas:

1. Research on human nutritional requirements.
2. Research on nutrient composition of foods and the effects of agricultural

practices, handling, food processing, and cooking on the nutrients they contain.

3. Surveillance of the nutritional benefits provided to participants in the food programs administered by USDA.
4. Research on the factors affecting food preference and habits.
5. The development of techniques and equipment to assist consumers in the home or in institutions in selecting food that supplies a nutritionally adequate diet.

Although the legislation points up the relationship between diet and leading causes of death in the United States, the research priority areas spelled out do not pursue this line of inquiry. Since the legislation pertains almost exclusively to USDA, it lays out what could be considered a partial strategy to solve the problems of diet and chronic degenerative diseases—research on nutrient needs, on the composition of the food supply, on ways to help consumers select a healthful diet, and surveillance of the population. Furthermore, funding proposed in the FY 1979 budget does not match the ambitious wording of the legislation.

The Food and Agriculture Act of 1977 designated the Secretary of Agriculture to “establish jointly with the Secretary of Health, Education, and Welfare procedures for coordination with respect to nutrition research in areas of mutual interest.” Section 1406 amends the National Science and Technology Policy, Organization, and Priorities Act of 1976 (90 Stat. 471; 42 U.S.C. 6651 (h)), by creating a standing subcommittee to be known as the Subcommittee on Food and Renewable Resources.

The legislation also established a National Agricultural Research and Extension Users Advisory Board composed of 21 members representing a wide variety of agricultural producer, consumer, marketing, and environmental interests. Two members must be engaged in human nutrition work. The Advisory Board has the responsibilities for:

- “Reviewing the policies, plans, and goals of programs within USDA involving the food and agricultural sciences, and related programs in other Federal and State departments and agencies and in the colleges and universities developed by the Secretary under this title;
- Reviewing and assessing the extent of agricultural research and extension being conducted by private foundations and businesses, and the relationships of such research and extension to federally supported agricultural research and extension;
- Reviewing and providing consultation to the Secretary on national policies, priorities, and strategies for agricultural research and extension for both the short and long term;
- Assessing the overall adequacy of, and making recommendations to the Secretary with regard to, the distribution of resources and the allocation of funds authorized by this title;
- Preparing and submitting to the Secretary, not later than October 31 of each year, a statement of recommendations as to allocations of responsibilities and levels of funding among federally supported agricultural research and extension programs; and
- Not later than March 1 of each year submitting a report on its appraisal of the President’s proposed budget for the food and agricultural sciences for the fiscal year beginning in such year and the recommendations of the Secretary contained in the annual report.”

As indicated earlier, the Food and Agriculture Act of 1977 does not clearly give USDA the lead responsibility for human nutrition research. Section 1405 declares “the Department of Agriculture is designated as the lead agency of the Federal Government for agricultural research (except with respect to the biomedical aspects of human nutrition concerned with diagnosis or treatment of disease). . . .” Human nutrition is one of the areas included in the definition of “food and

agricultural sciences" (section 1404). But Section 1409 states that "It is the intent of Congress in enacting this title to augment, coordinate, and supplement the planning, initiation, and conduct of agricultural research programs existing prior to the enactment of this title, except that it is not the intent of Congress in enacting this title to limit the authority of the Secretary of Health, Education, and Welfare under any Act which the Secretary of Health, Education, and Welfare administers." Thus a clear mandate is not given to USDA to be the lead agency for human nutrition research.

Section 1423 (b) requires the Secretary of Agriculture to "periodically consult with the administrators of the other Federal departments and agencies." As discussed earlier, this unilateral approach to coordination relies on the goodwill of other agencies to cooperate with USDA in the goal of research coordination.

Research priorities at NIH are summarized in table 3. A wide range of basic and applied research are embodied in these priorities. The major emphasis is on basic and curative-oriented disease research rather than disease prevention. This becomes more clear as allocations of funds to the different areas are studied. The Nutrition Study Section at NIH reviewed a total of 181 grant proposals in FY 1977, and approved 119, totaling \$4.7 million. Only four other study sections recommended for approval grants totaling less than \$4.7 million in this period of time. Two of these sections have been disbanded, their work being referred to other study sections. Since research in nutrition involves many different disciplines and crosses traditional disciplinary lines, NIH maintains that many grant applications with nutrition components are referred to other study sections. It can therefore be assumed that \$4.7 million is what NIH clearly defined as human nutrition research, and the remainder of the \$80.4 million of nutrition research funded by NIH in FY 1977 was basic and disease-oriented research with nutrition components of varying degrees of relevance.

The Agency for International Development (AID) is the Federal agency primarily responsible for international nutrition research.

...the long-range goals of the AID nutrition program are: to have developing countries incorporate nutrition considerations into their social and economic development plans; to create the methodologies for assessing needs, determining causes, and selecting interventions; and to have available the most cost-effective interventions with information on when they are most appropriate to apply, the cost and other requirements for implementing them, the best methods for implementing them, and information on expected results.

The AID nutrition research program is designed to provide new knowledge that will help implement programs to attain these goals. The AID nutrition research program attempts to assess the functional significance of improvements in nutrition; it seeks to establish whether nutritional needs can be satisfied with locally available foods; it evaluates the effectiveness of nutrition intervention; and it seeks to inform governments about the potential impact of policies in food and nutrition.¹

It is therefore apparent that the AID nutrition research program is not and should not be designed to address the research needs outlined in this report. The AID program is designed to meet the needs of host countries. Should a research project yield results applicable to problems discussed in this report, it is serendipitous. There is a clear need to encourage international research, much of which would be epidemiological, to identify and explore dietary and lifestyle factors contributing to the major chronic diseases.

In theory, AID's nutrition research activities undergo peer review. Research funds are publicized through the distribution of a brochure, and information on AID's research needs are circulated among professional groups and announced at professional meetings. "Projects that are awarded on the basis of predominant capability are very carefully reviewed before approval. Fewer and fewer projects follow this latter route."²

In practice, the system seems to have functioned somewhat differently. Human nutri-

¹Irwin Hornstein, Deputy Director, Office of Nutrition, Agency for International Development, June 8, 1978.

²Ibid.

tion research received an estimated \$2.7 million from AID in FY 1977. Most of this research was conceived by agency staff who then had a scientific research group develop study proposals. The proposals were screened by AID staff members before being submitted to the Research Advisory Committee for technical feasibility evaluation. The agency does not widely advertise requests for proposals, and few unsolicited proposals are received. Some panel participants felt that this system reduces the scientific base of expertise on which the agency can draw and leads to an inbreeding of research ideas.

Definition and Funding

The Food and Agriculture Act of 1977 does not explicitly define the term "nutrition" nor the scope of "nutrition research." It implies that "nutrition research" includes research on diet and disease, certain aspects of agricultural policy, nutritional requirements, food composition and nutrient interactions, food safety, food enrichment, and means of encouraging better nutritional practices. There is no reference in the legislation to international nutrition research.

Section 1423 (a) of the Food and Agriculture Act of 1977 states that the Secretary of Agriculture "shall increase support for such research [research into food and human nutrition] to a level that provides resources adequate to meet the policy of this subtitle." No specific authorization for

human nutrition research is made in the Act.

In response to these requirements, USDA requested \$43 million for human nutrition research in its FY 1979 budget proposal. This is a 95-percent increase over its FY 1977 spending of \$22 million.

At NIH, nutrition research support has remained relatively constant over the last several years, constituting less than 3 percent of the total research budget. Estimates of actual dollar outlays for human nutrition research vary from \$20 million to \$80 million for FY 1977.

Personnel Resource Requirements

Both the USDA and HEW support undergraduate, predoctoral, and postdoctoral students through a variety of tuition grants, loans, fellowships, and training grants. The Food and Agriculture Act establishes grants and fellowships for food and agricultural sciences education at the undergraduate through postdoctoral levels. The program is authorized in FY 1978 for \$25 million, expanding to \$50 million by FY 1982. The proportion of this money to be devoted to training nutrition researchers is not specified.

The Department of Health, Education, and Welfare has traditionally supported training of research scientists through training grants and fellowships. In FY 1977 these totaled \$2.3 million for human nutrition research.

NEW DIRECTIONS IN FEDERALLY SUPPORTED HUMAN NUTRITION RESEARCH: THE OSTP REPORT

Goals and Priorities

In December 1977, OSTP published a report on Government nutrition research. The report defined the scope of human nutrition research, described existing Federal programs, identified research areas that need more attention, and suggested means for enhancing the coordination and quality of Fed-

eral nutrition research activities. Although the report focused only on domestic research, it encouraged various Federal agencies involved in such activities to assess the potential international benefits from current and planned projects.

The working groups of the OSTP inter-agency senior nutrition research staff recommended four priority research activities:

1. Effects of nutrition on human health and performance in pregnancy, infancy and early childhood, old age, obesity, iron deficiency, nutrient toxicity, and interactions;
2. Food sciences (methodology for analyzing food composition, nutrient bio-availability in foods, updating national nutrient data bank, expanding food composition measurements);
3. Nutrition education research (factors determining dietary practices, identification of good nutritional practices, ad hoc educational research committee); and
4. Diet and nutritional status surveillance (food composition, survey methodology, measurements of nutritional status, analysis of the Health and Nutrition Examination Survey (HANES) data, epidemiological studies).

The criteria used by the working group in selecting research areas for greater attention were impact, substantial existing knowledge gap, and researchability. The priority areas chosen reflect the narrowness of these criteria. The priorities tend toward short-term projects that lack long-term commitments needed to identify the nutrition elements of major health problems facing adult Americans—the chronic degenerative diseases and obesity.

In the OSTP report several recommendations are made for coordination within and among the departments conducting nutrition research. First of all, the participants in the study requested OSTP "to continue to take a lead role in coordinating and monitoring nutrition research activities." OSTP could serve as a focal point for interagency planning through the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), chaired by the Director of OSTP. Secondly, external reviews of the intramural grants process in both NIH and USDA with joint participation of Federal agencies in developing requests for proposals and in reviewing research in progress.

To improve coordination and communication within HEW and USDA, the report recommends:

In HEW, the programs of the Food and Drug Administration (FDA), the National Center for Health Statistics (NCHS), the Center for Disease Control (CDC), and NIH must be coordinated in the high-priority activities identified. . . . At NIH, it is essential for the NIH Director and for the Nutrition Coordinating Committee under his direction to have the authority to prioritize nutrition research needs. The Director of NIH, has a relationship to the several Institutes which permits allocation of funds for nutrition research in the absence of specific statutory authorities for reprogramming between Institute appropriations.

In USDA, it is essential that the nutrition research activities of the Agricultural Research Service (ARS), the Cooperative State Research Service (CSRS), the Food and Nutrition Service (FNS), and the Economic Research Service (ERS) be coordinated through the Secretary of Agriculture."

Finally, the establishment of an ad hoc interagency nutrition education research committee is recommended. This committee would: identify and summarize research findings related to nutrition education research and summarize pertinent findings from other areas of education research, establish priorities, and develop a plan for conducting nutrition education research.

It is doubtful that OSTP through FCCSET would be able to adequately oversee coordination of nutrition research activities. The staff of the Office is small, and their responsibilities large. With a budget of \$50 million to \$117 million per year, nutrition research is a very small component of the FY 1977 \$3.6 billion research budget for health and agriculture.

External reviews by teams of nonagency scientists may improve the quality of intramural human nutrition research activities, but they cannot be expected to improve research coordination. This recommendation calls for the external reviews to be conducted within 12 months of the report's publication by an unspecified number of multidisciplinary teams. Scientists from agencies conducting nutrition research would also participate. The report suggests that this would be expected to increase communication and understanding of Federal programs. Since the review would only be conducted once and

no provisions are made for improving bad situations if they are found, it is doubtful that it would be of any lasting use in improving interagency communication or the quality of intramural research.

The proposal that Federal agencies jointly participate in developing requests for research proposals and in reviewing research in progress has merit, as does the proposal for an ad hoc interagency nutrition education research committee. The ideas could be further explored by USDA and HEW and proposals for implementation developed.

Definition and Funding

The scope of human nutrition research, as defined by the OSTP study, included investigation of:

- Basic physiological and biochemical mechanisms for the digestion, absorption, metabolism, and transport of nutrients; the role of food ingredients in human health and performance and in the prevention and treatment of disease;
- Nutrient composition of foods; the effects of storage, processing, and packaging; and the biological availability of nutrients in the foods at the time of consumption;
- Determinants of dietary practices and methods for educating the public about dietary practices; and

- Food consumption patterns and nutritional status of the general population and of special high-risk subgroups within the population; evaluation of the nutritional impacts of various intervention strategies and public policies.

The OSTP report established Federal expenditures for nutrition research for FY 1977 at \$116.6 million. The report stated that no specific funding levels would be recommended, but that the report's objectives could be met "at least in part by reallocation of resources from existing programs to the higher priority areas identified." It is highly unlikely that this could be accomplished without outside intervention. It is also questionable whether such a strategy makes good sense, since the amount of human nutrition research conducted in this country is so small in comparison to our \$3.6 billion in health and agriculture research expenditures and our \$160.6 billion in health costs. Furthermore, at least \$60 million of the \$117 million is basic research on metabolism which underlies many of the biological and health sciences. A cut in this funding would severely constrain progress in basic research.

Personnel Resource Requirements

The OSTP report does not consider the personnel resources needed to fulfill the research priorities contained in the report.

FEDERAL HUMAN NUTRITION RESEARCH NEEDS A COORDINATED APPROACH TO ADVANCE NUTRITION KNOWLEDGE: THE GAO REPORT

Goals and Priorities

The General Accounting Office was asked to identify research gaps and needs in the field of human nutrition. The scope of the report was restricted to the domestic situation. Gaps identified by GAO included:

- Knowledge of dietary nutrients required to promote or maintain growth or well-being at various stages and conditions of life;
- Information on the composition of the current U.S. food supply and the extent that nutrients are biologically available;

- Evaluation of long-term health consequences of the modern diet; and
- Assessment of the Nation's current nutritional status in terms of dietary excesses and imbalances, as well as deficiencies.

GAO recommended research along the following lines to overcome these research gaps:

- Long-term studies of human subjects across the full range of both health and disease;
- Comparative studies of populations of differing geographic, cultural, and genetic backgrounds;
- Basic investigations of the functions and interactions of dietary components;
- Updated and expanded food composition data; and
- Improved techniques for assessing long-term toxicological risks.

The priorities set out in the GAO report involve the types of research that will probably provide the most information on the role of diet in disease. However, work is also needed on how best to convey the research findings to the public so they can be translated into daily life.

The GAO report cites "lack of central focus and coordination" and "shortage of nutrition scientists" as two of the three principal barriers to progress in human nutrition research. To remedy the first of these, the report recommends that the Director of OSTP "work with the Federal agencies to further define the subject areas comprising human nutrition research and make recommendations to the Director of OMB to:

- Assign where practicable, each area to a lead Federal agency.

- Eliminate unnecessary research that may exist among Federal agencies.
- Promote Government-wide human nutrition research planning, coordination, and reporting."

These recommendations are not sufficiently specific to be considered a strategy for organizing nutrition research. Furthermore, in an early draft of their report, OSTP assigned lead and support agency responsibilities for specific nutrition research areas. This approach was abandoned in the final report because of agency objections. A general goal of improved research planning, coordination, and reporting is commendable, but without specifics probably will not be attained.

Definition and Funding

GAO identifies the third barrier to progress in nutrition research as "instability of federally funded extramural research." The report does not make specific recommendations as to how to improve this situation. However, it endorses the development of federally funded regional research centers in conjunction with universities and colleges.

GAO estimates U.S. Government expenditures for human nutrition research at \$73 million to \$117 million annually. It makes no attempt to define nutrition research or to analyze agency reports on nutrition research expenditures.

Personnel Resource Requirements

The GAO report highlights the concern of the scientific community that there is a shortage of nutrition research scientists. If this situation exists, it holds significant implications for the ability of the research community to absorb research funds should large increases be made in the future. Since no accurate information exists on the numbers and expertise of nutrition research scientists outside Government laboratories, analysis of research capabilities is impossible.

A COMPREHENSIVE NUTRITION RESEARCH STRATEGY

Goals and Priorities

The focus now lacking in Federal nutrition research could be achieved by defining the scope of human nutrition research, defining general goals for Federal agencies that conduct such research, and specifying research priority areas that are in line with the general goals. A reorientation of Federal nutrition research efforts should recognize the changing nature of our food supply by placing greater emphasis on the role of diet in preventing chronic diseases. At the same time, Government programs must continue striving to eliminate hunger and malnutrition through intervention programs and research.

Such a reoriented research strategy requires an increased focus on today's complex food supply, especially on the effects of processed food, food additives and contaminants, and similar problems that concern consumers, food producers, and health professionals. Research in the food sciences would enable us to evaluate the adequacy of the food supply and to develop recommendations for needed changes. Such changes might include new processing techniques, fortification, reformulation, or selection of alternative food items by consumers.

Broader information and intervention efforts outside of the health care system are also necessary. The public should know what the scientific community has learned about the relationships among lifestyles, food consumption, and health. Developing improved ways of conveying such knowledge would encourage the public to adopt better eating habits and other health-promoting behavior.

OTA working group participants felt that neither the existing legislation nor the priorities suggested in the OSTP and GAO reports provided the holistic, integrated research strategy needed to meet current and projected diet-related problems in the United States. Seven elements of a comprehensive research strategy to define the role of nutrition in the prevention of chronic disease and to improve management of current nutrition-related problems were discussed. The seven

points are outlined in table 5. The rationale for the selection of each is contained in the appendix.

Several mechanisms for coordinating Federal nutrition research activities have been suggested. These include assigning responsibilities for research areas to various agencies, making one agency the lead agency, placing coordination responsibility under a third party, assigning coordination responsibility to the assistant secretary level, and concentrating all nutrition research activities in either USDA or HEW.

The first alternative (assigning responsibilities for research areas to various agencies) would make USDA and HEW the two lead agencies in human nutrition research. This approach is similar to the one taken in the Food and Agriculture Act of 1977 in which the legitimate roles of both agencies in nutrition research are recognized. Under such a system of joint responsibility, the concerns of each agency would have to be defined to minimize duplication of effort. An effective system of intra-agency cooperation would also be necessary. However, since it may not be possible to clearly separate the concerns of nutrition and disease from those of "normal nutrition," some overlap would probably be inevitable.

The second alternative assigns one agency main responsibility for nutrition research. Since USDA and HEW fund 87 percent of Federal human nutrition research, they are the most likely candidates for the lead agency role. There are arguments both for and against giving such responsibility to one or the other agency.

Currently USDA plays the major role in carrying out food intervention programs in the United States. By giving it primary responsibility for funding and coordinating nutrition research efforts, the Government's research and food intervention activities might be better coordinated. At the same time, Federal research activities might become more responsive to consumer views and needs because of USDA's major involvement in food and nutrition education programs.

Table 5.—A Seven-Point Nutrition Research Strategy

The role of diet in the prevention of chronic disease and obesity

Major health problems and diet-related risk factors
Diet, aging, and disease
Methods for preventing obesity
Nutrition and mental development

The role of nutrition in the treatment of disease and support of therapy

Nutritional support of patients with severe disease and injury
Other disease states
Technology for delivery of nutrients to patients
Behavioral and emotional problems

Nutrition education and consumer information

Factors affecting lifetime eating habits and identification of critical points for education
Development and evaluation of nutrition education and communication methods
Methods for simplifying consumer information utilization

Requirements for essential nutrients

Methods for determining nutrient needs
Interactions among nutrient requirements based on functional criteria
Pharmacologic and toxicologic effects of nutrients
Bioavailability of nutrients in foods

Nutritional aspects of food science and food safety

Food composition
New food processing and handling procedures to maintain nutrient content
Better methods of assuring food safety

Monitoring nutritional status

Methods for improving integration of food consumption and nutritional status surveillance
Evaluation of the effects of food and nutrition education programs

Nutrition policy and management

Food-related interventions
Other interventions

USDA now coordinates research in the area of food production with the State agriculture experiment stations and other cooperating institutions. Some link between the nutritional concerns of consumers and the food production system seems to be essential. But USDA has traditionally had little responsibility or expertise in the area of human health and disease. One of the major needs in Federal nutrition research activities is a reorientation of priorities to stress the role of nutrition in the prevention of disease. Thus separating health-related nutrition research from the overall direction of health research may not be wise. If health-related nutrition research fell exclusively under USDA, potential conflicts might arise. The research might produce recommendations for substantial shifts in food practices. Such findings and recommendations could conflict with the traditional interests of producer groups.

Many of the research priorities identified by OTA as well as other groups involve the relationship of human health to nutritional practices. Therefore, there are strong argu-

ments for giving HEW, the agency concerned with health, the lead responsibility for directing nutrition research. However, such research has not been a main HEW concern in the past. Disease-prevention research has generally received much less support than specific disease-oriented or curative-oriented research. Moreover, HEW has not been concerned with the nutrient requirements of healthy people, food consumption patterns, or food composition. In addition, HEW has no nationwide programs of nutrition and health education comparable to those developed by USDA.

The report by OSTP recommended that the lead role in nutrition research be given to a third party which would formulate policy and coordinate and monitor programs. Under this arrangement, various agencies would retain their existing nutrition research responsibilities, but their activities would be overseen by the third party. The concept offers some positive features. It would focus attention on nutrition while retaining the healthy

competition among agencies involved in nutrition research.

However, such a third-party concept also raises several problems. It involves another layer of Federal bureaucracy. A third-party oversight body might have no real power to influence budgets and allocate resources within and among agencies, especially since it would lack a political constituency. These potential deficiencies would be further magnified by inadequate staff and expertise. In the end, such a coordinating mechanism would probably only serve as a means to exchange information, much as the nutrition coordinating committee does within NIH and the Current Research Information System (CRIS) does for USDA.

Another alternative would give assistant secretaries in HEW and USDA responsibility for coordinating nutrition research policy within and between their respective agencies. Lack of high-level commitment to nutrition research has been a problem in the past. Placing responsibility for nutrition at the assistant secretary level might create the visibility and commitment needed to effectively coordinate nutrition research efforts. Such an arrangement would require administrative changes within both agencies. At present, it is unclear if the USDA reorganization that created a Human Nutrition Center within SEA will accomplish this goal.

A final option would consolidate nutrition programs in one agency, either USDA or HEW. These activities would include research, education, regulation, training, service delivery, monitoring and surveillance, and food and other intervention programs. Both USDA and HEW have recently shown interest in this concept in papers entitled *USDA's Commitment to Food and Nutrition Policy* and *The Role of HEW in Human Nutrition: Future Directions*. However, the wisdom of such a consolidation is debatable. Although both agencies currently have a number of nutrition programs, the expertise involved is quite specialized. Whether this approach would solve coordination problems probably depends on the agency's commitment to the field of nutrition.

A pluralistic approach to human nutrition research, with well-defined agency responsibilities for HEW and USDA, appears to be the best means of coordinating Federal research efforts. Such an approach could produce the kind of creative competition that would likely enhance human nutrition research. It would also result in some overlapping of efforts, which should be minimized by the coordinating process.

The coordinating function might best be carried out by an interagency committee with a rotating chairmanship. This arrangement would be consistent with a pluralistic approach to research. At the same time, it would help ensure against any one agency building a "most-favored" relationship with the coordinating committee.

Coordination of Federal nutrition activities extends beyond specific mechanisms for intra- and inter-agency coordination. It also includes information storage, retrieval, and integration. No uniform system presently exists among the various agencies involved in nutrition research. Computerized systems that permit information integration and retrieval need to be explored. At the very least, relevant branches of HEW and USDA should have a common indexing and data retrieval system for this type of information. Since federally supported research accounts for the major share of research in the nutrition and health maintenance areas, integration among these agencies is essential. Integration of nutrition research data is also desirable among the public, private, and voluntary sectors.

Definition and Funding

As outlined under issue 2, OTA could not perform an analysis of the present Federal human nutrition research budget, since present expenditure estimates are so disparate.

Federal spending on human nutrition research should be precisely determined. By eliminating the present confusion, Congress will be better able to judge appropriate levels of funding for nutrition research. Congress could request GAO to audit the human nutri-

tion research expenditures of Federal agencies. The GAO audit, based on a constant definition, should determine total Federal spending for human nutrition research, the number of scientist years involved, and Federal expenditures in the seven priority areas set out in this report.

On the basis of such information, Congress would have several options. The first would be to maintain the status quo in nutrition research funding, with possible reallocation of some funds to areas not now receiving support. As a second option, Congress could appropriate additional funds to specific nutrition research areas that are not getting enough support. Finally, Congress could earmark a percentage of Hatch funds for human nutrition research. Such an audit, together with a uniform system for reporting human nutrition research spending, could also

facilitate future congressional oversight hearings.

Personnel Resource Requirements

If Congress were to choose to implement the OTA comprehensive nutrition research strategy, there is a clear need to establish how many scientists are both presently involved in, or training for, nutrition research. This census would include a breakdown in terms of various research areas, such as Government facilities, universities, medical facilities, private institutes, and industry. This kind of census would identify where nutrition research personnel gaps exist and where greater support is necessary. To fill such gaps, expanded Federal support should be considered.

Chapter IV

CONGRESSIONAL OPTIONS



vitamins



fats



minerals



carbohydrates



proteins

CONGRESSIONAL OPTIONS

OTA found that three key issues underlie the basic finding that the Federal Government has failed to adjust the emphasis of its human nutrition research activities to meet the changing health problems of the American people. Alternative approaches of dealing with these issues have been explored. Congress can elect to maintain the status quo, with or without minor shifts, or choose among the strategies and options offered by OTA, the General Accounting Office (GAO), and the Office of Science and Technology Policy (OSTP), (see chapter III). Either alternative has economic, institutional, and health implications.

Option 1: Congress Could Choose To Maintain the Overall Status Quo

Maintaining the status quo could mean refraining from any action. In a broader sense, it also could involve minor improvements in the present system—without making substantial changes.

A. Congress could refrain from any action, awaiting the recommendations of the President's Reorganization Project.

In August of 1977, President Carter directed the Reorganization Project staff at the Office of Management and Budget to thoroughly review the organization and structure of Federal food and nutrition programs. Food and nutrition research is one of the seven major areas under review. A final report to the President, expected in January of 1979, will include recommendations that may significantly alter the organization, and thus the course, of nutrition research activities.

Since significant strides have been made in nutrition research, there is no reason to expect a decline in research productivity if current funding levels are maintained. However, since several important areas of nutrition research receive little support at present, progress in these areas would be slow. These areas include the role of nutrition in the prevention of disease, nutrition education, mon-

itoring nutrition status, and nutrition policy and management.

If Congress chooses to refrain from any action to await the recommendations of the President's Reorganization Project, no adverse effects would be expected.

B. Congress could amend the Food and Agriculture Act of 1977 to clarify the designation of lead agency for human nutrition research.

At the present time, the Department of Agriculture (USDA) interprets the Food and Agriculture Act of 1977 to mean that USDA is the lead agency for human nutrition research, an interpretation not shared by the Department of Health, Education, and Welfare (HEW). If Congress intended USDA to have primary responsibility for this research area, the Act will require amendment.

C. Congress could develop nutrition research goals and priorities for HEW that complement the goals and priorities outlined for USDA in the Food and Agriculture Act of 1977.

The legislation contains strong language on the relationship of diet to many of the leading

causes of death in the United States, the importance of proper nutrition in disease prevention, and the need for more knowledge in several areas of nutrition research. The research priorities spelled out in the bill do not fully reflect these thoughts.

Since the legislation pertains almost exclusively to USDA, it lays out what could be considered a partial strategy to solve the problems of diet and chronic degenerative diseases.

Congress could develop legislation containing research goals and priorities for HEW that complement those already legislated for USDA. These goals and priorities could be based on either the GAO, OSTP, or OTA strategies.

D. Congress could enact legislation establishing a coordinating mechanism for Federal human nutrition research activities.

Numerous recommendations for coordinating Federal human nutrition research have been made since the 1969 White House Conference on Food, Nutrition, and Health.

The fact that the issue remains alive indicates the need for improvement.

E. Congress could consider legislation to improve data storage and retrieval, and to link the systems currently in use.

Coordination of Federal nutrition activities extends beyond specific mechanisms for intra- and inter-agency coordination. It also includes information storage, retrieval, and integration. No uniform system presently exists among the various agencies involved in nutrition research. Computerized systems that permit information integration and retrieval need to be explored. At the very least, relevant branches of HEW and USDA should have a common indexing and data retrieval system for this type of information. Since federally supported research accounts for the major share of research in the nutrition and health maintenance areas, integration among these agencies is essential. Integration of nutrition research data is also desirable among the public, private, and voluntary sectors.

Option 2: Congress Could Choose To Pursue a Human Nutrition Research Strategy Different From That of the Status Quo

Since this assessment found that the present nutrition research establishment has failed to respond to the changing health needs of Americans, Congress could move to change the emphasis of federally funded nutrition research. Such change could be based on the strategies and options put forward by OSTP, GAO, and OTA (reviewed and analyzed, chapter III). If Congress decides to follow this path, more information is required on current expenditures and existing expertise. Based on the results of needed studies, Congress could then determine which strategies and options would be most productive.

A. Congress could request GAO to conduct an audit of Federal expenditures for human nutrition research.

To eliminate the present confusion over how much Government agencies are spending

on human nutrition research, Congress could ask the GAO to audit such Federal expenditures, using the definition of human nutrition research developed in this report. On completion of the audit, Congress would be in a better position to determine which areas of nutrition research are receiving inadequate support. At that point, Congress might consider reallocating some funds or appropriating additional funds to specific areas of nutrition research identified as poorly supported, or earmarking a percentage of Hatch funds for human nutrition research.

B. Congress could request the lead agency for human nutrition research to conduct a census of research personnel.

There is a clear need to establish how many scientists are both presently involved in and training for nutrition research. This cen-

sus would include a breakdown in terms of various research areas, such as Government facilities, universities, medical facilities, private institutes, and industry. This kind of census would identify where nutrition research personnel gaps exist and where greater support is necessary. To fill such gaps, expanded Federal support should be considered.

C. Congress could increase training grants and fellowships, and consider establishing midcareer training for scientists.

If a need is established for more research personnel, this could be met through a com-

bination of two routes: increasing training of young scientists and providing midcareer training for established scientists. By making fellowship and training grants available, candidates would be attracted to those fields in which more research is needed (particularly the newer fields). Congress might also consider alternative means to facilitate training such as loans, work/study funds, pay-back scholarships, and income tax rebates for students.

For established scientists wishing to broaden the scope of their research interests to encompass nutrition research priorities, midcareer training or continuing education could be considered.

APPENDIX



vitamins



fats



minerals



carbohydrates



proteins

APPENDIX

SUPPORTING MATERIALS

BACKGROUND FOR OTA RESEARCH STRATEGY

In the preparation of this report, OTA found that Federal nutrition research lacks focus and direction. This is demonstrated by the lack of general consensus on overall goals and priorities. The picture is further complicated by the large number of Federal agencies involved—7 departments encompassing 14 separate agencies. Without a concerted, continuous effort to integrate their efforts, the agencies have been unable to share information on planned, ongoing, or completed research. Furthermore, the inability to develop an agreed upon definition of what constitutes "nutrition research" has led to widely divergent reports on Federal spending.

In view of public concern over the food we eat, how we live, and their relationship to how we die, human nutrition research receives little Federal attention. Research along the lines in the comprehensive nutrition research plan developed by OTA will help determine if causal relationships can be established between the American diet and the American way of death. Implementation of the results of this research could hopefully improve the health status of many Americans.

A technical analysis and rationale for the proposed research strategy are presented below.

Criteria for Evaluation

The establishment of research priorities and the development of appropriate budgets

involve various kinds of judgments. Only a few of the documents reviewed attempted to set priorities for nutrition research, and the criteria used differed from one report to another (see table 6). For the purpose of this assessment, the criteria used in the other reports were found wanting in a number of respects.

First, some of the criteria were ill-defined, difficult to interpret in a uniform manner, or were not mutually exclusive. Second, the criteria for types of technology necessary to achieve results were unclear. For example, the criterion for researchability was defined in one document as being either an area in which effort was likely to advance knowledge or one in which the knowledge base, personnel, and basic research techniques were available. From the standpoint of technology assessment, the two are quite different. Use of the same term to describe these two different characteristics confuses rather than simplifies decisionmaking. Third, costs or relative dollar requirements were not included in the criteria. Fourth, because most of the documents which used criteria for selecting priorities were written by research scientists or Government officials, estimates of need and potential impacts were viewed from their vantage point rather than from that of the users or ultimate beneficiaries of research—the American public. In contrast, the OTA advisory panel represented a wide range, including not only the producers and administrators of research but also users outside of the Federal Government and consumer representatives. Finally, the criteria selected for reports suggesting domestic nu-

Table 6.—Criteria Used for Assessing Research Priorities

Office of Science & Technology Policy*	National Academy of Sciences**	General Accounting Office***
1. <i>Impact</i> : Research findings are expected to have major influence on human health or dietary practices.	1. What advances in knowledge will specific areas of research produce, and what is the scientific or technological significance of these advances?	1. Knowledge gaps at present.
1. <i>Substantial existing knowledge gap</i> : There is insufficient knowledge in a specific area either because little relevant research has been carried out or because the research has not yielded conclusive results.	2. If research does produce results, what effect would they likely have on reducing global hunger and malnutrition over the next several decades?	
3. <i>Researchability</i> : An adequate capability—knowledge base, skilled personnel, and research techniques—exists to address the problem so that research is likely to result in a significant breakthrough in knowledge. This criterion depends on scientific judgment about the methods available to operationalize research questions.	3. What supportive action will be required to conduct research for accelerated activity recommended (e.g., more resources, policy changes, organizational changes)?	

*Office of Science and Technology Policy, *New Directions in Federally Supported Human Nutrition Research*, December 1977.

**NAS, *World Food and Nutrition Study*, 1977.

***GAO, *Federal Human Nutrition Research—Need for a Coordinated Approach To Advance Our Knowledge*, 1978.

trition research priorities tended by definition to favor short-term gains. By developing a separate criterion for the immediacy of application, this bias was reconciled. The criteria used by OTA in evaluating research priorities were need, current state of knowledge, capability, cost, and immediacy.

Importance of the Problem

There are two different viewpoints on how to assess the importance of the problem or the need for a solution. Health professionals might advocate an approach based upon epidemiological considerations. Since estimates of the prevalence, incidence, duration, and mortality rates of various diseases generally reflect their effects upon human health, they are useful.

Economists use more general considerations in defining needs. They concentrate upon the economic impacts of the expected solutions.

Also important are the more subjective human dimensions of suffering and inconvenience, which are conveyed only imperfectly by the epidemiological data, and the benefits

projected by the estimates of economic impact. For example, heart attacks kill three times as many people in this country as cancer, but most people fear cancer more than they do heart disease. Overnutrition is associated with much more illness in the United States than undernutrition. Yet there is a widespread belief that it is worse to be hungry than to be overfed and that the Government has a special obligation to help those who might otherwise go hungry.

While the factors mentioned above involve expert judgment to some extent, need is difficult to assess because of the many subjective factors involved. Congress and the public have as much ability as anyone else to evaluate their relative importance. Since public monies are to be spent, a wide spectrum of opinions likely to be representative of the public is therefore useful. Indeed, all these various types of expertise will be helpful in making judgments.

Current State of Knowledge or Relative Potential of the Area

Here the emphasis shifts to the state of knowledge in the field and how likely it is that

expected results or answers will be found and knowledge advanced. Estimating the relative potential of research efforts is an area in which expert judgment is particularly useful, since knowledge of the present state of the art and current research ideas is helpful. One difficulty often encountered here is that science must take into account what is practical and possible rather than solely what is deemed to be important.

Capability

This criterion involves estimates of the present capacity for performing research from the standpoint of personnel, technology, and the availability of basic research techniques to deal with the problem. Special expertise is helpful in making these estimates.

Cost

This factor involves the relative amounts of money required by the proposed research in the immediate future.

Immediacy

This criterion evaluates whether yields are likely to be seen over the short, medium, or long term. Specific target dates in terms of application are very difficult to predict. In general, short term was used to describe projects in which usable results could be expected in under 5 years; medium term, 5 to 10 years; and long term, 10 to 20 years. Expert judgment was helpful in making these decisions, but even so they represent guesses and not certainties.

Other Criteria Which Were Considered

While the major criteria used for assessing the various possibilities for emphasis are mentioned above, other points were also considered in arriving at overall judgments. These included the following:

Potential for achieving multiplier effects by developing closer links between research and training. Lists of research priorities tend to be specific. Yet the best researchers are those with broad experience and training who can solve problems requiring various kinds of technical expertise. Research topics

which are amenable to such broad approaches are therefore particularly suitable for exposing research personnel in training to the very collaborative endeavors that may be the most fruitful.

Maintenance of research potential. The setting in which research is carried out affects the ability to maintain nutrition research potential. In some settings such as universities, particular emphasis is placed upon the transmission of knowledge by training young investigators, while in others the focus is restricted to the production of new knowledge. Since there is no solid evidence available to indicate that research by contract or by private or Government organizations is more efficient in producing results, particular emphasis was given by the OTA advisory panel to topics or funding mechanisms that would have secondary gains, in that they would also produce scientists.

Approaches which maximized the benefits to be gained by focusing research priorities and minimized the undesirable effects. Efforts to direct research toward useful solutions by establishing priorities and funding are helpful in several ways. They encourage dialogue among scientists, funding agencies, and the ultimate users of research efforts, thus helping to achieve consensus, summarize our current state of knowledge, and strengthen the public understanding of science. They may permit public monies to be better spent for achieving desired objectives and speed up the process of application of fundamental research findings to human problems.

However, undesirable effects also stem from efforts to direct research. These include placing greater power and control in the hands of bureaucrats who may be limited in their ability to judge quality. Scientific judgment may be weakened. Perfunctory research which follows bureaucratic guidelines but involves little intellectual effort may be favored. More productive areas of research may be disregarded in favor of "popular" areas of interest in which a paucity of new research ideas exists.

THE ROLE OF DIET IN THE PREVENTION OF CHRONIC DISEASE AND OBESITY

The role of nutrition must be given greater priority in the prevention and improved management of today's major health problems. Nutritional factors deserve particular attention for two reasons. First, it is possible to change diets while some of the other factors that influence disease development cannot be altered. Second, nutrition is basic to health and deserves attention as one of many factors that influence health and disease.

Justification

Major Health Problems and Diet-Related Risk Factors

The major health problems of Americans include cardiovascular disease, cancer, diabetes, hypertension, osteoporosis, obesity, drug and alcohol abuse, mental illness, and dental disease. All of these diseases have a complex etiology of which nutrition is a part. Thus, research must aim at identifying the interrelationships between diet, exercise, stress, other environmental and genetic factors, and general health. More attention must be paid to nutrition as a variable in ongoing studies of disease which are mentioned below. This kind of research will be long term (10 to 20 years), but some payoff can be expected relatively soon (such as the reduction in coronary heart diseases in the past 10 years and recent reports linking high dietary sodium levels with hypertension).

Cardiovascular disease. Although more research effort has been directed to atherosclerotic heart disease than to other chronic diseases, it remains a major health problem. Each year 850,000 cardiovascular deaths are caused by arteriosclerosis, 25 percent of these occurring before the age of 65.

The role of diet in the development of heart disease is generally accepted but still not understood. Further definition of the relative importance of specific dietary components—such as type and amounts of fat, dietary cholesterol, type of carbohydrates, dietary fiber, and alcohol—is required. The positive or negative effects they produce are particularly germane to the clinical and public health application of findings. Both specific risks

produced by individual components and the combined risks of different dietary patterns need exploration.

The relationship between atherosclerotic disease and other conditions such as obesity, hypertension, and diabetes needs more careful study. The exciting new observations on the role of high-density lipoproteins, which transport blood fats, in retarding the development of atherosclerosis provide a possible basis for approaches involving the manipulation of selected food constituents or other factors which may increase high-density lipoproteins.

More research is also needed on the ways in which various dietary factors—such as type and amount of fat, alcohol, and energy balance—affect the disease process. Why and how these factors affect the development of cardiovascular disease are more difficult to uncover than discovering if they have positive or negative influences.

Cancer. Three quarters of the cancers that occur in this country are believed to be related to environmental factors, which include foods and their constituents. Epidemiologic data and findings from animal studies relate cancer of the esophagus, stomach, colon, breast, and liver to diet. A variety of factors in food has been implicated.

A primary effort must be directed toward identifying the dietary patterns and dietary constituents which are associated with high risk in populations. Food factors—such as nutrients and other substances naturally occurring in food, food contaminants, food additives, or total dietary patterns—may all influence the development of cancer. There are many types of cancer which affect many different tissues and organs, and no single "cause" of cancer can be expected to be identified. Until basic research efforts have better explained the causes of cancer, it will be difficult to achieve a breakthrough in the applied area. Thus a renewed emphasis on basic research funding will be necessary.

Diabetes mellitus. Diabetes correlates with cardiovascular disease and certain kinds of

cancer and is itself a major cause of death and disability. Projections of current rates of increase suggest that 20 percent of all Americans may develop diabetes unless methods of prevention are found. Maturity-onset diabetes is clearly related to obesity. Diabetics are known to be particularly susceptible to arteriosclerotic heart disease. These interrelationships suggest common causal factors that need clarification.

Study of the interrelationships among the amount and kind of various carbohydrates and fats and the total energy intake in the causation and control of diabetes mellitus should be particularly useful.

Hypertension. Hypertension is epidemic in the U.S. population. Nearly 23 million Americans are affected. Epidemiologic data, as well as animal feeding studies, link hypertension to sodium intake, and low-sodium diets have been useful in the control of hypertension. Hypertension is also linked to obesity and, as with most chronic diseases, there is probably a strong genetic component. The role that sodium intake may play within the American population is not clear, nor have the possible effects of sodium restriction in preventing hypertension been adequately explored. The interrelationships between the genetic component and diet, particularly salt intake, must be thoroughly studied. The role of diet coupled with other preventive measures also needs more exploration than it has as yet received.

Osteoporosis. Most adults lose bone substance as they age. Morbidity associated with osteoporosis has been estimated to affect probably 20 percent of the population over 50 years of age. Adequate epidemiologic data are not yet available. A nutritional component in the development of osteoporosis is likely. Excessive intakes of protein and phosphate and relative deficiencies of calcium, fluoride, and vitamin D have been implicated. Research in this field has been miniscule relative to the importance of the problem.

A broad attack ranging from the collection of satisfactory epidemiologic data within and between countries, the development of appropriate animal models, and appropriate clinical studies aimed at exploring the rela-

tionships among nutrition, endocrinology, and genetics will be required to develop solutions.

Chronic digestive disorders. Ulcer disease, inflammatory bowel disease, and diverticular disease of the colon may have nutrition-related causes. These need exploration.

Dental disease. Dental caries and periodontal disease are a serious and expensive health problem. Dental caries afflict 95 percent of the population under 17 and significantly increase health-care costs. Nearly 45 percent of the total population has periodontal disease, which is the primary cause of tooth loss after age 35. Fermentable carbohydrate is the primary factor causing tooth decay. Fluoride has a protective effect when consumed during the period of enamel development or when applied topically. But other diet-related factors are also involved. Attempts to identify other dietary factors having cariogenic or cariostatic effects are currently focused on the effects of trace elements upon the oral microflora and enamel solubility and on the role of nutrition in the development and activity of the salivary glands. Recent studies have clarified the role of food consistency in gingival health, and current research is focusing on the role of nutrition in the maintenance of gingival health and the resistance to periodontal disease.

But our knowledge of the role of nutrition in the causation of periodontal disease is minimal. The importance of specific dietary components and their interrelationships with dental hygiene, heredity, the oral microflora, eating patterns, and other factors in these diseases must be defined. Research should show the major causes and provide guidance on practical means of preventing dental caries and periodontal disease.

Diet, Aging, and Disease

The diseases which have been discussed constitute major health problems which are prevalent among the aged, although they are not necessarily restricted to the aged or directly correlated with aging. A major and growing segment of our population is elderly, yet we know very little about how to deal with the combination of aging and these disease

problems. A great deal of data are now available to demonstrate that the aging process in animals can be delayed by appropriate diets and particularly by limiting food intake.

The implications of these studies on human nutrition are profound, yet very little is known about how dietary modification achieves these effects, what might be the role of specific food components, or how they can be applied in human nutrition. The importance of research in this area is self-evident as various diseases (particularly the infectious diseases) come under increasing control and the number of elderly people increases. Fundamental research in this area must receive attention.

Research is also needed on the relationship between food intake in the early years of life and the later development of cardiovascular and other diseases.

Methods for Preventing Obesity

Obesity is a condition of excessive fatness rather than a disease itself. It is related to several of the major health problems mentioned above. Specific causes and factors involved in obesity—such as heredity, nutrition in early life, emotional factors, the nature of the food supply, and physical inactivity—must be studied to develop better methods for controlling the condition.

The role of obesity in the development of chronic disease needs attention so we can define associated disease problems and act to prevent or control them. Obesity may be detrimental to the health of some people while not to others. Study of the interactions of obesity with other risk factors may help to unravel the interrelationships of obesity with chronic diseases.

Present preventive and curative programs have only limited success. Carefully conducted clinical trials which would allow cost-effectiveness comparisons between different approaches are not available, but are sorely needed, and may prove helpful in developing new and better preventive techniques.

Nutrition and Mental Development

Nutrition plays a positive role in mental as well as physical health. Although malnutrition in the prenatal and early postnatal periods has been linked to retarded mental development, the specific role of nutrition and its relationship to other factors which affect mental development remains obscure. Continued effort is required to clarify these relationships and also to develop methods which will assure that each child's potential for mental and physical development is fulfilled. Studies concentrating on clarification of the relationships between nutrition, mental development, and behavior are particularly germane to the problems in developing countries where diets may be severely limited. They may also benefit certain disadvantaged groups in our own country, such as handicapped children, with better methods for feeding. Techniques for speeding the rehabilitation of abused children who have been nutritionally deprived might also be developed.

Analysis

Need

The severity, irreversibility, and toll in human suffering of these common diseases with nutritional components make this an urgent area of concern. The economic impacts of preventing or delaying the onset of these diseases would be enormous.

Current State of Knowledge

There is a long-standing belief, backed by substantial evidence, that proper choices of diets and lifestyles can do much to enhance and maintain good health. The specific role of diet in the development of these major chronic diseases is not certain. But several—including heart disease, cancer, diabetes, and hypertension—are so common and serious that every effort must be made to diminish their impact.

The potential for advances in this area is high, but the returns for a specific project are never known in terms of what the practical application will be or whether they will be ap-

plicable to human nutrition problems. In terms of the improvement of human health, however, many great breakthroughs have resulted in the past from the identification of general principles which underlie biological phenomena, whether these have arisen from serendipity, general studies, or mission-oriented research concerned with a particular problem.

Capability

The lack of appropriate basic research techniques and appropriately trained personnel are major limitations in this area. Nevertheless, presently available techniques need to be applied more broadly. The extent and nature must be known of the correlations among dietary composition, other causative factors, and the incidence of major diseases in order to do this. Extensive animal feeding trials in appropriate species, biochemical studies, and some experimentation with human subjects are also directly relevant.

Cost

Costs of research in the role of diet in the prevention of chronic diseases and obesity will be high, but not in comparison to the health costs these diseases generate. A great deal remains to be done, and significant increases are likely to be necessary.

Immediacy

Research on disease prevention has a relatively long leadtime before it reaps results, al-

though some advances can be expected in a few years. Since this type of research has received little attention from the nutrition perspective over the past few decades, it is particularly important to begin to catch up. Our aim should be to build a research program that deals with the problems of today as well as one that will be ready to meet those of the future. Since this type of research furnishes the foundation upon which applied research is based, it is fundamental to all practical programs. Yet a number of recent reports—including the President's Biomedical Research Panel, the World Food and Nutrition Study, and the recent OTA assessment on basic research needs in agriculture—all agree that much important fundamental information of this type is not being developed and that our storehouse of knowledge for building applied programs based on these advances is rapidly becoming depleted. Therefore it is absolutely essential that immediate attention be paid to this problem.

Other Criteria

The opportunities for achieving multiplier effects with funds spent to develop close links between research and training are high. The development of this area is essential for maintaining research potential and keeping nutrition viable and in the mainstream of advances in biomedical research. The priorities are general enough to encourage creativity.

THE ROLE OF NUTRITION IN THE TREATMENT OF DISEASE AND SUPPORT OF THERAPY

Justification

There is increasing recognition today that nutrition plays a significant role in the management of many disease states. Its application to the management of a wide variety of diseases, including postoperative and chronic

care, genetic abnormalities, gastrointestinal disease, allergies, and behavioral disorders, has aroused increased interest in recent years.

The results of research on nutrition in the management of disease can help health care

providers integrate nutritional concerns more fully into the health-care system. By applying these results and by improving the quality of information provided to patients, the nutritional status of those under medical care can be improved and the chances for success of treatments for their specific conditions improved.

Nutritional Support of Patients With Severe Disease and Injury

The treatment of severe disease and injury accounts for the major costs involved in hospital care and represents the greatest opportunity for trained physicians and other health professionals to use new knowledge in the care of patients.

Severe systemic and infectious diseases. Patients with severe illnesses resulting in permanent and prolonged disability may require major qualitative and quantitative modifications of their intakes with respect to energy, amino acids, minerals, and vitamins. Others may require special routes for feeding. Major areas for research include:

1. Gastrointestinal diseases, including regional ileitis, ulcerative colitis, short bowel syndrome, primary bowel disorders;
2. Infection;
3. Liver disease;
4. Renal disease;
5. Cancer; and
6. Diabetes mellitus.

Severe injury. Severe injury involves burns, severe trauma (such as that sustained from damage to vital structures through accident or gunshot or stab wounds), compression-decompression injury, irradiation, and major surgical procedures. It is well known that nutrient requirements and metabolism are altered in these states. Moreover, the possible methods of feeding and nutrient mixtures may need to be modified in those specialized states (e.g., intravenous feedings, continuous infusions, alterations in hormone release and responsiveness). Therefore, these topics are important research priorities.

Inborn errors of metabolism. The number of people with inborn errors of metabolism is

not large. These diseases include the inborn errors of amino-acid metabolism and the lipid-storage diseases such as Tay-Sachs disease. These disorders have profound effects in terms of early death and permanent physical and/or mental disability. Further research on the nutritional management of these diseases may yield benefits similar to those achieved in the treatment of phenylketonuria (PKU). Infants born with PKU, when raised on a special diet, develop normally and avoid the mental retardation that occurs in untreated PKU.

Other Disease States

Other less severe conditions need to be examined as to the role of nutrition in their management. While they are not causes for hospitalization, they are inconvenient and temporarily disabling. Therefore, clinic time, lost time to the patient, and cost of prescribed or over-the-counter drugs are considerable. The potential role of nutrition in providing care or prevention of these conditions has not yet been clarified and awaits future developments in the area of basic research. Those areas of importance include:

Acute gastrointestinal disease in adults, infants, and children. Acute gastrointestinal infections may lead to secondary malnutrition from malabsorption if they are treated incorrectly. Research is needed to identify these conditions and correct treatment.

Food intolerances. Food intolerances such as celiac disease, sensitivity to various milk proteins, other sensitivities, and intolerances.

Immune and autoimmune diseases. Preliminary findings suggest a relationship between diet and the development of some immune and autoimmune diseases.

Technology for Delivery of Nutrients to Patients

We are concerned here with a variety of very practical problems aimed at improving the nutritional status of severely ill patients. These involve:

Improvement of dietary formulas. Improvement of dietary formulas for those with special feeding problems such as patients

who must be maintained for substantial periods by parenteral nutrition alone, those with genetic defects who require chemically defined diets, those in whom certain foods or nutrients must be severely limited as may be desirable in chronic renal disease, institutionalized patients with special feeding problems as in mental hospitals and homes for the aged. Palatability is a particular issue of importance to patients when oral feeding routes are used and must not be forgotten in the quest for more effective formulas from the metabolic standpoint.

Improvement in the delivery of such formulas. Better techniques for delivery of parenteral solutions, intragastric feeding and intravenous feeding outside the hospital (often called home total parenteral nutrition (TPN)), and the feeding of patients who cannot feed themselves are also needed. Substantial opportunities for lowering the cost of the management of such patients by these techniques as well as improving their nutritional status will result from such efforts.

Behavioral and Emotional Problems

The number of patients who come to health personnel with psychological and psychosomatic stress-related problems that they suspect are diet-associated is on the increase.

Effects of dietary constituents on behavior. Certain dietary constituents such as monoamine oxidase inhibitors, monosodium glutamate, and certain food colors and flavors have been implicated as having effects on behavior. The whole question of hyperactivity due to foods or food constituents is still an open one, yet results from two large studies to date indicate that the results of attempting to associate or disassociate foods and hyperkinesis have been equivocal. Recent findings in other areas suggest that diet-drug interactions affecting behavior may be more common than was previously thought. Research exploring the possible effects of these food constituents and interactions on behavior is needed to make satisfactory medical recommendations as well as to provide regulatory agencies with information which may be helpful in decisionmaking on the use of certain food additives. Methodologies for precise

and sensitive measurement of different behavioral indices are urgently needed; the lack of such indices limits progress on the effects of dietary constituents on behavior.

Effects of various patterns of moderate alcohol use on behavior and performance. Dose, pattern of alcohol consumption, the purposes for which it is used, and the social context of consumption are all associated with its potential for misuse. Forms of alcohol consumption that pose the least risks of harm need to be identified.

Other related studies. Research on the effects of diet on human behavior must involve studies of specific dietary constituents as well as studies on food consumption. Three research areas are therefore apparent: the effects of kind of food, amount of food, and feeding interval on behavior; the effects of specific nutrient deficiencies and marginal deficiencies on behavior; and the pharmacological effects of food constituents, food additives, and accidental food contaminants on behavior.

Analysis

Need

Recent studies have uncovered a shocking degree of overt undernutrition among hospitalized patients. The sources of this malnutrition may be undernourishment in the elderly and ill before they enter the hospital, recognition of a problem that has always been with us, or failure to provide nutritional support.

Research advances in the nutritional management of disease can be expected to shorten hospital confinement, prevent complications, and hasten convalescence. It is important to evaluate the impact of new methods of nutritional support and treatment on such variables as patient response to treatment and changes in number of hospitalization days. If significant positive changes are achieved, inclusion in patient care may largely pay for itself by tradeoffs in other areas.

Finally, the impact upon quality of life of this research is likely to be high. The chronic diseases include many which cause serious incapacitation and pain, as well as those

which collectively account for the vast majority of urgent demands for health-care services. Improvements in management may therefore improve quality of life.

Current State of Knowledge

Recent advances in the applied sciences have opened up a whole new field involving reversal or management of disease by provision of supportive nutritional therapy. Here potential for breakthrough is high, particularly if it is possible to train physicians and other health providers who presently lack this knowledge.

A good deal of basic science background is already available in some areas so that fundamental "breakthroughs" to achieve transfer of findings from research to application at the clinical level can be expected relatively quickly.

Applied research efforts in this field can be expected to yield results which require large-scale testing and refinement to demonstrate effectiveness. Such clinical trials are exceedingly expensive and must therefore be undertaken only after careful planning and experimental design.

Capability

While the technologies and personnel are available at present, they are in short supply and highly specialized. Only small-scale research studies are being done. Better integration of research with clinical training may help in making this type of expertise more widely available.

The development of clinical nutrition research must be primarily a medically related activity. However, it should have a close relationship to other nutrition and food science research activities and personnel whose interests are broader than nutrition in the treatment of disease so that their specialized knowledge may be transferred as rapidly as possible.

Cost

Current levels of funding are inadequate to develop technology transfer to the wide-scale practice of procedures which have already

been demonstrated useful. Resources required are essentially financial.

This research can be expected to have economic implications over the long term in terms of lessened disability, fewer complications, and shorter total hospital stays.

Most research on improvement of dietary formulas and techniques for delivery of formulas is supported by private industry. Federal research costs in this area are therefore expected to be low.

Immediacy

The time span involved to solve these problems varies a good deal and depends upon the disease state under consideration as well as on the availability of basic science and technology. Where these are sufficiently developed, a mission-oriented approach would be most appropriate for speeding up practical applications. However, past experience shows that applied studies must rest upon relevant data generated at the basic science level. In many of the areas mentioned, long-term studies will be needed before clinical application of findings can be considered.

Other Considerations

The potential for linking this type of research with training is high. Such an approach would also help to maintain research potential. This research, conducted in clinical settings, would be a stimulus to health-care providers and encourage them to integrate nutritional concerns more fully into the health-care system. The research which has already been done has had a positive effect in that it has generated increased interest in clinical nutrition and preventive medicine among some sections of the medical community and particularly among medical students.

The necessity for assuring that adequate training in newer aspects of clinical nutrition application is provided to students in medical and other health professions is closely associated with this priority. Over the long run, provision of such training funds would allow more rapid application of existing research fundings and technologies to patient care problems, thus achieving greater impacts per research dollar expended.

NUTRITION EDUCATION AND CONSUMER INFORMATION

Justification

Present knowledge as to how nutrition contributes to the maintenance of positive health as well as to the prevention or treatment of chronic diseases is considerable. To realize the potential benefits from this research and from future research, findings must be translated into practice. Individuals must have the opportunity to incorporate them into their own eating practices and lifestyle. We know very little about how to support the maintenance of nutritionally desirable behavior to help individuals adjust their dietary practices. Nutritional behavior in this context includes such practices as food consumption, food selection and purchase, food preparation and storage, physical activity, and lifestyle.

The Federal Government supports several different types of nutritional intervention programs. These include nutrition education, food fortification, food regulation and inspection, food price support, and various feeding programs, including Food Stamps, programs for the elderly, women, infants, and children. For many nutrition practices, consumer nutrition education alone or in combination with a feeding program may be the most feasible mechanism for influencing food choices. It also possesses the advantage of leaving decisions in the hands of the public rather than expanding the role of Government.

While there is a common core of research questions that must be explored in order to develop a basic understanding of the dynamics of food choices, it must be remembered that different agencies with different legislative mandates have unique concerns which must be served by nutrition education research. Therefore, different research emphases of individual agencies must be considered.

In FY 1976, the Departments of Agriculture and Health, Education, and Welfare supported roughly \$70 million of nutrition education activities. Very little of this money is ac-

tually allocated to research, and the vast majority goes to programs.

The primary emphasis of Federal nutrition education programs until now has been the obtaining of an adequate diet. Since this is not the major nutritional problem in the United States today, the public deserves to be informed about nutrition and other measures that promise to help in health maintenance and the prevention of disease. Knowledge is often incomplete to move forward with firm recommendations of demonstrated utility. But the public's need for information on the pros and cons of the measures is still present. Such information would allow them to understand the changing nature of scientific knowledge and to play a more active role in adopting healthful food consumption practices in their own lives if they wish to do so. It would also help them to make more rational use of the enormous amount of health-related information they constantly encounter.

Since little research on nutrition behavior and education is currently conducted by the Federal Government, research in these areas should accomplish four goals:

1. Definition of the focus of nutritional behavior and education research. The specific issues, concerns, or content most urgently in need of study or attention in light of national interests need to be defined. The panel's recommendations on these areas are described in the following section.
2. Guidance for Federal food and nutrition policies and programs. In view of the relatively large amounts of Federal money spent each year on nutrition education programs and the lack of evidence of effectiveness of these programs, this area is probably one of the greatest congressional concerns.
3. Development of a theoretical framework for nutritional behavior. Little or no theory has been developed to explain or allow prediction of nutritional behavior or to indicate which nutrition education

approaches are likely to be most effective in different situations.

4. Development of methodologies for studying nutritional behavior, testing nutrition communications, and evaluating nutrition education effectiveness. There have been few systematic attempts to catalog the methodologies available and applicable to such studies.

Factors Affecting Lifetime Eating Habits and Identification of Critical Points for Education

Successful nutrition education must take into account all of the various factors that motivate consumer food choices. Current nutrition information and education programs funded at the Federal, State, and local levels have a weak research base. A modest expenditure of funds in the following areas should yield high returns in improving the effectiveness of existing programs:

Sociocultural and other lifestyle factors that influence American dietary patterns. Improved public health through better nutrition for groups that run particularly high risk of problems depends on better approaches being developed in this area. A great deal is known about clinical implications of certain dietary lifestyle habits, but we know very little about the factors that influence the adoption of these eating patterns or how they can best be influenced. One step in the right direction is to identify the various characteristics of groups within our diverse population.

Times of life which are particularly ripe for education intervention. We need to know when particular types of consumers are most responsive in terms of their lifestyles and food habit formation to receiving different types of nutrition and health-related information.

Food advertising and its effects. The influence of food advertising on eating habits needs more careful study. The food industry spends between \$1 billion and \$5 billion annually on advertising. The degree to which such advertising influences food choices and affects or competes with consumer compre-

hension of nutrition information from other more objective sources needs study.

Development and Evaluation of Nutrition Education and Communication Methods

Since the goal of nutrition research is to improve the health of people, it is important that current research knowledge be communicated to the public in daily living. Means for communicating useful research findings to the public so they can be acted upon in daily life need testing. The message communicated must optimize the ability to make food choices that will promote health, taking into account lifestyle constraints.

More effective methods for evaluating the effects of teaching efforts in schools are needed. Since public education is the responsibility of the States, intergovernmental collaboration between Federal and State agencies will be necessary in order to achieve this.

Evaluation of nutrition education programs requires clear criteria for achievement. Research efforts in this area include investigations of effective program design and development of criteria for success. Methods for nutritional status and risk factor evaluation may be relevant and need incorporation. Significant research findings which can be put into practice should be available within a relatively short term. However, pilot programs, carried out over a period of 5 to 10 years, will also be needed to assess the utility and long-term effects of such improvements.

The development and testing of models for screening and evaluating educational materials is also needed. Such systems can be used to examine the appropriateness and effectiveness of materials currently being used in relation to functional literacy, nutritional problems, and communication modes of the various populations towards which they are directed.

This research focuses on finding the most useful ways of fostering healthful food consumption practices by educational means. Useful areas of research here include:

Identifying current sources of information and locations or settings in which specific

types of nutrition information are most effectively delivered and the most appropriate means to do this (e.g., family support systems, community organizations, the health care system, work sites, the school system, media, Government, private sector, etc.).

Measuring the effectiveness of communicating objective information on controversial topics and information with respect to diet and health risks. People need to have information on the pros and cons of different choices with respect to diet so that they can make their own decisions and choose dietary practices which are appropriate to their styles of both life and health. Enough evidence exists at present to suggest broad guidelines with respect to prudent measures for health, price, and other aspects of diet. There is no expectation that a single optimal dietary pattern can or should be generated.

Research must be directed toward developing a series of dietary recommendations for different income, ethnic, age, and sex groups within the population, taking into account variations in their total environment, habits, economics, and their own estimates of risk. Some recommendations can appropriately be made today, but a good deal remains to be done in finding the most effective ways to communicate such changes. Research is also needed to determine the most effective means for researching different target groups.

Many risk factors associated with the later development of chronic diseases are already present by the time children leave grammar school. Some of these, such as obesity and dental caries, are nutrition-related. People of all ages have enormous difficulties in comprehending low risks or judging low-probability events. Issues that currently fall into this category include the advisability of various nutritional patterns for health maintenance and the nutritional value and safety of the food supply as well as the association of diet with disease.

The proper response of Government when faced with the dissemination of new findings with respect to risk factors is an important question that must be clarified by public debate.

There is virtual unanimity that Government does have an obligation to provide information that promotes health-related behavior; however, as attested to by recent congressional investigations and Federal legislation and appropriations in the area, research is needed on the best ways to do this.

Research on Methods for Simplifying Consumer Information Utilization

Consumers are likely to benefit most directly from information which reaches them in their daily lives. Food labeling for nutrients, ingredients, and unit prices are examples of how consumers can acquire information directly. Many foods are not adequately labeled today, and the present form of nutrition labeling may be difficult for some consumers to understand. The value of graphic forms of labeling; extension of the number and type of foods labeled to include meats, fruits, vegetables, and other commodities; and the expansion of the information provided to include such food constituents as sodium, potassium, type of fat, cholesterol, refined carbohydrates, and dietary fiber should also be explored.

Analysis

Need

The public's need for information, particularly with respect to chronic diseases, obesity, and wise food choices, is high. In view of the fact that changes in the major food programs (such as replacing food stamps with income subsidies) are now being considered, information and education on wise food choice may be even more important in the future. The impact of improved methods for helping the public to adopt healthful eating practices was assessed to be high.

Current State of Knowledge

The major difficulty identified here is that the basic knowledge base is weak. Behavioral and social scientists have given only superficial attention to nutrition education research. It has been a scientific backwater which has failed to attract the attention it deserves from applied scientists in many dif-

ferent disciplines. Programs designed to provide information on nutrition and to change eating practices are presently funded by a variety of Federal, State, and local government bodies. But information provision is not synonymous with information that attracts attention, is being attended to, comprehended, accepted, and used in daily life. Much of what is already known in the field of nutrition can benefit people if it is readily available in useful and appealing forms. Research addressing the question of how best to communicate nutrition information is needed to do this.

The final difficulty is our diversity. We are a heterogeneous people with diverse needs and preferences. There is no single, simple, cheap, easy answer as to how to go about developing approaches that reach all of these diverse groups. We also require reasonable limits for our expectations of what can be accomplished by education.

Capability

Research in food and nutrition education should involve a variety of disciplines, particularly nutrition scientists, food scientists, social and behavioral scientists, and educators. Collaborative research efforts involving interdisciplinary groups including such specialists as social and consumer psychologists, educators, home economists, human ecologists, anthropologists, economists, epidemiologists, health care evaluators, sociologists, communications researchers, and consumer representatives are needed to develop the research strategies. There is a need to develop appropriate psychological and behavioral testing procedures. The resources that are the most sophisticated with respect to this type of research are in other fields. The Federal Government has until now had almost no involvement in developing methods of educating the public with respect to nutrition.

In recent years no Federal expenditures have been specifically earmarked for nutrition education research. Thus while vast sums are being spent by the food industry to find ways to influence people's purchase behavior and many Government agencies administer consumer nutrition education and information programs, virtually none of this

money is devoted to finding out how to provide this material in a manner that would facilitate consumer comprehension and usage. Even modest amounts of funds expended on such research can be expected to yield high returns per research dollar spent.

Cost

While a great deal of research must be done, great benefits can be reaped from the transfer of already developed technologies from the industrial and communications fields; thus development costs are reduced. Moreover, economies may be effected by the development of more efficient program efforts. Federal programs now spend over \$70 million on nutrition education, yet research efforts financed by Federal efforts amount to very little. The food industry has been much more active in investigating factors that influence our food choices. A vast amount of money (estimates range from \$1 billion to \$5 billion) is spent annually on food advertising in an effort to influence consumers' food choices, and careful research underlies their efforts to influence brand choice. But little of this research is devoted directly to the issue of choosing diets that promote good health by preventing chronic as well as deficiency diseases and obesity. Federal expenditures are needed to broaden the research base on which to build nutrition education programs dealing with these issues.

Immediacy

While some benefits can be expected over the short term, as in developing improved labeling and nutrition information programs on risk factors, most of the outcomes will reach the stage of practical application in 5 to 10 years.

Other Factors

The potential for links between research and training was judged to be excellent. Maintenance of research potential is also high if such endeavors are carried out in settings in which new professionals are trained. The priority areas are broad and are not such that creativity is likely to be hampered by this type of mission-oriented research.

REQUIREMENTS FOR ESSENTIAL NUTRIENTS

Justification

Better understanding of nutrient needs and interrelationships increases the store of fundamental knowledge and makes practical advances possible. The amounts of certain nutrients required by individuals of different age, sex, and occupational groups are still unknown. These nutrients deserve particular attention. Little-explored interactions between nutrients and toxic materials also need more study.

Methods for Determining Nutrient Needs

Estimation of requirements for nutrients about which little is known. Our knowledge of needs is deep for some of the 50-odd nutrients human beings require and is shallow for others. For a number of nutrients, estimates of requirements have reached a point where further refinements can be expected to yield rather trivial gains in improving human health. A great deal of work remains to be done in developing better methods for estimating requirements for nutrients about which little is known. These nutrients include most of the trace minerals and certain of the vitamins. In some instances the gaps in knowledge are so great that even the methodology to determine their requirements does not yet exist.

Nutrient needs for population subgroups, such as low-birthweight infants, adolescents, women using oral contraceptives, pregnant and lactating women, and the elderly. We know very little about nutrient needs for special times and events in life. We do know that certain vulnerable groups in the population have a higher risk of nutrition problems because of changing needs. These groups include low-birthweight infants (especially those having weights under 1,300 grams), adolescents (especially pregnant adolescents), women who are using oral contraceptives, pregnant women (and their fetus), lactating women, and the elderly (with particular attention to the effects of aging on nutrient need in chronic disease). The range of requirements for various groups of people and

the interactions between ranges of requirements may be important.

Nutrition research directed toward a healthy survival of low-birthweight infants should produce massive payoffs in terms of reducing the prevalence of mental retardation, learning disabilities, and perhaps neuromuscular disorders. All of these are most common in children and adults who suffered intrauterine growth retardation and or short gestation. Approximately 8 percent of newborns fall into these groups. If they can be helped to a healthy survival, they could have 70 to 80 years of productive living.

Nutrient Requirements Based on Functional Criteria

The needs for many nutrients have been set on the basis of rather arbitrary criteria. For example, the requirements for iron is set by determining what is considered to be a satisfactory concentration of hemoglobin in the blood or biochemical measures that reflect iron stores. More meaningful measures from the standpoint of significance to human health and well-being might be resistance to infection, levels associated with the best learning ability, or exercise tolerance. Numerous examples exist of other nutrients for which relatively arbitrary criteria are presently used. Attention must be devoted to studies on functional criteria related to reproductive function, work capacity or productivity, and mental function.

Nutrient Interactions

Food is the most complex mixture of chemicals the population comes in contact with on a regular basis. The topic of chemical-drug-nutrient interactions has not yet been approached except in a peripheral way, yet it could yield significant information from the standpoint of human well-being and welfare. Interactions among nutrients, foods, food components, drugs, and environmental agents need careful study.

Efforts to keep knowledge of nutrient needs current and applicable are very important.

Because of the complexity of this task, it will be increasingly necessary to develop new approaches to understanding what constitutes an appropriate diet.

Requirements for some nutrients vary depending on the level of other nutrients in the diet. Studies on interactions among nutrients are therefore needed. In some instances other food components, drugs, or environmental agents to which people are exposed also act to modify nutrient requirements or the availability of nutrients in foods that are eaten. Our food supply consists increasingly of processed foods. Constant effort is necessary to keep knowledge of nutrient needs abreast of and applicable to this changing world.

Pharmacologic and Toxicologic Effects on Nutrition

Safety and effects of high doses of nutrients. The public is exposed to a great deal of material concerning the merits and liabilities of large doses of nutrients and dietary fiber, although little satisfactory evidence exists about their effects. Clarification of the potential for damage or benefit is needed. This type of research should be conducted with concurrent investigations on how these substances exert their effects.

Nutrient needs of patients suffering from chronic diseases that involve constant medication. It is likely that some of the chronic diseases have specific effects upon requirements for nutrients or other substances in food. As the American population continues to live longer each year, the proportion of the population suffering from various types of chronic disease is on the increase. The special requirements of these persons need attention.

Effects of alcohol on nutritional status. Alcohol is a food as well as a drug and is consumed by a high proportion of the adult population. Alcohol abuse is a major problem in this country, affecting both performance and nutritional status at some levels of intake. Studies of the effects of alcohol on nutrition status deserve attention because of its widespread abuse.

1. Effects of alcohol intake during pregnancy on the fetus and its subsequent development. Alcoholism has been clearly linked with poor outcomes of pregnancy. The effects of more moderate alcohol use also needs to be explored since there may be serious effects on the development of the fetus. Such research can provide guidance about acceptable levels of alcohol intake during pregnancy.
2. Effects of alcohol consumption on nutritional status and nutrient utilization. Alcohol consumption is the norm rather than the exception in American life today. The nutritional effects of alcohol consumption need to be better delineated. Information amassed will help to define the physical and social consequences of various levels of alcohol consumption and provide the basis for the development of practical recommendations on the controlled use of this substance.
3. Interactions among diet, alcohol, and other addictions. Although studies on the interrelationships between alcohol consumption and nutritional status have been done, practically no such studies are available with other addictive drugs. Many addictions obviously result in dietary neglect and malnutrition, so their nutritional implications deserve attention.

Bioavailability of Nutrients in Foods

Because of the form in which they occur and the food's composition or processing, some nutrients may not, in fact, be available to the body even though they are eaten in the food. One example is certain forms of iron, but there are many others. Other nutrients present in the raw state may be altered by processing to become either more or less available. The effects on nutritional status of these factors need more careful investigation.

Analysis

Need

The prevalence of undernutrition in the United States is fortunately very much less than it was even a few generations ago. However, for some nutrients, techniques for measuring needs have not been available, and therefore we cannot yet ascertain if problems exist. In other cases, the important questions of interrelationships between nutrients and special needs for nutrients by high-risk groups within the population cannot be answered until more studies are successfully completed. The health impact of developing better knowledge of the needs of premature infants, pregnant women (particularly teenagers), and other high-risk groups may be considerable.

Current State of Knowledge

The relative potential of this area is limited in areas such as interrelationships between nutrients because basic science information is not yet adequate. For some nutrients there are also methodological or ethical limitations that make it difficult to measure needs. Fun-

damental advances in methodology are required.

Capability

The fields of nutritional pharmacology and toxicology are presently underdeveloped, and a reorientation in training of research personnel will be necessary to fill these gaps.

Cost

Payoffs in this area are most likely to result from steady research over many years. This long-term process therefore requires steady funding over many years rather than large sums for short periods of time.

Immediacy

Steady research over many years is necessary to develop this type of information.

Other Considerations

The potential for achieving multiplier effects by developing close interrelationships between research and training is high in this area, as is that for the maintenance of research potential. A mission-oriented approach is probably most suitable in these areas.

NUTRITIONAL ASPECTS OF FOOD SCIENCE AND FOOD SAFETY

Justification

Food composition, processing, and safety are related to the development of better understanding of current nutrition and food issues. First, there is the problem of discovering more about the chemical composition of both processed and unprocessed foods. Surprisingly little is known about this. For example, it is extremely difficult to obtain information on nutrients such as zinc, folic acid, and trace elements; data for other food constitu-

ents such as dietary fiber or sugar are lacking for almost all foods. Second, more needs to be known about changes in chemical composition that occur in food production and in processing and storage before food reaches the consumer. Also, what consumers do in food handling and preparation after they buy the food must be considered, since this too influences nutrient and food composition. Finally, it is important to learn more about how food composition and processing may interact. Such interactions also may affect nutrient content and food safety.

Food Composition

New and improved methods of analysis of food composition. A complete food analysis must include not only complete nutrient content but other food components of significance as well, such as fiber, additives, and toxic materials. For several substances of interest, such as various forms of fiber and types of carbohydrates, such methods (or analysis) are sorely needed.

Composition of foods currently on the market and new foods as they become available (or new varieties in the case of fruits and vegetables). The composition of many foods on the market today is not known, whether with respect to the nutrients or to other food components.

How the composition of foods may be altered through processing, handling, and holding prior to use and in institutional or home preparation. Changes in nutrients and other substances occur during food storage and processing. The changes include possible complexing with other food components, decomposition, or formation of toxic chemicals. Those that are likely to impact adversely upon health are of top priority.

New Food Processing and Handling Procedures to Maintain Nutrient Content

New methods for maximizing use of food and minimizing spoilage, waste, and other deterioration that lead to nutrient losses are needed in the entire food chain from producer through the marketing system to the ultimate consumer.

Better Methods of Assuring Food Safety

Better methods are urgently needed for assessing, monitoring, and minimizing toxicants (both natural and environmental) in foods and food systems. Since all substances are toxic at some high exposure level, such methods must distinguish between risks of very different magnitudes. Appropriate priorities are critically important. Research directed at risk reduction must concentrate first on those toxicants that are largest or more easily and significantly reduced. The development of new handling and processing techniques should emphasize maximization of

safety rather than concentrating upon minimum standards. Research in this area must:

Identify food constituents, both microbiological and chemical, that bear on food safety and ultimately on health. The isolation and identification of food constituents of possible hazard is a considerable analytical task that currently must precede effective toxicological evaluation.

Develop quick and reliable methods for assessing the toxicity of food constituents and additives. Toxins of bacterial and fungal origin pose hazards which, with the nutritional hazards, far outweigh all other food risks. Appropriate preservation and sanitation can prevent most microbiological problems. For chemical hazards, conventional toxicological approaches rely on expensive, long-term, error-prone feeding of single, identified substances to test animals. New short-term methods, or preferably a battery of such tests, may replace these for screening purposes. Before such short-term tests are employed for decisionmaking purposes, they must be rigorously validated by extensive collaborative study on a sufficient variety of substances in food and in an environment to create a background of interpretive experience. By such validated tests on crudely separated food fractions, the elaborate and expensive conventional, analytical, and toxicological methods may perhaps be largely avoided and focused only where they are most needed.

Mechanisms for the improvement and coordination of surveillance and monitoring of these various substances in the food supply must also be developed. These are discussed in the next section, "Monitoring Nutritional Status." At present, USDA and FDA each have independent surveillance systems for monitoring toxic substances in foods, and these need better coordination.

Analysis

Need

The monitoring and surveillance of the safety of the food supply and consumption patterns is presently hindered because food

composition information is not complete. The composition of a food includes all of the chemicals contained in the food. These include naturally occurring compounds as well as additives classified as nutrients, colors, flavors, texturizers, preservatives, and so on. Some substances in food that may be important to human health are indirect additives or unintentional contaminants; others are direct additives. In addition, there is a large and unquantified number of chemical-reaction products induced by processing or associated with formulation, fabrication, and cooking. Some of these constituents of food have physiological effects to a lesser or a greater extent. Their significance upon human health can be ascertained only by careful research. The economic impact of eliminating harmful substances from the food supply may be considerable. But research is also necessary in this area to assure that changes are based on facts rather than opinion, since the negative economic impact of unwarranted changes in the food supply is also considerable.

Current State of Knowledge

Basic knowledge necessary for reaping practical benefits is available for achieving the goals of learning more about food composition and the effects of processing and handling procedures upon nutrients. Better methods of assuring food safety await advances in basic knowledge. However, reorientation in focus may be helpful.

Capability

The resources are available to achieve most of the goals in this section. Methodologies for some types of food safety testing require refinement and validation and the expertise of food toxicologists.

Cost

Since laboratories equipped to perform this type of research are already available,

particularly at larger universities, major development costs can be avoided.

Immediacy

The results of this research will have immediate and long-term practical application. Some results can be expected very soon and others within 5 to 10 years. However, their ultimate practical utility is great. Among other things, they should help us to:

Evaluate the nutrient value of food consumed and develop recommendations for changes where required. Changes recommended might include new processing techniques adopted by the manufacturer, fortification, reformulation, or selection of alternative food items by consumers.

Provide means to evaluate potential changes in the nutrient supply related to introduction and use of new foods, new varieties, or formulated or fabricated foods, and to furnish the basis for factual recommendations and appropriate action when needed.

Prevent the introduction of unsafe foods resulting from interactions during processing of various components or selection of varieties with potential adverse properties.

Expand the availability of nutritionally adequate processed foods and maximize agricultural production.

Other Considerations

The potential for achieving multiplier effects by linking research and training are present if the research is carried out at institutions with graduate programs. The ability to maintain research potential will depend upon whether the settings in which the research is carried out provide for training.

MONITORING NUTRITIONAL STATUS

Justification

If the national objective of assuring the best possible nutritional status for every citizen is to be achieved, accurate, up-to-date nutritional profiles of the population and ways of measuring the impacts of various environmental changes upon this status is required. Particular attention is necessary for groups likely to be at high risk of malnutrition. Such information is also fundamental for sound policymaking for food and health programs designed to enhance nutritional status as well as for monitoring changes in the food supply.

Certain groups—such as members of the Armed Forces, patients in Federal hospitals, American Indians, and Aleuts—are the wards of the Federal Government, and thus their health is its direct responsibility. Research on better means to provide for monitoring and improving their nutritional health is also of particular importance.

Methods for Improving Integration of Food Consumption and Nutritional Status Information

Adequate methods are sorely needed for continually obtaining information on food consumption patterns and nutritional status which can be correlated. Existing systems neither are sufficiently integrated nor is their overall capacity sufficient to do this job. Data currently available from the Department of Agriculture Food Consumption Survey, the HEW Health and Nutrition Examination Survey (HANES), and the Center for Disease Control furnish useful information on the overall nutritional status of the population. But they were not planned in coordination nor designed to concentrate on high-risk groups. Subgroups within the population that are suspected to have particularly high nutritional risks are not represented in sufficient numbers, nor are data complete enough to permit detailed evaluation of their most likely problems. Thus the facts needed for launch-

ing useful interventions are not available. Neither survey is appropriate for surveillance or assessing the results of intervention programs; nor does either provide the sophisticated information on food practices, attitudes, and related habits that are necessary if more effective intervention and information programs are to be mounted. The Food and Drug Administration has recently launched yet another separate type of monitoring effort which may provide some of this type of information; this is another independent effort that is poorly linked to existing systems. Even from this brief review, the fractionation, gaps, and potential for duplication in monitoring and surveillance efforts are all too evident.

It has been suggested that there should be efforts to integrate monitoring and surveillance with local and regional systems. Local efforts would presumably be more effective in identifying problem areas and in evaluating the effects of intervention programs and thus would be useful in program development. They might utilize information from such already existing systems as market research organizations, sales of food outlets, school health examinations, hospitals, insurance companies, and unions as well as additional information which it may be necessary to collect. Research on how best to link the various levels of information into a national survey system is needed.

Evaluation of the Effect of Food and Nutrition Education Programs

Evaluation methodology for improving the effectiveness of current programs. Better methods for evaluating programs designed to improve nutritional status are urgently needed. Present food programs include school breakfast and lunch and the Supplementary Food Programs, as well as special milk programs for summer and several schemes for provision of surplus commodities to nonprofit institutions at low cost. Educating and informing the public on food and nutrition is accomplished through 12 dif-

ferent Federal agencies engaged in educational programs as well as by food labeling and food advertising efforts. Finally, the safety of the food supply is governed by regulations enforced by FDA and USDA. Research must continue on present programs with the objective of improving program efficiency and effectiveness, developing information which may be needed for mounting better programs, and integrating these with other health and educational efforts directed toward the same recipients.

It is sometimes contended that the food programs are essentially a politically palatable form of welfare with few or no advantages over direct-income supplements with respect to improvement of nutritional status. Before this hypothesis is accepted, it deserves careful testing involving large-scale experiments that include survey research on knowledge, attitudes, and practices with respect to nutrition, nutritional status, unexpected but likely effects on employment, etc., and consumer acceptance among recipients. The cost is small relative to the critical need for objective data in making decisions about such multibillion-dollar programs.

Improved monitoring of food consumption and nutrition status in Federal facilities. The Federal Government is the Nation's largest food purchaser. In federally operated facilities such as defense installations, veterans' hospitals, Public Health Service hospitals, and Government offices and installations, the Federal Government is responsible for the whole food delivery system. Such institutions provide an opportunity for applied research in how best to monitor food consumption and nutritional status. The medical facilities offer additional opportunities for research on ways to monitor nutritional status in hospitals. As yet their potential has hardly been realized.

Analysis

Need

Since these studies furnish the basic information directly necessary to estimate the

extent of problems related to nutrition and the impact achieved by intervention efforts, they are extremely important. The need for a better system of monitoring the nutritional status of Americans is great.

Current State of Knowledge

The current state of knowledge is poor regarding the nutritional status of our population, particularly that of groups which are most likely to be malnourished. There are many methodological limitations that may best be overcome by the development of better techniques for measuring nutritional status.

Capability

Technological innovations permitting more rapid data collection and analysis are necessary.

Cost

Cost for an integrated system for monitoring nutritional status would be high. It is uncertain whether it is possible to either develop or implement an ideal system. Therefore, research and field trials are needed.

Of prime concern in the area of monitoring nutritional status is the stabilization of funding. Assuring a research budget over the operating costs of the present system would encourage research on methodology and integration of survey efforts between USDA and HEW.

Other Considerations

The opportunities for maintaining research potential are high since most of the research is conducted in Government facilities. Most links with this type of research are low at present.

NUTRITION POLICY AND MANAGEMENT

Justification

Shifts in policy in the areas of economics, labor, energy, or food may result in alterations in nutritional status. Their effects are not widely appreciated, and only recently have attempts been made to measure them. The distinguishing characteristic of nutrition-policy research is its concern with nutritional effects. Food policy in the past has been based largely upon economic, political, and agricultural considerations, while health policy has been largely oriented towards curative medicine. Many changes of either a planned or unplanned nature or changes in societal institutions and systems may have profound and unforeseen effects on nutrition status. These changes include income supplements, agricultural price supports, level of employment, farm size, cost, availability of energy, and others.

Analysis

Need

The need for assessing the impacts of various policies is high and may be helpful in assessing the relative merits of existing programs.

Current State of Knowledge

Each discipline tends to believe that it holds the keys to unlocking problems in other areas; yet there is no way of validating these suppositions. There is also the dangerous tendency in policy-oriented research to equate politically expedient solutions with truth.

Capability

The problems addressed in food and nutrition policy cannot be well handled in a single

agency of the Federal Government. These are most logically attacked by joint efforts on a cross-agency basis with a number of problem-solving groups. The bottom line, however, must be a primary concern for solving nutrition-related problems or evaluating solutions on a nutritional basis, and the nutrition and food researchers should have a major input into each group.

Joint efforts involving persons from many different disciplines must be mounted, with the "mix" of such persons depending upon the problem. The underlying concern, however, must remain constant: solving nutrition-related problems or evaluating solutions with nutritional criteria in mind. Nutrition and food scientists should have major inputs in each of these groups. Since nutrition policy studies are concerned with the relationships between nutrition and such diverse factors as health, supply and demand, experts in other disciplines must be represented.

Cost

Costs for policy research should be low.

Immediacy

Some immediate benefits could be expected from interdisciplinary and interagency collaboration in discussing policy questions and in performing needed research.

Other Considerations

Since most policy decisions and research are done in settings in which training does not occur simultaneously, the potential for linking this type of research with training efforts is low. Maintenance of research potential is also likely to be poor because of the location. For these reasons, extramural research conducted at universities should be implemented.

RELATIONSHIP OF DOMESTIC AND INTERNATIONAL RESEARCH

There should be a strong relationship between human nutrition research carried out in an international context and domestic research needs in the United States. The priority research goals identified in this report can best be achieved if research is carried out internationally and domestically relative to certain areas. The conduct of research internationally has a basic relationship to the U.S. nutrition research policy. In many cases, research carried out in areas of the world outside the United States may be the best way to solve problems that have considerable domestic relevance.

For example, epidemiological investigation of certain chronic diseases states requires good information about disease incidence and food patterns of societies with lifestyles and food habits different from our own. The high incidence of extreme cases of malnutrition in some developing countries also provides an opportunity to investigate the relationships between nutritional status and functional performance of individuals in a way that could not be done in the United States. Study of the clear effects in extreme cases may make it possible to extrapolate the results to marginal nutritional states.

To be able to investigate some of the priority research areas of nutrition, the study of populations and food patterns worldwide is essential. Thus any effort to increase international research capability in the United States and abroad will have a dual reward: improved nutritional status of malnourished people and increased knowledge of human nutrient needs and health status under changing environmental conditions.

Other international research may have significance principally for problems of malnutrition in the developing world. Identifying the social, political, and economic determinants of malnutrition may be the major research that must be carried out to design intervention programs to alleviate the widespread malnutrition in certain areas of the world. The policy research that needs to be carried out may be quite specific to the political,

social, and economic situations of the countries involved.

The 1977 National Academy of Sciences report, *The World Food and Nutrition Study*, recommended four priority areas for nutrition research:

1. *Nutrition-performance relations.* This research should determine the damage caused by various levels of malnutrition and the effects of diet patterns on levels of human functioning.
2. *Role of dietary components.* This research would determine specific foods that best meet nutritional needs under differing circumstances and the effects of individual nutrient levels, as consumed, on nutritional status.
3. *Policies affecting nutrition.* This research would improve the effects of the full range of Government policies from the perspective of their effects on nutritional policies and practices.
4. *Nutrition intervention programs.* This research would improve the effects of direct intervention programs and evaluate the effectiveness of alternative programs to reach nutritional goals.

These provide opportunities to examine a wide range of intervention strategies in many parts of the world that may have relevance to solving nutrition problems in the United States. The effectiveness of agricultural policies, food fortification policies, and interventions to alleviate malnutrition in certain vulnerable population groups may be established by programs carried out in other countries.

Therefore, U.S. involvement in international nutrition research should be viewed as an integral part of the domestic research effort and not as a separate effort. The coordination of domestic and international research efforts is currently poor and reflects the current divisions of authority. Separate Federal agencies have responsibility for fund-

ing domestic and international research, with the Agency for International Development supporting the majority of international human nutrition research.

The NAS report suggests that AID should continue to play the leading role in international human nutrition research. The recommendations propose substantial increases in the scale of and improvements in the substance of the activities of AID to help establish research and development of international research centers and programs and support U.S. groups that wish to undertake food and nutrition research in the developing countries.

However, AID has suffered a serious deterioration of professional staff capability. Resources outside of AID, whether universities or others, cannot be effectively mobilized, nor can accountability be assured, unless AID develops a significant cadre of nutrition and related specialists. This need must be met if Congress implements the NAS recommendations that AID triple, from \$30 million to \$90 million by 1980, its efforts in nutrition.

AID must do much more before a specific agenda for human nutrition research activities should be funded. Several checkpoints need to be assessed before Congress makes decisions about whether to provide additional funds for international nutrition or to reallocate existing funds to this area. These are:

- Demonstration of commitment by the Agency for International Development to the development of human nutrition research. This would be accomplished by upgrading and increasing the in-house technical capability of the Agency.
- Completion of a research plan to implement the recommendations of the NAS *World Food and Nutrition Study*.
- Submission of evidence of accomplishment of the above two tasks at oversight hearings held during FY 1979.

The alternatives to coordination of international nutrition research through AID include:

1. Earmarking a percentage of U.S. money to international centers for nutrition.

This ensures that money goes to nutrition and also provides ties to production and other aspects of agricultural research. However, it removes nutrition research from the health complex which is strong in many developing countries. Since these centers are regional, the research may be too general to be useful in specific countries.

2. Developing U.S.-developing country institutional relationships. This is a proven mechanism that has worked in agricultural research and offers opportunities for the formation of consortia among a number of U.S. and developing country institutions. Title XII of the Foreign Assistance Act of 1975 declared that the United States should provide "increased and longer term support to the application of science to solving food and nutrition problems of the developing countries." This has served as the basis for land-grant and other eligible universities entering into cooperative research programs with counterparts in developing countries. Critics of this type of cooperative arrangement point out that political agents tend to undermine long-term development, that too much money is spent within the United States, and that this country does not have the capability to solve the problems of other countries.
3. Provision of funds to international organizations. The funding of nutrition research through international organizations would strengthen international cooperation, depoliticize U.S. involvement, and strengthen United Nations capabilities. However, there has been a lack of coordination within the United Nations research complex, and the type of research required for the solution of nutritional problems traversing both health and agricultural concerns has suffered. Funding of international research through international organizations also removes accountability of how priorities are set, research monitored, and money spent.

4. Provision of funds directly to developing country institutions. This mechanism puts money where the problems are, reduces U.S. overhead and administrative costs, helps to build individual national capabilities, and may increase the relevance of the research done. Such a

mechanism for research funding would have little direct U.S. payoff and would decrease the amount of technical assistance that could be offered. There is also a loss of accountability of how priorities are set, research monitored, and money spent.

DEVELOPMENT OF RESEARCH PERSONNEL

Better coordination between projections for research needs and the training of research personnel is needed. This section addresses this priority. Increased emphasis on federally funded research requires some changes in existing programs to encourage application of what is known to better human health as well as an increase in training of certain types of research scientists.

Links Between Research and Training

Research requires trained personnel. Such persons, at every level, are produced only by universities. Although this expertise can be further developed in a variety of settings by participation in actual research efforts, it is debatable whether the recent emphasis on research by contract or by private and governmental organizations has in fact been more efficient. It is likely that university-related research efforts, which also produce scientists, have been impoverished as a result. The fruits of such shortsightedness in the past are presently evident in the fields of nutrition and food science, where there is a shortage of appropriately oriented research personnel. There was a widespread perception in the 1950's and 1960's that the field was unimportant. Funding was minimal, research efforts were limited, few research personnel were trained, and positions available for them were few. These effects are still felt today because a field of effort cannot be "turned on" or "turned off" readily as problems are perceived to be more or less important. A "leadtime" of 10 to 20 years is required to produce a research effort of the magnitude that can be felt at the national level. More careful planning is needed in this area. Since

a number of fields of research that received major emphasis during the 1960's apparently produce excessive numbers of personnel, more precise methods are needed so that similar types of overflow do not develop in new fields.

Types of Personnel Available

Doctorates in nutritional sciences and related disciplines such as public health nutrition, veterinary medicine, and food science. Although the availability of training grants in the nutritional sciences has declined because of phasing out of this program at HEW, nutrition departments continue to attract graduate students. Lack of student support is a liability for attracting top-quality students who have the option of going into other biological and health research areas.

Many outstanding graduate programs already exist where a major part of the basic nutritional research of that unit is conducted by graduate students as part of their doctoral theses. Yet some changes in emphasis within these programs might be helpful. Greater stress on human diseases with a nutritional component, nutritional pharmacology, food science principles, and evaluation of nutritional status are but a few examples of the direction these changes might take in nutrition sciences training.

Public health nutrition research also needs reorientation and increased emphasis on the importance of related fields such as epidemiology, behavioral sciences, health services administration, community organization, and nutrition policy, without losing their strong basic core in nutritional sciences.

It is generally agreed that training for a research career must incorporate research experience over an extended time. These scientists can best meet the health-related nutrition research needs of the Nation by extending their training as postdoctoral trainees in a clinical or community setting, which will expose them to the nutritional problems of healthy or diseased persons.

Veterinarians are particularly well prepared to do experimental animal research, but very few receive training in nutrition or develop research capabilities. They are in a particularly favorable position to correlate clinical disease with its underlying nutritional bases, using multidisciplinary approaches involving nutritional biochemistry, toxicology, and pathology. Postdoctoral training of veterinarians in nutrition research is needed to attract these people and make them fully productive in the area.

The complex chemical nature of food requires a thorough foundation in the chemical and biological aspects of food as well as an understanding of food processing principles. Not all State universities or agricultural experiment stations and a very limited number of private universities have food science graduate programs. A small but increasing number of universities have combined food science and nutrition programs. Only a few universities have capability in food safety, toxicology, and pathology.

Training of physicians and dentists for research in clinical nutrition. The physician or dentist who is interested in a research career in clinical or experimental nutrition will profit from postdoctoral experience in a stimulating research team working with either humans or experimental animals, where he or she can become familiar with the chemical and physical methods which underlie nutritional investigations. Greater emphasis in undergraduate medical education on exposure to the facts of nutritional biochemistry and clinical nutrition in the broadest sense will help to attract physicians to the field and assure transfer of knowledge resulting from research to the patient.

The Nutrition Cluster Report of the President's Biomedical Research Panel suggested

that 25 to 40 postdoctoral fellowships per year could reduce the timelag in having an adequate supply of instructors for our medical and dental schools. To further stimulate the initiation and expansion of such training, this same report recommended that 10 to 15 faculty positions in medical schools be created with Federal funds with the stipulation that after a limited period, support would be assumed by the medical school. Such positions would be regular faculty appointments in traditional academic departments such as pediatrics, internal medicine, or surgery; the subspecialty would be clinical nutrition. Such faculty might have a double affiliation in a clinical or community medicine department and some appropriate basic science department. These recommendations would provide a means of hastening the introduction of clinical nutrition and public health nutrition into the mainstream of academic medicine.

Research is also necessary in how best to integrate food- and nutrition-related concerns into the health care system. Professionals who are experts in one area may have unsound information in other areas that are equally important in clinical and public health nutrition.

Training of dietitians and allied health personnel in nutrition research methods. Research efforts in the health sciences require the participation of health professionals in various fields. Dietitians, pharmacists, and other allied health professionals trained and experienced in research methods would be needed to complete the multidisciplinary teams of scientists engaged in clinical nutrition research.

Training of nutrition educators. Nutrition educators are persons trained in any of the fields mentioned in this section who have special expertise in the dissemination of accurate information on the sciences of nutrition to others as well as training in nutrition sciences. They often lack the specialized expertise necessary to interpret technical research articles to laymen and suffer from the failures of the scientific community to mount effective efforts aimed at information transfer. However, given appropriate information they are able to further package and shape it

in a form most appropriate to the audience in question. Their training needs include stronger preparation in basic sciences and greater attention to information transfer—more specifically, learning theory, instructional media, methodology, art, and graphics.

Associate- and bachelor-level training. As widespread nutrition and monitoring and intervention programs develop, the need for extensive numbers of persons for routine work in laboratories or in the field will become apparent. In many cases, these jobs can be done by technicians with bachelor or associate degrees. In the fields of chemistry, engineering, and medical technology, these persons have traditionally been trained through work/study programs to supplement more formal training at the educational institution. Similar programs could be developed for technicians in nutrition.

Present Estimates of Personnel Available

In an attempt to determine the current number of scientists engaged in human nutrition research and the numbers of research scientists being trained, OTA contacted five professional societies and six Government agencies. Of the professional societies, the American Public Health Association, the Institute of Food Technologists, and the American Chemical Society make no attempt to distinguish between members engaged in research versus other career orientations and therefore could not supply information on the proportion of their membership engaged in human nutrition research or training of nutrition research scientists. Membership in the American Institute of Nutrition is limited to those who have made significant contributions to the field of nutrition research. By definition, all of AIN's 1,730 members are nutrition-research scientists. This number seriously underestimates the total number of scientists in the field, since junior people are not eligible for membership and very few behavior and education researchers are included. AIN does not keep any figures on training. Of

the American Dietetic Association's 21,751 members in 1977, 764 state they are engaged in research activities. This does not indicate the degree of involvement and, of course, neglects those outside of dietetics engaged in nutrition research.

The two Government agencies that fund the largest portion of nutrition research, HEW and USDA, do maintain figures on scientist-years devoted to nutrition research and USDA also makes 5-year projections of personnel needs. At USDA* in FY 1976, 193.5 scientist-years were devoted to human nutrition research as defined by the Agency. The 5-year projection of need for nutrition research scientists at USDA is for 260.7 scientist-years, a 20-percent increase. At NIH in FY 1977, the intramural manpower figure was 70 scientist-years devoted to human nutrition research as defined by the Agency. However, in testimony before the Senate Select Committee on Nutrition and Human Needs in October 1977, Dr. Donald Fredrickson stated that "180 intramural investigators directly involved in nutrition research" were employed at NIH but that only 20 intramural investigators could be considered "classical nutritionists." In FY 1977, 20 lead scientists, those holding MD, PhD, or DVM degrees, and 50 junior scientists were conducting nutrition research at Letterman Army Institute of Research of the Department of Defense.

There is therefore a clear need to identify the number of scientists engaged in nutrition research and the numbers of those in training with a breakdown by research interest (general categories such as nutrition education, clinical nutrition, etc.) and site of research (Government facility, university, industry, private research institutes).

In order to finance preparation of those research careers to fill gaps which are obvious, the extension of expanded Federal support must be considered. Candidates for training in these areas, particularly the newer fields, will be attracted by the availability of fellowship and training grants at institutions where outstanding research is done.

*USDA scientist-years include nutrition research scientists at State Agriculture Experiment Stations.

REVIEW OF REPORTS ON HUMAN NUTRITION RESEARCH 1969-77

In preparation for this assessment, OTA reviewed numerous journal articles, Government documents, and activities. The 1969 White House Conference on Food, Nutrition, and Health was chosen as a starting point for analysis, since it marked the beginning of the growth of public and congressional interest in nutrition. Twelve reports were identified that contained specific recommendations on nutrition research priorities and on organization of the Government to improve coordination of nutrition research activities. These 12 reports were:

- 1969— *White House Conference on Food, Nutrition, and Health*
- 1974— *World Food Conference*
- 1975— Senate Select Committee on Nutrition and Human Needs, *Towards a National Nutrition Policy*
- 1975— Agricultural Research Policy Advisory Committee (ARPAC), *Statement on Agricultural Research and Development*
- 1975— Department of Health, Education, and Welfare, *Forward Plan for Health 1977-81*
- 1976— Congressional Research Service, *The Role of the Federal Government in Human Nutrition Research*
- 1976— Joint FAO/WHO Expert Committee on Nutrition, *Food and Nutrition Strategies in National Development*
- 1976— *Report of the President's Biomedical Research Panel*
- 1977— National Academy of Sciences, *World Food and Nutrition Study*
- 1977— Congressional Research Service, *The Role of the Federal Government in Nutrition Education*
- 1977— Office of Science and Technology Policy, *New Directions in Federally Supported Human Nutrition Research*
- 1978— General Accounting Office, *Federal Human Nutrition Research—Need for a Coordinated Approach to Advance our Knowledge*

Few of these deal with nutrition research exclusively. The specific objectives of the reports must be recognized. The White House Conference on Food, Nutrition, and Health did not deal specifically with nutrition research. However, selecting from specific sessions (such as Surveillance and Evaluation of the State of Nutrition of American People; Establishing Guidelines for the Nutrition of Vulnerable Groups; Adults in an Affluent Society; the Aging; the Sick; the Provision of Food as It Affects the Consumer; and Nutrition Teaching and Nutrition Education) some conclusions can be reached about recommendations on research priorities. In general, there is "something for everyone" in this report, and no attempt was made to realistically appraise the recommendations in light of the relative need for the research, the feasibility of the research, and the technical, physical, and monetary resources available.

The Senate Select Committee's *Toward a National Nutrition Policy* stressed research in areas related to the policy and organizational recommendations made in that report. Since one of the major policy recommendations was to develop and implement a national nutrition plan containing an improved system of nutritional surveillance, priority was given to the development of better, cheaper, and more reliable methods for measuring nutritional status. The main areas identified were:

- Increased understanding of nutritional requirements, especially the dietary needs of preschool children, teenagers, and the elderly.
- Better information on the effects of malnutrition on mental as well as physical development.
- Research into the impact of changing patterns of food consumption.
- Basic research on nutrient-nutrient interaction, nutrient-additive interaction, and long-term accumulation of minerals in the body, if significant progress is ever to be made on diseases associated with the aging process.

- Agricultural practice, use of processed food, and changing lifestyles.
- Food consumption habits or the long-term effects of food additives, pesticides, and other aspects of food quality and safety.
- Better methods of nutritional surveillances, especially the development of nutritional indicators that are sensitive, reliable, and inexpensive to collect and evaluate.
- Better understanding of basic metabolism.

The recommendations relating to nutrition education and nutrition education research were:

- Intensify national efforts to provide nutrition education to teachers in colleges and universities.
- Support in-service and continuing education after graduation.
- Support a series of summer institutes in nutrition and food modeled on the National Science Foundation programs of science teaching institutes.
- Utilize modern multimedia materials and techniques to instruct teachers.
- Favor resource and development training centers at select universities and colleges.
- Urge the National Science Foundation to play a more active role in exchanging information among nutrition research groups.
- Field testing of nutrient fortification proposals, intervention or novel use of nutrients on human subjects. Measurement of the impact of field tests should be a focus of national nutritional surveillance.
- Support for the training of nutrition research specialists should be stepped up.

The HEW *Forward Plan for Health 1977-81* contained a policy statement on the health

aspects of nutrition and research priorities. The emphasis was on biomedical research to increase knowledge of human nutritional requirements and to improve understanding of the individual and complementary action of the essential nutrients. Special mention was made of eight areas:

1. nutrient requirements,
2. complementary action of nutrients,
3. prevention and treatment of disease,
4. maternal and child health,
5. aging,
6. behavioral research,
7. nutritional assessment, and
8. health service delivery.

The report of the President's Biomedical Research Panel concentrated on assessing the state of the science and identifying areas of greatest promise in nutritional science. In the latter, the approach taken was to catalog the areas along the classical lines:

- Vitamins. Metabolism and mechanisms of action, genetic diseases methodology, transport of vitamins, relationship of vitamins to central nervous system function, interrelationship of vitamin nutrition and drug action, factors that modify vitamin requirements, turnover, biosynthesis, and degradation of the vitamins.
- Minerals. Trace minerals, other mineral elements.
- Lipids.
- Carbohydrates and energy-yielding nutrients.
- Protein and amino acids. Basic cell mechanisms, protein metabolism, nutritional requirements.
- Absorption.
- Nutrition-endorcine interrelationships.
- Aspects of food quality, supplements, and regulations.

The OSTP report, *New Directions in Federally Supported Human Nutrition Research*, identified four priority areas:

1. Studies of human nutrient needs. Pregnancy, infancy, the elderly, obesity,



Office of Technology Assessment

The Office of Technology Assessment (OTA) was created in 1972 as an advisory arm of Congress. OTA's basic function is to help legislative policymakers anticipate and plan for the consequences of technological changes and to examine the many ways, expected and unexpected, in which technology affects people's lives. The assessment of technology calls for exploration of the physical, biological, economic, social, and political impacts which can result from applications of scientific knowledge. OTA provides Congress with independent and timely information about the potential effects—both beneficial and harmful—of technological applications.

Requests for studies are made by chairmen of standing committees of the House of Representatives or Senate; by the Technology Assessment Board, the governing body of OTA; or by the Director of OTA in consultation with the Board.

The Technology Assessment Board is composed of six members of the House, six members of the Senate, and the OTA Director, who is a non-voting member.

OTA currently has underway studies in eight general areas—energy, food, health, materials, oceans, transportation, international trade, and policies and priorities for research and development programs.

iron deficiency, and nutrient toxicity and nutrient interactions.

2. Food sciences. Methods for food composition analysis, bioavailability of nutrients in foods as consumed, updating National Nutrient Data Bank, and expansion of Federal food composition measurement capabilities.
3. Nutrition education research. Identification of factors influencing consumer dietary practices, identification of "good" nutritional practices.
4. Monitoring diet and nutrition-related health status. Food consumption survey, clinical and laboratory methods for measuring changes in nutritional status, analysis of HANES data, and nutrition-related epidemiology studies.

The GAO report, *Federal Human Nutrition Research—Need for Coordinated Approach to Advance Our Knowledge*, identified four areas in which major gaps in nutrition knowledge exist:

1. Human nutritional requirements. Uses and limitations of current quantitative nutrition standards; pregnancy, infancy, and lactation; childhood and adolescence, women, elderly, disease and stress, drug and vitamin usage, need for long-term studies and comparative culture studies, need for studies defining functions and interactions of dietary components.
2. Food composition and nutrient biological availability. Need for more current and comprehensive food composition data, need for improved methods of determining composition and biological availability.
3. Diet, disease causation, and food safety. Diet in obesity, diet in heart disease and stroke, diet in cancer, dietary fiber in disease prevention, and need to develop improved techniques of assessing toxic hazards in foods.
4. Food consumption and nutritional status. Need for a surveillance program monitoring nutrition status, need to improve methods of nutritional assessment

and identify determinants of nutritional status, need to define the role of diet in the aging process.

Lastly, the Food and Agriculture Act of 1977 identified five nutrition research priorities for USDA. The areas were:

1. Human nutritional requirements.
2. Nutrient composition of foods and the effects of agricultural practices, handling, food processing, and cooking on the nutrients they contain.
3. Surveillance of the nutritional benefits provided to participants in the food programs administered by USDA.
4. Factors affecting food preference and habits.
5. Development of techniques and equipment to assist consumers in the home or in institutions in selecting food that supplies a nutritionally adequate diet.

The agencies have fulfilled the stipulation that within 90 days after enactment, the Secretary of Agriculture and the Secretary of Health, Education, and Welfare shall submit to Congress a proposal for a comprehensive nutrition status monitoring system.

In reviewing all the above studies, several trends can be seen. The White House Conference on Food, Nutrition, and Health emerges as a significant milestone, even though it was never designed to be a serious assessment of research needs. Probably because of the significant public participation, several areas were identified that have only now emerged as areas of high research priority. These areas are food safety, consumer information, and nutrition education research, and the emphasis on translation of research findings into applications in daily life. Those reports on domestic research needs since 1969 have all contained as areas of high-priority food composition, food consumption surveys, nutritional surveillance methodology, and nutrient requirements of specific populations (especially pregnant and nursing women and the aging). In 1975, the policy statement contained in the HEW *Forward Plan for Health* specifically emphasized the prevention and treatment of disease through nutrition. This has

since been followed through in subsequent HEW plans, as well as in the OSTP report and the GAO report. Food safety emerged as a priority research area in the White House Conference report, but not until the 1976 Report of the President's Biomedical Research Panel and subsequently in the OSTP and GAO reports was food safety seen as a nutrition research priority. More recently, NAS, OSTP, and GAO named the bioavailability of nutrients and the role of nutrition in performance as areas of high priority.

An analysis of the recommendations contained in the reviewed reports on organization to improve coordination is more difficult to do than for research priorities since the recommendations on organization and coordination have usually been vague. The White House Conference on Food, Nutrition, and Health recommended one system to administer all food and nutrition activities within the Federal Government. An Office of Nutrition

was recommended to be established within HEW to administer all food programs, develop policy, and coordinate activities. The concept of consolidating all food programs and nutrition activities into one agency was abandoned by 1975 when *Toward a National Nutrition Policy* recommended the establishment of an independent agency to formulate policy and coordinate and monitor programs; while the existing pluralism would be maintained, budget and line responsibilities would rest in the agencies with nutrition programs. This concept of a coordinating body independent of the agencies involved, but housed within the executive branch, is retained in the OSTP report. All the reports reviewed since 1975 recognize the need for better coordination of Federal nutrition research activities, while also admitting the benefits to be derived from maintaining the current division of responsibilities or some permutation thereof. They differ in the specifics of where the coordinating responsibilities should lie.

Low-Salt Medications: An Updated List To Help Pharmacists

You've been asking for a compilation of Rx and OTC products that can be recommended for use by patients on salt-restricted diets. Here it is—773 items in 35 therapeutic categories. Each meets the generally accepted "low-sodium" definition: less than 5 mg of sodium per dosage unit.

The list of low-salt medicinals appearing on these pages is the most extensive compiled anywhere in recent years. It contains 773 Rx and OTC products, and is based on information supplied by 115 pharmaceutical manufacturers queried by AMERICAN DRUGGIST.

All the products listed contain less than 5 mg of sodium per dosage unit, according to the manufacturers. Experts agree that the 5 mg figure is suitable for defining—and thereby classifying—drugs low in sodium chloride content.

For the convenience of pharmacists, the list is divided into an alphabetical section and a section by therapeutic category.

Hypertension: Salt was first linked to

high-blood pressure about 75 years ago. Today, more than 35 million Americans have the disease, and about 10 million regularly take drugs to combat it. This list—which makes no claim to all-inclusiveness—enables the pharmacist to check quickly on drugs used by patients with hypertension, cardiac conditions, or any problems requiring low-sodium intake.

Formulations of the products listed are subject to change. Some manufacturers were unable to provide a listing. One said: "Such a listing would be extremely complex, as not only must each formula be checked, but also the formula for the various ingredients. We do not have the resources to compile such a listing."

Another manufacturer faced a different problem, stating: "We do not know the sodium content of the various commercial excipients we purchase from outside manufacturers."

Still, most manufacturers have apparently become attuned to the growing demand for low-salt medications. One company's advertisements, for example, emphasize that its antacid is "low in sodium."

And the new demand is understandable. Many doctors claim that Americans consume 10-25 times more salt than they need for retaining essential bodily fluids and keeping the heart pumping strongly. Older people in particular are being warned to use less salt or none at all.



LOW-SALT LIST AT A GLANCE

A

Accurbron, Dow Chemical
Actidil Syrup, Burroughs Wellcome
Actifed-C Expectorant, Burroughs Wellcome

Actifed Syrup, Burroughs Wellcome
Adeflor Drops, Upjohn
Aldactazide, Searle
Aldactone, Searle
Aldoclor Tablets, MSD

Aldomet Tablets, MSD
Aldoril Tablets, MSD
Allbee with C Capsules, Robins
Alkeran Tablets, Burroughs Wellcome

LOW-SALT LIST AT A GLANCE (Continued)

Alkets Tablets, Upjohn
 Alphadrol Tablets, Upjohn
 Alterna Gel, Stuart
 Alupent Syrup, Boehringer Ingelheim
 Alka-2, Miles
 Akineton Tablets, Knoll
 Aminodur Dura-Tabs, Cooper
 Aminophyllin Ampuls, Searle
 Aminophyllin Tablets, Searle
 Amnestrogen, Squibb
 Anadrol, Syntex
 Anavar, Searle
 Anodynos DHC Tablets, Cooper
 Antepar Syrup, Burroughs Wellcome
 Antrocol Tablets, Capsules & Elixir, Poythress
 Aquaphyllin Syrup, Ferndale
 Aquatensen Tablets, Mallinckrodt
 Arfonad Ampules, Roche
 Arthralgen Tablets, Robins
 Arthropan Liquid, Purdue Frederick
 Ascodeen-30 Tablets, Burroughs Wellcome
 Ascorbin Acid, Squibb
 Aspirin, Squibb
 Aspirin Tablets, USP, Upjohn
 Atarax Syrup, Roerig
 Atussin, Federal
 Atussin D.M., Federal
 Avazyme Tablets, Wallace
 Axotal Tablets, Adria
 Azo-Mandelamine, Warner-Chilcott

B

Bactrim Suspension, Roche
 Banthine, Searle
 Barbidonna Elixir, Mallinckrodt
 Barbidonna Tablets, Mallinckrodt
 Belap Elixir, Lemmon
 Bellergal Tablets, Dorsey
 Bellergal-S Tablets, Dorsey
 Benemid, MSD
 Benzadrine Capsules, SKF Labs
 Berubigen Sterile Solution, Upjohn
 Brevicon, Syntex
 Brondecon Elixir, Warner-Chilcott
 Brondecon Tablets, Warner-Chilcott
 Butibel Elixir, McNeil
 Butibel Tablets, McNeil
 Butibel-Zyme Tablets, McNeil
 Buticaps, McNeil
 Butigetic Tablets, McNeil
 Butiserpazide, McNeil
 Butisol Sodium Elixir, McNeil
 Butisol Sodium Tablets, McNeil

C

Calciferol Tablets, Kremers-Urban
 Calcium, Phosphorous & Vitamin D Tablets, Squibb
 Calcium Gluconate Tablets, USP, Upjohn
 Calcium Lactate Tablets, USP, Upjohn
 Calurin Tablets, Dorsey
 Cama Inlay-Tabs, Dorsey
 Cardilate Chewable Tablets, Burroughs Wellcome
 Cardilate-P Tablets, Burroughs Wellcome
 Cardilate Tablets, Burroughs Wellcome
 Cardiografin, Squibb
 Cardioquin Tablets, Purdue Frederick
 Cardrose Tablets, Upjohn
 Castor Oil, USP, Philips Roxane
 Castor Oil (flavored), Philips Roxane
 Casyllium, Upjohn
 Cebetinic Tablets, Upjohn
 Cephalac, Merrell
 Cheracol Cough Syrup, Upjohn
 Cheracal D Family Cough Syrup, Upjohn
 Chexit Tablets, Dorsey
 Children's Tylenol Tablets, McNeil
 Children's Tylenol Drops, McNeil
 Children's Tylenol Elixir, McNeil
 Cholelyl Tablets, Warner-Chilcott
 Chlordiazephal Capsules, Rachelle

Circanol, Riker
 Cleocin HC1 Capsules, Upjohn
 Cleocin Pediatric Flavored Granules, Upjohn
 Clinoril, MSD
 Clistin Elixir, McNeil
 Clistin Tablets, McNeil
 Clistin R-A Tablets, McNeil
 Clistin-D T Tablets, McNeil
 Codeine Sulfate Tablets, Knoll
 Cod Liver Oil, Squibb
 Cod Liver Oil (mint-flavored), Squibb
 Cogentin Tablets, MSD
 Colace Capsules, Mead Johnson
 Colace Liquid, Mead Johnson
 Colace Syrup, Mead Johnson
 Col Benemid Tablets, MSD
 Colestid, Upjohn
 Colonil Liquid, Mallinckrodt
 Colonil Tablets, Mallinckrodt
 Coly-Mycin Pediatric, Warner-Chilcott
 Combid Capsules, SKF Labs
 Compazine, Capsules, SKF Labs
 Comycin Capsules, Upjohn
 Cortef Suspension, Upjohn
 Cortef Fluid Oral Suspension, Upjohn
 Cortef Tablets, Upjohn
 Cortisone Suspension, Upjohn
 Cortisone Acetate Tablets, Upjohn
 Co-Tylenol Liquid, McNeil
 Co-Tylenol Tablets, McNeil
 Covanamine Liquid, Mallinckrodt
 Covanamine Tablets, Mallinckrodt
 Covagesic Tablets, Mallinckrodt
 Crysticillin 300 AS, Squibb
 Crysticillin 600 AS, Squibb
 Cuprimine Capsules, MSD
 Cyclogesterin Tablets, Upjohn
 Cytomel Tablets, SKF Labs

D

Dainite Tablets, Mallinckrodt
 Dainite-KI Tablets, Mallinckrodt
 Daranide Tablets, MSD
 Daraprim Tablets, Burroughs Wellcome
 Deaner, Riker
 Deapril-ST Tablets, Mead Johnson
 Decadron Tablets, MSD
 Deconamine Elixir, Cooper
 Deconamine Tablets, Cooper
 Deladumone, Squibb
 Deladumone OB, Squibb
 Delalutin, Squibb
 Delatestryl, Squibb
 Delestrogen, Squibb
 Delta-Cortef Tablets, Upjohn
 Deltasone Tablets, Upjohn
 Demulen, Searle
 Depo-Medrol Suspension, Upjohn
 Depo-Provera Suspension, Upjohn
 Deprol Tablets, Wallace
 Dexamyil Spansule Capsules, SKF
 Dexedrine Elixir, SKF
 Dexedrine Spansule Capsules, SKF
 Diafen, Riker
 Dialume Capsules, Armour
 Dibenzylamine Capsules, SKF
 Dico did Tablets, Knoll
 Didrex Tablets, Upjohn
 Dilaudid Cough Syrup, Knoll
 Dilaudid Tablets, Knoll
 Dilor Elixir, Savage
 Dilor-G Liquid, Savage
 Dimacol Capsules, Robins
 Dimacol Liquid, Robins
 Dimetane Elixir, Robins
 Dimetane Expectorant, Robins
 Dimetane Expectorant-DC, Robins
 Dimetane Tablets, Robins
 Dimetapp Elixir, Robins
 Dimetapp Extentabs, Robins
 Diostate D Tablets, Upjohn
 Disalcid, Riker
 Disipal, Riker

Diulo, Searle
 Diupres Tablets, MSD
 Diuril Tablets, MSD
 Diutensen Tablets, Mallinckrodt
 Diutensen-R Tablets, Mallinckrodt
 Dolonil Tablets, Warner-Chilcott
 Donnatal Capsules, Robins
 Donnatal Elixir, Robins
 Donnatal Extentabs, Robins
 Donnatal Tablets, Robins
 Donnatal No. 2 Tablets, Robins
 Donnazyme Tablets, Robins
 Dorbane, Riker
 Dorcol Syrup, Dorsey
 Doxidan Capsules, Hoechst-Roussel
 Doxychel Capsules, Rachelle
 Dramamine Liquid, Ampuls, and Suppositories, Searle
 Drinus Syrup, Federal
 Duadacin, Hoechst-Roussel
 Duohaler, Riker
 Duo Medihaler, Riker
 Duovent, Riker
 Duricef, Mead Johnson
 Dyazide Capsules, SKF
 Dyrenium Capsules, SKF

E

Edecrin Tablets, MSD
 Efudex Topical Solutions 2% & 5%, Roche
 Elavil Tablets, MSD
 Elixir Propadrine, MSD
 Elixicon Suspension, Cooper
 Elixophyllin Elixir, Cooper
 Elixophyllin KI Elixir, Cooper
 Elixophyllin Soft Gelatin Capsules, Cooper
 Elixophyllin S.R. Capsules, Cooper
 Empirin Compound c/Codeine Tablets, Burroughs Wellcome
 Empirin Compound Tablets, Burroughs Wellcome
 Emprazol Tablets, Burroughs Wellcome
 Emprazol-C Tablets, Burroughs Wellcome
 E-Mycin Tablets, Upjohn
 Enuretrol Tablets, Cooper
 Ephed Organidin, Wallace
 Ephed-Organidin Elixir, Wallace
 Epsilan-M Capsules, Adria
 Eskatrol Spansule Capsules, SKF
 Estomul-M, Riker
 Estrace, Mead Johnson
 Euthroid, Warner-Chilcott
 Evex, Syntex
 Exna-R Tablets, Robins
 Exna Tablets, Robins
 Extra-Strength Tylenol Adult Liquid, McNeil
 Extra-Strength Tylenol Capsules, McNeil
 Extra-Strength Tylenol Tablets, McNeil

F

Federazil Tablets, Burroughs Wellcome
 Feminone Tablets, Upjohn
 Feosol Elixir, SKF
 Feosol Plus Capsules, SKF
 Feosol Spansule Capsules, SKF
 Fer-In-Sol Capsules, Mead Johnson
 Fer-In-Sol Drops, Mead Johnson
 Fer-In-Sol Syrup, Mead Johnson
 Ferritricin Tablets, Upjohn
 Ferronord Tablets, Cooper
 Ferrous Sulfate Tablets, USP, Upjohn
 Flagyl Tablets, Searle
 Florinef Tablets, Squibb
 Fortespan Spansule Capsules, SKF

G

Gantrisin Ampules, Roche
 Gantrisin Pediatric Suspension, Roche
 Gantrisin Syrup, Roche
 Gantanol Suspension, Roche
 Gastroenterase, Wallace
 Gelfoam Powder (nonsterile), Upjohn
 Geltabs Vitamin D Capsules, Upjohn

LOW-SALT LIST AT A GLANCE (Continued)

Gelusil Liquid, Warner-Chilcott
 Gelusil Tablets, Warner-Chilcott
 Gelusil II Liquid, Warner-Chilcott
 Gelusil II Tablets, Warner-Chilcott
 Gentlax Granules, Purdue Frederick
 Gerizyme, Upjohn
 G.G.I. Expectorant, Federal
 Glysenid Tablets, Dorsey
 Golden Bounty Multivitamins c/Iron,
 Squibb
 Grifulvin V Suspension, McNeil
 Grifulvin V Tablets, McNeil
 Gris-PEG Tablets, Dorsey
 Gynorest, Mead Johnson

H

Haldol Concentrate, McNeil
 Haldol Tablets, McNeil
 Halodrin Tablets, Upjohn
 Halotestin Tablets, Upjohn
 Hispril Spansul Capsules, SKF
 Hista-Vadrin Syrup, First Texas
 Hycomine, Endo
 Hycomine Pediatric, Endo
 Hycotuss Expectorant, Endo
 Hydreltra TBA Suspension, MSD
 Hydriotic Acid Cough Syrup, Upjohn
 Hydrocortisone Powder, MSD
 Hydrocortone Tablets, MSD
 HydroDiuril Tablets, MSD
 Hydrogenated Ergot Alkaloids, Riker
 Hydrolase Syrup, Upjohn
 Hydrepres Tablets, MSD
 Hyptran, Wallace

I

Ilopan-Choline Tablets, Adria
 Imavate Tablets, Robins
 Imuran Tablets, Burroughs Wellcome
 Indocin Capsules, MSD
 Infantol Pink Liquid, First Texas
 Infantol White Liquid, First Texas
 Inversine Tablets, MSD
¹³¹I-19-Iodocholesterol, Searle
 Iron c/Vitamin C Tablets, Squibb
 Isoclor Liquid, Arnar-Stone
 Isoclor Tablet, Arnar-Stone
 Isoclor Timesule Capsule, Arnar-Stone

K

Kanokion Ampules, Roche
 Kanulase Tablets, Dorsey
 Kaochlor-Eff Tablets, Adria
 Kaochlor 10% Liquid, Adria
 Kaochlor S-F 10% Liquid, Adria
 Kaon Elixir (grape), Adria
 Kaon Elixir (lemon-lime), Adria
 Kaon-C1 20% Liquid, Adria
 Kaon-C1 Tablets, Adria
 Kaon Tablets, Adria
 Kaopectate, Upjohn
 Kaopectate Concentrate, Upjohn
 Kay Ciel Elixir, Cooper
 Kay Ciel Packette, Cooper
 Kemadrine Tablets, Burroughs Wellcome
 Kenacort Tablets, Squibb
 Ketochol Tablets, Searle
 KI-N Tablets, Mallinckrodt
 Klorvess Effervescent Tablets, Dorsey
 Klorvess Granules, Dorsey
 Klorvess 10% Liquid, Dorsey
 K-Lyte, Mead Johnson
 Kondremul, Fisons
 Kondremul c/Cascara, Fisons
 Kondremul c/Phenolphthalein, Fisons
 Krem Tablets (mint & cherry),
 Mallinckrodt
 Kutrased Capsules, Kremers-Urban
 Ku-Zyme Capsules, Kremers-Urban
 Ku-Zyme HP Capsules, Kremers-Urban

L

Lanoxine Elixir, Burroughs Wellcome
 Lanoxin Tablets, Burroughs Wellcome
 Larotid Suspension, Roche

Lasix Tablets, Hoechst-Roussel
 Laud Iron Suspension, Federal
 Leritine Tablets, MSD
 Lev Keran Tablets, Burroughs Wellcome
 Levo Dromoran Ampules & Vial, Roche
 Levsin Drops, Kremers-Urban
 Levsin PB Drops, Kremers-Urban
 Levsin Elixir, Kremers-Urban
 Levsin Forte Tablets, Kremers-Urban
 Levsin c/Phenobarbital Elixir,
 Kremers-Urban
 Levsin Tablets, Kremers-Urban
 Levsin c/Phenobarbital Tablets,
 Kremers-Urban
 Lincocin Capsules, Upjohn
 Lincocin Pediatric Capsules,
 Upjohn

Lipo Gantrisin, Roche
 Lipomul Oral, Upjohn
 Lincocin Syrup, Upjohn
 Lipotriad Liquid, Cooper
 Lixaminol-AT Elixir, Ferndale
 Lixaminol Elixir, Ferndale
 Lomotil Liquid & Tablets, Searle
 Lofan Ampules & Vial, Roche
 Loryl Capsules, Kremers-Urban
 Luftodil Tablets, Mallinckrodt
 Lufyllin Elixir, Mallinckrodt
 Lufyllin Tablets, Mallinckrodt
 Lufyllin-400 Tablets, Mallinckrodt
 Lufyllin-EPG Tablets, Mallinckrodt
 Lufyllin-GG Elixir, Mallinckrodt
 Lufyllin-GG Tablets, Mallinckrodt
 Luride Drops, Hoyt
 Luride Tablets, Hoyt
 Lydia Pinkham Tablets, Cooper
 Lyovac Cosmegen, MSD

M

Maalox Therapeutic Concentrate, Rorer
 Magan Tablets, Adria
 Maltsupex Powder/Liquid/Tablets,
 Wallace
 Mandelamine Granules, Warner-Chilcott
 Mandelamine Suspension, Warner-Chilcott
 Mandelamine Suspension Forte,
 Warner-Chilcott
 Mandelamine Tablets, Warner-Chilcott
 Maolate Tablets, Upjohn
 Marax Syrup, Roerig
 Marezin Tablets, Burroughs Wellcome
 Matropinal Elixir, Comatic
 Matropinal Forte Inserts, Comatic
 Matropinal Forte Tablets, Comatic
 Matropinal Inserts, Comatic
 Matropinal Tablets, Comatic
 Medihaler Epi, Riker
 Medihaler Ergotamine, Riker
 Medihaler Iso, Riker
 Medrol Tablets, Upjohn
 Megace, Mead Johnson
 Menrium Tablets, Roche
 Mephyton Tablets, MSD
 Meprospan Tablets, Wallace
 Meprospan Tablets, Wallace
 Mestinson Ampules, Roche
 Mestinson Syrup, Roche
 Metaprel Syrup, Dorsey
 Metaprel Tablets, Dorsey
 Metrazol Tablets, Knoll
 Migral Tablets, Burroughs Wellcome
 Milkinol Liquid, Kremers-Urban
 Milk of Magnesia, USP, Philips Roxane,
 Squibb
 Milk of Magnesia-Mineral Oil Emulsion
 (plain), Philips Roxane
 Milk of Magnesia Tablets, Squibb
 Milpath Tablets, Wallace
 Milprem Tablets, Wallace
 Miltown Tablets, Wallace
 Miltate Tablets, Wallace
 Mineral Oil, USP, Philips Roxane
 Mintezol Chewable Tablets, MSD
 Mintezol Suspension, MSD
 Modane Mild Tablets, Adria

Modane Tablets, Adria
 Motrin Tablets, Upjohn
 MSC Triaminic Tablets, Dorsey
 Mundrane GG Elixir, Poythress
 Mychel Capsules, Rachelle
 Mycifradin Sulfate Oral Solution, Upjohn
 Mycifradin Sulfate Tablets, Upjohn
 Mycostatin Oral Suspension, Squibb
 Mycostatin Oral Tablets, Squibb
 Mycostatin Vaginal Tablets, Squibb
 Mylanta, Stuart
 Mylanta Liquid, Stuart
 Mysterlin F Capsules, Squibb
 Mysterlin F Syrup, Squibb

N

Naprosyn, Syntex
 Nardil Tablets, Warner-Chilcott
 Naturetin Tablets, Squibb
 Navane Oral Concentrate, Roerig
 Nebralin Tablets, Dorsey
 Neo-Calglucon Syrup, Dorsey
 Neomycin, Squibb
 Neomycin Sulfate Sterile Powder, Squibb
 Neothyllyne Elixir, Lemmon
 Neothyllyne-G Elixir, Lemmon
 Neo-Vadrin Cough Syrup, First Texas
 Nervine Tablets, Miles
 Neutralox, Lemmon
 Niacin Tablets, Squibb
 Nico-Metrazol Tablets, Knoll
 Nilcol Tablets, Warner-Chilcott
 (discontinued)
 Nisentil Ampules, Roche
 Noctec Capsules, Squibb
 Norflex Tablets, Riker
 Norgesic, Riker
 Norgesic Forte, Riker
 Norinyl Tablets, Syntex
 Norpace Capsules, Searle
 Nor-Q.D., Syntex
 Novahistine Elixir, Dow
 Nydrizid Syrup, Squibb
 Nydrizid Tablets, Squibb

O

Obotan Tablets, Mallinckrodt
 Obotan-Forte Tablets, Mallinckrodt
 One-A-Day Vitamins, Miles
 One-A-Day Vitamins plus Iron, Miles
 One-A-Day Vitamins plus Minerals, Miles
 Oraphen-PD Syrup, Comatic
 Ora-Testryl Tablets, Squibb
 Organidin Elixir, Wallace
 Organidin Solution, Wallace
 Organidin Tablets, Wallace
 Orinase Tablets, Upjohn
 Ornade Spansule Capsules, SKF
 Ortho-Novum Tablets, Ortho
 Orthoxine Hydrochloride Syrup, Upjohn
 Orthoxine Hydrochloride Tablets, Upjohn
 Orthoxine and Aminophylline Capsules,
 Upjohn
 Ovcon-34 Tablets, Mead Johnson
 Ovcon-50 Tablets, Mead Johnson
 Ovulen, Searle

P

Pabirin Buffered Tablets, Dorsey
 P-A-C Compound Capsules, Upjohn
 P-A-C Compound Tablets, Upjohn
 P-A-C Compound c/Codeine Sulfate
 Capsules, Upjohn
 P-A-C Compound c/Codeine Sulfate
 Tablets, Upjohn
 Pan-Kloride Elixir, Panray
 Pamine Tablets, Upjohn
 Pamine PB Tablets, Upjohn
 Panmycin Tablets, Upjohn
 Panmycin Hydrochloride Capsules, Upjohn
 Pantopon Ampules
 Papase Tablets, Warner-Chilcott
 Paraflex Tablets, McNeil
 Parafon Forte Tablets, McNeil
 Paregoric USP, Philips Roxane

LOW-SALT LIST AT A GLANCE (Continued)

Parsidol Tablets, Warner-Chilcott
 Pecto Kaolin, Lemmon
 Pedicran Liquid, First Texas
 Pedicran c/Iron Liquid, First Texas
 Pensyn Capsules, Upjohn
 Pensyn Oral Powder, Upjohn
 Pentids Tablets, Squibb
 Periactin Tablets, MSD
 Peritrate c/Nitroglycerin Tablets,
 Warner-Chilcott
 Peritrate SA, Warner-Chilcott
 Peritrate SA c/Phenobarbital,
 Warner-Chilcott
 Peritrate Tablets, Warner-Chilcott
 Peritrate Tablets c/Phenobarbital,
 Warner-Chilcott
 Phenaphen Capsules, Robins
 Phenaphen c/Codeine No. 2 Capsules,
 Robins
 Phenaphen c/Codeine No. 3 Capsules,
 Robins
 Phenaphen c/Codeine No. 4 Capsules,
 Robins
 Phenobarbital, USP, Elixir, Upjohn
 Phenobarbital & Belladonna Tablets,
 Upjohn
 Phenolax Wafers, Upjohn
 Poly-Vi-Flor Drops, Mead Johnson
 Poly-Vi-Flor 0.25 Drops, Mead Johnson
 Poly-Vi-Flor c/Iron Drops, Mead Johnson
 Poly-Vi-Sol Circus Shape Tablets, Mead
 Johnson
 Poly-Vi-Sol Drops, Mead Johnson
 Poly-Vi-Sol c/Iron Drops, Mead Johnson
 Poly-Vi-Sol c/Iron Circus Shape Tablets,
 Mead Johnson
 Poly-Vi-Sol c/Iron Tablets, Mead Johnson
 Poly-Vi-Sol Tablets, Mead Johnson
 Poly-Vi-Sol Teaspoon, Mead Johnson
 Pondimin Tablets, Robins
 Potassium Chloride Oral Solution, USP,
 5%, Philips Roxane
 Pre-Sak Tablets, Warner-Chilcott
 Principen Capsules, Squibb
 Principen c/Probenecid Capsules, Squibb
 Pro-Banthine P.A. Tablets, Searle
 Pro-Banthine c/Phenobarbital Tablets,
 Searle
 Pro-Banthine Tablets, Searle
 Pro-Banthine Vials, Searle
 Prolixin Elixir, Squibb
 Prolixin Tablets, Squibb
 Proloid Tablets, Warner-Chilcott
 Pronestyl Capsules, Squibb
 Pronestyl Tablets, Squibb
 Propdrine Capsules, MSD
 Prostigmin Ampules & Vials, Roche
 Provera Tablets, Upjohn
 Purinethol Tablets, Burroughs Wellcome
 Pyridium Tablets, Warner-Chilcott
 Pyrroxate, Upjohn
 Pyrroxate c/Codeine Phosphate Capsules,
 Upjohn

Q

Quadrinal Tablets, Knoll
 Questran Powder, Mead Johnson
 Quibron Capsules, Mead Johnson
 Quibron-300 Capsules, Mead Johnson
 Quibron-Plus Capsules, Mead Johnson
 Quinaglate Dura-Tabs, Cooper
 Quinidex Extentabs, Robins

R

Raudixin Tablets, Squibb
 Rau-Sed, Squibb
 Rautensin Tablets, Dorsey
 Rautrax-N Modified Tablets, Squibb
 Rautrax-N Tablets, Squibb
 Rautrax Tablets, Squibb
 Rauwiloid, Riker
 Rauzide, Squibb
 Reno-M-30, Squibb
 Reno-M-60, Squibb
 Reno-M-DIP, Squibb

Repoise Tablets, Robins
 Reserpoid Tablets, Upjohn
 Rhinex DM, Lemmon
 Rhinosyn-DM Syrup, Comatic
 Rhinosyn-PD Syrup, Comatic
 Rhinosyn Syrup, Comatic
 Rhinosyn-X Syrup, Comatic
 Riopan Chewable Tablets, Ayerst
 Riopan Plus Chewable Tablets, Ayerst
 Riopan Plus Suspension, Ayerst
 Riopan Plus Swallow Tablets, Ayerst
 Riopan Suspension, Ayerst
 Riopan Swallow Tablets, Ayerst
 Robalate Tablets, Robins
 Robamox Capsules, Robins
 Robaxin Tablets, Robins
 Robaxin-750 Tablets, Robins
 Robaxisal Tablets, Robins
 Robicillin-VK Tablets, Robins
 Robinul Forte Tablets, Robins
 Robinul-PH Forte Tablets, Robins
 Robinul-PH Tablets, Robins
 Robinul Tablets, Robins
 Robitet Capsules, Robins
 Robitussin A-C Liquid, Robins
 Robitussin-CF Liquid, Robins
 Robitussin-DAC Liquid, Robins
 Robitussin Liquid, Robins
 Robitussin-PE Liquid, Robins
 Rendomycin 150/300 Capsules, Wallace
 Rendomycin Syrup, Wallace
 Rubramin PC, Squibb
 Ryna-C Liquid, Mallinckrodt
 Ryna-CX Liquid, Mallinckrodt
 Ryna Liquid, Mallinckrodt
 Rynatan Pediatric Suspension,
 Mallinckrodt
 Rynatan Tablets, Mallinckrodt
 Rynatuss:Tablets, Mallinckrodt
 Rynatussadin Expectorant Liquid,
 Mallinckrodt
 Rynatussadin Expectorant Tablets,
 Mallinckrodt

S

Salimeph Forte Tablets, Kremers-Urban
 Secran Fe Liquid, First Texas
 Secran Liquid, First Texas
 Sedamyl, Riker
 Senokap DSS Capsules, Purdue Frederick
 Senokot Granules, Purdue Frederick
 Senokot Syrup, Purdue Frederick
 Senokot S Tablets, Purdue Frederick
 Senokot Tablets, Purdue Frederick
 Septra D.S. Tablets, Burroughs Wellcome
 Septra Suspension, Burroughs Wellcome
 Septra Tablets, Burroughs Wellcome
 Serenium Tablets, Squibb
 Serentil Concentrate, Boehringer Ingelheim
 Sidonna, Reed & Carnick
 Silain-Gel Liquid, Robins
 Silain Tablets, Robins
 Sine-Aid Tablets, McNeil
 Sinemet Tablets, MSD
 Sinografin, Squibb
 Sinubid Tablets, Warner-Chilcott
 Sinutab c/Codeine Tablets,
 Warner-Chilcott
 Sinutab Extra Strength Tablets,
 Warner-Chilcott
 Sinutab Tablets, Warner-Chilcott
 Sinutab II Tablets, Warner-Chilcott
 Skelaxin Tablets, Robins
 SK-Ampicillin Capsules, SKF
 SK-Ampicillin Chewable Tablets, SKF
 SK-Ampicillin for Oral Suspension, SKF
 SK-Ampicillin Pediatric Drops, SKF
 SK-APAP Elixir, SKF
 SK-Penicillin VK Tablets, SKF
 SK-Tetracycline Capsules, SKF
 Solfoton Tablets & Capsules, Poythress
 Solu-B, Upjohn
 Soma Compound c/Codeine Tablets,
 Wallace
 Soma Compound Tablets, Wallace

Soma 350 Tablets, Wallace
 Sombulex, Riker
 Somophyllin Oral Liquid, Fisons
 Sonilyn Tablets, Mallinckrodt
 Sopor Tablets, Arnar-Stone
 Spec-T Antibacterial Troches, Squibb
 Spec-T Cough Suppressant Troches,
 Squibb
 Spec-T Decongestant Troches, Squibb
 Stelazine Concentrate, SKF
 Sudafed Syrup, Burroughs Wellcome
 Sudafed Tablets, Burroughs Wellcome
 Sugracillin Flavored Granules, Upjohn
 Sulfathalide Tablets, MSD
 Sulla Tablets, Robins
 Sultrin Tablets, Ortho
 Sumycin Capsules, Squibb
 Sumycin Tablets, Squibb
 Super D Cod Liver Oil, Upjohn
 Super D Perles, Upjohn
 Surfak Capsules, Hoechst-Roussel
 Suspension Divril, MSD
 Syllact Powder, Wallace
 Syllamalt Effervescent Powder, Wallace
 Syllamalt Powder, Wallace
 Symmetrel, Endo
 Synkayvite Ampules, Roche
 Synkayvite Tablets, Roche
 Syrup Periactin, MSD

T

Tagamet Ampules, SKF
 Tagamet Tablets, SKF
 TAO Oral Suspension, Roerig
 Taractan Concentrate Suspension, Roche
 Tavist Tablets, Dorsey
 Tedral Elixir, Warner-Chilcott
 Tedral Expectorant Tablets,
 Warner-Chilcott
 Tedral (Pediatric) Suspension,
 Warner-Chilcott
 Tedral SA Tablets, Warner-Chilcott
 Tedral Tablets, Warner-Chilcott
 Tedral-25 Tablets, Warner-Chilcott
 Tedral Anti-H Tablets, Warner-Chilcott
 Teldrin Spansule Capsules, SKF
 Temaril Spansule Capsules, SKF
 Temaril Syrup, SKF
 Tempra Drops, Mead Johnson
 Tempra Syrup, Mead Johnson
 Tensillin Ampules & Vials, Roche
 Tepanil, Riker
 Tepanil Ten-Tab, Riker
 Terfonyl Tablets, Squibb
 Tetrachel Capsules, Rachelle
 Theolair, Riker
 Theolair Liquid, Riker
 Theolair-SR, Riker
 Theo-Organidin Elixir, Wallace
 Theophyl Chewable Tablets, Knoll
 Theophyl 225 Elixir & Tablets, Knoll
 Theophyl SR Capsules, Knoll
 Theophylline Elixir, Philips Roxane
 Therapau Capsules, Cooper
 Thiamine HC1 Tablets, Squibb
 Thorazine Concentrate, SKF
 Thorazine Spansule Capsules, SKF
 Thorazine Syrup, SKF
 Toleron Suspension, Mallinckrodt
 Toleron Tablets, Mallinckrodt
 Tolinase Tablets, Upjohn
 Tolu-Sed Cough Syrup, First Texas
 Tolu-Sed DM Cough Syrup, First Texas
 Trest Tablets, Dorsey
 Triaminic Expectorant, Dorsey
 Triaminic Expectorant DH, Dorsey
 Triaminic Expectorant c/Codeine, Dorsey
 Triaminic Juvellets, Dorsey
 Triaminic Oral Infant Drops, Dorsey
 Triaminic Syrup, Dorsey
 Triaminic Tablets, Dorsey
 Triaminicin Allergy Tablets, Dorsey
 Triaminicin Chewables, Dorsey
 Triaminicin Tablets, Dorsey
 Triaminicol Syrup, Dorsey

LOW-SALT LIST AT A GLANCE (Continued)

Triavil Tablets, MSD
 Trigesic Tablets, Squibb
 Trilisate Tablets, Purdue Frederick
 Trind Syrup, Mead Johnson
 Tri-Vi-Sol c/Iron Drops, Mead Johnson
 Tri-Vi-Sol Tablets, Mead Johnson
 Trocinate Tablets, Poythress
 Trophite Liquid, SKF
 Troph-Iron Liquid, SKF
 Tussagesic Suspension, Dorsey
 Tussagesic Tablets, Dorsey
 Tussaminic Tablets, Dorsey
 Tussi-Organidin DM Elixir, Wallace
 Tussi-Organidin Elixir, Wallace
 Tuss-Ornade Spansule Capsules, SKF
 Tybatran Capsules, Robins
 Tylenol c/Codeine Elixir, McNeil
 Tylenol c/Codeine Tablets, McNeil
 Tylenol Tablets, McNeil
 Tylox Capsules, McNeil

U

Ulo, Riker
 Unitensen Tablets, Mallinckrodt
 Upjohn Vitamin C Tablets, Upjohn

Upjohn Vitamin E Capsules, Upjohn
 Uracil Mustard Capsules, NF, Upjohn
 Urecholine Chloride Tablets, MSD
 Ursinus Inlay-Tabs, Dorsey
 Utibid Tablets, Warner-Chilcott
 Uticillin VK Tablets, Upjohn

V

Valadol Chewable Tablets, Squibb
 Valadol Tablets, Squibb
 Vasodilan, Mead Johnson
 Veetids Tablets, Squibb
 Velosef 125 & 500 for Oral Suspension, Squibb
 Velosef Capsules, Squibb
 Verequad Tablets, Knoll
 Veriloid, Riker
 Verstran 10 mg Tablets, Warner-Chilcott
 Vesprin High Potency Suspension, Squibb
 Vesprin Tablets, Squibb
 Vicodin Tablets, Knoll
 Vigran Capsules, Squibb
 Vigran c/Iron Tablets, Squibb
 Vigran Chewable Tablets, Squibb
 Vi-Penta Multi-vitamin Drops, Roche

Vita-Metrazol Tablets, Knoll
 Vitamin E IU Tablets, Squibb
 Vitamin E Capsules, Squibb
 Vitamin B₁₂ Capsules, Squibb
 Vitamin B₁ Tablets, Squibb
 Vitamin A Capsules, Squibb
 Vivactil Tablets, MSD

W

Wellcome Thioguanine Tablets, Burroughs
 Wellcome

X

X-Prep Liquid, Purdue Frederick
 X-Prep Powder, Purdue Frederick

Y

Yeast Grain Tablets, Squibb
 Yeast Tablets, Squibb
 Yeast Tablets, Mead Johnson

Z

Zyloprim Tablets, Burroughs Wellcome
 Zymacap Capsules, Upjohn
 Zymalixir, Upjohn

LOW-SALT DRUGS BY THERAPEUTIC CATEGORY

Ammonia Detoxicant

Cephulac, Merrell

Analgesics/Antipyretics

Anodynos DHC Tablets, Cooper
 Arthralgen Tablets, Robins
 Arthropan Liquid, Purdue Frederick
 Ascdeen-30 Tablets, Burroughs
 Wellcome
 Aspirin, Squibb
 Aspirin Tablets, USP, Upjohn
 Axotal Tablets, Adria
 Butigetic Tablets, McNeil
 Calurin Tablets, Dorsey
 Cama Inlay-Tabs, Dorsey
 Children's Tylenol Drops, McNeil
 Children's Tylenol Elixir, McNeil
 Children's Tylenol Tablets, McNeil
 Clinoril, MSD
 Codeine Sulfate Tablets, Knoll
 Co-Tylenol Liquid, McNeil
 Co-Tylenol Tablets, McNeil
 Covangesic Tablets, Mallinckrodt
 Dilaudid Cough Syrup, Knoll
 Dilaudid Tablets, Knoll
 Disalcid, Riker
 Empirin Compound c/Codeine Tablets, Burroughs Wellcome
 Empirin Compound Tablets, Burroughs Wellcome
 Empirazil Tablets, Burroughs Wellcome
 Empirazil-C Tablets, Burroughs Wellcome
 Extra-Strength Tylenol Adult Liquid, McNeil
 Extra-Strength Tylenol Capsules, McNeil
 Extra-Strength Tylenol Tablets, McNeil
 Indocin Capsules, MSD
 Leritine Tablets, MSD
 Levo Dromoran Ampules & Vial, Roche
 Magan Tablets, Adria
 Meprospan Tablets, Wallace
 Mepro tabs Tablets, Wallace
 Motrin Tablets, Upjohn
 Naprosyn, Syntex
 Nisentil Ampules, Roche
 Oraphen-PD Syrup, Comatic
 Pabirin Buffered Tablets, Dorsey
 P-A-C Compound Capsules, Upjohn

P-A-C Compound c/Codeine Sulfate Capsules, Upjohn
 P-A-C Compound Tablets, Upjohn
 Pantopon Ampules, Roche
 Phenaphen Capsules, Robins
 Phenaphen c/Codeine No. 2 Capsules, Robins
 Phenaphen c/Codeine No. 3 Capsules, Robins
 Phenaphen c/Codeine No. 4 Capsules, Robins
 Phenaphen Tablets, Robins
 Rhinex DM, Lemmon
 Salimeph Forte Tablets, Kremers-Urban
 Sine-Aid Tablets, McNeil
 Sinubid Tablets, Warner-Chilcott
 Sinutab c/Codeine Tablets, Warner-Chilcott
 Sinutab Extra Strength Tablets, Warner-Chilcott
 Sinutab Tablets, Warner-Chilcott
 Sinutab II Tablets, Warner-Chilcott
 SK-APAP Elixir, SKF
 Soma Compound c/Codeine Tablets, Wallace
 Soma Compound Tablets, Wallace
 Soma 350 Tablets, Wallace
 Tempra Drops, Mead Johnson
 Tempra Syrup, Mead Johnson
 Trigesic Tablets, Squibb
 Trilisate Tablets, Purdue Frederick
 Tylenol c/Codeine Elixir, McNeil
 Tylenol c/Codeine Tablets, McNeil
 Tylenol Tablets, McNeil
 Tylox Capsules, McNeil
 Unigesic-A Tablets, Upjohn
 Valadol Chewable Tablets, Squibb
 Valadol Tablets, Squibb

Antacids

Alka-2, Miles
 Alkets Tablets, Upjohn
 AlternaGel, Stuart
 Dialume Capsules, Armour
 Gelusil Liquid, Warner-Chilcott
 Gelusil Tablets, Warner-Chilcott
 Gelusil II Liquid, Warner-Chilcott
 Gelusil II Tablets, Warner-Chilcott
 Krem Tablets (mint & cherry), Mallinckrodt

Maalox Therapeutic Concentrate, Rorer
 Mylanta, Stuart
 Mylanta Liquid, Stuart
 Neutralox, Lemmon
 Riopan Chewable Tablets, Ayerst
 Riopan Plus Chewable Tablets, Ayerst
 Riopan Plus Suspension, Ayerst
 Riopan Plus Swallow Tablets, Ayerst
 Riopan Suspension, Ayerst
 Riopan Swallow Tablets, Ayerst
 Robalate Tablets, Robins

Anti-Cholinergics

Akineton Tablets, Knoll
 Antrocol Tablets, Capsules & Elixir, Poythress
 Banthine, Searle
 Barbidonna Elixir, Mallinckrodt
 Barbidonna Tablets, Mallinckrodt
 Belap Elixir, Lemmon
 Bellergal Tablets, Dorsey
 Bellergal-S Tablets, Dorsey
 Butibel Elixir, McNeil
 Butibel Tablets, McNeil
 Butibel-Zyme Tablets, McNeil
 Cogentin Tablets, MSD
 Disipal, Riker
 Dolonil Tablets, Warner-Chilcott
 Donnatal Capsules, Robins
 Donnatal Elixir, Robins
 Donnatal Extentabs, Robins
 Donnatal Tablets, Robins
 Donnatal No. 2 Tablets, Robins
 Donnzyme Tablets, Robins
 Enuretrol Tablets, Cooper
 Estomul-M, Riker
 Kemadrine Tablets, Burroughs Wellcome
 Leusin Drops, Kremers-Urban
 Leusin Elixir, Kremers-Urban
 Leusin Forte Tablets, Kremers-Urban
 Leusin PB Drops, Kremers-Urban
 Leusin c/Phenobarbital Elixir, Kremers-Urban
 Leusin c/Phenobarbital Tablets, Kremers-Urban
 Leusin Tablets, Kremers-Urban
 Matropinal Elixir, Comatic
 Matropinal Forte Inserts, Comatic
 Matropinal Forte Tablets, Comatic
 Matropinal Inserts, Comatic

LOW-SALT DRUGS BY THERAPEUTIC CATEGORY (Continued)

Matropinal Tablets, *Comatic*
 Norflex Tablets, *Riker*
 Norgesic, *Riker*
 Norgesic Forte, *Riker*
 Pamine Tablets, *Upjohn*
 Pamine PB Tablets, *Upjohn*
 Pro-Banthine P.A. Tablets, *Searle*
 Pro-Banthine c/Phenobarbital Tablets, *Searle*
 Pro-Banthine Tablets, *Searle*
 Pro-Banthine Vials, *Searle*
 Robinul Forte Tablets, *Robins*
 Robinul-PH Forte Tablets, *Robins*
 Robinul-PH Tablets, *Robins*
 Robinul Tablets, *Robins*
 Sidonna, *Reed & Carnick*
 Trest Tablets, *Dorsey*
 Trocinate Tablets, *Poythress*

Anti-Depressants

Elavil Tablets, *MSD*
 Imavate Tablets, *Robins*
 Nardil Tablets, *Warner-Chilcott*
 Vivactil Tablets, *MSD*

Anti-Diarrheals

Colonil Liquid, *Mallinckrodt*
 Colonil Tablets, *Mallinckrodt*
 Infantol Pink Liquid, *First Texas*
 Infantol White Liquid, *First Texas*
 Kaopectate, *Upjohn*
 Kaopectate Concentrate, *Upjohn*
 Lomotil Liquid & Tablets, *Searle*
 Paregoric, *USP, Philips Roxane*
 Pecto Kaolin, *Lemmon*

Anti-Emetics

Combid Capsules, *SKF*
 Compazine Capsules, *SKF*
 Dramamine Liquid, Ampuls, and Suppositories, *Searle*
 Eskatrol Spansule Capsules, *SKF*
 Marezine Tablets, *Burroughs Wellcome*
 Migral Tablets, *Burroughs Wellcome*

Anti-Flatulents

Silain-Gel Liquid, *Robins*
 Silain Tablets, *Robins*

Anti-Gout

Zyloprim Tablets, *Burroughs Wellcome*

Antihistamines/Antitussives

Actidil Syrup, *Burroughs Wellcome*
 Actifed-C Expectorant, *Burroughs Wellcome*
 Actifed Syrup, *Burroughs Wellcome*
 Atussin, *Federal*
 Atussin D.M., *Federal*
 Brondecon Elixir, *Warner-Chilcott*
 Brondecon Tablets, *Warner-Chilcott*
 Cheracol Cough Syrup, *Upjohn*
 Cheracol D Family Cough Syrup, *Upjohn*
 Chexit Tablets, *Dorsey*
 Clistin Elixir, *McNeil*
 Clistin Tablets, *McNeil*
 Cliston-D Tablets, *McNeil*
 Clistin R-A Tablets, *McNeil*
 Covanameine Liquid, *Mallinckrodt*
 Covanameine Tablets, *Mallinckrodt*
 Deconamine Elixir, *Cooper*
 Deconamine Tablets, *Cooper*
 Diafen, *Riker*
 Dicodid Tablets, *Knoll*
 Dimacol Capsules, *Robins*
 Dimacol Liquid, *Robins*
 Dimetane Elixir, *Robins*

Dimetane Expectorant, *Robins*
 Dimetane Expectorant-DC, *Robins*
 Dimetane Tablets, *Robins*
 Dimetapp Elixir, *Robins*
 Dimetapp Extentabs, *Robins*
 Dorcol Syrup, *Dorsey*
 Drinus Syrup, *Federal*
 Duadacin, *Hoechst-Roussel*
 Ephed Organidin, *Wallace*
 Ephed-Organidin Elixir, *Wallace*
 Fedevazil Tablets, *Burroughs Wellcome*
 G.G.I. Expectorant, *Federal*
 Hispril Spansule Capsules, *SKF*
 Hista-Vadrin Syrup, *First Texas*
 Hycomine, *Endo*
 Hycomine Pediatric, *Endo*
 Hycotuss Expectorant, *Endo*
 Hydriodic Acid Cough Syrup, *Upjohn*
 Isochlor Liquid, *Arnar-Stone*
 Isochlor Tablet, *Arnar-Stone*
 Isochlor Timesule Capsule, *Arnar-Stone*
 KI-N Tablets, *Mallinckrodt*
 MSC Triaminic Tablets, *Dorsey*
 Neo-Vadrin Cough Syrup, *First Texas*
 Nervine Tablets, *Miles*
 Nilcol Tablets, *Warner-Chilcott*
 (discontinued)
 Novahistine Elixir, *Dow*
 Organidin Elixir, *Wallace*
 Organidin Solution, *Wallace*
 Organidin Tablets, *Wallace*
 Ornade Spansule Capsules, *SKF*
 Periactin Tablets, *MSD*
 Pyrroxate, *Upjohn*
 Pyrroxate c/Codeine Phosphate Capsules, *Upjohn*
 Quadrinal Tablets, *Knoll*
 Rinosyn-DM Syrup, *Comatic*
 Rhinosyn-PD Syrup, *Comatic*
 Rinosyn Syrup, *Comatic*
 Rinosyn-X Syrup, *Comatic*
 Robitussin A-C Liquid, *Robins*
 Robitussin-CF Liquid, *Robins*
 Robitussin-DAC Liquid, *Robins*
 Robitussin Liquid, *Robins*
 Robitussin-PE Liquid, *Robins*
 Ryna-C Liquid, *Mallinckrodt*
 Ryna-CX Liquid, *Mallinckrodt*
 Ryna Liquid, *Mallinckrodt*
 Rynatan Pediatric Suspension, *Mallinckrodt*
 Rynatan Tablets, *Mallinckrodt*
 Rynatuss Tablets, *Mallinckrodt*
 Rynatussadine Expectorant Liquid, *Mallinckrodt*
 Rynatussadine Expectorant Tablets, *Mallinckrodt*
 Syrup Periactin, *MSD*
 Tagamet Ampuls, *SKF*
 Tagamet Tablets, *SKF*
 Tavist Tablets, *Dorsey*
 Teldrin Spansule Capsules, *SKF*
 Temaril Spansule Capsules, *SKF*
 Temaril Syrup, *SKF*
 Tolu-Sed Cough Syrup, *First Texas*
 Tolu-Sed DM Cough Syrup, *First Texas*
 Triaminic Expectorant, *Dorsey*
 Triaminic Expectorant c/Codeine, *Dorsey*
 Triaminic Expectorant DH, *Dorsey*
 Triaminic Juvelets, *Dorsey*
 Triaminic Oral Infant Drops, *Dorsey*
 Triaminic Syrup, *Dorsey*
 Triaminic Tablets, *Dorsey*
 Triaminic Allergy Tablets, *Dorsey*
 Triaminic Chewables, *Dorsey*
 Triaminic Tablets, *Dorsey*
 Triaminicol Syrup, *Dorsey*
 Trind Syrup, *Mead Johnson*
 Tussagesic Suspension, *Dorsey*
 Tussagesic Tablets, *Dorsey*
 Tussaminic Tablets, *Dorsey*
 Tussi-Organidin DM Elixir, *Wallace*
 Tussi-Organidin Elixir, *Wallace*
 Tuss-Ornade Spansule Capsules, *SKF*
 Ulo, *Riker*

Ursinus Inlay-Tabs, *Dorsey*
 Vicodin Tablets, *Knoll*

Anti-Infective Agents

Antepar Syrup, *Burroughs Wellcome*
 Azo-Mandelamine, *Warner-Chilcott*
 Bactrim Suspension, *Roche*
 Cleocin HCl Capsules, *Upjohn*
 Cleocin Pediatric Flavored Granules, *Upjohn*
 Coly-Mycin Pediatric, *Warner-Chilcott*
 Comycin Capsules, *Upjohn*
 Crysticillin 300 AS, *Squibb*
 Crysticillin 600 AS, *Squibb*
 Daraprim Tablets, *Burroughs Wellcome*
 Doxychel Capsules, *Rachelle*
 Duricef, *Mead Johnson*
 E-Mycin Tablets, *Upjohn*
 Flagyl Tablets, *Searle*
 Gantanol Suspension, *Roche*
 Gantrisin Ampules, *Roche*
 Gantrisin Pediatric Suspension, *Roche*
 Gantrisin Syrup, *Roche*
 Grifulvin V Suspension, *McNeil*
 Grifulvin V Tablets, *McNeil*
 Gris-PEG Tablets, *Dorsey*
 Larotid Suspension, *Roche*
 Lincocin Capsules, *Upjohn*
 Lincocin Pediatric Capsules, *Upjohn*
 Lincocin Syrup, *Upjohn*
 Lipo Gantrisin, *Roche*
 Mandelamine Granules, *Warner-Chilcott*
 Mandelamine Suspension, *Warner-Chilcott*
 Mandelamine Suspension Forte, *Warner-Chilcott*
 Mandelamine Tablets, *Warner-Chilcott*
 Mintezol Chewable Tablets, *MSD*
 Mintezol Suspension, *MSD*
 Mychel Capsules, *Rachelle*
 Mycifradin Sulfate Oral Solution, *Upjohn*
 Mycifradin Sulfate Tablets, *Upjohn*
 Mycostatin Oral Suspension, *Squibb*
 Mycostatin Oral Tablets, *Squibb*
 Mycostatin Vaginal Tablets, *Squibb*
 Mystecin F Capsules, *Squibb*
 Mystecin F Syrup, *Squibb*
 Neomycin, *Squibb*
 Neomycin Sulfate Sterile Powder, *Squibb*
 Nydrizid Syrup, *Squibb*
 Nydrizid Tablets, *Squibb*
 Panmycin Hydrochloride Capsules, *Upjohn*
 Panmycin Tablets, *Upjohn*
 Pensyn Capsules, *Upjohn*
 Pensyn Oral Powder, *Upjohn*
 Pentids Tablets, *Squibb*
 Principen Capsules, *Squibb*
 Principen c/Probenecid Capsules, *Squibb*
 Pyridium Tablets, *Warner-Chilcott*
 Robamox Capsules, *Robins*
 Robicillin-VK Tablets, *Robins*
 Robitet Capsules, *Robins*
 Randomycin 150/300 Capsules, *Wallace*
 Randomycin Syrup, *Wallace*
 Septra D.S. Tablets, *Burroughs Wellcome*
 Septra Suspension, *Burroughs Wellcome*
 Septra Tablets, *Burroughs Wellcome*
 Serenium Tablets, *Squibb*
 SK-Ampicillin Capsules, *SKF*
 SK-Ampicillin Chewable Tablets, *SKF*
 SK-Ampicillin for Oral Suspension, *SKF*
 SK-Ampicillin Pediatric Drops, *SKF*
 SK-Penicillin VK Tablets, *SKF*
 SK-Tetracycline Capsules, *SKF*
 Sonilyn Tablets, *Mallinckrodt*
 Spec-T Antibacterial Troches, *Squibb*
 Spec-T Cough Suppressant Troches, *Squibb*
 Sugracillin Flavored Granules, *Upjohn*
 Sulfathalidine Tablets, *MSD*
 Sulla Tablets, *Robins*
 Sultrin Tablets, *Ortho*
 Sumycin Capsules, *Squibb*

LOW-SALT DRUGS BY THERAPEUTIC CATEGORY (Continued)

Sumycin Tablets, *Squibb*
Symmetrel, *Endo*
TAO Oral Suspension, *Roerig*
Terfonyl Tablets, *Squibb*
Tetrachel Capsules, *Rachelle*
Utibid Tablets, *Warner-Chilcott*
Uticillin VK Tablets, *Upjohn*
Veetids Tablets, *Squibb*
Velosef Capsules, *Squibb*
Velosef 125 & 500 for Oral Suspension, *Squibb*

Anti-Lipemic

Colestid, *Upjohn*

Anti-Neoplastics

Alkeran Tablets, *Burroughs Wellcome*
Efudex Topical Solutions 2% & 5%, *Roche*
Imuran Tablets, *Burroughs Wellcome*
Leukeran Tablets, *Burroughs Wellcome*
Lyovac Cosmegen, *MSD*
Megace, *Mead Johnson*
Purinethol Tablets, *Burroughs Wellcome*
Thioguanine Tablets, *Burroughs Wellcome*
Uracil Mustard Capsules, NF, *Upjohn*

Anti-Parkinsonism

Parsidol Tablets, *Warner-Chilcott*
Sinemet Tablets, *MSD*

Carbonic Anhydrase Inhibitors

Cardrase Tablets, *Upjohn*
Daranide Tablets, *MSD*

Cardiac Drugs

Cardilate Chewable Tablets, *Burroughs Wellcome*
Cardilate-P Tablets, *Burroughs Wellcome*
Cardilate Tablets, *Burroughs Wellcome*
Cardioquin Tablets, *Purdue Frederick*
Lanoxin Elixir, *Burroughs Wellcome*
Lanoxin Tablets, *Burroughs Wellcome*
Norpace Capsules, *Searle*
Peritrate c/Nitroglycerin Tablets, *Warner-Chilcott*
Peritrate SA, *Warner-Chilcott*
Peritrate SA c/Phenobarbital, *Warner-Chilcott*
Peritrate Tablets, *Warner-Chilcott*
Peritrate Tablets c/Phenobarbital, *Warner-Chilcott*
Pronestyl Capsules, *Squibb*
Pronestyl Tablets, *Squibb*
Questran Powder, *Mead Johnson*
Quinaglute Dura-Tabs, *Cooper*
Quinidex Extentabs, *Robins*

Cathartics/Laxatives/Stool Softeners

Castor Oil (flavored), *Philips Roxane*
Castor Oil, USP, *Philips Roxane*
Casyllium, *Upjohn*
Colace Capsules, *Mead Johnson*
Colace Liquid, *Mead Johnson*
Colace Syrup, *Mead Johnson*
Dorbane, *Riker*
Doxidan Capsules, *Hoechst-Roussel*
Gentlax Granules, *Purdue Frederick*
Glysenid Tablets, *Dorsey*
Hydrolose Syrup, *Upjohn*
Kondremul, *Fisons*
Kondremul c/Cascara, *Fisons*
Kondremul c/Phenolphthalein, *Fisons*
Maltsupex Powder/Liquid/Tables, *Wallace*
Milkinol Liquid, *Kremers-Urban*

Milk of Magnesia, USP, *Philips Roxane, Squibb*
Milk of Magnesia-Mineral Oil Emulsion (plain), *Philips Roxane*
Milk of Magnesia Tablets, *Squibb*
Mineral Oil, USP, *Philips Roxane*
Modane Mild Tablets, *Adria*
Modane Tablets, *Adria*
Phenolax Wafers, *Upjohn*
Senokap DSS Capsules, *Purdue Frederick*
Senokot Granules, *Purdue Frederick*
Senokot S Tablets, *Purdue Frederick*
Senokot Syrup, *Purdue Frederick*
Senokot Tablets, *Purdue Frederick*
Surfak Capsules, *Hoechst-Roussel*
Syllact Powder, *Wallace*
Syllamalt Effervescent Powder, *Wallace*
Syllamalt Powder, *Wallace*
X-Prep Liquid, *Purdue Frederick*
X-Prep Powder, *Purdue Frederick*

Diagnostic Agents

Cardiografin, *Squibb*
¹³¹I-19-Iodocholesterol, *Searle*
Reno-M-30, *Squibb*
Reno-M-60, *Squibb*
Reno-M-DIP, *Squibb*
Sinografin, *Squibb*
Tensillin Ampules & Vials, *Roche*

Digestive Enzymes

Gastroenterase, *Wallace*
Kanulase Tablets, *Dorsey*
Ketochole Tablets, *Searle*
Kutrased Capsules, *Kremers-Urban*
Ku-Zyme Capsules, *Kremers-Urban*
Ku-Zyme HP Capsules, *Kremers-Urban*

Electrolytes

Calcium Gluconate Tablets, USP, *Upjohn*
Calcium Lactate Tablets, UPS, *Upjohn*
Kanokion Ampules, *Roche*
Kaochlor-Eff Tablets, *Adria*
Kaochlor 10% Liquid, *Adria*
Kaochlor S-F 10% Liquid, *Adria*
Kaon Elixir (grape), *Adria*
Kaon Elixir (lemon-lime), *Adria*
Kaon-Cl 20% Liquid, *Adria*
Kaon-Cl Tablets, *Adria*
Kaon Tablets, *Adria*
Kay Ciel Elixir, *Cooper*
Kay Ciel Packette, *Cooper*
Klorvess Effervescent Tablets, *Dorsey*
Klorvess Granules, *Dorsey*
Klorvess 10% Liquid, *Dorsey*
K-Lyte, *Mead Johnson*
Neo-Calglucon Syrup, *Dorsey*
Pan-Kloride Elixir, *Panray*
Potassium Chloride Oral Solution, USP, 5%, *Philips Roxane*

Enzymes

Avazyme Tablets, *Wallace*
Papase Tablets, *Warner-Chilcott*

Heavy Metal Antagonist

Cuprimine Capsules, *MSD*

Hemostatic

Gelfoam Powder (nonsterile), *Upjohn*

Hypnotic-Sedatives/Tranquilizers

Atarax Syrup, *Roerig*
Buticaps, *McNeil*
Butisol Sodium Elixir, *McNeil*
Butisol Sodium Tablets, *McNeil*

Chlordiazephal Capsules, *Rachelle*
Deprol Tablets, *Wallace*
Haldol Concentrate, *McNeil*
Haldol Tablets, *McNeil*
Hyprtran, *Wallace*
Loryl Capsules, *Kremers-Urban*
Menrium Tablets, *Roche*
Milpath Tablets, *Wallace*
Milprem Tablets, *Wallace*
Miltown Tablets, *Wallace*
Miltrate Tablets, *Wallace*
Navane Oral Concentrate, *Roerig*
Nebralin Tablets, *Dorsey*
Noctec Capsules, *Squibb*
Phenobarbital, USP, Elixir, *Upjohn*
Phenobarbital and Belladonna Tablets, *Upjohn*
Prolixin Elixir, *Squibb*
Prolixin Tablets, *Squibb*
Repoise Tablets, *Robins*
Sedamyl, *Riker*
Seventil Concentrate, *Boehringer Ingelheim*
Solfoton Tablets & Capsules, *Poythress*
Sombulex, *Riker*
Sopor Tablets, *Arnar-Stone*
Stelazine Concentrate, *SKF*
Taractan Concentrate Suspension, *Roche*
Thorazine Concentrate, *SKF*
Thorazine Spansule Capsules, *SKF*
Thorazine Syrup, *SKF*
Triavil Tablets, *MSD*
Tybatran Capsules, *Robins*
Verstran 10 mg Tablets, *Warner-Chilcott*
Vesprin High Potency Suspension, *Squibb*
Vesprin Tablets, *Squibb*

Hormones

Alphadrol Tablets, *Upjohn*
Amnestrogen, *Squibb*
Anadrol, *Syntex*
Anavar, *Searle*
Brevicon, *Syntex*
Cortef Fluid Oral Suspension, *Upjohn*
Cortef Suspension, *Upjohn*
Cortef Tablets, *Upjohn*
Cortisone Acetate Tablets, *Upjohn*
Cortisone Suspension, *Upjohn*
Cyclogesterin Tablets, *Upjohn*
Cytomel Tablets, *SKF*
Decadron Tablets, *MSD*
Deladumone, *Squibb*
Deladumone OB, *Squibb*
Delalutin, *Squibb*
Delatestryl, *Squibb*
Delestrogen, *Squibb*
Delta-Cortef Tablets, *Upjohn*
Deltasone Tablets, *Upjohn*
Demulen, *Searle*
Depo-Medrol Suspension, *Upjohn*
Depo-Provera Suspension, *Upjohn*
Estrace, *Mead Johnson*
Euthroid, *Warner-Chilcott*
Evex, *Syntex*
Feminone Tablets, *Upjohn*
Florinef Tablets, *Squibb*
Gynorest, *Mead Johnson*
Halodrin Tablets, *Upjohn*
Halotestin Tablets, *Upjohn*
Hydeltra TBA Suspension, *MSD*
Hydrocortisone Powder, *MSD*
Hydrocortone Tablets, *MSD*
Kenacort Tablets, *Squibb*
Medrol Tablets, *Upjohn*
Norinyl Tablets, *Syntex*
Nor-Q.D., *Syntex*
Ora-Testryl Tablets, *Squibb*
Ortho-Novum Tablets, *Ortho*
Ovcon-35 Tablets, *Mead Johnson*
Ovcon-50 Tablets, *Mead Johnson*
Ovulen, *Searle*
Proloid Tablets, *Warner-Chilcott*
Provera Tablets, *Upjohn*

LOW-SALT DRUGS BY THERAPEUTIC CATEGORY (Continued)

Hypoglycemics

Orinase Tablets, *Upjohn*
Tolinase Tablets, *Upjohn*

Hypotensive Agents

Aldactazide, *Searle*
Aldactone, *Searle*
Aldoclor Tablets, *MSD*
Aldomet Tablets, *MSD*
Aldoril Tablets, *MSD*
Aquatensen Tablets, *Mallinckrodt*
Arfonad Ampules, *Roche*
Butiserpazide, *McNeil*
Diupres Tablets, *MSD*
Diuril Tablets, *MSD*
Diutensen Tablets, *Mallinckrodt*
Diutensen-R Tablets, *Mallinckrodt*
Dyazide Capsules, *SKF*
Dyrenium Capsules, *SKF*
Edecrin Tablets, *MSD*
Exna Tablets, *Robins*
Exna-R Tablets, *Robins*
Hydropres Tablets, *MSD*
HydroDiuril Tablets, *MSD*
Inversine Tablets, *MSD*
Lasix Tablets, *Hoechst-Roussel*
Naturetin Tablets, *Squibb*
Raudixin Tablets, *Squibb*
Rau-Sed, *Squibb*
Rautensin Tablets, *Dorsey*
Rautrax-N Modified Tablets, *Squibb*
Rautrax-N Tablets, *Squibb*
Rautrax Tablets, *Squibb*
Rauwiloid, *Riker*
Rauzide, *Squibb*
Reserpoid Tablets, *Upjohn*
Suspension Diuril, *MSD*
Unitensin Tablets, *Mallinckrodt*
Vasodilan, *Mead Johnson*
Veriloid, *Riker*

Narcotic Antagonist

Lorfan Ampules & Vial, *Roche*

Parasympathomimetics

Mestinon Ampules, *Roche*
Mestinon Syrup, *Roche*
Prostigmin Ampules & Vials, *Roche*
Urecholine Chloride Tablets, *MSD*

Respiratory and Cerebral Stimulants

Benzedrine Capsules, *SKF*
Deaner, *Riker*
Dexamyl Spansule Capsules, *SKF*
Dexedrine Elixir, *SKF*
Dexedrine Spansule Capsules, *SKF*
Didrex Tablets, *Upjohn*
Metrazol Tablets, *Knoll*
Nico-Metrazol Tablets, *Knoll*
Obotan Tablets, *Mallinckrodt*
Obotan-Forte Tablets, *Mallinckrodt*
Pondimin Tablets, *Robins*
Pre-Sate Tablets, *Warner-Chilcott*
Tepanil, *Riker*
Tepanil Ten-Tab, *Riker*
Vita-Metrazol Tablets, *Knoll*

Skeletal Muscle Relaxants

Diulo, *Searle*
Maolate Tablets, *Upjohn*
Paraflex Tablets, *McNeil*
Parafon Forte Tablets, *McNeil*
Robaxin Tablets, *Robins*
Robaxin-750 Tablets, *Robins*
Robaxisal Tablets, *Robins*
Skelaxin Tablets, *Robins*

Spasmolytics/Bronchodilators/ Anti-Asthmatics

Accurbron, *Dow Chemical*
Alupent Syrup, *Boehringer Ingelheim*
Aminodur Dura-Tabs, *Cooper*
Aminophyllin Ampules, *Searle*
Aminophyllin Tablets, *Searle*
Aquaphyllin Syrup, *Ferndale*
Choledyl Tablets, *Warner-Chilcott*
Dainite-KI Tablets, *Mallinckrodt*
Dainite Tablets, *Mallinckrodt*
Dilor Elixir, *Savage*
Dilor-G Liquid, *Savage*
Duohaler, *Riker*
Duo Medihaler, *Riker*
Duovent, *Riker*
Elixicon Suspension, *Cooper*
Elixophyllin Elixir, *Cooper*
Elixophyllin KI Elixir, *Cooper*
Elixophyllin Soft Gelatin Capsules, *Cooper*
Elixophyllin S.R. Capsules, *Cooper*
Lixaminol-AT Elixir, *Ferndale*
Lixaminol Elixir, *Ferndale*
Luftodil Tablets, *Mallinckrodt*
Lufyllin Elixir, *Mallinckrodt*
Lufyllin-EPG Tablets, *Mallinckrodt*
Lufyllin-400 Tablets, *Mallinckrodt*
Lufyllin Tablets, *Mallinckrodt*
Lufyllin-GG Elixir, *Mallinckrodt*
Lufyllin-GG Tablets, *Mallinckrodt*
Marax Syrup, *Roerig*
Medihaler Epi, *Riker*
Medihaler Iso, *Riker*
Metaprel Syrup, *Dorsey*
Metaprel Tablets, *Dorsey*
Mudrane GG Elixir, *Poythress*
Neothylline Elixir, *Lemmon*
Neothylline-G Elixir, *Lemmon*
Orthoxine and Aminophylline Capsules, *Upjohn*
Orthoxine Hydrochloride Syrup, *Upjohn*
Orthoxine Hydrochloride Tablets, *Upjohn*
Propadrine Capsules, *MSD*
Propadrine Elixir, *MSD*
Quibron Capsules, *Mead Johnson*
Quibron-Plus Capsules, *Mead Johnson*
Quibron-300 Capsules, *Mead Johnson*
Somophyllin Oral Liquid, *Fisons*
Sudafed Syrup, *Burroughs Wellcome*
Sudafed Tablets, *Burroughs Wellcome*
Tedral Anti-H Tablets, *Warner-Chilcott*
Tedral Elixir, *Warner-Chilcott*
Tedral Expectorant Tablets, *Warner-Chilcott*
Tedral (Pediatric) Suspension, *Warner-Chilcott*
Tedral SA Tablets, *Warner-Chilcott*
Tedral Tablets, *Warner-Chilcott*
Tedral-25 Tablets, *Warner-Chilcott*
Theolair, *Riker*
Theolair Liquid, *Riker*
Theolair-SR, *Riker*
Theo-Organidin Elixir, *Wallace*
Theophyl Chewable Tablets, *Knoll*
Theophyl SR Capsules, *Knoll*
Theophyl 225 Elixir & Tablets, *Knoll*
Theophylline Elixir, *Philips Roxane*
Therapau Capsules, *Cooper*
Verequad Tablets, *Knoll*

Sympatholytics

Circanol, *Riker*
Deapril-ST Tablets, *Mead Johnson*
Dibenzylamine Capsules, *SKF*
Hydrogenated Ergot Alkaloids, *Riker*
Medihaler Ergotamine, *Riker*

Uricosurics

Benemid, *MSD*
ColBenemid Tablets, *MSD*

Vitamins

Adeflor Drops, *Upjohn*
Allbee with C Capsules, *Robins*
Ascorbic Acid, *Squibb*
Berubigen Sterile Solution, *Upjohn*
Calciferol Tablets, *Kremers-Urban*
Calcium, Phosphorus & Vitamin D Tablets, *Squibb*
Cebetinic Tablets, *Upjohn*
Cod Liver Oil, *Squibb*
Cod Liver Oil (mint-flavored), *Squibb*
Diosate D Tablets, *Upjohn*
Epsilan-M Capsules, *Adria*
Feosol Elixir, *SKF*
Feosol Plus Capsules, *SKF*
Feosol Spansule Capsules, *SKF*
Fer-In-Sol Capsules, *Mead Johnson*
Fer-In-Sol Drops, *Mead Johnson*
Fer-In-Sol Syrup, *Mead Johnson*
Ferritric Tablets, *Upjohn*
Ferronord Tablets, *Cooper*
Ferrous Sulfate Tablets, *UPS, Upjohn*
Fortespan Spansule Capsules, *SKF*
Geltabs Vitamin D Capsules, *Upjohn*
Gerizyme, *Upjohn*
GoldenBounty Multivitamins c/Iron, *Squibb*
Ilopan-Choline Tablets, *Adria*
Iron c/Vitamin C Tablets, *Squibb*
Laud Iron Suspension, *Federal*
Lipomul Oral, *Upjohn*
Lipotriad Liquid, *Cooper*
Luride Drops, *Hoyt*
Luride Tablets, *Hoyt*
Lydia Pinkham Tablets, *Cooper*
Mephyton Tablets, *MSD*
Niacin Tablets, *Squibb*
One-A-Day Vitamins, *Miles*
One-A-Day Vitamins plus Iron, *Miles*
One-A-Day Vitamins plus Minerals, *Miles*
Pedicran Liquid, *First Texas*
Pedicran c/Iron Liquid, *First Texas*
Poly-Vi-Flor Drops, *Mead Johnson*
Poly-Vi-Flor 0.25 Drops, *Mead Johnson*
Poly-Vi-Flor c/Iron Drops, *Mead Johnson*
Poly-Vi-Sol Circus Shape Tablets, *Mead Johnson*
Poly-Vi-Sol Drops, *Mead Johnson*
Poly-Vi-Sol c/Iron Drops, *Mead Johnson*
Poly-Vi-Sol c/Iron Tablets, *Mead Johnson*
Poly-Vi-Sol c/Iron Circus Shape Tablets, *Mead Johnson*
Poly-Vi-Sol Tablets, *Mead Johnson*
Poly-Vi-Sol Teaspoon, *Mead Johnson*
Rubramin PC, *Squibb*
Secran Fe Liquid, *First Texas*
Secran Liquid, *First Texas*
Solu-B, *Upjohn*
Super D Cod Liver Oil, *Upjohn*
Super D Perles, *Upjohn*
Synkayvite Ampules, *Roche*
Synkayvite Tablets, *Roche*
Thiamine HCl Tablets, *Squibb*
Toleron Suspension, *Mallinckrodt*
Toleran Tablets, *Mallinckrodt*
Tri-Vi-Sol c/Iron Drops, *Mead Johnson*
Tri-Vi-Sol Tablets, *Mead Johnson*
Troph-Iron Liquid, *SKF*
Trophite Liquid, *SKF*
Unicap Capsules, *Upjohn*
Upjohn Vitamin C Tablets, *Upjohn*
Upjohn Vitamin E Capsules, *Upjohn*
Vigran Capsules, *Squibb*
Vigran Chewable Tablets, *Squibb*
Vigran c/Iron Tablets, *Squibb*
Vi-Penta Multi-vitamin Drops, *Roche*
Vitamin A Capsules, *Squibb*
Vitamin B₁ Tablets, *Squibb*
Vitamin B₁₂ Capsules, *Squibb*
Vitamin E IV Tablets, *Squibb*
Vitamin E Capsules, *Squibb*
Yeast Grain Tablets, *Squibb*
Yeast Tablets, *Mead Johnson*
Yeast Tablets, *Squibb*
Zymacap Capsules, *Upjohn*
Zymalixir, *Upjohn*