Nutrition Research Alternatives

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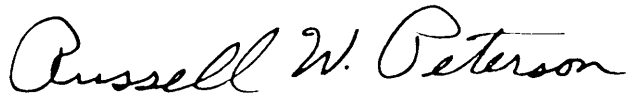
FOREWORD

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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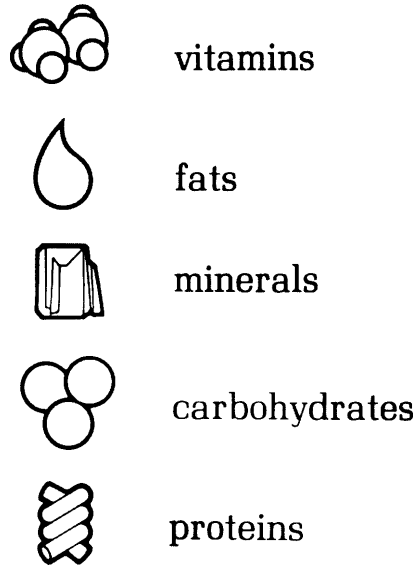
EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

During this century, particularly since World War 11, 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 recommendtions 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 Departrment 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
Researcn priorities	• 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 informatlon • Nutritional aspects of food science and food safety . Monitoring nutritional status . Nutrition policy and management	Research gaps: . 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 i n terms of dietary excesses and imbalances, as well as deficiencies Research needs: . 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	. Effects of nutrition on human health and performance . Food sciences • Nutrition education research . Diet and nutritional status surveillance
Definition and funding	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.	Does not define nutrition research. Instability of federally funded extramural research is a barrier to progress. Endorses development of federally funded regional research centers i n conjunction with universities.	Definition includes basic physiological and biochemical research. Establishes FY 1977 research spending at $116.6 million, Recommends no increases i n funding with real location of resources to the higher priority areas.
Personnel requirements	No reliable figures are available for numbers of nutri - tion research scientists in the laboratory or in training. Before a comprehensive research program IS estab- I I shed, must consider ability of the field to implement and sustain a program.	There is a shortage of nutrition research scientists.	Not considered.
Research organization	• 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	• Assign each area to a lead Federal agency • Eliminate unnecessary research . Promote Government-wide research planning, coordination, and reporting	• 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

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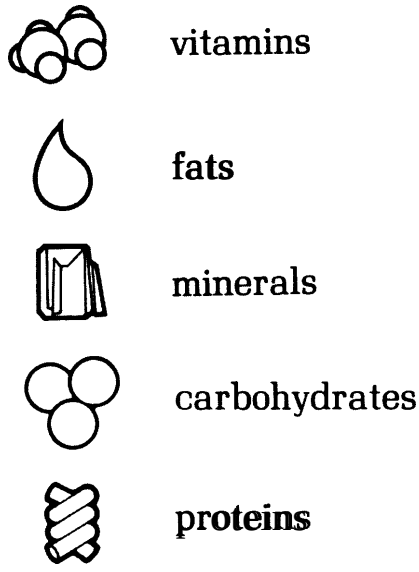
Chapter I

OVERVIEW



Chapter I

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 hypertension 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

[a]Includes 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 o f 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 **chal**lenge to remedy such problems and reach people with needed nutrition services,

Chapter II

KEY ISSUES



vitamins



fats



minerals



carbohydrates



proteins

Chapter II

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—(l) 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		*National Institute of Arthritis, Metabolism, and Digestive Diseases (N/AMDD), Basic* physiological studies of nutrients; basic metabolism studies; obesity; trace elements nutrition support of patients; fiber; anemias.
			National Institute of Child Health and Human Development (NICHHD). 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.
			National Cancer Institute (NC/). 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.
			National Heart, Lung, and Blood Institute (NHLBI). Nutrition in etiology of arteriosclerosis and hypertension; achieving and maintaining dietary change; development of food composition tables; methodology —collecting, recording, and evaluating dietary data.
			National Institute of General Medical Sciences (NIGMS). Traumatized/burned patients and nutrition.
			National Institute of Environmental Health Sciences (NIEHS). Neurotoxicity; mutagenesis; teratology; environmental contaminants in food.
			National Institute of Neurological and Communicative Disorders and Stroke (N/NCDS). 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.
			National Institute of Dental Research (NIDR). 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.
			National Institute of Allergy and Infectious Disease (NIAID). Interrelated factors hearing on malnutrition, infection, and the immune system.
			National Eye Institute (NE/). Vitamins A, B-12, and other nutrients in visual processes; diseases of visual system, e.g., keratomalacia; metab-0lism of visual cells; protein changes in the lens.
			National Institute on Aging (N/A). 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.
			Division of Research Resources (DRR). 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 bioavailabiiity 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 Centrol		Epldemlological surveillance studies in cooperation with State agencies assistance to Al D i n similar international areas.
	Health Services Admin-istration		Collaborateive research and screening program for phenylketonurla,
	Alcohol, Drug Abuse, & Mental Health Admin-istration		Effects of alcohol consumption on 'nutrient metabolism and nutritional deficiencies; study of food additive consumption and hyperactivity in children.
Agriculture	Agricul-tural Re-search Service .		Human 'Reqirements for Nutrient Determine the requirements for lipid intake and identification of the forms of these nutrients in foods that may be useful in meeting these requirements. Determine the requirements for mineral intake by humans and identi-fication of the forms of these nutrients in foods that may be useful in meeting these requirements. Determine the requirements for vitamin intake by humans and identi-fication of the forms of these nutrients in foods that may be useful in meeting these requirements. 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. 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. Food Composition and Improvement 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. 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. Food Consumption and Use To provide accurate, up-to-date, and comprehensive Information In a readily usable form on food consumption and dietary levels. 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 man-agers; to Identify techniques which will assist people in selecting nu-tritionally adequate diets within different budget Iimitatlons, to iden-tify means to modify undesirable food habits; to strengthen nutri - tionally desirable food choice. To identify and develop suitable and safe procedures for food man-agement and preparation for home and institutional consumers, for best retention of both nutritional and eating qualities and to avoid food-borne illness.
	Coopera-tive 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 Interact Ions: 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 i n 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 withinthe 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 nutrition 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[c]	
Center for Disease Control	0.3[c]	
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[c]	4.1
National Science Foundation	0.3[c]	0
Grand total	**$116.6**	**$50.2**

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

[b]Office of Management and Budget *Special Analyses—Budget of the US. Government FY 1979.*

[c]This 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.

[d]This 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 ana1ysis 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 c.onnection 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 sub mitted 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

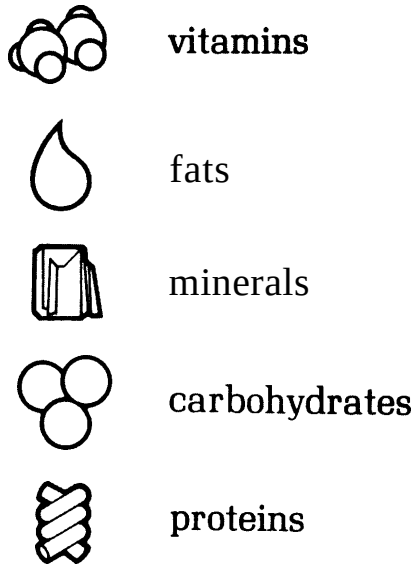
at Letterman Army Institute of Research of the Department of Defense.

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



Chapter III

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 infants, 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 if 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.]

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, "z

In practice, the system seems to have functioned somewhat differently, Human nutr~-

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

[2]Ibid.

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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 $2.8 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 Federal 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 interagency 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 camot 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

:DS A COORDINATED APPROACH TO ADVAN

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 four 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 nutritionin 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 beinevitable.

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
- ınteractions among nutrient requirements based on functional criteria
- Pharmacologic and toxicologic effects of on nutritions
- Bioavaiability 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 arguments 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 setout in this report.

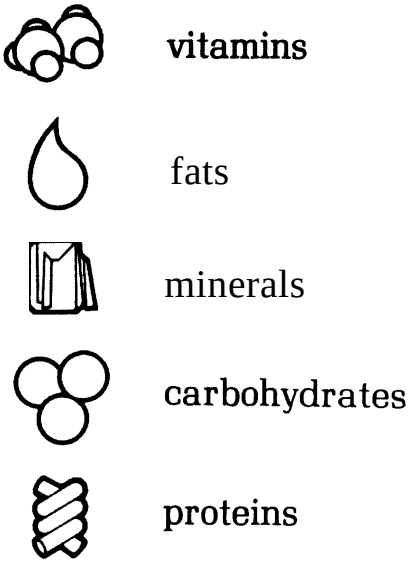
On the basis of such information, Congress would have several options. The first would be to maintain the status quo in nutrition research funding, with possible reallocation of some funds to areas not now receiving support. As a second option, Congress could appropriate additional funds to specific 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



Chapter IV

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 I Ii). 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, monitoring 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 combination 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



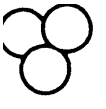
vitamins



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 crieria 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 1ikely 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. *Irnpact:* 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. Substantial existjng 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.	2. If research does produce results, what effect would they likely have on reducing global hunger and malnutrition over the next several decades?	
3. Researchability: 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 met hods 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 Supporled Nurnan Nutrition Research,* December 1977
" " NAS, *World Food and Nufrition 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,

Just if i cat ion

Major Health Problems and Diet-Related Risk Factors

The major health problems of Americans include cardiovascular disease, cancer, diabetes, hypertension, osteoporosis, obesity, drug and alchohol 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,

Fiypertension. 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.

0steoporosis. 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 relationships 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 volubility 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, although 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, injants, 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 problemsas 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 hospitalizatio$_n$ 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 particular 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.

Just if i cat ion

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 actually 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 comprehension 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 materiak 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.

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 particula~ 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.

Bioavailabilit y 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. Fundamental 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

Just if i cat ion

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 constituents 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 completing 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:

ldentify 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 availabdity 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 abilit y to maintain research potential will depend upon whether the settings in which the research is carried out provide for training.

Just if i cat ion

If the national objective of assuring the best possible nutritional status for every citizen is to be acheived, 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 launching 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 ar[e] 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 monitorin[g] nutritional status is the stabilization of funding. Assuring a research budget over the op crating costs of the present system would encourage research on methodolog[y] 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.

Just if i cation

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 affection 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 pro grams 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,

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.