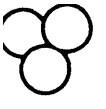
APPENDIX

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.

NUTRITION EDUCATION AND CONSUMER INFORMATION

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.