NIH OFFICE OF DIETARY SUPPLEMENTS

Strategic Plan 2017–2021

Strengthening Knowledge & Understanding of Dietary Supplements

DECEMBER 2016

National Institutes of Health
Office of Dietary Supplements

TABLE OF CONTENTS

From the Director, Office of Dietary Supplements 1

I. Background 2

II. The 2017–2021 Strategic Plan: Translating Office of Dietary Supplements Goals into Action 10

Goal 1: Expand the scientific knowledge base on dietary supplements by stimulating and supporting a full range of biomedical research and by developing and contributing to collaborative initiatives, workshops, meetings, and conferences. 12

GOAL 2: Enhance the dietary supplement research workforce through training and career development. 14

GOAL 3: Foster development and dissemination of research resources and tools to enhance the quality of dietary supplement research. 16

GOAL 4: Translate dietary supplement research findings into useful information for consumers, health professionals, researchers, and policymakers. 18

Appendix A: ODS Mandates in the Diet ary Supplement Health and Education Act (DSHEA) of 1994 and Subsequent Congressional Language 20

Appendix B: Areas of Focus 2010–2016 22

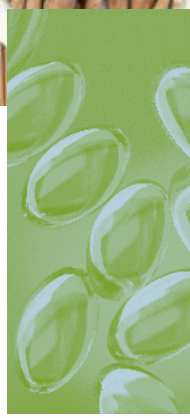
Appendix C: Glossary 32

FROM THE OFFICE OF DIETARY SUPPLEMENTS (ODS) DIRECTOR

As the lead federal entity for the scientific exploration of dietary supplements, ODS has achieved remarkable progress in advancing research and—equally important—translating the results of that research into valuable information for use by scientists, policymakers, health professionals, industry, and consumers. This progress has been possible only through the continued and evolving collaborations that ODS has forged with partners in the federal sector, including the National Institutes of Health (NIH) Institutes and Centers (ICs) and other federal agencies, as well as in the private and academic sectors.

About half the U.S. population uses dietary supplements on a regular basis. The array of products on the market is large, with ingredients that range from vitamins and minerals to herbs and other complex mixtures. Dietary supplements are regulated differently from "conventional" foods and drug products. Under the Dietary Supplement Health and Education Act of 1994, the manufacturer is responsible for ensuring that a dietary supplement is safe before it is marketed and that the product label information is truthful and not misleading. However, the manufacturer does not have to prove that the supplement is effective.

Consumers and health professionals have many questions about dietary supplements and their effects on health. To answer these questions, ODS takes a critical look at the science behind supplements, identifying gaps in knowledge that must be addressed and filling those gaps with the necessary research. ODS's investigations are highly consistent with broader NIH efforts to enhance transparency, rigor, and reproducibility in the conduct of science in general (see NIH Strategic Plan).



ODS also develops and disseminates research tools to advance the science and works to increase the cadre of investigators who study dietary supplements, providing much-needed information to the public and informing public health policy. The focus of dietary supplement research at ODS is on the efficacy, safety, and quality of these products. A variety of strategies are needed to address each of these factors, as this document conveys.

Since its inception in 1995, ODS has provided the vision and leadership needed to galvanize and support collaborations within and beyond NIH. These collaborations capitalize on the talents and capabilities of ODS staff and other agencies to meet mutually beneficial goals. They are also efficient and cost effective because ODS does not duplicate the work of other agencies. ODS engages in international collaborative work as well.

The ODS staff are exceptionally talented, with national and international reputations for their work in such fields as analytical chemistry, pharmacognosy, biochemistry, epidemiology, clinical nutrition, dietetics, and health communications. Importantly, staff members have a shared vision and a collaborative spirit that enhance their roles in addressing complex and sometimes challenging issues.

ODS enters this 2017–2021 strategic planning period with a wealth of experience to guide it and a robust history of results that make a difference in people's lives. As ODS moves forward with future endeavors, the question that guides us will be, "What are the key emerging public health priorities that should drive our work?"

Paul M. Coates, Ph.D.
Director, Office of Dietary Supplements
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I. Background

The history of the Office of Dietary Supplements (ODS) is rooted in legislation—the Dietary Supplement Health and Education Act (DSHEA) of 1994 (see Appendix A)—and subsequent congressional language that form the basis of its mission, vision, and programs. The National Institutes of Health (NIH) created ODS in 1995 and placed it within the Office of Disease Prevention (ODP), in the Office of the Director (OD). ODS and ODP are now administratively located in the Division of Program Coordination, Planning, and Strategic Initiatives (DPCPSI) in the OD.

The ODS budget increased from $1 million in 1996 to $5 million in 2000, and then from $5 million to $26 million between 2000 and 2004. The budget remained relatively stable through 2014, but in 2015 was cut by 8% to $24.7 million. The ODS fiscal year (FY) 2016 budget is $25.3 million.

Through its activities, and consistent with the overall mission of DPCPSI, ODS helps NIH Institutes and Centers (ICs) strengthen existing programs in research and training and enhances the array of resources available to investigators and other ODS stakeholders.

STRATEGIC PLANNING PROCESS

At more than 20 years of age, ODS maintains its commitment to promoting the best science that can inform public health policy and consumers' decisions about their own health care. ODS uses its strategic planning cycles to communicate and evaluate the outcomes of its investments, submit itself to public scrutiny, consider its research prioritization, and offer an opportunity for the public to provide input into its plans.

This fourth strategic plan capitalizes on ODS's advances in past years to enhance tools for successful research, to build on remarkable collaborations with other NIH ICs and Offices as well as federal agencies, and to further forge public-private partnerships. The ultimate goals of these activities are to support, conduct, and coordinate scientific research, thereby continuing to build the scientific underpinnings for dietary supplement research and to provide resources that will better inform people about nutrition in general and dietary supplements in particular.

The ODS strategic planning process has evolved over time. At the inception of ODS, strategic planning included discussions with NIH IC directors and with representatives of the scientific community, industry, other federal agencies, and the public to identify areas of common interest. Beginning with the 2004–2009 strategic plan, a more comprehensive approach to the ongoing review and evaluation of ODS activities has been an important component of the planning process.

The 2017–2021 ODS strategic planning process followed a framework of evaluation and priority setting beginning with the Strategic Plan 2010–2014 Progress Report developed by ODS staff in 2015 to assess their activities and achievements since 2010. This progress report was distributed in 2015 to federal partners and publicly posted to seek input from the dietary supplement stakeholder community. Consultation with NIH IC leadership along with the comments received from partner federal agencies, dietary supplement industry trade associations, and the public were categorized and provided as feedback to ODS staff. The report (see summary in Appendix B) was the basis for an internal review of program performance that helped guide the strategic planning process. In the fall of 2015, ODS established a working group to draft a new strategic plan.

MISSION, VISION, AND GOALS

As a result of this strategic planning process, ODS has confirmed its mission statement and refined its goals with a stated vision for research on dietary supplements and health outcomes, while still maintaining a focus on the office's core purpose and responsibilities as mandated by DSHEA.

THE MISSION OF THE OFFICE OF DIETARY SUPPLEMENTS (ODS) is to support, conduct, and coordinate scientific research and provide intellectual leadership for the purpose of strengthening the knowledge and understanding of dietary supplements to foster an enhanced quality of life and health for the U.S. population.

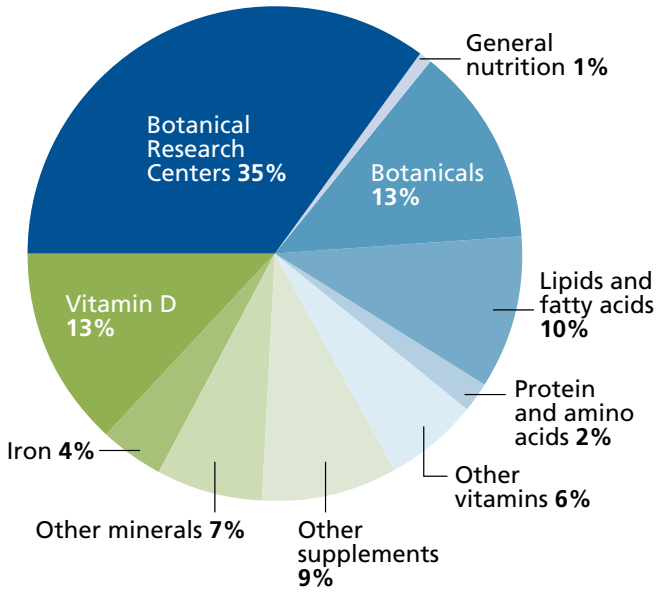
THE VISION OF ODS is that researchers, health professionals, government officials, other policymakers, and consumers will have ready access to scientific information of the highest quality on the health effects of dietary supplements.

ODS'S FOUR GOALS ARE TO:

1. Expand the scientific knowledge base on dietary supplements by stimulating and supporting a full range of biomedical research and by developing and contributing to collaborative initiatives, workshops, meetings, and conferences.
2. Enhance the dietary supplement research workforce through training and career development.
3. Foster development and dissemination of research resources and tools to enhance the quality of dietary supplement research.
4. Translate dietary supplement research findings into useful information for consumers, health professionals, researchers, and policymakers.

Selected Program Accomplishments

ODS Extramural Research Portfolio by Investment Category, FY 2015 ($11.8 million total funding)



RESEARCH GRANT CO-FUNDING

More than half of the ODS research budget goes to co-funding grants with NIH IC partners. Of particular note is the NIH Botanical Research Centers Program, managed in collaboration with NCCIH, which has studied the safety and mechanisms of action of botanicals in women's health, metabolic syndrome, cancer, immune function, cardiovascular disease, and other areas.

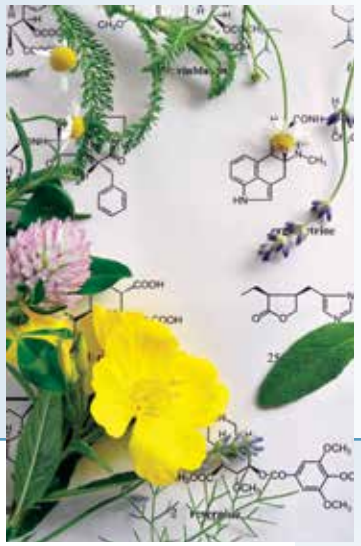
ODS Co-Funded Investments with NIH ICs (FY 2015)	
	$ Thousands
National Center for Complementary and Integrative Health	5,765
National Heart, Lung, and Blood Institute	1,638
National Institute of Diabetes and Digestive and Kidney Diseases	1,421
National Cancer Institute	855
National Institute on Alcohol Abuse and Alcoholism	536
National Institute on Aging	462
Fogarty International Center	253
National Institute of Environmental Health Sciences	199
National Institute of Child Health and Human Development	163
National Institute of Allergy and Infectious Diseases	100
National Institute of General Medical Sciences	100
National Institute of Neurological Disorders and Stroke	100
National Eye Institute	91
National Institute of Arthritis and Musculoskeletal and Skin Diseases	85
National Institute of Dental and Craniofacial Research	34

ANALYTICAL METHODS AND REFERENCE MATERIALS (AMRM) PROGRAM

The utilization of accurate, precise, and reliable analytical methods and matching reference materials is required for rigorous assessment of dietary supplement ingredients. The AMRM Program supports product quality and provides resources for characterization and verification of product content that enhance the reliability and reproducibility of research using these products.

Analytical Methods and Reference Materials (AMRM) Program priorities are identified through open stakeholder meetings and met through collaborative efforts with federal and non-federal institutions. Industry, government, not-for-profit groups, and academic institutions participate in the process of identifying needs and developing standards. Through its contracts and collaborations (National Institute of Standards and Technology [NIST] and U.S. Department of Agriculture [USDA]) the AMRM program:

- Supports the development of certified reference materials (CRMs) for dietary supplement ingredients with assigned values for concentrations of active and/or marker compounds, pesticides, and toxic metals to assist in the verification of product label claims and in quality control during the manufacturing process.
- Supports the Dietary Supplement Laboratory Quality Assurance Program, in which participants measure concentrations of active and/or marker compounds and nutritional and toxic elements in practice and test materials.
- Conducts workshops to discuss best practices and advances in methodologies for characterizing dietary supplements and to provide guidance on improving laboratory performance.
- Supports the validation of methods used in biomedical research on botanicals and other dietary supplement ingredients.
- Disseminates information and data about validated analytical methods and reference materials to stakeholders through its new website that includes a searchable database of analytical methods.

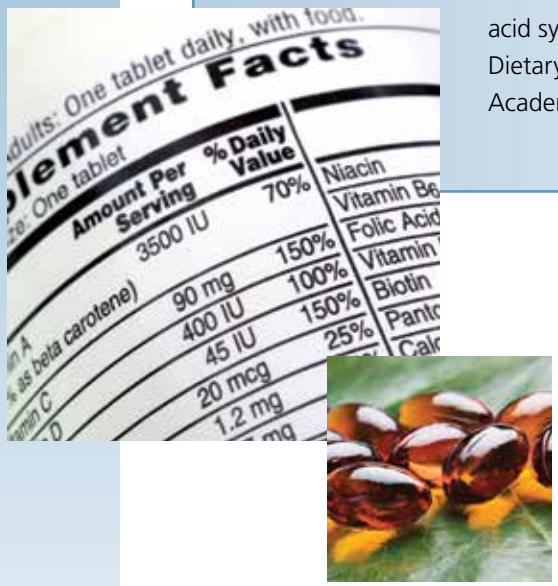


EVIDENCE-BASED REVIEW PROGRAM

In response to congressional encouragement to review the current scientific evidence on efficacy and safety of dietary supplements and identify research needs, ODS developed an Evidence-based Review Program through the Agency for Healthcare Research and Quality's (AHRQ) Evidence-based Practice Center Program.

Evidence-based reviews have informed the development of research agendas for ODS and its National Institute of Health (NIH) partners:

- Since its inception in 2001, the Evidence-based Review Program sponsored 18 systematic reviews on topics related to dietary supplements, including B-vitamins, ephedra, multivitamin/multimineral supplements, omega-3 fatty acids, soy, probiotics, and vitamin D.
- ODS has also sponsored 3 reports on nutrition research methodology and a 5-volume series of technical reports on the application of systematic review methodology to the field of nutrition.
- ODS initiated updates of its vitamin D and omega-3 fatty acid systematic reviews which may be used for future Dietary Reference Intake evaluations by the National Academy of Medicine.

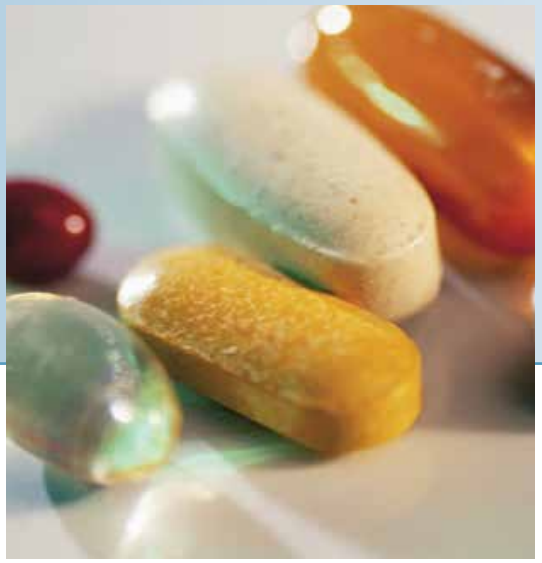


DIETARY SUPPLEMENT DATABASES

ODS funds and leads the development of two databases, the Dietary Supplement Ingredient Database (DSID) and the Dietary Supplement Label Database (DSLD), containing information on the composition of many dietary supplements for sale in the United States. Using these databases together with food composition databases makes it possible to estimate the total daily intakes of nutrients and other bioactive substances from both foods and dietary supplements. ODS and the National Library of Medicine (NLM) created and continue to enhance a Dietary Supplement Subset of NLM's PubMed. The subset limits search results to citations from a broad spectrum of the dietary supplement literature. Another ODS-supported database, Computer Access to Research on Dietary Supplements (CARDS), contains information on research projects pertaining to dietary supplements funded by the U.S. Department of Agriculture (USDA), Department of Defense (DoD), or NIH since 1999.

ODS continues to develop and expand the utility of dietary supplement databases:

- The Dietary Supplement Label Database (DSLD) is a repository for all the information on the product label (composition, claims, manufacturer contact information, etc.) of dietary supplements. The database has data from more than 60,000 labels, and data from another 1,000 labels are added each month.
- The Dietary Supplement Ingredient Database (DSID) contains analytically derived information on the amount of labeled ingredients of many dietary supplements offered for sale in the United States. It currently includes adult, child, and prenatal multivitamin/multimineral supplements and omega-3 fatty acid products.
- Since 2010 the Federal Dietary Supplement Database Working Group* has developed criteria for choosing botanicals and other dietary ingredients of public health interest to add to the DSID that do not have established recommended intakes but that should be analytically evaluated. This prioritization process led to the decision to focus first on adding data on green tea products to the DSID, and a pilot study on these products has been completed.



**The working group consists of representatives from ODS, National Library of Medicine (NLM), National Cancer Institute (NCI), U.S. Department of Agriculture (USDA), Centers for Disease Control and Prevention (CDC), Food and Drug Administration (FDA), Department of Defense (DoD), and National Institute of Standards and Technology (NIST).*

VITAMIN D INITIATIVE

ODS has taken a lead role in the federal government to advance scientific understanding of the role of vitamin D in health. The Vitamin D Initiative has underpinned the standardization of serum 25-hydroxyvitamin D [25(OH)D] measurements, thereby allowing public health and clinical decision-making around the world to be based on accurate measurements of the vitamin D status of their citizens.

Using the research agenda from the 2011 Institute of Medicine (now the National Academy of Medicine) report on Dietary Reference Intakes (DRIs) for vitamin D and calcium, Office of Dietary Supplements (ODS) led and collaborated with agencies (Centers for Disease Control and Prevention [CDC], National Institute of Standards and Technology [NIST] and U.S. Department of Agriculture [USDA]) on significant research activities:

- Studies that compare the vitamin D measurement results of different laboratories.
- Standardization of vitamin D measurement and certification for laboratories measuring vitamin D levels in blood.
- Vitamin D Metabolites Quality Assurance Program and Vitamin D External Quality Assurance Scheme to help clinical and research laboratories use commercial clinical vitamin D kits properly.
- Studies of international health and nutrition surveys for vitamin D levels in blood and reported vitamin D intakes.
- A systematic review on vitamin D research with evidence from more recent studies related to health outcomes of vitamin D alone or in combination with calcium.
- Analysis of vitamin D exposure from sunlight, dietary supplements, and food consumption.
- Hosted the conference, "Vitamin D: Moving Toward Evidence-Based Decision Making in Primary Care" on the evaluation and application of evidence for decision making by practitioners, approaches to counseling about vitamin D in primary care settings when data are uncertain, and issues surrounding laboratory measurement of serum 25-hydroxyvitamin D [25(OH)D].

WORKFORCE DEVELOPMENT

ODS has developed several mechanisms to develop a cadre of researchers skilled in the science of dietary supplements.

Using a variety of mechanisms, the Office of Dietary Supplements (ODS):

- Funds training and career development awards in National Institutes of Health (NIH) laboratories.
- Sponsors the ODS Intramural Scholars awards with NIH Institutes and Centers (ICs).
- Collaborates with other federal agencies (e.g., National Institute of Standards and Technology [NIST] and U.S. Department of Agriculture [USDA]) to support postdoctoral fellows.
- Offers short-term training opportunities for students and faculty members at ODS.
- Hosts the annual Dietary Supplement Research Practicum, a 3-day intensive course on issues in dietary supplement research.

COMMUNICATING THE SCIENCE OF SUPPLEMENTS

ODS has communicated the science of dietary supplements to diverse audiences through its information products—primarily a library of fact sheets on ingredients in supplements. Most of these products are available on the ODS website, accessed by more than 1.5 million people per month.

The Office of Dietary Supplements (ODS) Communications Program provides helpful, up-to-date information on dietary supplements through various channels, including social media platforms:

- ODS communications staff respond directly to media inquiries and questions from the public about dietary supplements.
- Fact sheets on dietary supplement ingredients (the most frequently viewed materials on the ODS website) include more than two dozen fact sheets on nutrients such as vitamin D and magnesium with detailed versions including references directed to health care professionals as well as easy-to-read versions for consumers in both English and Spanish.
- Additional fact sheets are available on dietary supplements such as multivitamin/mineral products and on supplements marketed for specific purposes (such as weight loss).
- The ODS website provides detailed descriptions of ODS program areas and activities, including the Analytical Methods and Reference Materials Program and the vitamin D, iodine, and iron initiatives.
- The ODS website includes information that is particularly relevant to the scientific research community: research funding opportunities, a listing of funded grants, dietary supplement databases, and features allowing for biomedical literature searches in PubMed to be limited to citations from the dietary supplement literature.
- Through the ODS website, users can sign up to receive e-newsletters, such as **ODS Update** (directed to professional audiences) and **The Scoop** (for consumers), as well as email blasts on special topics.
- ODS posts information daily about dietary supplements or nutrition on Twitter and Facebook.

II. The 2017–2021 Strategic Plan: Translating Office of Dietary Supplements Goals into Action

This 2017–2021 Office of Dietary Supplements (ODS) strategic plan captures the momentum of current ODS programs and activities. ODS's prioritization of activities is an ongoing process, continuing beyond the strategic planning period, and is based on research opportunities and public health needs. For example, its experience in building capacity related to vitamin D in particular has taught ODS much about how to approach other emerging public health research opportunities.

Building and expanding key partnerships with National Institutes of Health (NIH) Institutes and Centers (ICs) and offices and with other federal agencies will continue to be a focus for ODS. Through these partnerships, ODS contributes to funding research and workforce development; identifying areas of research need; and developing tools and resources for researchers, regulators, and industry. In all these efforts, ODS takes a multipronged approach that is guided by several key questions:

- **What is the nature of the public health issue?** Is the intake of a nutrient or other supplement ingredient too low or too high? What is the evidence?
- **How are nutritional status and bioavailable levels of dietary supplement metabolites measured?** Are there concerns about the reliability of the measures?
- **What is the evidence on the health effects of dietary supplements?** What levels of dietary supplements influence the observed effects?
- **How should ODS and the research community fill the gaps in knowledge?**
- **How should ODS and its partners translate the results of research for policymakers, clinicians, and the public?**

ODS will measure the success of its activities to address its four goals (see page 3) based on the relevance of publications in the peer-reviewed literature arising from co-funded grants, research tools developed, information pieces written, initiatives and workshops developed by

staff, and manuscripts published by ODS and other NIH staff. ODS will assess the impact of these results over time as they inform policy and influence health practices related to dietary supplements.

EXAMPLES OF NEW DIRECTIONS

ODS's activities are built upon the successful development of programs since the office's inception and continue to reflect the mandate set by the Dietary Supplement Health and Education Act (DSHEA) of 1994. However, new knowledge, technologies, and public health concerns take some programs in new directions. Examples of how ODS is planning to expand its directions in the next 5 years include:

- ODS, in coordinating the creation and dissemination of analytical tools, will expand this effort from measuring nutrient ingredients in dietary supplement products to include the identification and measurement of biomarkers of nutrient exposure and status in blood and other biological specimens in relation to chronic disease risk in individuals and populations.
- ODS will seek to understand the role of the microbiome in mediating the effects of bioactive components of food and dietary supplements.
- ODS will evaluate and help develop tools to more precisely investigate dietary supplement usage patterns, using national and other large health surveys, in specific population cohorts (such as seniors, Native American communities, pregnant women, infants, children, and cancer survivors). ODS will also study consumer use of dietary supplements in combination with widely used over-the-counter and prescription medications. In addition, ODS plans to evaluate the cognitive and behavioral factors underlying dietary supplement use.
- ODS will enhance consumer access to the Dietary Supplement Label Database (DSLD) by releasing a mobile version for use on smartphones.
- ODS will expand the Mary Frances Picciano Dietary Supplement Research Practicum by identifying ways to increase participation, possibly with a live webcast of future events. ODS will also consider broadening the practicum's reach through a video archive of the most recent practicum and/or a repository of presentations from selected practicum speakers.
- ODS will explore additional mechanisms to support postdoctoral research training in collaboration with other NIH ICs and federal agencies.

ODS's prioritization of activities is an ongoing process, continuing beyond the strategic planning period, and is based on research opportunities and public health needs.

The details of ODS's strategic plan for 2017–2021 are presented by individual goals and strategies on the following pages.

GOAL 1: Expand the scientific knowledge base on dietary supplements by stimulating and supporting a full range of biomedical research and by developing and contributing to collaborative initiatives, workshops, meetings, and conferences.

Today, at least 75,000 dietary supplement products are available that contain vitamins and minerals, herbs and botanicals, and other ingredients (such as glucosamine, fish oils, and probiotics). Yet there are questions about the efficacy and safety of many dietary supplements. ODS plans to continue working in collaboration with NIH ICs and other research institutions to answer such questions. ODS will continue to choose research priorities based on their public health importance, and it will use systematic reviews as a primary assessment tool to address efficacy and safety issues. ODS will also use systematic reviews to translate research results for public health policy decision-making.

STRATEGY 1-1: Increase understanding of the health impacts and biological effects of dietary supplements.

ODS will support innovative research to evaluate the health effects of dietary supplements—primarily for promoting health and reducing the risk of disease—and the underlying biological mechanisms by which they do so. In addition to co-funding new research with partner NIH ICs, ODS will continue to expand its ability to promote research on dietary supplements by providing supplemental funding to existing NIH grants, thus stimulating more investigations of dietary supplements' health effects.

In a joint effort with the National Center for Complementary and Integrative Health (NCCIH), ODS will continue to support transdisciplinary research to characterize the active components and health effects of inherently complex botanical dietary supplements. The NIH Centers for Advancing Research on Botanical and Other Natural Products (CARBON) Program will continue to conduct preclinical research to inform future clinical trials and accelerate state-of-the-art, high-throughput, and high-content method development.

ODS will support research to identify and measure biomarkers of nutrient exposure and status in relation to chronic disease in populations and individuals.

Recent research, such as that supported by the NIH Human Microbiome Project, has revealed many insights into the influence of human-associated microbes on health and nutrition and has raised many more questions. ODS will seek to understand the role of the microbiome in mediating the effects of bioactive components in food and dietary supplements. ODS will remain committed to supporting novel research, workshops, symposia, and trans-federal agency efforts aimed at elucidating the functional relevance of the microbiota to nutritional status, energy balance, and risk of disease.

STRATEGY 1-2: Conduct research on patterns of dietary supplement use in the U.S. population.

ODS staff will assess the prevalence, frequency, duration, levels, and types of dietary supplements used in the United States. For example, ODS plans to use National Health and Nutrition Examination Survey (NHANES) data to investigate dietary supplement usage patterns in diverse population cohorts (such as seniors, Native American communities, pregnant women, infants, children, and cancer survivors) and consumer use of dietary supplements in combination with widely used over-the-counter and prescription medications. ODS also plans to evaluate the cognitive and behavioral factors underlying dietary supplement use.

ODS will address methodological issues related to assessment of supplement usage in epidemiologic and other study designs. It will also evaluate current and novel laboratory methods to measure supplement usage and nutritional status for individual ingredients in supplements.

STRATEGY 1-3: Identify knowledge gaps and research needs.

ODS will support and co-sponsor systematic reviews of dietary supplements and their ingredients. Topics will include the efficacy and safety of supplement use and their potential role in reducing disease risk. ODS will also sponsor systematic reviews to assess the strength and quality of the science on the health effects of dietary supplements and their ingredients.

ODS will continue to conduct internal and NIH-wide portfolio analyses with NIH ICs and other federal partners, leading to priority setting for funding decisions and identification of emerging research opportunities.

ODS will lead and sponsor workshops and conferences with NIH ICs and offices to discuss and evaluate the current state of the science. Attendees will include dietary supplement researchers, clinicians, government officials, industry representatives, and other stakeholders.

GOAL 2: Enhance the dietary supplement research workforce through training and career development.

Despite the widespread use of dietary supplements, the scientific investigation of many of these products and their ingredients remains a relatively new and small field. Therefore, funding is needed to develop and support a cadre of researchers who study dietary supplements and view their work as a recognized, important, and productive area of investigation.

STRATEGY 2-1: Support scientific training programs and continuing education activities.

The co-funding that ODS provides to extramural researchers will also give them access to ODS staff expertise. ODS will continue to co-fund training grants and career development grants with partner ICs to train junior scientists in methodologies that will enhance dietary supplement research. All components of the CARBON centers, for example, will train young investigators (students, postdoctoral fellows, and new faculty) and encourage recruitment of junior researchers through the support of innovative pilot projects.

ODS will continue its new program that provides administrative supplements to awarded grants for up to a year. This will allow investigators, including junior scientists, to expand the scientific scope of their NIH-funded projects to include work related to dietary supplements.

The ODS will expand the Mary Frances Picciano Dietary Supplement Research Practicum by identifying ways to increase attendance, possibly with a live webcast of future practicums. ODS will also consider broadening the practicum's reach through a video archive.

STRATEGY 2-2: Provide continuing education activities and career development for professionals through opportunities to work with ODS.

ODS will continue to offer postdoctoral and career training in its offices. ODS plans to maintain its sponsorship of fellows through the John A. Milner Fellowship with the U.S. Department of Agriculture (USDA) and the American Association for the Advancement of Science's Science & Technology Policy Fellowship. ODS will explore other mechanisms to support postdoctoral research training in collaboration with other NIH ICs and federal agencies.

ODS will continue to offer opportunities for academic faculty members to work at ODS during their sabbaticals. Mid- and senior-level faculty members will come to ODS for up to a year to develop experience in investigating dietary supplements and to work with ODS scientists on new initiatives, similar to the new initiative related to iron, for example, that ODS developed with the help of a visiting professor from Cornell University.

STRATEGY 2-3: Provide funding to stimulate research training in federal laboratories.

ODS will continue to train young intramural investigators in the stimulating environments of research laboratories across the federal government. ODS will maintain its support for the ODS Intramural Research Scholars Program, a 1-year competitive scholarship opportunity for NIH intramural junior scientists who have at least 1 year of postdoctoral research experience. This program will enable them to develop expertise in the scientific exploration of dietary supplements for health promotion and disease prevention.

ODS will maintain its support for interagency agreements to sponsor junior and senior investigators at collaborating federal agencies, such as the National Institute of Science and Technology (NIST) and the USDA, on projects of mutual interest. An interagency agreement with NIST, for example, supports a postdoctoral fellow in metrology (the science of measurement).

Despite the widespread use of dietary supplements, the scientific investigation of many of these products and their ingredients remains a relatively new and small field.

GOAL 3: Foster development and dissemination of research resources and tools to enhance the quality of dietary supplement research.

There is an ongoing need to develop new research methodologies, resources, and tools to support the study of dietary supplements. ODS will continue to coordinate the creation and dissemination of analytical tools for the characterization of dietary supplement ingredients through its Analytical Methods and Reference Materials Program. This effort will continue to expand beyond dietary supplements to include the measurement of biomarkers of nutrient status in blood and other biological specimens.

STRATEGY 3-1: Enhance the development of appropriate study methods for dietary supplement research.

ODS will stimulate the development, evaluation, and use of appropriate and rigorous research paradigms for investigating the efficacy and safety of dietary supplements. For example, ODS will continue to support and plan workshops on the latest knowledge and emerging approaches in the study of dietary supplements (similar to the workshop on the unique challenges of assessing the safety of botanical dietary supplements co-sponsored by ODS).

ODS will support the development of cutting-edge approaches to elucidate the mechanisms of action of complex botanical dietary supplements. The Centers for Advancing Natural Products Innovation and Technology component of the CARBON Program develops high-content, high-throughput methods to rapidly generate hypotheses on active compounds and their cellular targets.

ODS will also encourage the development and use of appropriately validated biomarkers of nutrient status in studies of the health effects of dietary supplement ingredients. In addition, through its Population Studies Program, ODS will help to develop tools to evaluate dietary supplement usage more precisely in national health surveys and other large cohorts.

The ability to compare, reproduce, and replicate published research results is essential for building scientific knowledge. ODS will ensure that its co-funded grants adhere to rigorous standards for dietary supplement identification to ensure product integrity using a paradigm established by the NCCIH. ODS will also continue to promote the highest quality research in dietary supplements by requiring investigators to thoroughly characterize and report the composition of the products they use in mechanistic and clinical investigations.

STRATEGY 3-2: Foster the highest quality laboratory analyses for dietary supplement constituents to enhance the quality of dietary supplement products by developing and promoting validated analytical methods and certified reference materials (CRMs).

NIST is the main U.S. producer of reference materials that industry and academia use to ensure precision and accuracy in measurements. ODS will engage stakeholders in identifying needs for new validated analytical methods and CRMs. ODS will continue to produce and make available CRMs through collaborative interagency activities.

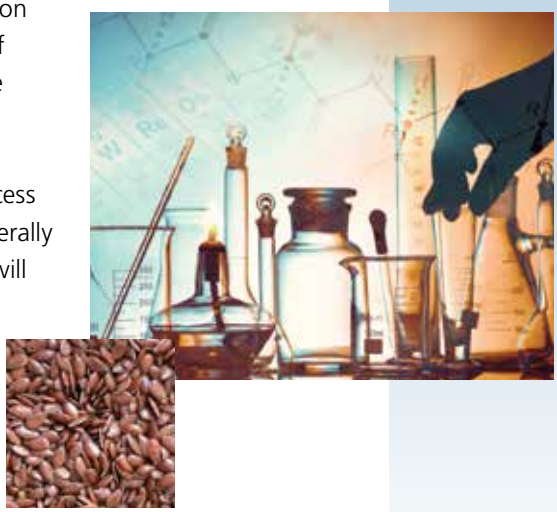
Furthermore, ODS will foster the development, optimization, validation, and use of reliable and accurate analytical techniques for identifying and quantifying specific dietary supplement ingredients and potential contaminants. ODS will support these efforts through funding for research grants, interagency agreements, and contracts with non-government organizations.

STRATEGY 3-3: Develop and provide publicly accessible databases for use in clinical, epidemiological, and other population research on dietary supplements.

ODS will continue to compile dietary supplement product label information in a publicly accessible database. As it has done since launching the DSLD in 2013, ODS will continue to add dietary supplement product label information to the DSLD and ensure its reliability. ODS will also continue to call on external experts and request public comments to further enhance the DSLD by increasing its utility for researchers and consumers.

ODS will continue to prioritize its efforts to analyze ingredients for the Dietary Supplement Ingredient Database (DSID) based on their public health relevance. ODS will also support analyses of ingredients in both foods and dietary supplements to estimate total intakes, especially of key nutrients.

ODS will continue to maintain and enhance the Computer Access to Research on Dietary Supplements (CARDS) database of federally funded research projects to include more years of data. ODS will also develop a more user-friendly interface and create a more precise and informative research-categorization system for CARDS.



GOAL 4: Translate dietary supplement research findings into useful information for consumers, health professionals, researchers, and policymakers.

ODS provides an array of information on dietary supplements and their ingredients that the public views as reliable and up to date. Dietary supplement users will continue to benefit from free access to this objective information. Along with the general public, the website-user community includes health professionals, researchers, and policymakers. ODS will continue to collaborate with others in translating research findings into actionable information for public policy and guideline development.

STRATEGY 4-1: Develop and maintain informational resources on dietary supplements for diverse audiences.

ODS will publish new dietary supplement fact sheets (the most frequently viewed materials on the ODS website) and revise existing fact sheets as necessary to keep them current. By 2021, ODS expects to complete fact sheets on all vitamins and minerals. It will also prepare fact sheets on other ingredients in dietary supplement products (such as omega-3 fatty acids) and on dietary supplements for specific purposes (such as to enhance exercise and athletic performance). ODS will continue to create several forms of each fact sheet: a detailed, referenced version directed to health professionals and easy-to-read versions in both English and Spanish directed to consumers.

ODS will periodically review and update the ODS website to ensure that it meets the needs and interests of users. ODS will further increase access to ODS informational resources through various outreach efforts, such as expanding and promoting its service that provides personal responses from ODS nutrition staff to questions about dietary supplements from ODS website users.

STRATEGY 4-2: Provide leadership on dietary supplement research and educational activities within the federal government.

By congressional mandate, ODS advises the U.S. Department of Health and Human Services (HHS) and its agencies on matters related to dietary supplements, and it will continue to do so. For example, ODS scientists and the staff of the U.S. Food and Drug Administration's Office of Dietary Supplement Programs will continue to meet by conference call every other month, and more often as needed.

To further collaborative efforts on dietary supplement research, education, and communications beyond the HHS, ODS will continue to lead the Federal Working Group

on Dietary Supplements that includes representatives of most NIH ICs and other federal agencies. ODS plans to increase representation on this working group from additional federal agencies that address dietary supplement issues. Through these efforts, ODS will continue to build strategic partnerships and engage leaders and stakeholders in exchanging information and ideas on nutrition and dietary supplement research, education, and policy.

STRATEGY 4-3: Collaborate with stakeholders to inform public health policy and clinical practice related to nutrients and other ingredients in dietary supplements.

ODS has enhanced the scientific framework for developing dietary recommendations through the incorporation of systematic reviews into the Dietary Reference Intake (DRI) development process. For example, ODS is supporting a systematic review of the health effects of potassium and sodium (including consideration of levels that may reduce or increase the risk of chronic diseases) and assisting in the coordination of a federal effort to re-examine the DRIs for these nutrients. ODS will continue to promote rigorous evidence-based research for establishing dietary recommendations.

For several years, ODS has conducted an Iodine Initiative. After convening a series of workshops to identify research needs in this area, ODS is working with other federal agencies to improve assessment of iodine status and measure the iodine content of foods and dietary supplements.

In 2015, ODS established an Iron Initiative to explore issues surrounding iron during pregnancy, infancy, and early childhood. With the help of federal partners, ODS convened a public workshop on iron screening and supplementation of iron-replete pregnant women and young children (aged 6–24 months) in September 2016. The workshop identified the key research needed to address gaps in understanding iron homeostasis in these populations, identify more accurate ways to measure iron status, and determine when iron supplementation is appropriate. ODS will consider the next steps for its iron initiative after the workshop. The workshop proceedings are being prepared for publication in 2017.

ODS provides an array of information on dietary supplements and their ingredients that the public views as reliable and up to date.

Appendix A: ODS Mandates in the Diet ary Supplement Health and Education Act (DSHEA) of 1994 and Subsequent Congressional Language

ODS PURPOSE:

- Explore more fully the potential role of dietary supplements as a significant part of the efforts of the United States to improve health care.
- Promote scientific study of the benefits of dietary supplements in maintaining health and preventing chronic disease and other health-related conditions.

ODS RESPONSIBILITIES:

- Conduct and coordinate scientific research within the National Institutes of Health (NIH) relating to dietary supplements and the extent to which the use of dietary supplements can limit or reduce the risk of diseases.
- Collect and compile the results of scientific research relating to dietary supplements, including scientific data from foreign sources.
- Serve as the principal advisor to the Secretary and to the Assistant Secretary for Health and provide advice to the Director of NIH, the Director of the Centers for Disease Control and Prevention (CDC), and the Commissioner of the Food and Drug Administration (FDA) on issues relating to dietary supplements. These issues include the safety of dietary supplements, the claims characterizing the relationship between the use of dietary supplements and the prevention of disease or other health conditions and the maintenance of health, and scientific issues arising in connection with the labeling and composition of dietary supplements.
- Compile a database of scientific research on dietary supplements and individual nutrients.
- Coordinate funding relating to dietary supplements for the NIH.

Explore more fully the potential role of dietary supplements as a significant part of the efforts of the United States to improve health care.

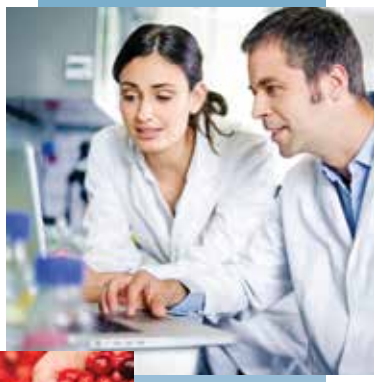
CONGRESSIONAL MANDATES TO ODS SUBSEQUENT TO DSHEA:

- Develop a botanical research center initiative (1999).
- Conduct evidence-based reviews of the efficacy and safety of dietary supplements (2001).
- Accelerate the validation of analytical methods and reference materials for dietary supplements (2001).
- Support the development of a dietary supplement label database (2004).

DEFINITION OF A DIETARY SUPPLEMENT (FROM DSHEA):

- A product (other than tobacco) that is intended to supplement the diet and that bears or contains one or more of the following dietary ingredients: a vitamin; a mineral; an herb or other botanical; an amino acid; a dietary substance for use by humans to supplement the diet by increasing the total daily intake; or a concentrate, metabolite, constituent, extract, or combination of these ingredients.
- Intended for ingestion in pill, capsule, tablet, or liquid form.
- Not represented for use as a conventional food or as the sole item of a meal or diet.
- Labeled as a dietary supplement.

Appendix B: Areas of Focus 2010–2016



This section summarizes and updates the details of ODS's activities as presented in the Strategic Plan 2010–2014 Progress Report published on the ODS website. ODS invited comments on the report from the public, and it used the comments it received to shape the current strategic plan presented in Section II of this document.

ODS categorizes its programs and activities into five broad areas:

1. Research and training
2. Population studies and nutrient interventions
3. Research resources
4. Collaborations with other federal agencies
5. Translating research findings

An ODS staff member oversees each program, and most ODS staff members are active in more than one program. Each program interacts with one or more stakeholder communities.

AREA 1: RESEARCH AND TRAINING

Dietary Supplement Research. ODS supports research largely through grants that it co-funds with National Institutes of Health (NIH) Institutes and Centers (ICs) as well as through contracts and interagency agreements. From fiscal year (FY) 2010 to FY 2016, ODS provided co-funding for 649 grants at a total investment of $90.3 million. ODS-funded research on dietary supplements has characterized the use of these products by the public, described their composition in more detail, determined their effects on body functions, and has led to the development of new analytical technologies, all of which will enhance the quality of future dietary supplement research. Research planning activities—such as workshops, conferences, and symposia—provide critical input on new directions for the ODS research portfolio, give researchers access to ODS staff expertise on dietary supplement matters, and help ensure that the studies that ODS funds use well-characterized and high-quality products.

In FY 2010, ODS used 62% of its $21.75 million research investment budget to fund extramural research. In FY 2016, ODS spent a slightly smaller proportion of its $21.3 million research investment budget (52.5%) to support extramural investments in research.

Botanical Research Centers (BRCs). ODS and its NIH partners established several BRCs in response to a congressional mandate to ODS in 1999. In 2010, ODS, the National Center for Complementary and Alternative Medicine (NCCAM) (now the National Center for Complementary and Integrative Health [NCCIH]) and the National Cancer Institute (NCI) issued 5-year awards for BRCs at Louisiana State University, University of Illinois at Chicago, University of Illinois at Urbana-Champaign, University of Missouri, and Wake Forest University. These BRCs studied the safety and mechanisms of action of botanicals in women's health, metabolic syndrome, cancer, cardiovascular disease, and immune function. Between 2010 and 2015, investigators at these BRCs published 272 research articles in peer-reviewed journals. In 2015, ODS expanded the scope of the BRC Program to include accelerating state-of-the-art method development and changed its name to the NIH Centers for Advancing Research on Botanical and Other Natural Products (CARBON).

Training and Career Development. ODS has provided support for traditional NIH extramural mechanisms that offer training and career development opportunities to junior and mid-career scientists. In addition, ODS created the Research Scholars Program to provide opportunities for junior scientists in intramural NIH laboratories to conduct research on dietary supplements for 1 year.

Dietary Supplement Research Practicum. The Mary Frances Picciano Dietary Supplement Research Practicum is a multiday course on the NIH campus that provides dietary supplement and nutrition research training and career development opportunities to researchers, academic faculty members, students, and health professionals. Since 2007, this annual practicum has included presentations and discussions on issues, concepts, knowledge gaps, and controversies pertaining to dietary supplements and their ingredients. The practicum faculty consists of experts from ODS and NIH ICs, academic institutions, federal regulatory agencies (such as the Food and Drug Administration [FDA] and the Federal Trade Commission [FTC]), industry, consumer, media, and standard-setting organizations. Eligibility for the practicum was originally limited to full-time academic faculty members, doctoral students, postdoctoral researchers, and fellows in health-related disciplines as well as selected government employees and contractors. In 2012, ODS expanded eligibility to all health professionals and scientists with a postgraduate degree whose work involves dietary supplements; master's degree students; and medical, dental, and nursing students.

AREA 2: POPULATION STUDIES AND NUTRIENT INTERVENTIONS

Vitamin D Initiative. To advance scientific understanding of the importance of vitamin D to human health, ODS leads and collaborates in such activities as:

- An update [1] of an evidence-based review of the health effects of vitamin D and clinical vitamin D metabolites with the Agency for Healthcare Research and Quality (AHRQ) [2].
- The measurement of vitamin D exposure and status in the U.S. population with the Centers for Disease Control and Prevention (CDC) [3-6].
- The development of methods, standardized measures, and reference materials for vitamin D with the National Institute of Standards and Technology (NIST) [7].

ODS also co-funds grants for basic, epidemiological, and clinical research on vitamin D with NIH ICs. Finally, ODS established the international Vitamin D Standardization Program (VDSP) with the CDC and NIST to standardize the laboratory measurement of vitamin D status in national health surveys worldwide [8].

Folate and Vitamin B12 Monitoring in the United States. ODS scientists have collaborated with experts at the CDC to review and analyze National Health and Nutrition Examination Survey (NHANES) data on folate and vitamin B12 intake and status. ODS scientists have published these analyses in peer-reviewed journals and presented their findings at national and international meetings [9-14]. In 2010, ODS convened a roundtable of experts and scientists to discuss the measurement of folate and vitamin B12 status biomarkers in NHANES and to identify research gaps. ODS and colleagues who participated in the roundtable published nine articles on the meeting proceedings in a supplement to the *American Journal of Clinical Nutrition* [15]. To improve the accuracy of the laboratory measurement of homocysteine and folate in serum, ODS and NIST jointly developed a certified reference material (CRM) for measuring the levels of these metabolites in frozen human serum.

Evaluation of Dietary Supplement Use in the United States and Relationship to Health and Disease Risk. ODS collaborates with NIH researchers (e.g., from NCI and the Office of Disease Prevention [ODP]), other government agencies (e.g., CDC and U.S. Department of Agriculture [USDA]), academia, and private consulting companies to evaluate dietary supplement use in the United States. ODS and partner scientists analyze data on use of all supplements and of individual nutrients (e.g., iodine, calcium, and vitamin D) and reasons for use in adults and children. We have reported the results in peer-reviewed journals and workshop presentations [5, 13, 16-38]. In addition, ODS investigators have compared the contribution of nutrient intake from dietary supplements with the total intake of nutrients from all sources.

Nutrition and Dietary Supplement Interventions for Inborn Errors of Metabolism (IEM) and Primary Mitochondrial Diseases. ODS established this IEM Initiative in 2010 in collaboration with the NIH Office of Rare Diseases Research (ORDR), in the National Center for Advancing Translational Sciences (NCATS), to identify gaps in research on the safety, efficacy, and effectiveness of nutritional management strategies, including dietary supplements, for IEM. ODS and other NIH partners have convened meetings of federal partners to engage the metabolic disease research community and develop a plan to promote evidence-based research on nutrition and dietary supplement interventions used in IEM. ODS sponsored a workshop in December 2011 to address challenges and share successes in IEM research. One outcome of these efforts has been the development of a research agenda to guide the metabolic disease community in the conduct of research on the safety and efficacy of nutritional interventions and dietary supplement use in IEM [39]. In collaboration with the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) and the ORDR at NIH, ODS held a workshop in December 2014 on nutritional interventions (including dietary supplements) in primary mitochondrial diseases. The workshop goals were to identify gaps in knowledge, develop a research agenda, and identify research opportunities that will promote an evidence base for use of these therapies in primary mitochondrial diseases [40]. Currently, this initiative is developing research approaches that are suitable for the study of all rare disorders. These activities fit into the broader context of public health because they will likely lead to better approaches to manage diseases that affect millions of people.

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AREA 3: RESEARCH RESOURCES

Analytical Methods and Reference Materials (AMRM) Program. Researchers use analytical methods for the quantitative and qualitative analysis of both dietary supplement raw materials and finished products. Ideally, these methods generate reliable, accurate data for use by manufacturers, regulators, and researchers when characterizing these materials and products. Similarly, CRMs are necessary for the development, use, calibration, and evaluation of the methods. Validated analytical methods and CRMs allow analysts to demonstrate that measurements are accurate, precise, and reproducible. The results of these analyses enhance consumer confidence in the quality of marketed dietary supplements and ensure confidence in the results of research on dietary supplements. The AMRM Program has resulted in numerous publications of methods development, methods validation, reference material development, education and outreach, and laboratory performance evaluation.

Dietary Supplement Databases. ODS funded and led the development of two databases on the composition of many dietary supplements for sale in the United States and supports a third. The Dietary Supplement Label Database (DSLD) provides product information taken directly from supplement labels. An internet-based version of the DSLD is available, and ODS will release a mobile version for smartphones later in 2016. A second database, the Dietary Supplement Ingredient Database, provides analytically derived estimates of amounts of ingredients in a nationally representative sample of popular dietary supplements. ODS also supports and is currently updating an internet-based database, Computer Access to Research on Dietary Supplements (CARDS). CARDS contains information on research projects pertaining to dietary supplements. These efforts are more fully described in recent publications [41-57].

Systematic Reviews. ODS developed an evidence-based review program through AHRQ's Evidence-based Practice Center Program. To date, this ODS program has sponsored 21 systematic reviews on topics related to dietary supplements, including B vitamins, ephedra, multivitamin/mineral supplements, omega-3 fatty acids, soy, probiotics, and vitamin D. These reviews have informed the development of research agendas for ODS and its NIH partners. They have also informed the development of Dietary Reference Intakes (DRIs) for calcium and vitamin D.

AREA 4: COLLABORATIONS WITH OTHER FEDERAL AGENCIES

Federal Working Group on Dietary Supplements. In 2005, ODS established the Federal Working Group on Dietary Supplements. The working group's members represent most NIH ICs as well as several other federal agencies (AHRQ, Administration for Community Living [ACL], CDC, Consumer Product Safety Commission [CPSC], Department of Defense [DoD], Department of Justice [DoJ], Department of Veterans Affairs [VA], FDA, FTC, Health Resources and Services Administration [HRSA], National Aeronautics and Space Administration [NASA], NIST, HHS Office of Disease Prevention and Health Promotion [ODPHP], U.S. Agency for International Development [USAID], and USDA). This group has met twice a year since January 2005 to strengthen individual agency and collaborative efforts involving dietary supplement research, education, and communication.

Several descriptions and profiles of ODS programs in this document mention additional ODS collaborations with federal agencies. The following collaborations are examples of ODS's ability to catalyze research partnerships and serve as an advisor to federal agencies on topics related to dietary supplements:

FDA. ODS provides expert consultation to FDA staff and has collaborated with them to create systematic reviews (e.g., of probiotic safety) and organize conferences. FDA and ODS are co-leads on the recently formed microbiome working group to coordinate related activities.

USDA. ODS collaborations with the USDA Agricultural Research Service include funding the DSID, developing and validating research methods to identify ingredients in botanicals, and establishing the John A. Milner Postdoctoral Fellowship Program. To date, two fellows have been funded.

DoD. ODS helps the DoD study the use, safety, and efficacy of dietary supplements in military populations. ODS also helps DoD educate warfighters about the benefits, risks, and proper use of such products. Finally, ODS provides expert consultation to DoD staff, and ODS staff serve on DoD advisory committees.

AREA 5: TRANSLATING RESEARCH FINDINGS

Communications. ODS communication efforts include a broad spectrum of outreach activities, such as enhancing and maintaining the ODS website, engaging with social media, responding to media and public inquiries, and developing useful information for consumers and health professionals. Two ODS newsletters have wide readerships, and ODS disseminates each one electronically to more than 7,000 addresses. ODS staff scientists frequently give seminars at scientific and professional conferences, workshops, and lectures for university courses.

Public Health Policy and Clinical Practice Related to Dietary Supplements. ODS has supported the development of DRIs for the United States and Canada and research on the science underpinning these values and their application. Although the original intent of DRIs was to help ensure that adults and children have adequate nutrient intakes, ODS is now studying whether it is possible to establish such values for the use of dietary supplements to prevent chronic diseases.

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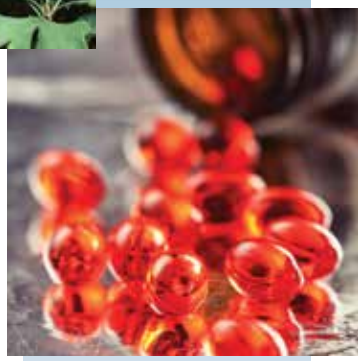

Appendix C: Glossary

25(OH)D	25-hydroxyvitamin D
ACL	Administration for Community Living
AHRQ	Agency for Healthcare Research and Quality
AMRM	Analytical Methods and Reference Materials
BRC	Botanical Research Center
CARBON	Centers for Advancing Research on Botanical and Other Natural Products
CARDS	Computer Access to Research on Dietary Supplements
CDC	Centers for Disease Control and Prevention
CPSI	Consumer Product Safety Commission
CRM	certified reference material
DoD	Department of Defense
DoJ	Department of Justice
DPCPSI	Division of Program Coordination, Planning, and Strategic Initiatives
DRIs	Dietary Reference Intakes
DSHEA	Dietary Supplement Health and Education Act
DSID	Dietary Supplement Ingredient Database
DSLD	Dietary Supplement Label Database
FDA	U.S. Food and Drug Administration
FTC	Federal Trade Commission
FY	fiscal year
HHS	Department of Health and Human Services
HRSA	Health Resources and Services Administration
ICs	Institutes and Centers (of NIH)
IEM	inborn errors of metabolism
NASA	National Aeronautics and Space Administration
NCATS	National Center for Advancing Translational Sciences
NCCAM	National Center for Complementary and Alternative Medicine (now NCCIH)
NCCIH	National Center for Complementary and Integrative Health (formerly NCCAM)
NCI	National Cancer Institute
NHANES	National Health and Nutrition Examination Survey
NICHD	*Eunice Kennedy Shriver* National Institute of Child Health and Human Development
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NLM	National Library of Medicine
OD	Office of the Director
ODP	Office of Disease Prevention
ODS	Office of Dietary Supplements
ORDR	Office of Rare Diseases Research
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
VA	U.S. Department of Veterans Affairs
VDSP	Vitamin D Standardization Program

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