

# Aging Well in the 21<sup>st</sup> Century: Strategic Directions for Research on Aging

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## Contents

Introduction .....	1
Understanding the Dynamics of the Aging Process.....	4
<b>Goal A Better understand the biology of aging and its impact on the prevention, progression, and prognosis of disease and disability. ....</b>	<b>4</b>
<b>Goal B Better understand the effects of personal, interpersonal, and societal factors on aging, including the mechanisms through which these factors exert their effects.....</b>	<b>8</b>
Improving the Health, Well-Being, and Independence of Adults as They Age.....	11
<b>Goal C Develop effective interventions to maintain health, well-being, and function and prevent or reduce the burden of age-related diseases, disorders, and disabilities.....</b>	<b>12</b>
<b>Goal D Improve our understanding of the aging brain, Alzheimer’s disease, related dementias, and other neurodegenerative diseases. Develop interventions to address Alzheimer’s and other age-related neurological conditions.....</b>	<b>166</b>
<b>Goal E Improve our understanding of the consequences of an aging society to inform intervention development and policy decisions.....</b>	<b>21</b>
<b>Goal F Understand health disparities and develop strategies to improve the health status of older adults in diverse populations. ....</b>	<b>233</b>
Supporting the Research Enterprise .....	288
<b>Goal G Support the infrastructure and resources needed to promote high quality research. ....</b>	<b>288</b>
<b>Goal H Disseminate information to the public, medical and scientific communities, and policy makers about research and interventions. ....</b>	<b>31</b>

## Aging...by the Numbers

**47.3:** Average life expectancy at birth, 1900

**78.7:** Average life expectancy at birth, 2011

**43 million:** Number of Americans ages 65 and over, 2012

**72 million:** Estimated number of Americans ages 65 and over, 2030

**89 million:** Estimated number of Americans ages 65 and over, 2050

**6 million:** Number of Americans ages 85 and older, 2012

**19 million:** Estimated number of Americans ages 85 and older, 2050

**3 thousand:** Number of Americans ages 100 and older, 1950

**62 thousand:** Number of Americans ages 100 and older, 2012

**Approximately 1 million:** Estimated number of Americans ages 100 and older, 2050

**23 million:** Americans ages 65 and older reporting difficulty performing at least one basic or complex activity, 2010

**45.4 percent:** Americans ages 65 or older reporting two or three chronic health conditions, 2012

**14.1 percent:** Americans ages 65 and older reporting four or more chronic health conditions, 2012

*(Adults were categorized as having 0 to 1, 2 to 3, or 4 or more of these conditions: hypertension, coronary heart disease, stroke, diabetes, cancer, arthritis, hepatitis, weak or failing kidneys, chronic obstructive pulmonary disease, or current asthma)*

Sources: Older Americans 2012: Key Indicators of Well-Being; CDC and ACL data

## Introduction

There is no question that Americans have long benefited from sweeping advances in nutrition, sanitation, and medicine that transformed public health practice and dramatically increased average lifespan during the first half of the twentieth century. But it is also true that these advances, along with a mid-century surge in the American birthrate, have brought with them a new set of challenges.

As growing numbers of people live well into their 80s and 90s, age-related diseases and conditions – and the disability often associated with them – continue to be a major public health concern. For example, Alzheimer’s disease, cardiovascular disease, cancer, and diabetes remain widespread among older Americans. In addition, many older Americans suffer from multiple chronic health conditions, complicating treatment and impairing quality of life.

At the same time, we are only beginning to understand and address the social, economic, and health service implications of the United States’ changing demographics. Our health care, insurance, and retirement systems face the daunting task of meeting the needs of a rising number of “customers,” and the impact of an increasingly elderly population on our communities is not fully understood.

To reduce the burden of illness, enhance quality of life, and maintain health among older adults, we must first understand the aging contexts for illness and health. Some biological, physical, emotional, and cognitive changes are normal with increasing age, and so we seek deeper knowledge of what happens to our bodies and minds over time, influenced by genetics, the environment, and disease-specific processes, and to apply what we have learned to improved health, better function and reduced risk of disease. To that end, we are exploring “aging” not as a single process, but rather as an intricate web of interdependent genetic, biochemical, physiological, economic, social, and psychological factors.

Modern medicine, healthier lifestyles, and other environmental influences have already allowed a growing number of people to remain healthy and socially and emotionally vital into advanced age. The challenge for the 21st century will be to make these added years as healthy and productive as possible for growing numbers of people.

## **The National Institute on Aging**

Congress established the National Institute on Aging (NIA) at the National Institutes of Health (NIH) in 1974 to lead a national scientific effort to understand the nature of aging in order to promote the health and well-being of older adults. The Institute was subsequently designated as the lead within NIH for Alzheimer's disease research.

NIA is one of the 27 Institutes and Centers that make up the NIH, a component of the U.S. Department of Health and Human Services.

### **The Institute's mission is to:**

- Support and conduct genetic, biological, clinical, behavioral, social, and economic research related to the aging process, diseases and conditions associated with aging, and other special problems and needs of older Americans.
- Foster the development of research and clinician scientists in aging.
- Provide research resources.
- Communicate information about aging and advances in research on aging to the scientific community, health care providers, and the public.

NIA pursues this mission by funding extramural research at universities and medical centers across the United States and around the world; maintaining an active communications and outreach program; and conducting a vibrant intramural research program at NIA laboratories in Baltimore and Bethesda, Maryland.

## **About This Document**

This document outlines the broad strategic directions of the Institute. It provides a point of reference for setting priorities and a framework for systematically analyzing the Institute's scientific portfolio and assessing progress. NIA developed and refined these goals over a period of approximately one year, in close consultation with stakeholders in the research community, non-governmental organizations, partners within the NIH and elsewhere within the federal government, and members of the general public. We will update it as needed as the field of aging research evolves.

## **Our goals are:**

### Understanding the Dynamics of the Aging Process

**Goal A Better understand the biology of aging and its impact on the prevention, progression, and prognosis of disease and disability.**

**Goal B Better understand the effects of personal, interpersonal, and societal factors on aging, including the mechanisms through which these factors exert their effects.**

### Improving the Health, Well-Being, and Independence of Adults as They Age

**Goal C Develop effective interventions to maintain health, well-being, and function and prevent or reduce the burden of age-related diseases, disorders, and disabilities.**

**Goal D Improve our understanding of the aging brain, Alzheimer's disease and other neurodegenerative diseases. Develop interventions to address Alzheimer's and other age-related neurological conditions.**

**Goal E Improve our understanding of the consequences of an aging society to inform intervention development and policy decisions.**

**Goal F Understand health differences and develop strategies to improve the health status of older adults in diverse populations.**

### Supporting the Research Enterprise

**Goal G Support the infrastructure and resources needed to promote high quality research.**

**Goal H Disseminate information to the public, medical and scientific communities, and policy makers about research and interventions.**

***Our vision is to enable all Americans to enjoy robust health and independence with advancing age.***

# Understanding the Dynamics of the Aging Process

Aging is associated with changes in dynamic biological, physiological, environmental, psychological, behavioral, and social processes. Some age-related changes are benign, such as graying hair. Others result in declines in function of the senses and activities of daily life and increased susceptibility to and frequency of disease, frailty, or disability. In fact, advancing age is the major risk factor for a number of chronic diseases in humans.

Studies from the basic biology of aging using laboratory animals – and now extended to human populations – have led to the emergence of theories to explain aging. While there is no single ‘key’ to explain aging, these studies have demonstrated that while the passage of time is not altered, the rate of aging can be slowed. These studies suggest that targeting aging will coincidentally slow the appearance and/or lessen the burden of numerous diseases and increase health span (the portion of life spent in good health).

NIA-supported researchers are engaged in basic science at all levels of analysis, from molecular to social, to understand the processes of aging and the factors that determine who ages well and who ages poorly. Research is also ongoing to identify the interactions among genetic, environmental, lifestyle, behavioral, and social factors and their influence on the initiation and progression of age-related diseases and degenerative conditions.

To develop new interventions for the prevention, early detection, diagnosis, and treatment of aging related diseases, disorders, and disabilities, we must first understand their causes and the factors that place people at increased risk for their initiation and progression. NIA has established two goals in the basic science of aging:

## Goal A

Better understand the biology of aging and its impact on the prevention, progression, and prognosis of disease and disability.

## Goal B

Better understand the effects of personal, interpersonal, and societal factors on aging, including the mechanisms through which these factors exert their effects.

## Goal A

### **Better understand the biology of aging and its impact on the prevention, progression, and prognosis of disease and disability.**

One of our challenges is to develop a clearer understanding of the basic biology underlying changes that accompany aging, as distinct from the basic biology underlying disease. Aging is not, in and of itself, a disease. However, aging is the major risk factor for developing many major chronic diseases. Furthermore, many diseases (chronic or inherited) appear to accelerate aging – which is manifested as declines in functionality and reduced quality of life.

For example, in response to bacterial infections or wounds, inflammation is an essential part of the recovery and healing process. However, low-level chronic inflammation that appears in the absence of clinically diagnosed infection may increase the susceptibility to and rate of progression of age-related pathologies. Chronic inflammation may also contribute to frailty in ways that are independent of overt disease.

Another challenge is to take advantage of the most promising opportunities presented by work in laboratory animals and to translate those findings to humans. A few seminal discoveries offer possibilities for improved human health in an aging population. For example:

- Interventions that extend lifespan also extend health span – the proportion of lifespan spent in good health – implying that interventions that extend life can reduce the burden of multiple diseases.
- Certain circulating proteins (or other factors) have been shown to reverse some negative effects of aging in mice, possibly suggesting treatments for some age-related functional losses or pathologies found in the human population.
- Starvation causes normal cells to mount stress-response defenses that are not available to cancer cells, a finding that has entered the early phase of clinical testing as a possible intervention to enhance chemotherapy while also reducing some of its side effects.
- Longevity can be inherited across generations through *epigenetic* changes – that is, changes that affect gene expression but do not alter the nucleotide sequence of DNA. This suggests that parental lifespan and even parental behavior can influence the lifespans and health spans of the next generation through mechanisms other than genetics.

These and newly emerging findings from the basic biology of aging hold great promise for improving health, and NIA is committed to continuing support of this research and translating these discoveries into interventions that support better health.

Our objectives in this area are to:

- A-1 Identify genetic, molecular and cellular factors that determine the rate of aging processes.
- A-2 Determine how the cellular and molecular bases of changes associated with aging contribute to decreased function and increased incidence of disease.
- A-3 Improve our understanding of the molecular, genetic, cellular, and tissue changes with aging that contribute to increased risk for, alter the course of, and/or vary the response to the treatment of major age-associated diseases.
- A-4 Understand the sensory and motor changes associated with aging and how they lead to decreased function and increased incidence of disease.
- A-5 Understand the role of stem cells in tissue maintenance and how stem cells and their environments change with age.
- A-6 Identify the genetic and epigenetic bases of aging and age-related diseases and conditions as well as factors that affect disease initiation and progression.
- A-7 Identify the molecular and cellular bases of age-related decline in immune responses and improve our understanding of how the inflammatory process affects – and is affected by – aging.
- A-8 Understand the influence of metabolic status and nutrient sensing in healthy aging.
- A-9 Understand the interactions between microbiome, tissue integrity and function with aging, and the contributions of changes to these systems to declining health and function.
- A-10 Understand the basis for changes in adaptation to macromolecular damage and response to stress affect – and are affected by – aging.
- A-11 Identify and characterize compounds that hold the promise of increasing healthy lifespan, and determine the differential effects on males versus females.

- A-1 Identify cellular and molecular factors that determine the rate of aging processes.** Researchers have identified key factors affecting the rate of aging, including the body's response to a variety of stresses; the function of the immune system; the role of cellular senescence; and protein quality control (proteostasis), among others. NIA will support research to identify additional factors and to elucidate the role of each of these processes in both animal models of aging and in humans.
- A-2 Determine how the cellular and molecular bases of changes associated with aging contribute to decreased function and increased incidence of disease.** Increasing age is often accompanied by a progressive decline in almost all physiological functions, resulting in increased susceptibility to disease. At the same time, many people maintain physical function and enjoy robust health well into older age. Together, these findings suggest that manipulation of the basic processes of aging in order to maintain physiological function might provide an effective way to prevent or treat age-related diseases. NIA will encourage research in both the loss and maintenance of functions during the aging process and will foster studies both in humans and in animal models to investigate the health- and disease-related effects of manipulating aging-related processes at the molecular or cellular level.
- A-3 Improve our understanding of the fundamental factors that contribute to increased risk for, alter the course of, and vary the response to the treatment of major age-associated diseases.** We will increase efforts to understand the factors that can alter individuals' susceptibility to disease and affect the response to treatment. In addition, we will work with other NIH institutes and centers to study how phenomena such as anxiety and other negative emotions – high levels of which can damage cells, tissues, and organ systems – can alter nervous system function.
- A-4 Understand the sensory and motor changes associated with aging and how they lead to decreased function and increased incidence of disease.** Mobility changes in the aging adult can result from changes in gait, balance, physical strength, and can negatively influence the number and severity of falls, social participation, and independence. Loss of sensory functions such as vision, hearing, or the ability to taste is also common among older individuals. NIA-supported research to better understand the underlying mechanisms of age-associated sensory and motor changes will provide the knowledge base necessary to develop interventions that optimize mobility and sensory function and prevent disease in the later years of life.
- A-5 Understand the role of stem cells in tissue maintenance and how stem cells and their environments change with age.** Stem cells are specialized cells in specialized locations that contribute to tissue development and replenishment throughout life and are important tools for both cell-based therapies and regenerative medicine. Tissues and organs lose function with advanced age, and such losses may result from declines in stem cell function. This loss of function occurs at different levels, including the stem cells themselves, the specialized locations where they self-renew (the niche), and the ability to engraft and differentiate in tissues undergoing turnover or in need of repair.

NIA will pursue the major challenges in stem cell-based therapies and regenerative medicine, including techniques that will help ensure that stem cells can be grown in adequate numbers for tissue repair or replacement while preserving their potency. NIA will also foster research to create a detailed molecular and functional understanding of the effects of aging on stem cells and their niches, as well as strategies to reprogram somatic cells into pluripotent stem cells and direct pluripotent and stem cell differentiation into specific cell types. This research will inform efforts to devise repair and replacement strategies suitable for older humans, while minimizing potentially harmful side effects.

**A-6 Identify the genetic and epigenetic bases of aging and age-related diseases and conditions as well as factors that affect disease initiation and progression.** Studies of genes associated with aging processes, longevity, and age-related diseases will continue to provide insights into disease pathologies and vulnerability. However, emerging research suggests that epigenetic mechanisms may also underlie, in part, both the aging process and susceptibility to common and complex diseases of aging, particularly those subject to environmental influences. We will support research to understand the basic epigenetic mechanisms influencing the aging process as a whole. In addition, we will work to understand the interplay among genes and environmental influences, as this knowledge will be essential to our understanding of the development of both healthy aging and disease.

**A-7 Identify the molecular and cellular bases of age-related decline in immune responses and improve our understanding of how the inflammatory process is affected by aging and how these changes impact tissue function.** The age-related decrease in the cellular response for manufacturing antibodies and killing pathogens makes older adults more prone to a variety of infections and reduces the efficacy of vaccinations. NIA will conduct and support research to develop more protective vaccine regimens and strategies to improve immune responses in the aging population.

NIA will conduct and support research to examine the role of different cell types, including immune cells, adipose tissue (fat), and brain cells in the age-related increase in levels of pro-inflammatory cytokines and other circulatory factors. Researchers will also investigate how changes in the circulating levels of these cytokines and factors contribute to pathological changes in tissues and organs. NIA will facilitate exploration of the ways in which the response of different tissues to pro-inflammatory cytokines are affected by age and how these changes contribute to the overall balance of the immune system.

**A-8 Understand the influence of metabolic status and nutrient sensing in healthy aging.** We will continue collaborative studies on the interactions and cross-talk among obesity, metabolic pathways and regulation, insulin signaling, hypertension, and diabetes. We will conduct and support exploration into the relationships among mitochondrial biogenesis, oxidative stress, musculoskeletal function, and energy to understand how these factors affect healthy aging.

**A-9 Understand the interactions between microbiome and tissue integrity and function.** The human microbiome is important for human health and disease. The gut microbiome is especially important for immunity, and both gut physiology and the microbiome change during aging. Because there are 30 times more lymphocytes in the gut (mucosa) than in peripheral blood, study of the interactions between the gut and its microbiome are important areas of study in the immunobiology of aging, as well as nutrient absorption and metabolism.

**A-10 Understand the basis for changes in adaptation to macromolecular damage and response to stress that affect – and are affected by – aging.** Research addressing damage to macromolecules has long been supported by NIA, as this damage has been considered a major driver of aging processes. Resistance to this damage (i.e., resilience) and how the cell responds to damage has gained significant attention and NIA will support further research into these areas, including hormesis and how to differentiate between healthy and unhealthy stresses.

**A-11 Identify and characterize interventions that hold the promise of increasing healthy lifespan and determine the differential effects on males versus females.** The NIA established and continues to



support the Intervention Testing Program (ITP), to test the reproducibility of candidate interventions that will prolong lifespan and increase health span. In this and other research the NIA promotes studies in both female and male organisms. Similar studies are supported in the Caenorhabditis Interventions Testing Program (CITP) to explore the impact of genetic diversity on the efficacy of interventions. We support studies on the mechanisms of action of these interventions which will facilitate their translation to benefit healthy aging in humans.

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## **TRANS-NIH GEROSCIENCE INTEREST GROUP**

The elderly comprise the fastest growing segment of our population, and aging itself is the largest single risk factor for most chronic diseases. As a result, a large proportion of health care resources are used to treat the elderly, who are often affected by multiple chronic diseases and conditions.

Over the past few decades, researchers have made impressive progress in understanding the genetics, biology and physiology of aging. Basic research in animal models has demonstrated the plasticity of lifespan. Most importantly, slowing the aging processes leads to an increase in health span, or the portion of life spent in good health.

By developing a collaborative framework that includes several NIH Institutes with an interest in the biological mechanisms that drive the appearance of multiple diseases of the elderly, the GeroScience Interest Group (GSIG) aims to accelerate and coordinate efforts to promote further discoveries on the common risks and mechanisms behind such diseases. By pooling resources and expertise, the GSIG identifies major cross-cutting areas of research and proposes coordinated approaches to identify hurdles and envision solutions. To assist scientists interested in solving the health problems of our rapidly expanding elderly population, the GSIG supports the development of new tools, models and paradigms that address the basic biological underpinnings of multiple diseases.

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## **Goal B**

### **Better understand the effects of personal, interpersonal, and societal factors on aging, including the mechanisms through which these factors exert their effects.**

Behavioral and psychological factors – for example, physical activity, smoking and other health behaviors, cognitive and social engagement, personality, and psychosocial stress – play a critical role in health across the lifespan. For example, studies have shown that up to 50 percent of preventable deaths in the United States can be attributed to adverse health behaviors such as smoking and unhealthy diet that results in obesity. Likewise, social factors – including social relationships and socioeconomic circumstances – have a similarly important impact on health and well-being. For example, subjective feelings of loneliness are known to be a risk factor for serious functional declines and even death, and converging lines of evidence from multiple cross-national epidemiological studies indicate that social isolation is a major risk factor for morbidity and premature mortality. Behavioral and social factors interact with genetic, molecular, and cellular mechanisms to influence health at older ages.

Basic research in the biological, neurological, social, and behavioral sciences has revolutionized our understanding of healthy aging. New findings about genetic, molecular, and cellular factors and processes that affect the course of aging are providing valuable insights about aging, longevity, and the

pathogenesis of disease. Basic behavioral science is uncovering individual level psychological, social, and behavioral factors that predict adaptive and healthy aging or confer risk for age-related decline. Similarly, population studies are uncovering potential risk and protective factors such as environmental exposures, health related behaviors, and social relationships, as well as the influence of co-existing conditions across the lifespan and their relationship to health and the progression of disease.

Evidence suggests that these factors and their interplay are critical to minimizing disease and achieving full potential and vitality as people age. NIA will support and conduct research to verify the linkages and to better understand their underlying mechanisms.

Research supported and conducted by NIA is helping to identify lifestyle factors and health behaviors that directly influence physical, cognitive, sensory, and emotional health and risk of disease as people age, such as research linking work and social engagement to cognition. Scientists are developing and refining recommendations for people of all ages regarding optimal diet, use of dietary supplements, mental stimulation, physical exercise, quality sleep, social engagement, stress reduction, and other practices to increase their likelihood of enjoying healthy old age. NIA will conduct and support research to lay the groundwork for a unified science of behavior change that capitalizes on advances in basic behavioral and social science research to better characterize mechanisms of change at all levels of description, from molecular to social. We anticipate that this research will ultimately enable us to build upon the progress we have already made and facilitate development of effective behavioral interventions in specific disease areas.

Still other researchers are looking for better ways to enhance the physical, mental, and social capacities of older people and to expand opportunities for them to achieve personal goals and contribute to society in meaningful ways. As investigators more precisely identify the psychological, behavioral, and social processes that influence health and quality of life, we will be able to reinforce prevention efforts, enhance symptom management, and conserve function among older people.

Our objectives in this area are to:

- B-1 Understand the basic behavioral, social, and psychological aspects of aging and well-being.
- B-2 Illuminate the pathways by which social, psychological, economic, and behavioral factors affect health in middle-aged and older adults.
- B-3 Identify developmental, prenatal, early life, and environmental processes that affect individual differences in aging and risk of disease.
- B-4 Explore the mechanisms that account for the effects of disadvantage, including research that focuses on critical periods for reversing such effects and/or the optimal timing of intervention.
- B-5 Identify, analyze, and track changing patterns of disability and mortality for older adults and better understand factors contributing to these patterns.

**B-1 Understand the basic behavioral, social, and psychological aspects of aging and well-being.** Along with new physical, social, and emotional challenges, increasing age brings changes in cognition and emotion that have impacts on subjective well-being, social relationships, decision making, and self-control. How individuals respond to these challenges has implications for their independence, cognitive function, social relationships, mental health, physical function, and economic well-being.

NIA will continue to conduct and support basic research in cognition, emotion, and motivation in normal aging, including their neurobiological and genetic bases. We will also explore these factors' relationships to individual differences, social processes, and contextual factors. Finally, NIA will

continue research on the interrelationships among emotion, cognition, and brain function; this information will guide the development of new biobehavioral interventions.

**B-2 Illuminate the pathways by which social, psychological, economic, and behavioral factors affect health in middle-aged and older adults.** Research is needed to help fully establish the pathways through which genes, environments, and behavior interact. For example, research on the impact of social relationships on health has shown that loneliness and social isolation are associated with risk for illness and premature mortality through different biological and behavioral pathways. NIA-supported investigators are also exploring the roles of behavior and biology, including genetics, in mediating the link between stress and disease. We will encourage multi-level and interdisciplinary research on the interactive effects of genes, behavior, biology, and social and physical environments on health and well-being as people age. Finally, we will work to identify important biomarkers that are linked to aging-relevant social and behavioral phenomena, including the integration of neuroimaging data in large-scale surveys and laboratory-based studies with representative samples.

**B-3 Identify developmental, prenatal, early life, and environmental processes that affect individual differences in aging and risk of disease.** Exposure to harmful substances can exert profound and long-lasting physical effects on a developing fetus, and childhood exposure to environmental agents such as infections or drugs can greatly limit adult physical and cognitive health and longevity. Contextual factors such as residential segregation and socioeconomic status may greatly determine exposure to these agents. NIA will continue to support mechanistic and epidemiological studies to identify such factors and participate in translational studies to find ways to minimize their effects in adults.

**B-4 Explore the mechanisms that account for the effects of disadvantage, including research that focuses on critical periods for reversing such effects and/or the optimal timing of intervention.** Many old-age outcomes and behaviors are influenced by events, social relationships, non-cognitive character skills, environmental factors, and habits that begin relatively early in life. Subgroups of the population experience disadvantage throughout their lives or for extended periods in life that generate persistent stress, and their patterns of stress reactivity appear to hasten the progression of disease. It is therefore important to identify key behavioral and social factors associated with all forms of social adversity in order to identify opportunities for their amelioration. Life course data connecting childhood circumstances to mid-life/old-age outcomes will facilitate research that identifies such mechanisms.

**B-5 Identify, analyze, and track changing patterns of disability and mortality for older adults and better understand factors contributing to these patterns.** The current pattern of increased “active life expectancy,” the average number of years an individual will live without a limiting disease or disability in parallel with increased length of life, is threatened by increases in obesity and disability rates among younger Americans. Likewise, longevity rates in the United States are lagging relative to other developed nations. Research supported and conducted by NIA will address disability dynamics at several levels, including longitudinal research to understand the determinants of onset, severity, and recovery from disabling conditions. At the population level, we will foster research to understand the pathways to disability and the causes of change in mobility and function over time as well as subgroup disparities. We will also invest in research on more sensitive measures of functional disability that are needed to better track these changes. Finally, we will identify and address the factors that account for worsening trends in mortality in midlife and at older ages in the U.S.

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## Using Longitudinal Data to Influence Health

NIA supports a number of longitudinal studies in which we have already collected a large amount of data on the participants. Because so much is already known about these groups, they provide us with a unique “living laboratory” in which to study both risk persistence mechanisms and factors that enhance responsiveness to intervention. New techniques for inferring causality from observational studies and complex data are also enabling us to draw important conclusions about the links between behavior and biology, and about possible behavioral interventions, as a complement to experimental studies and randomized controlled trials.

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## Improving the Health, Well-Being, and Independence of Adults as They Age

New insights into lifestyle, psychological, and other environmental influences on health promise to have a profound impact on the ability of older adults to remain physically healthy and cognitively, emotionally, and socially vital into very advanced ages – ideally, for as long as they live. Capitalizing on new insights from basic research, scientists will continue to work from multiple perspectives to develop and test strategies for preempting or reducing the severity of the full range of health problems that midlife and older adults experience. We will also work to strengthen the translation of basic findings and cutting-edge technological breakthroughs into practical applications to improve health and well-being at older ages.

We have established four goals for improving the health, well-being, and independence of adults as they age.

### Goal C

Develop effective interventions to maintain health, well-being, and function and prevent or reduce the burden of age-related diseases, disorders, and disabilities.

### Goal D

Improve our understanding of the aging brain, Alzheimer’s disease and other neurodegenerative diseases. Develop interventions to address Alzheimer’s and other age-related neurological conditions.

### Goal E

Improve our understanding of the consequences of an aging society to inform intervention development and policy decisions.

### Goal F

Understand health differences and develop strategies to improve the health status of older adults in diverse populations.

## Goal C

### Develop effective interventions to maintain health, well-being, and function and prevent or reduce the burden of age-related diseases, disorders, and disabilities.

Physical fitness, proper nutrition, and avoidance of smoking and other behaviors that adversely affect health can help older individuals maintain good health and function into old age. Conversely, unhealthy lifestyle choices may be associated with significant health problems. However, research has shown that it is almost never too late to decrease risk of disease and disability by establishing healthier patterns. Improved health habits can help people live longer, postpone the onset of disability, and increase quality of life and function at older ages. Research has also shown that optimizing both the physical and social environment is important to the health and functioning of older adults.

Our objectives in this area are to:

- C-1 Develop efficacious and cost-effective strategies for promoting and ensuring adherence to healthy and safe behaviors among older adults.
- C-2 Develop improved approaches for the early detection and diagnosis of disabling illnesses and age-related debilitating conditions.
- C-3 Develop interventions for treating, preventing, or delaying the onset of age-related diseases and conditions.
- C-4 Find significantly improved and cost-effective ways to reduce caregiver, family, and patient stress and improve older adults' ability to cope with chronic disease
- C-5 Develop strategies to improve the interaction of older adults with the health system.
- C-6 Understand and develop strategies to enhance societal roles and interpersonal support for older adults, reduce social isolation, and promote caregiving outcomes and supports.

#### **C-1 Develop efficacious and cost-effective strategies for promoting and ensuring adherence to healthy and safe behaviors among older adults.**

- **Build on our understanding of the roles of nutrition, obesity, sleep, and metabolic status to develop more effective health maintenance strategies.** Epidemiological studies – and, in some cases, studies in animals – have shown clear positive effects of lifestyle choices such as healthy diet and exercise, as well as the negative effects of obesity, malnutrition, and less-than-optimal sleep patterns on health and age-related morbidity. We will use these and other findings to develop and test in clinical trials cost effective dietary and other behavioral measures and adherence strategies for the prevention or delay of disease and disability.
- **Use our increased understanding of the underlying science to maximize the positive effect of exercise on older adults.** Several studies strongly suggest that modest exercise may have beneficial effects in maintaining health – including mental health – and that these benefits are possible even at advanced ages. For example, weight-bearing exercise can build bone strength, protecting against osteoporosis and subsequent fragility fractures. We will:
  - Continue to foster research into the molecular, cellular, and physiological mechanisms by which exercise improves health.
  - Support further research on the effects of exercise programs on older adults within specific age groups and develop strategies for promoting adherence.
  - Continue to disseminate information about the importance of exercise for older people through our **Go4Life** health promotion campaign.

- **Continue to support and conduct research to understand hormone changes in older adults and pursue the development of interventions to address these changes without unwanted side effects.** Counteracting some effects of aging by supplementing hormones such as estrogen, testosterone, human growth hormone, melatonin, and DHEA (dehydroepiandrosterone) is an area of active study, but there are concerns that individuals may be taking such agents before their safety and efficacy have been established. NIA will support studies to understand the biological action of hormonal changes in older men and women, assess whether or not hormone therapy will improve health, investigate the use of compounds to produce the beneficial responses of hormones in the body without detrimental side effects, and determine the potential to regulate hormone production in specific body tissues where increased or decreased amounts of these hormones are favorable to health.
- **Support and conduct research to understand and address the needs of people with multiple chronic health conditions.** In a recent study, over two-thirds of Medicare beneficiaries reported living with two or more chronic conditions. NIA will support research to identify and test interventions to facilitate optimal management of multiple conditions and will work to disseminate in print and online results of these findings to a broad audience.
- **Improve the safe use of medications by older adults.** Managing medications can be complex for older adults, many of whom take drugs, often prescribed by more than one physician, for multiple health problems. Complications include adverse drug interactions and interactions with dietary supplements coupled with the physiological and functional changes associated with aging or age-related diseases. Research supported and conducted by NIA will improve our understanding and maximize the effectiveness of medications, develop new technical aids for physicians to monitor drug use, and provide new technologies and information to enable patients to manage medications better and avoid adverse reactions.
- **Develop strategies to reduce falls and their consequences.** Research supported and conducted by NIA will continue to identify safety risks for older adults in home and work environments, improve screening strategies, and develop and disseminate information important to reducing the risk of falls.
- **Explore new ways to improve safety in the home and community through studies of ergonomics and the built environment.** This will include continuing research to identify cost-effective alterations in design that can reduce injuries and provide a safer environment for older adults, and one that encourages physical activity and social engagement.
- **Pursue a better understanding of needs and develop interventions to improve the safety of older drivers.** We will continue to support research to identify factors such as visual impairment, hearing, attention, speed of processing, and other cognitive changes that put older drivers at risk of automobile accidents. In addition, we will continue to support the development of tools for assessing visual, cognitive, and other abilities associated with safe driving, interventions to improve the physical and cognitive skills necessary for safe driving, and technology and design changes to accommodate or compensate for the special needs of older drivers. We will also support research to understand the dynamics of making the decision to stop driving, the implications of that decision for the health and well-being of older adults, and alternative transportation options that help older adults maintain as much independence as possible. This research will provide the insights needed to develop guidelines for older adults, their health care providers, and family members.

**C-2 Develop improved approaches for the early detection and diagnosis of disabling illnesses and age-related debilitating conditions.** NIA will help develop and evaluate improved biochemical, imaging, and other techniques and tools to measure the well-being of older adults as well as symptoms of disease and disability. As new interventions are ready, the Institute will disseminate

information about the interventions to the public and health care communities, working to help move interventions into mainstream medical practice.

### **C-3 Develop interventions for treating, preventing, or delaying the onset of age-related diseases and conditions.**

- **Support and conduct research into the mechanisms by which lifestyle interventions affect aging-related changes and determine how individuals can maintain function with age or regain that function after loss due to immobility, illness, or trauma.** After peaking in early adulthood, most tissue functions decline with advancing age. This leads to increased risk of developing diseases such as cardiovascular disease and cancer and may lead to declines in overall health and quality of life. Further research is needed on the mechanisms through which common interventions, both medical and behavioral, may slow physical and cognitive decline. NIA will continue to support research into the mechanisms of functional decline and its delay, with the goals of identifying molecular targets for drug interventions and treatments that minimize losses and promote the recovery of function after illness or trauma.
- **Identify, characterize, and where appropriate, develop interventions for physiologic changes that influence the risk of age-related diseases across the human lifespan.** Studies will include changes that are associated with increased risk of disease and disabling conditions such as sarcopenia (reduced muscle mass), as well as those that are associated with exceptional health and longevity.
- **Test compounds that hold the promise of increasing healthy lifespan.** Promising compounds must undergo preclinical safety and efficacy testing using animal and cellular models before being tested in full scale clinical trials. We will continue to support the testing of promising compounds in worms, mice, and other model systems with the long-term goal of selecting for further development those most likely to have beneficial effects in humans.
- **Conduct clinical studies and encourage the translation of new interventions to the clinical setting.** As mechanisms, pathways, and processes of disease are better defined, basic research findings can be translated expeditiously to the development of clinical applications. We will pursue the use of novel, flexible research designs where appropriate, and we will work with others to facilitate the navigation of barriers to the translation of promising compounds into clinical trials and ultimately approval by the U.S. Food and Drug Administration.
- **Support comparative effectiveness research.** NIA will continue to support research to identify the relative merits of differing interventions for older adults. For example, investigators are testing the effectiveness of different interventions in improving quality and efficiency, eliminating disparities in treatment, and reducing unwarranted variations in expenditures at hospitals. Still others are comparing exercise interventions and cognitive interventions to determine their relative effectiveness and examining the interactive effects of a combined exercise/cognitive intervention program.

### **C-4 Find significantly improved and cost-effective ways to reduce caregiver, family, and patient stress and improve older adults' ability to cope with chronic disease.** Families and others who care for people with chronic disease frequently face emotional stress as well as physical and financial burdens. At present, the direct economic costs of caregiving to caregivers and society are unknown, and it is not well understood how caregiving impacts the health and well-being of some caregivers and why some caregivers thrive in the experience of caregiving, whereas others succumb to caregiver distress and burden and unhealthy outcomes of their own. Investigators will continue to evaluate strategies to improve social support, skills training, and assistive services both for those who cope with chronic disease and for their caregivers. Research supported and conducted by NIA will clarify needs and patterns of family caregiving and how people make

decisions on providing care and inform guidance on support and skills, including a focus on families with diverse ethnic and socioeconomic backgrounds.

**C-5 Develop strategies to improve the interaction of older adults with the health system.** For older adults and their families, effective health care requires quality communication with and among health care professionals. According to one study, fewer than 40 percent of people experiencing symptoms associated with heart and circulatory or musculoskeletal systems seek a physician's care. Similarly, women often avoid seeking care for urinary incontinence. NIA will help develop strategies to assist patients in dealing with multiple services for multiple chronic conditions. We will seek better interventions to help older adults recognize the implications of disease-related signs and symptoms and consult a physician or other health care provider when they first occur. And we will work to find ways to help health care providers coordinate their services to older adults to optimize health status.

**C-6 Understand and develop strategies to enhance societal roles and interpersonal support for older adults, reduce social isolation, and promote positive caregiving outcomes and supports.**

Despite negative stereotypes, millions of older adults work productively, contribute to society, and place a high value on retaining their independence. Research suggests that social support and continued involvement in useful activities foster positive effects on physical and mental health and on longevity. This effort is especially important for older adults who are at increased risk for multiple diseases, disability, and functional limitations that may keep them from fully engaging in the world around them. Improvements in acute and long-term health care for older adults are also essential, including strategies to ease the burdens of caregivers and enhance quality of care at home and in different long-term care settings. These initiatives should result in more effective approaches for prevention, treatment, and rehabilitation. NIA will continue to support and conduct research to:

- **Identify ways for older adults to retain valued roles and maintain independence.** Older men and women often continue to work in paid jobs, perform meaningful work as volunteers, maintain their own households, and/or support children and grandchildren. Research supported and conducted by NIA will seek and apply technological, social, and behavioral findings to interventions that help extend the ability of older adults to remain independent, active, and productive.
- **Investigate the social aspects of family caregiving and develop and disseminate effective interventions for patient care in family and community settings.**
  - *Assess and evaluate family relationships over time.* This research will help us understand the effects of changing relationships on the health and well-being of older adults.
  - *Address issues centered on the increased demands faced by family caregivers in light of changing patterns of work and family demographics.* We will pay particular attention to the ways in which characteristics such as gender, marital status, income, socioeconomic status, race, and ethnicity influence these demands.
- **Develop strategies to help older adults and their families prepare for and manage age-associated changes in health, income, function, and roles.** Older adults and family members are faced with many complex decisions about medical treatment and various aspects of their retirement, finances, and long-term care that can affect their independence and well-being. Issues of concern include the ability of health care delivery systems to support patient and family needs, adherence to a patient's advance directives, and financial resources to cover out-of-pocket costs for acute and long-term care and assistance needed for maintenance of optimal health. We will support research to develop data resources incorporating work, financial status, health care utilization, and outcomes to allow analyses of pathways to independent



healthy aging. Research findings will be useful for people as they plan for later life transitions as well as to inform policy decisions.

- **Research and develop strategies to improve decision making for long-term and end-of-life care.** There is a pressing need to identify approaches that will ensure quality, affordable long-term care that maintains optimal health and function for older adults. There is also a critical lack of empirically generated knowledge on how to improve quality at the end of life. To better address these issues, we will:
  - *Support research to examine component parts of health care delivery systems and their impact on medical, social, functional, and cost outcomes and use this information to test interventions to improve care.* This research will help inform the development of interventions to coordinate care that promotes attention to patient and family preferences, facilitates smooth transitions among care settings, and maximizes independence. We will explore ways to support long-term care including care provided in the home. We will focus on interventions that reduce the burdens of caregivers, with an emphasis on the unique challenges faced by caregivers of patients with dementia.
  - *Understand caregiving patterns and improve the effectiveness of strategies for helping families manage the care needs of the physically frail.* For example, we will support research to identify effective caregiving strategies, environmental modifications, and technological supports for both informal and formal long-term care settings.
  - *Develop strategies to improve the experience of older adults at the end of life.* We will support research to better understand the decision making process and changing preferences associated with advance care planning; better understand the transitions among end-of-life care settings such as the home, hospital, nursing home, and hospice; assess the benefit of end-of-life therapies and the cost effectiveness of interventions to improve end-of-life care; develop better measures of end-of-life quality for the patient and the family to improve our understanding of psychosocial issues that impact the end-of-life experience; and understand the social and economic context of caring for an older person who is dying.
- **Understand and develop strategies to address self-neglect, adverse social relationships, and susceptibility to financial abuse among older adults.** NIA will continue to partner with other agencies to identify the best ways to detect and address financial fraud and abuse facing older adults, promote adaptive self-care and care of others, and develop strategies to identify and support vulnerable elders in our communities.

## Goal D

### **Improve our understanding of the aging brain, Alzheimer’s disease, related dementias, and other neurodegenerative diseases. Develop interventions to address Alzheimer’s and other age-related neurological conditions.**

A better understanding of how the brain ages can provide important information on which to base strategies for maintaining and enhancing cognitive, emotional, sensory, and motor function. For example, studies have shown that new neurons form in certain regions of the brain even in adulthood. This phenomenon, known as *neurogenesis*, suggests that we may be able to develop medical and behavioral approaches to stimulate formation of new neurons to compensate for the loss and functional decline of neurons with aging, disease, or traumatic injury.

NIA will continue to support research to identify age-related neural changes and mechanisms the older brain uses to maintain optimal learning, memory, and other cognitive functions. We will continue to

support research to clarify the interactions between the brain and the peripheral nervous, endocrine, hematopoietic, cardiovascular, and immune systems. And we will support the development of preventive and therapeutic approaches to maintaining health in cognition, emotion, sleep function, sensory processes, and motor function.

Our objectives in this area are to:

- D-1 Understand the mechanisms involved in normal brain aging; the role of cognition and sleep in everyday functioning; and protective factors for sensory, motor, emotional, and cognitive function.
- D-2 Identify and understand the molecular and cellular mechanisms underlying the pathogenesis of Alzheimer's disease (AD) and other neurodegenerative disorders of aging.
- D-3 Expand research to improve assessment and diagnostic tools for distinguishing people with normal brain aging from those who will develop mild cognitive impairment (MCI), Alzheimer's disease (AD), and related conditions.
- D-4 Translate discoveries about the cellular and molecular mechanisms of cognitive, emotional, sensory, motor, and sleep function with age and the mechanisms of early and late stage AD pathogenesis into diagnostic, treatment, and/or prevention strategies.
- D-5 Conduct research to better understand and develop interventions to address the special caregiving needs of patients with AD and other dementias, as well as the needs of their caregivers.

**D-1 Understand the mechanisms involved in normal brain aging; the role of cognition and sleep in everyday functioning; and protective factors for sensory, motor, emotional, and cognitive function.**

- **Improve our understanding of nervous system and behavioral changes that occur with normal aging and how brain function is maintained and enhanced.** Changes in brain structure and function continue throughout life. For example, research shows that the hippocampus, a region of the brain important for acquiring and processing information, is capable of generating new nerve cells. Furthermore, research in mice demonstrates that increased physical activity that starts in middle age can increase hippocampal neurogenesis and decrease signs of neuronal aging. This suggests that neurogenesis may be one factor underlying the beneficial effects of an active lifestyle on cognition and function in humans.

We will continue to explore the role of physical and mental exercise in promoting healthy cognitive, emotional, and motor functioning as well as quality of sleep. We will work to identify and find ways to activate the cellular processes that protect the brain from damage and promote its repair. This research will help form the basis for future investigation of more subtle neural changes that occur with age.

- **Determine how genetic, molecular, cellular, and environmental factors interact for optimal brain health and functioning, including in the oldest old (people ages 85 and older).** The overall integrity of brain structure and many neural systems is largely preserved in normal aging, while in age-related diseases, specific brain cell types and their connections are damaged or lost. We will work to gain a greater understanding of the many factors that interact to maintain brain structure and function, including compensatory mechanisms and adaptive or dynamic changes. For example, we will:
  - Continue to pursue a greater understanding of the interaction among genetic factors that underlie normal cognitive, emotional, sensory, motor, and sleep function as well as abnormal decline and the interactions between genetics and the environment.

- Investigate epigenetic changes, which can significantly influence the structure, function, and expression of genes and molecular pathways within the cell.
- Support research to better understand the neurological and behavioral effects of environmental factors, both early and later in life.

In addition, we will continue to investigate the changes in brain structure and function that take place in people 85 or older. In the absence of disease, many of these individuals continue to lead healthy and productive lives even into unusually old age. Others, however, suffer from health conditions that can contribute to cognitive decline and dementia, emotional dysfunction, motor instability, and/or sensory deficits. We will work to identify and address the conditions that most affect brain health in this group in order to find ways to maintain function as long as possible.

- **Understand the role of cognition and sleep in everyday functioning.** NIA will support research to examine the influence of contexts – behavioral, social, cultural, and technological – on older adults’ cognitive functioning; investigate the effects of age-related changes in sleep and cognition on activities of daily living, social relationships, and health status; and develop strategies for improving everyday functioning through various interventions such as cognitive training.

## **D-2 Identify and understand the molecular and cellular mechanisms underlying the pathogenesis of Alzheimer’s disease (AD), related dementias, and other neurodegenerative disorders of aging.**

- **Refine our knowledge of molecular, cellular, cognitive, and other behavioral changes that cause or accompany development of AD and other dementias of aging.** We will encourage a systems-based approach to investigate the pathological changes associated with the preclinical development of AD, including accumulation of abnormal proteins, loss of synapses, and death of neurons. We will also explore the impact of genetic and inflammatory processes on the development of AD. We will promote further characterization of these pathological changes in tissue culture, animal models, and humans. Our research will also address the behavioral and psychological changes associated with the development of AD as well as psychiatric conditions such as clinical depression.
- **Investigate the relationship between systemic metabolism and brain function during preclinical AD.** Metabolic and vascular risk factors such as obesity, diabetes, hypertension, and heart disease during midlife are associated with accelerated age-related cognitive decline and with increased risk for AD – particularly among individuals with three or more of these risk factors. We will continue to support research to examine the mechanisms by which these risk factors may influence the transition between normal brain aging and AD, and whether the negative impact of metabolic and vascular risk factors on brain aging can be counteracted through behavioral and lifestyle changes.

We will also continue to support research that examines brain-body interactions in AD and overall health, especially interactions mediated by stress and other hormones. For example, short sleep – less than an average of six hours per night – has been associated with hormonal and metabolic changes associated with obesity, diabetes, hypertension, cardiovascular disease, and cognitive decline.

- **Understand the role of sleep in brain function and neurodegenerative disorders of aging.** Sleep and circadian clock disruption affect age-related brain function and alter the expression and course of neurodegenerative diseases. We will support research on the molecular and cellular underpinnings of age-related changes in quality and quantity of sleep and deterioration of circadian function. We will continue efforts to elucidate the effects of sleep deficiency on

the brain and behavior, as well as the association between sleep and circadian disruption and neurodegenerative disease.

**D-3 Expand research to improve assessment and diagnostic tools for distinguishing people with normal brain aging from those who will develop mild cognitive impairment (MCI), Alzheimer’s disease (AD), and related conditions.** Successfully distinguishing people who are aging normally from those who will develop MCI – often a precursor to AD – and AD itself is critical to promoting healthy aging behaviors and the prevention, early detection, diagnosis, and treatment of disease. A critical step in accomplishing this goal is to clearly delineate changes that occur with aging in people who do not develop MCI or AD until very late in life. This knowledge can help in the identification of biomarkers of the transition from normal function to cognitive impairment and disease.

NIA will continue to support research to:

- **Explore possible additional risk and protective factors for brain health and function, cognitive decline, MCI, and AD through epidemiological and other population studies.** Community-based studies of aging and AD are becoming progressively more sophisticated. Traditional interviews, clinical evaluations, and routine laboratory tests are increasingly complemented by advanced imaging and other technologies to identify risk factors and protective factors and to relate them to specific biological mechanisms. NIA will place a special emphasis on community-based studies, including studies in racial and ethnic minority populations, capable of linking early life or midlife factors with late life cognitive decline or impairment. We will include studies of the ways that multiple factors such as lifestyle, genetics, comorbid diseases, sleep, or sensory or motor dysfunction interact to cause disease or contribute to cognitive decline. We will also support international comparative research on risk factors, incidence and prevalence of cognitive impairment and dementia.
- **Identify and establish links among neuroimaging, biological, and clinical markers for early detection of cognitive decline, MCI, and AD and for understanding the progression from normal cognitive aging to MCI to early AD.** Biomarkers may be helpful in earlier and more accurate diagnosis of disease and in tracking disease progression and treatment response in clinical trials, which can decrease the time and cost of trials. The Alzheimer’s Disease Neuroimaging Initiative (ADNI) has achieved considerable success in developing sensitive and precise tools for detecting AD at its earliest stages and following the disease’s progression through the use of a combination of biomarkers. These results are also supporting the development of measures to assess the effectiveness of potential interventions. Future efforts will include continued collection of biomarkers to fill critical gaps in our understanding of the biomarker trajectories of AD and aging.
- **Improve neuropsychological assessment of cognitive function.** Despite remarkable advances in neuroimaging, neuropsychological assessment of cognitive function continues to be the gold standard by which AD is diagnosed. We will continue to support the development of better tools for assessing cognitive function in the clinic, in the primary care setting, and in the home environment.
- **Improve methods for assessing changes in sensory and motor systems as markers of age-related change and AD and decrease the frequency of late and misdiagnoses.** Age-related changes in sensory systems occur in both normal individuals and those with AD. We will continue to examine how the use of sensory testing to predict early neurodegeneration could assist in clinical diagnoses. We will also continue research to explore possible correlations between changes in sensory perception and AD. For example, we will investigate how changes in a person’s ability to navigate visually through the environment or changes in a person’s sense of smell may predict the development of AD.

**D-4 Translate discoveries about the cellular and molecular mechanisms of cognitive, emotional, sensory, motor, and sleep function with age and the mechanisms of early and late stage AD pathogenesis into diagnostic, treatment, and/or prevention strategies.** Studies supported and conducted by NIA have tested both cognitive training and drug treatments, alone and in combination, to improve memory in patients with dementia. Other NIA supported and conducted trials focus on slowing the progression of cognitive symptoms in dementia and on strategies to manage behavioral symptoms. Still others focus on preventing the early stages of cognitive decline. NIA supported and conducted translational studies apply the findings of basic science on brain mechanisms in healthy aging and in disease to the identification and preclinical testing of new prevention and treatment strategies as a precursor to testing in human clinical trials. NIA will continue to:

- **Stimulate translational research aimed at discovery and preclinical development of new candidate drugs and biologics.** By supporting the early steps of the drug discovery and development process, we can play a critical role in facilitating the very long, difficult, and enormously expensive process of translating the wealth of basic science discoveries into successful AD therapeutics.
- **Support clinical trials for drug and non-pharmacological interventions to prevent, treat, and delay the onset and progression of cognitive decline, MCI, AD, and other dementias.** We will continue to test promising drug, behavioral, or combination interventions in clinical trials with the intention of moving them rapidly into clinical practice. We will examine ways to streamline the drug discovery, drug development, and clinical trial processes that advance the development for promising prevention and treatment targets.

**D-5 Conduct research to better understand and develop interventions to address the special caregiving needs of patients with AD and other dementias, as well as the needs of their caregivers.** A number of recent studies have demonstrated that the chronic stresses of caring for a family member with dementia can cause lasting psychological and even physical consequences for the caregiver. For example, sleep-wake patterns are altered in AD patients, often leading to chronic sleep deprivation for patient and caregiver. Research has shown that caregivers of AD patients have an increased risk of depression, elevated stress levels, increased vulnerability to influenza, and poor wound healing (among older caregivers).

NIA will continue to:

- **Conduct research on the family and economic burdens of AD and other dementias.** We will support research at several levels, including studies on the mechanisms through which the stress of caregiving affects physical and mental health. Because formal and informal care for older adults with dementia is a major cost for families, private insurers, and the public sector, we will support other studies to help us to quantify and understand the economic burdens associated with care provision and quality of care.
- **Develop better strategies for the care of patients with MCI and AD and for their caregivers.** NIA-supported investigators have developed multifaceted, personalized interventions that can significantly improve the quality of life for caregivers of people with dementia. We will continue to develop and test other interventions of this type. In addition, we will research the needs of spousal caregivers following the death of their spouses and support development of post-bereavement interventions aimed at providing assistance in addressing traumatic and stressful memories of their years of caregiving.

## Goal E

### Improve our understanding of the consequences of an aging society to inform intervention development and policy decisions.

While the increased longevity and improved health at older ages seen in many parts of the world represent one of the crowning achievements of the 20<sup>th</sup> century, they also present significant challenges. Societal aging can affect economic growth, patterns of work and retirement, the way that families function, the ability of governments and communities to provide adequate resources for older adults, and the prevalence of chronic disease and disability.

NIA will continue to support research on the social, economic, and demographic consequences of the aging population in the United States and other countries. We will support research to better understand the impact of the changing age composition of the population and economic factors across the lifespan that affect health and well-being.

Our objectives in this area are to:

- E-1 Understand how population aging and changes in the social, economic, and demographic characteristics of cohorts reaching old age affect the health and well-being of older adults in the United States and other countries.
  - E-2 Understand how social and economic factors throughout the lifespan affect health and well-being and lead to health disparities at older ages.
  - E-3 Conduct research aimed at modifying organizational or individual behaviors in order to improve important health outcomes among members of population groups at older ages.
- E-1 Understand how population aging and changes in the social, economic, and demographic characteristics of cohorts reaching old age affect the health and well-being of older adults in the United States and other countries.**
- **Analyze the effects of social and demographic factors on health and well-being at older ages.** Educational attainment, for example, is one of the strongest correlates of physical health and cognitive functioning at older ages, and changes in family structure can affect both the need for and the supply of informal caregivers. We will support research to unravel the reasons for such connections, help project health and long-term care needs, and devise ways to intervene and to reduce disparities.
  - **Seek to better understand decision making among older adults.** As the population ages, it will be important to understand how people make decisions about retirement, lifestyle, health, and health care. NIA seeks to better understand the incentives that keep people in the workforce and what motivates people to make healthy choices. We will support research in this area along the full spectrum, from neuroeconomic, cognitive and affective research on how aging individuals perceive stimuli and make decisions to social network research.
  - **Assess the impact of changing family structures on health and caregiving.** NIA will support research on the ways in which the evolution of the American family structure will affect the well-being of older adults. Changing kinship systems in modern American society and unprecedented demographic changes have profound implications for living arrangement options for older adults, cost of living, cost of health care, caregiving, retirement, and Social Security. Researchers will need to examine how the availability of home- and community-based services (e.g., adult day care, home visits, and assisted living) influences the experience of family caregiving.

- **Encourage comparative analyses to evaluate the impact of institutions and networks on population and individual well-being and foster longitudinal studies on aging.** Other countries have larger proportions of their populations at older ages than the United States, and some of those with currently younger populations are aging at a much more rapid rate. We will support comparative research on the effects of these changes on behavior, and we will evaluate institutional reform efforts to gain insights useful both in the United States and elsewhere for enhancing population health.
- **Examine the bases for individual and societal attitudes toward older people and develop effective strategies to improve them.** Older people may be the target of inaccurate and negative stereotypes and discrimination. We will support research to explore the causes of these negative attitudes and develop strategies to counter them with community and other interventions. For example, engaging older people in meaningful volunteer work may prove to be a “win-win” situation, replacing the image of dependence with one of active and productive citizenship.
- **Continue research on the measurement of subjective well-being in a policy-relevant framework.** Measurement of subjective and psychological well-being in population-based surveys and in intervention studies holds potential for understanding how older adults’ lives are impacted by major challenges of aging, including retirement, caregiving, living with disability, onset of illness and impending death, and for assuring that interventions promote not only better health, but better quality of life at older ages.

**E-2 Understand how social and economic factors throughout the lifespan affect health and well-being at older ages.** Individual differences in potential for a healthy and secure old age emerge in midlife. For example, work and other decisions by people in their 50s and 60s are already affected by chronic conditions and disability. NIA will continue to:

- **Support and conduct research on how middle-aged and older adults manage the multiple health-related decisions imposed by increasing longevity.** NIA will support research to better understand the social determinants of health and well-being of older people, including incentives and supports provided by public and private programs that have an impact on health outcomes. Such research will include the measurement of the economic value of good health.
- **Support and conduct research that models and measures the economic risks of old age with the potential for developing interventions to protect against these risks and adverse health consequences.** Demographic and retirement income trends lead to expanding economic risks among older Americans and concomitant impact on health. Many Americans will require long-term care, but few purchase private insurance to support formal care expenses. We will support research to understand the behavioral aspects of demand for insurance against these old age risks.
- **Promote the development of data resources to support the development of effective interventions.** Measures of time use, experience sampling, and in-home sensor-based technologies also offer potential for new insights for understanding and designing interventions to promote healthy aging.

**E-3 Conduct research aimed at modifying organizational or individual behaviors in order to improve important health outcomes among members of population groups at older ages.** Research examining the cognitive effects of work and retirement, the basic science of behavior change, and changing environmental defaults to influence health-related aging outcomes have generated findings with enormous practical implications. Country comparisons available through harmonized

surveys have revealed the role of a longer work-life in maintaining cognitive function. Recent evidence suggests that personality and self-control are relatively stable individual traits that predict long-term health and mortality. NIA will continue to support interventions involving behavioral treatments, economic incentives, dynamic recursive treatment regimes, and conditioned incentives interventions to promote adaptive behaviors in midlife and older age. We will support research to better understand the factors in the health care system that support prevention and the successful management of disease.

## Goal F

### Understand health disparities and develop strategies to improve the health status of older adults in diverse populations.

*Health Disparities* are differences in any health-related factor – disease burden, diagnosis, response to treatment, quality of life, health behaviors and access to care, to name only a few – that exist among population groups. In 2015, NIA developed and adopted its new “NIA Health Disparities Research Framework” (<https://ethndis.org/edonline/index.php/ethndis/article/view/39/63>) to stimulate the study of environmental, sociocultural, behavioral and biological factors that influence health disparities related to aging. Many of these factors are broad, complex, and interrelated.

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#### What are NIA’s approaches for addressing health disparities?

*Health Disparities* are differences in any health-related factor – disease burden, diagnosis, response to treatment, quality of life, and access to care, to name only a few – that exist among population groups. Health disparities are associated with a broad, complex, and interrelated array of factors, and may reflect:

- Age
- Race
- Ethnicity
- Socioeconomic status (SES)
- Disability Status
- Identity and Expression\* (e.g. gender, racial, ethnic)
- Geographic location (e.g., rural or urban environment)
- Education
- Healthcare (e.g. access, quality)
- Culture (e.g. norms, traditions, collective responses)
- Health Behaviors (e.g. smoking, violence, substance abuse)
- Biological (e.g. sex, chronic inflammation, telomere attrition, cellular senescence)
- ...Or a combination of these

*\*Identity and Expression are both commonly used to describe LGBT populations and health disparities. Identity and expression are also very important for understanding racial disparities in health. Individuals may vary greatly in their sense of belonging to a racial group, even though they are perceived to be part the racial group because of physical characteristics. This is very important for understanding how culture and social networks/support may differ because of this varied sense of belonging which may ultimately influence network dynamics, health behavior and health outcomes.*



To address the contribution of these factors on health disparities related to aging, NIA has supported research – for example - that discovered Alzheimer’s disease to be more prevalent among African Americans and Hispanics than other ethnic groups in the U.S. Other studies have found that lower Socioeconomic Status (SES) is associated with poorer health and reduced lifespan in the U.S. Scientists have also observed gender differences in health and longevity. For example, overall women live longer than men, but are more likely to develop osteoporosis or depressive symptoms or to report functional limitations as they age; men, on the other hand, are more likely to develop heart disease, cancer, or diabetes.

Environmental factors such as residential segregation, immigration, social mobility, work, retirement, education, income, and wealth can also have a serious impact on health and well-being. Economic circumstances can determine whether an individual can afford quality health care and proper nutrition from early life into old age. Individual and family financial resources and health insurance often determine whether an older adult enters an assisted living facility or nursing home or stays at home to be cared for by family members.

The causes of health disparities are dynamic and multidimensional, and to address them adequately, NIA will consider a number of environmental, sociocultural, behavioral and biological factors. For this reason, NIA will use an integrative approach to motivating health disparities research related to aging. Specifically, our objectives in this area are to:

- F-1 Understand health disparities among older adults.
- F-2 Develop strategies to promote active life expectancy and improve the health status of older adults in diverse populations.
- F-3 Develop and implement strategies to increase inclusion of diverse populations in research.

**F-1 Understand health disparities among older adults.** Many complex and interacting factors (see box) can affect the health and quality of life of older adults. For example:

- *Environmental factors* related to income, education, occupation, retirement, and wealth may have a serious impact on key determinants of health over the life course and ultimately the health and well-being of the elderly.
- *Sociocultural factors* can have a tremendous influence on approaches for managing stress, diet and food preferences, attitudes toward exercise and other critical health/coping behaviors.
- *Behavioral factors* and psychological processes represent major pathways by which environmental and social factors impact health. Optimism, pessimism and sense of control serve as risk or resilience factors for impacting health.
- *Biological factors* that are influenced by environmental and sociocultural factors -and transduced through behavioral processes - may alter the course, severity and acceleration of disease and disability.

All of these factors and their interconnections must be understood in order to develop and implement effective interventions to address health disparities among various population groups.

NIA will support and conduct research across diverse population groups to:

- **Understand differences in aging processes.** We will characterize normal and accelerated processes of aging in diverse populations to increase our understanding of the course of disease and disability and to identify similarities and differences.
  - *Encourage research to understand sex and gender differences in health and disease at older ages.* Sex differences in health and longevity are well documented. For example, many of the compounds tested through the Interventions Testing Program demonstrate

differential effects on male and female mice. We will accelerate research on the basic biology driving health differences between sexes. In addition, recent demographic and economic trends have gender-specific implications for health and well-being at older ages. Unmarried women, for example, are less likely than unmarried men to have accumulated assets and pension wealth for use in older age, and older men are less likely to form and maintain supportive social networks. We will support research to explain how these and other factors may contribute to the differences in life expectancy and disability rates among men and women at older ages.

- **Understand how environmental, sociocultural, behavioral and biological factors lead to disparities in health at older ages and develop interventions to reduce those disparities.** Health disparities persist within and across diverse racial, ethnic, and socioeconomic groups. Research is needed to understand the causes of these disparities and how they relate to relevant factors. Examination of cross-national research opportunities has the potential to provide increased knowledge of natural experiments in divergent aging experiences and aging policy developments that would inform a more general understanding in aging societies.
- **Conduct research that explores mechanisms through which the effects of environmental and sociocultural factors manifest themselves, as well as research that focuses on critical periods for reversing such effects and/or the optimal timing of intervention.** Specific groups of the U.S. population experience chronic socioeconomic disadvantage throughout their lives or for extended periods in life that generate persistent, chronic stress. The patterns of stress reactivity appear to hasten the progression of disease. It is therefore important to invest in research on the effects of discrimination, bias, stigma and stereotypes, and particularly the mechanisms through which these environmental and sociocultural factors become biologically embedded to influence health disparities.
- **Assess the interplay among environmental, sociocultural, behavioral, and biological determinants to understand and prevent disease.** Environment, socioeconomic factors and risk behaviors, can all interact to influence biological factors and accelerate aging, the development, progression, and outcome of disease in populations groups. NIA will conduct and support research to:
  - *Determine the influence of and interaction among race, culture, ethnicity, sexual orientation, economic status, education, and work experiences in health.* NIA will support research to learn more about risk factors for disease and preventive factors contributing to good health by researching these influences individually and in concert. We will place a special emphasis on longitudinal data to untangle the multitude of factors that affect health and well-being.
  - *Determine the effects of early life factors on health disparities among older adults.* Differences in childhood socioeconomic status, stress exposure, risk/coping behaviors, disease incidence, environmental exposure, and health care in fetal development and early life can affect disease and disability in later life. NIA will support research to identify these early-life factors, as well as the mechanisms through which they influence health in later life. These findings can then be used to inform clinical and even policy interventions to reverse the effects of childhood disadvantage among older individuals.
- **Gather data to further distinguish patterns of health disparities and causes.**
  - *Gather and analyze data on burdens and costs of illness, healthy life expectancy, longevity, and mortality trajectories.* Determining the health burden and other costs of specific illnesses has always been difficult due to the lack of adequate data on incidence and prevalence as well as inconsistencies in calculating health and monetary costs. These difficulties are compounded across populations by differences in use of formal medical care

and informal family caregiving. Projections of future healthy life expectancy, longevity, and mortality depend on assumptions about how groups of individuals will change over time, particularly as recent immigrants become culturally assimilated. This research will be archived in the best interest of all populations and will provide valuable information for projecting the specific needs for health care services within various population groups.

- *Support the development and wide sharing of data resources that are needed to conduct health disparities research related to aging.* Research to understand health disparities requires that data from multiple sources be accessible in standard formats to researchers on a national level. NIA will continue to support and expand surveys of health disparity populations in order to provide the data needed by researchers and public policy makers, including cross-national, comparative, and historic research. We will provide access to these and related data for use in health disparities research and to inform policy development.
- *Develop comparable cross-national and intra-national databases on health outcomes, risk factors, and determinants of health disparities.* Although many of the disparities in adult health and life expectancy across national, racial/ethnic, and social class boundaries are well documented, causal mechanisms are less well understood. Research to understand these differences will be critical to the development of behavioral and public health interventions.
- *Use ongoing data collection programs to oversample health disparities populations.* These data will provide important information on socioeconomic factors, health care needs, collective cultural responses, social network characteristics, perceptions of stress and resilience, risk/coping behaviors, genetic stability, and other important factors.

## **F-2 Develop strategies to promote active life expectancy and improve the health status of older adults in diverse populations.**

Life expectancy has increased among all population groups; however, notable disparities remain. For example, African American men have the lowest life expectancy of all racial/gender population groups in the United States. In addition, more adults are living with one or multiple chronic conditions that may not affect length of life but may dramatically affect quality of life, and significant disparities have been observed in this area, as well. For example, African Americans suffer disproportionately from hypertension and prostate cancer, and Hispanics suffer more from diabetes.

NIA will continue research to:

- **Track and analyze reduced life expectancy and disease prevalence in diverse older adult populations.**
  - *Identify the determinants of disparities in the prevalence of diseases and conditions such as heart disease, obesity, hypertension, frailty, diabetes, comorbidities, and certain types of cancer.* Researchers will explore the influence of contextual factors such as residential segregation, stress, education, language, and access to health care and how these may link with genetic, molecular, and cellular mechanisms to sustain differences across populations.
  - *Determine the reasons for variation in the prevalence of cognitive decline and Alzheimer's disease (AD) and related dementias across population groups.* NIA will support research to better understand the differences in the prevalence of Alzheimer's disease among African Americans, Asians, and Hispanics compared to non-Hispanic whites. We will continue to examine a range of possible causes of these disparities, including the impact of comorbidities such as hypertension, cardiovascular disease, and diabetes; health behaviors; and disease processes. This research will draw on culturally appropriate and standardized measures to better understand these differences and to suggest culturally appropriate interventions.

- **Conduct research to better understand effective strategies for communicating health messages that are appropriate in diverse populations.** Because of language, educational, and cultural differences, disproportionately affected populations do not always receive important information about healthy behaviors. Research on communication with specific audiences will assist the development of appropriate health messages and dissemination channels; we will communicate with diverse audiences in varied ways, identifying health messages to enhance receptivity.
- **Develop appropriate strategies for disease, illness, and disability prevention and healthy aging among the underserved.** Aging Americans need understandable, culturally appropriate tools they can use to maintain and improve their well-being. For example, adults with low levels of education and limited fluency in English may need specially adapted assessments of cognitive function for the diagnosis of Alzheimer’s disease. Diet and exercise recommendations may need to be adjusted to take into account religious, ethnic, and cultural sensitivities. To address these concerns, researchers will:
  - *Develop and promote culturally appropriate interventions to improve healthy behaviors along with strategies to increase the likelihood that these interventions will be initiated and maintained.*
  - *Design and promote interventions appropriate for older adults in diverse populations to more effectively prevent, diagnose, or reduce the effects of disease.*
  - *Design and promote evidence-based and culturally appropriate strategies for self-management of chronic diseases.*
  - *Investigate the factors affecting medication misuse and culturally appropriate strategies for enhancing proper use and compliance with medication regimens.*
- **Develop and disseminate interventions to improve culturally appropriate health care delivery.** NIA will promote better access to appropriate preventive care and clinical treatment, earlier diagnosis, improved outcomes, and reduced healthcare costs in diverse populations by supporting the development, usage, and clinical translation of research findings.
  - *Develop interventions that build long-term and meaningful relationships among community leaders and members to create trust and to understand the cultural limitations of interventions.*
  - *Develop interventions to reduce health disparities and inequities associated with poor provider-patient interactions.* Recent studies have revealed that how older adults are diagnosed and treated is as much a function of who they are, who is treating them, and where care is provided as it is a function of the symptoms they present. NIA will investigate ways to ensure that each individual is treated with appropriate evidence-based interventions regardless of race, ethnicity, sexual orientation/gender identity, place of birth, or cultural background.
- **Develop training programs to prepare culturally proficient researchers.** We will facilitate training of researchers in the biomedical, behavioral, and social sciences working with older adults to help them better understand the medical implications of the growing diversity of our population. Training programs will help prepare the next generation of health professionals by incorporating new materials sensitive to these issues and preparing a cadre of culturally competent health care providers prepared to assist with patient decision making.

**F-3 Develop and implement strategies to increase inclusion of diverse populations in research.** The ability to recruit and retain research participants that are representative of the total U.S. population is essential to the conduct of rigorous health disparities research related to aging. However, specific racial, ethnic and SES population groups have been underrepresented in health

related research, including clinical trials and population-based research. Engagement and outreach efforts, such as collaborating with faith-based and community organizations, have had varied success. NIA will:

- **Continue to support training for clinical and research staff in message development, recruitment strategies, and community and media outreach.** NIA will explore effective ways to mitigate the difficulties associated with enrollment of health disparities populations in research studies and clinical trials. For example, Community Based Participatory Research methods may be used to address cultural and language barriers and encourage effective communication about the potential benefits of studies and trials that seek to address health disparities and improve public health in priority communities.
- **Investigate novel approaches for increasing recruitment and retention of underrepresented researchers pursuing careers in science, particularly health disparities research.** NIA will work to identify the best strategies for training and attracting a diverse workforce of new, mid-career, and senior researchers. This may important for evaluating important strategies - that account for cultural and geographic factors – to enhance the recruitment of underrepresented groups into aging research. We will continue programs to train high-quality researchers through flexible mechanisms that reflect the rapidly changing needs of science and provide cross-disciplinary training. NIA will also work to tap the talents of all groups of society by encouraging degree-granting institutions to establish and improve programs for identifying, recruiting, and training diverse groups of individuals for careers in biomedical science.

## Supporting the Research Enterprise

### Goal G

#### Support the infrastructure and resources needed to promote high quality research.

The availability of the infrastructure, resources, and training needed to support present and future research, program management, and information dissemination is critical to the NIA mission. NIA will provide resources to develop a skilled interdisciplinary research workforce, ensure that scientists have access to the technology and equipment they need to perform the research, promote clinical research participation, and facilitate the dissemination of research results to scientists, health professionals, and the public.

Our objectives in this area are to:

- G-1 Foster interdisciplinary exchange and encourage collaborative research across disciplines.
- G-2 Engage in partnerships to create synergy and leverage resources within and among institutions and organizations, including patient and advocacy groups.
- G-3 Train and attract the workforce necessary for rigorous research on aging, including new, mid-career, and senior investigators.
- G-4 Attract and train more researchers from diverse scientific and cultural backgrounds.
- G-5 Develop and distribute research resources.

G-6 Develop the necessary infrastructure to encourage translation of research from basic discovery and intervention development.

**G-1 Foster interdisciplinary exchange and encourage collaborative research across disciplines.**

- Support workshops and conferences that bring scientists from various disciplines together for discussion and planning.
- Provide funding opportunities that encourage interdisciplinary efforts and/or partnerships across two or more institutions or organizations.
- Facilitate ongoing dialogue with researchers and professional organizations.

**G-2 Engage in partnerships to create synergy and leverage resources within and among institutions and organizations as well as patient and advocacy groups.**

- Work closely with other NIH Institutes and Centers, other government agencies, and the private sector to collaborate across the continuum of research from basic science through translational research to clinical studies.
- Partner with other government agencies, professional organizations, private funders of research, and international research groups to collect data and other resources to facilitate understanding of science on a global level.
- Continue to participate in trans-NIH efforts such as the NIH Common Fund and the NIH Blueprint for Neuroscience Research.
- Partner with other government agencies, professional organizations, and advocacy groups to ensure that research results are translated into public health programs and medical practice and used to inform public policy.
- Collaborate with public and private partners to make results of research and other findings on successful patient recruitment strategies, including strategies targeted to minority and special populations, widely available to the research community.

**G-3 Train and attract the workforce necessary for rigorous research on aging, including new, mid-career, and senior investigators.**

- Develop and promote flexible mechanisms to meet the rapidly changing needs of science and prepare scientists, clinicians, and communicators to work effectively in interdisciplinary team environments across the continuum of research.
- Develop partnerships with academia, professional organizations, and other entities to establish and improve programs for identifying, recruiting, and training scholars for careers in research on aging.
- Participate in NIH efforts to improve recruitment, training, and retention of scientists across the full spectrum of research on aging.
- Expand bioethics training for investigators to address issues specific to older adults in research.

**G-4 Attract and train more researchers from diverse scientific and cultural backgrounds.**

- Participate in NIH efforts to narrow the racial gap in grant approval.
- Work to recruit, train, and retain scientists from under-represented groups.

#### **G-5 Develop and distribute research resources.**

- Support colonies of aged animal models that are necessary for research on aging processes and specific age-related diseases.
- Make cell cultures and tissue, cell, and blood banks available for basic and epidemiological research.
- Create and make available DNA resources for genetic studies on aging and disease.
- Support access to imaging and other advanced technologies in shared facilities for examining aging biological systems.
- Support the development of population-based data sets, especially from longitudinal studies, suitable for analysis of biological, behavioral, and social factors affecting health, well-being, and functional status through the life course.
- Support data archiving and data sharing. Consider innovative means for cost-effectively sharing data (i.e., remote enclaves) that expand research use while reducing disclosure risk.
- Support the development of internationally harmonized biological, social, and behavioral longitudinal data on aging to foster cross-national research.
- Support computer technologies to record and analyze interdisciplinary research findings on basic biological studies and long-term, population-based data.
- Implement efforts to encourage older individuals to participate in research and increase the numbers of participants in clinical trials.
- Support candidate drug evaluation programs, facilities, and related resources for animal and clinical studies.
- Develop innovative changes in the design, planning, and implementation of clinical trials and social and behavioral studies on the health and well-being of older people.

#### **G-6 Develop the necessary infrastructure to encourage translation of research from basic discovery and intervention development.**

Translational research provides the two-way bridge necessary to link scientific discoveries with development for and applications in medical practice and public health. For research on aging, basic discoveries typically begin with studies at a molecular or cellular level to understand the mechanisms of normal aging and disease or with basic behavioral or social science studies that uncover potential mechanisms responsible for driving differences in aging processes across individuals, groups, and geographical regions. New knowledge gained at “the bench,” “the lab,” or in “the field” takes a variety of paths to human intervention – the “bedside,” “the community,” or “the institution.” Equally important is providing a clear path back to the basic science for insights gained in the context of interventions. Several NIH initiatives are focusing on the broad issues of culture change required for the biomedical and behavioral science community to more successfully support translational activities that embody this process of back and forth translation. NIA will continue to:

- **Identify and optimize opportunities for moving new knowledge from basic discovery to intervention development and back.** We will accelerate our efforts to promote promising preclinical studies and community and health systems research. We will also work to ensure that new technologies such as advanced imaging and bioinformatics and other resources needed for effective translational research are accessible to scientists and clinicians.
- **Support a robust clinical trials infrastructure to facilitate the translation of basic research to human application in age-related diseases, and vice versa.** This support will include technical assistance for patient recruitment and retention of older adults in clinical trials.

- **Facilitate communication among researchers and encourage interdisciplinary collaboration.** The complexity of contemporary science demands collaboration among researchers from multiple disciplines along the continuum of research. We will invest in multidisciplinary research programs and provide supplemental funding to support promising interdisciplinary endeavors.
- **Foster communication and partnerships with other NIH institutes and centers and with other Federal agencies as well as other national and international research organizations.** NIA will continue to collaborate with other NIH Institutes and Centers on projects with a multi-disciplinary focus such as the NIH Common Fund, the NIH GeroScience Interest Group, and the NIH Blueprint for Neuroscience Research. We will continue to participate in partnerships with outside organizations to share resources, support collaborative research, eliminate barriers to drug development, and communicate research findings to the public.

## Goal H

### **Disseminate information to the public, medical and scientific communities, advocates and patient organizations, and policy makers about research and interventions.**

Communication efforts play a critical role in educating the public about research advances to improve health and well-being in later life. Health communication activities can increase the public's awareness of a specific aging issue, problem, or solution; reinforce certain knowledge, attitudes, or health behaviors; dispel misconceptions about aging; and encourage individual or collective action. Health education programs, activities, and materials can also inform, influence, and motivate the public.

Communicating effectively about health is challenging. Such information is often complex and technical. Moreover, the information may be inconclusive, controversial, contradictory, or subject to change as new research findings are released. Health information may also conflict with long held personal beliefs. Also, developments in technology quickly and dramatically are shifting the landscape for communicating health information. To succeed, health communication programs and materials must be based on an appreciation of the needs, interests and capabilities of the target audience, often with special considerations for physical and cognitive changes that come with age that may affect how information is received. Large scale, multi-year, multi-media efforts engaging community organizations already in place, such as NIA's *Go4Life* physical activity and exercise initiative and the Institute's Alzheimer's Disease and Education Referral (ADEAR) Center outreach on cognitive impairment and Alzheimer's, may be needed to inform, persuade, convince, and guide behavior change. Such efforts can be most successful when engaging important intermediaries representing health care providers, aging network and community services, advocates in aging and age-related diseases, the media, and others.

NIA communications are directly focused as well on professional audiences in research, clinical care and service delivery, policy and legislation, and advocacy. These constituencies are vitally interested not only in evidence-based health information, but also in NIA'S budget, grants and review policies and practices, funding opportunities, emerging research programs and priorities, and more. The NIA will continue to engage these communities in the planning and conduct of research as appropriate and in the dissemination of research results.



To ensure that research directions and study results are communicated as widely as possible, NIA will:

H-1 Increase awareness and promote adoption of evidence-based strategies to improve the health and quality of life of older adults.

H-2 Disseminate information to the public, medical and scientific communities, advocacy organizations, and policy makers.

**H-1 Increase awareness and promote adoption of evidence-based strategies to improve health and quality of life of older adults.**

- **Develop, test, and conduct health communication programs and outreach activities to inform the public about the interventions and health-related progress validated by the results of research on aging.** We will craft and deliver messages and materials based on research to understand how the various audiences perceive and react to health messages, how the public is persuaded to change behavior, and how people in general, and older adults in particular, respond to various media.
- **Explore successful networks for the transfer of research knowledge and to evaluate interventions for older adults.** NIA will continue to work with other federal agencies, state and local governments, and the private profit and nonprofit sectors to ensure that information about research and findings on diagnostics, treatment, prevention strategies, and behavioral and community interventions are widely shared and that strategies are developed and embraced for an impact on policies and programs. NIA will develop and maintain relationships with the traditional and digital media, providing evidence-based information and access to experts in aging and Alzheimer's research.
- **Maintain and upgrade *Go4Life*.** NIA will reach out to the public, agencies and organizations, health professionals and the media about the *Go4Life* campaign the NIA-led Federal Government's primary resource to promote physical activity and exercise among adults 50 and older. Joined by partners in the public and private sector to work with older adults in communities, the evidence-based campaign will use the Internet, social media, print, and other means to provide information and motivation for a diverse audience of older adults about exercise.
- **Provide information to support the training of people who work with older adults.** We will provide professional societies, community organizations, and academic institutions with research-based information that can be used in training geriatricians, social workers, counselors, and other community professionals and volunteers to work effectively with older adults and to implement evidence-based interventions.

**H-2 Disseminate information to the public, medical and scientific communities, advocacy organizations, and policy makers about research and research findings.**

- **Develop appropriate materials and programs for a variety of target audiences.** We will continue to work to overcome age, gender, cultural, and language barriers to the effective communication of health information, considering the best format for transmitting this information. We will continue to provide print materials for older adults without access to

digital and online resources, at the same time employing responsive design and web analytics to enhance and expand use of new technologies for health information as older adults become increasingly adept at using digital and online resources. .

- **Rapidly and effectively disseminate information to the medical community.** We will make widely available the latest advances in geriatric medicine, research on aging, and related health data through publications, professional education materials, public service announcements, videos, and other state-of-the-art communication technologies.
- **Make available health information and reports of research activities and findings on the [NIA Web site](#) and through other communications channels.** The Web site will continue to serve NIA's information hub for the public, researchers, health professionals, media, advocates, and policymakers interested in health, aging and research. Mobile applications, social media and other resources will provide information directly or invite audiences to the website. The NIA recognizes the different needs of these audiences and to the extent possible, it continue to tailor the information it shares, using a variety of outreach channels to enhance communication to specific audiences. These include the new blog for researchers and policymakers, webinars, content syndication, YouTube postings, meetings with groups and organizations, staff and leadership speeches, and more. NIA will continue to proactively explore ways to maintain and upgrade communications with both established and new audiences.
- **Maintain and promote the NIA [Alzheimer's Disease Education and Referral \(ADEAR\) Center](#).** This information center, the federal government's premier public information on Alzheimer's disease and age-related cognitive change, will continue to provide and expand evidence-based materials about these conditions, research, participation in clinical trials, and caregiving. The ADEAR Center is an important partner with the NIA Alzheimer's Disease Centers and researchers and clinicians in study recruitment and other aspects of community outreach.
- **Operate and promote [NIHSeniorHealth.gov](#).** Developed to recognize the cognitive and visual limitations many older adults may have in seeking health information online, NIHSeniorHealth will continue to serve as an age-focused, easy-to-read Internet resource. Its features, which are upgraded technically as new generations of older consumers become more proficient in web use, will be of particular importance as the population ages.
- **Develop materials for special audiences and diverse populations.** These may include non-English language materials and materials for people with limited literacy.
- **Support national education campaigns to encourage healthy practices among older adults.** These include not only the *Go4Life* campaign but also collaborations with other federal agencies, as well as state and community efforts.

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### **Ensuring the Ethical Integrity of NIA-Supported Research**

The research process is multi-faceted and includes many steps prior to, as well as following, the actual conduct of research. There are standard measures in place for each of these stages to insure that ethical integrity remains intact. For example, prior to implementation, all studies that seek to involve human subjects must be submitted to an Institutional Review Board (IRB). The IRB has an extensive list of qualifications that a study must uphold in order to be approved and/or continue. Other measures, such as the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule, protect the identity and safety of research participants even after the research process has been completed. NIA will always abide by strict regulations designed to prevent unethical research.

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