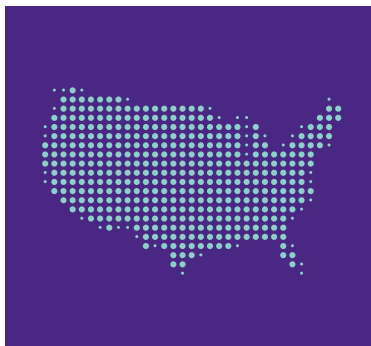
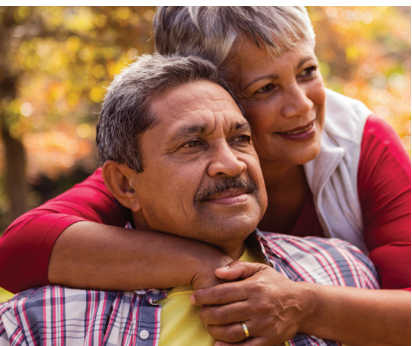


2020 Alzheimer's Disease Facts and Figures

SPECIAL REPORT

On the Front Lines:
Primary Care Physicians and
Alzheimer's Care in America

alzheimer's 
association®



About this report

2020 Alzheimer's Disease Facts and Figures is a statistical resource for U.S. data related to Alzheimer's disease, the most common cause of dementia. Background and context for interpretation of the data are contained in the Overview. Additional sections address prevalence, mortality and morbidity, caregiving and use and costs of health care and services. A Special Report examines primary care physicians' experiences, exposure, training and attitudes in providing dementia care and steps that can be taken to ensure their future readiness for a growing number of Americans living with Alzheimer's and other dementias.

**Specific information in this year's
Alzheimer's Disease Facts and Figures includes:**

- Brain changes that occur with Alzheimer's disease (page 5).
- Risk factors for Alzheimer's dementia (page 12).
- Number of Americans with Alzheimer's dementia nationally (page 18) and for each state (page 21).
- Lifetime risk for developing Alzheimer's dementia (page 22).
- Proportion of women and men with Alzheimer's and other dementias (page 22).
- Number of deaths due to Alzheimer's disease nationally (page 27) and for each state (page 29), and death rates by age (page 30).
- Number of family caregivers, hours of care provided, and economic value of unpaid care nationally (page 33) and for each state (page 36).
- The impact of caregiving on caregivers (page 37).
- National cost of care for individuals with Alzheimer's or other dementias, including costs paid by Medicare and Medicaid and costs paid out of pocket (page 46).
- Medicare payments for people with dementia compared with people without dementia (page 47).
- Number of geriatricians needed by state in 2050 (page 65).

The Appendices detail sources and methods used to derive statistics in this report.

When possible, specific information about Alzheimer's is provided; in other cases, the reference may be a more general one of "Alzheimer's or other dementias."

Contents

Overview of Alzheimer's Disease

Alzheimer's Disease or Dementia?	5
Brain Changes Associated with Alzheimer's Disease	5
Alzheimer's Disease Continuum	7
Diagnosis of Dementia Due to Alzheimer's Disease	9
Treatment of Alzheimer's Dementia	9
Active Management of Alzheimer's Dementia	12
Risk Factors for Alzheimer's Dementia	12
Looking to the Future	16

Prevalence

Prevalence of Alzheimer's and Other Dementias in the United States	18
Estimates of the Number of People with Alzheimer's Dementia by State	20
Incidence of Alzheimer's Dementia	22
Lifetime Risk of Alzheimer's Dementia	22
Differences Between Women and Men in the Prevalence and Risk of Alzheimer's and Other Dementias	22
Racial and Ethnic Differences in the Prevalence of Alzheimer's and Other Dementias	23
Trends in the Prevalence and Incidence of Alzheimer's Dementia Over Time	24

Mortality and Morbidity

Deaths from Alzheimer's Disease	27
Public Health Impact of Deaths from Alzheimer's Disease	28
State-by-State Deaths from Alzheimer's Disease	29
Alzheimer's Death Rates	31
Duration of Illness from Diagnosis to Death	31
Burden of Alzheimer's Disease	31

Caregiving	
Unpaid Caregivers	33
Who Are the Caregivers?	34
Caregiving and Women	34
Caregiving Tasks	35
Duration of Caregiving	37
Hours of Unpaid Care and Economic Value of Caregiving	37
Impact of Alzheimer's Caregiving	37
Interventions Designed to Assist Caregivers	41
Paid Caregivers	42
Direct-Care Workers for People with Alzheimer's or Other Dementias	42
Shortage of Geriatric Health Care Professionals	43
Enhancing Health Care for Family Caregivers	43
Trends in Dementia Caregiving	43

Use and Costs of Health Care, Long-Term Care and Hospice	
Total Cost of Health Care and Long-Term Care	46
Use and Costs of Health Care Services	48
Use and Costs of Long-Term Care Services	52
Use and Costs of Health Care and Long-Term Care Services by Race/Ethnicity	59
Avoidable Use of Health Care and Long-Term Care Services	60
Projections for the Future	61

Special Report — On the Front Lines: Primary Care Physicians and Alzheimer's Care in America	
Who Diagnoses and Provides Medical Care?	64
Growing Need, Projected Shortages in Specialists	64
Primary Care Physicians	66
Survey Results	67
Keeping Current	69
Meeting Future Demand	71
Conclusion	71

Appendices	
End Notes	72
References	75

Overview



Alzheimer's disease is the most common cause of dementia, accounting for **60% to 80%** of cases.

Alzheimer's disease is a type of brain disease, just as coronary artery disease is a type of heart disease. It is also a degenerative disease, meaning that it becomes worse with time. Alzheimer's disease is thought to begin 20 years or more before symptoms arise,¹⁻⁶ with changes in the brain that are unnoticeable to the person affected. Only after years of brain changes do individuals experience noticeable symptoms such as memory loss and language problems. Symptoms occur because nerve cells (neurons) in parts of the brain involved in thinking, learning and memory (cognitive function) have been damaged or destroyed. As the disease progresses, neurons in other parts of the brain are damaged or destroyed. Eventually, nerve cells in parts of the brain that enable a person to carry out basic bodily functions, such as walking and swallowing, are affected. Individuals become bed-bound and require around-the-clock care. Alzheimer's disease is ultimately fatal.

Alzheimer's Disease or Dementia?

Many people wonder what the difference is between Alzheimer's disease and dementia.

Dementia is an overall term for a particular group of symptoms. The characteristic symptoms of dementia are difficulties with memory, language, problem-solving and other thinking skills that affect a person's ability to perform everyday activities. Dementia has many causes (see Table 1, page 6). *Alzheimer's disease* is the most common cause of dementia.

Brain Changes Associated with Alzheimer's Disease

A healthy adult brain has about 100 billion neurons, each with long, branching extensions. These extensions enable individual neurons to form connections with other neurons. At such connections, called synapses, information flows in tiny bursts of chemicals that are released by one neuron and detected by another neuron. The brain contains about 100 trillion synapses. They allow signals to travel rapidly through the brain's neuronal circuits, creating the cellular basis of memories, thoughts, sensations, emotions, movements and skills.

The accumulation of the protein fragment beta-amyloid (called beta-amyloid plaques) *outside* neurons and the accumulation of an abnormal form of the protein tau (called tau tangles) *inside* neurons are two of several brain changes associated with Alzheimer's.

Plaques and smaller accumulations of beta-amyloid called oligomers may contribute to the damage and death of neurons (neurodegeneration) by interfering with neuron-to-neuron communication at synapses. Tau tangles block the transport of nutrients and other essential molecules inside neurons. Although the complete sequence of events is unclear, beta-amyloid may begin accumulating before abnormal tau, and increasing beta-amyloid accumulation is associated with subsequent increases in tau.⁷⁻⁸

Other brain changes include inflammation and atrophy. The presence of toxic beta-amyloid and tau proteins are believed to activate immune system cells in the brain called microglia. Microglia try to clear the toxic proteins as well as widespread debris from dead and dying cells. Chronic inflammation may set in when the microglia can't keep up with all that needs to be cleared. Atrophy, or shrinkage, of the brain occurs because of cell loss. Normal brain function is further compromised in Alzheimer's disease by decreases in the brain's ability to metabolize glucose, its main fuel.

A study⁵ of people with rare genetic mutations that cause Alzheimer's found that levels of beta-amyloid in the brain were significantly increased starting 22 years before symptoms were expected to develop (individuals with these genetic mutations usually develop symptoms at the same or nearly the same age as their parent with Alzheimer's). Glucose metabolism began to decrease 18 years before expected symptom onset, and brain atrophy began 13 years before expected symptom onset.

TABLE 1

Common Causes of Dementia and Associated Characteristics

Cause	Characteristics
Alzheimer's disease	<p>Alzheimer's disease is the most common cause of dementia, accounting for an estimated 60% to 80% of cases. Recent large autopsy studies show that more than half of individuals with Alzheimer's dementia have Alzheimer's disease brain changes (pathology) as well as the brain changes of one or more other causes of dementia, such as cerebrovascular disease or Lewy body disease. This is called mixed pathologies, and if recognized during life is called mixed dementia.</p> <p>Difficulty remembering recent conversations, names or events is often an early clinical symptom; apathy and depression are also often early symptoms. Later symptoms include impaired communication, disorientation, confusion, poor judgment, behavioral changes and, ultimately, difficulty speaking, swallowing and walking.</p> <p>The hallmark pathologies of Alzheimer's disease are the accumulation of the protein fragment beta-amyloid (plaques) <i>outside</i> neurons in the brain and twisted strands of the protein tau (tangles) <i>inside</i> neurons. These changes are accompanied by the death of neurons and damage to brain tissue. Alzheimer's is a slowly progressive brain disease that begins many years before symptoms emerge.</p>
Cerebrovascular disease	<p>Cerebrovascular disease refers to the process by which blood vessels in the brain are damaged and/or brain tissue is injured from not receiving enough blood, oxygen or nutrients. People with dementia whose brains show evidence of cerebrovascular disease are said to have vascular dementia. About 5% to 10% of individuals with dementia show evidence of vascular dementia alone.⁹⁻¹⁰ However, it is more common as a mixed pathology, with most people living with dementia showing the brain changes of cerebrovascular disease and Alzheimer's disease.</p> <p>Impaired judgment or impaired ability to make decisions, plan or organize may be the initial symptom, but memory may also be affected, especially when the brain changes of other causes of dementia are present. In addition to changes in cognitive function, people with vascular dementia commonly have difficulty with motor function, especially slow gait and poor balance.</p> <p>Vascular dementia occurs most commonly from blood vessel blockage or damage leading to areas of dead tissue or bleeding in the brain. The location, number and size of the brain injuries determine whether dementia will result and how the individual's thinking and physical functioning will be affected.</p>
Lewy body disease	<p>Lewy bodies are abnormal aggregations (or clumps) of the protein alpha-synuclein in neurons. When they develop in a part of the brain called the cortex, dementia (called dementia with Lewy bodies or DLB) can result. People with DLB have some of the symptoms common in Alzheimer's, but are more likely to have initial or early symptoms of sleep disturbances, well-formed visual hallucinations and visuospatial impairment. These symptoms may occur in the absence of significant memory impairment but memory loss often occurs, especially when the brain changes of other causes of dementia are present.</p> <p>About 5% of individuals with dementia show evidence of DLB alone, but most people with DLB also have Alzheimer's disease pathology.</p>
Fronto-temporal lobar degeneration (FTLD)	<p>FTLD includes dementias such as behavioral-variant FTLD, primary progressive aphasia, Pick's disease, corticobasal degeneration and progressive supranuclear palsy.</p> <p>Typical early symptoms include marked changes in personality and behavior and/or difficulty with producing or comprehending language. Unlike Alzheimer's, memory is typically spared in the early stages of disease.</p> <p>Nerve cells in the front (frontal lobe) and side regions (temporal lobes) of the brain are especially affected, and these regions become markedly atrophied (shrunken). In addition, the upper layers of the cortex typically become soft and spongy and have abnormal protein inclusions (usually tau protein or the transactive response DNA-binding protein, TDP-43).</p> <p>The symptoms of FTLD may occur in those age 65 years and older, similar to Alzheimer's, but most people with FTLD develop symptoms at a younger age. About 60 percent of people with FTLD are ages 45 to 60.¹¹ Scientists think that FTLD is the most common cause of dementia in people younger than 60.¹¹ In a systematic review, FTLD accounted for about 3% of dementia cases in studies that included people 65 and older and about 10% of dementia cases in studies restricted to those younger than 65.¹²</p>

TABLE 1 (cont.)

Common Causes of Dementia and Associated Characteristics

Cause	Characteristics
Parkinson's disease (PD)	<p>Problems with movement (slowness, rigidity, tremor and changes in gait) are common symptoms of PD. Cognitive symptoms develop either just before movement symptoms or later in the disease.</p> <p>In PD, alpha-synuclein aggregates appear in an area deep in the brain called the substantia nigra. The aggregates are thought to cause degeneration of the nerve cells that produce dopamine.¹³</p> <p>As PD progresses, it often results in dementia secondary to the accumulation of alpha-synuclein in the cortex (similar to dementia with Lewy bodies).</p>
Hippocampal sclerosis (HS)	<p>HS is the hardening of tissue in the hippocampus of the brain. The hippocampus plays a key role in forming memories. The most pronounced symptom of HS is memory loss, and individuals may be misdiagnosed as having Alzheimer's disease.</p> <p>HS brain changes are often accompanied by accumulations of a misfolded form of a protein called TDP-43.</p> <p>HS is a common cause of dementia in the "oldest-old," individuals age 85 or older.</p>
Mixed pathologies	<p>When an individual shows the brain changes of more than one cause of dementia, mixed pathologies are considered the cause. When these pathologies result in dementia symptoms during life, the person is said to have mixed dementia.</p> <p>Studies suggest that mixed dementia is more common than previously recognized, with more than 50% of people with dementia who were studied at Alzheimer's Disease Centers having pathologic evidence of more than one cause of dementia.¹⁰ In community-based studies, the percentage of mixed dementia cases is considerably higher.⁹ The likelihood of having mixed dementia increases with age and is highest in people age 85 or older.¹⁴⁻¹⁵</p>

It is critical to note that while the field of Alzheimer's research has made great gains over the years in understanding the brain changes associated with the disease and how the disease progresses, much of the research to date has not included sufficient numbers of blacks/African Americans, Hispanics/Latinos, Asian Americans/Pacific Islanders and Native Americans to be representative of the U.S. population. Moreover, because some studies¹⁶⁻¹⁹ find blacks/African Americans and Hispanics/Latinos to be at increased risk for Alzheimer's, the underrepresentation of these populations hampers the conduct of rigorous research to understand these health disparities. Additional research involving individuals from underrepresented ethnic and racial groups is necessary to gain a comprehensive understanding of Alzheimer's disease.

Alzheimer's Disease Continuum

The progression of Alzheimer's disease from brain changes that are unnoticeable to the person affected to brain changes that cause problems with memory and eventually physical disability is called the Alzheimer's disease continuum.

On this continuum, there are three broad phases: preclinical Alzheimer's disease, mild cognitive impairment

(MCI) due to Alzheimer's disease and dementia due to Alzheimer's disease (see Figure 1).²⁰⁻²³ The Alzheimer's dementia phase is further broken down into the stages of mild, moderate and severe, which reflect the degree to which symptoms interfere with one's ability to carry out everyday activities.

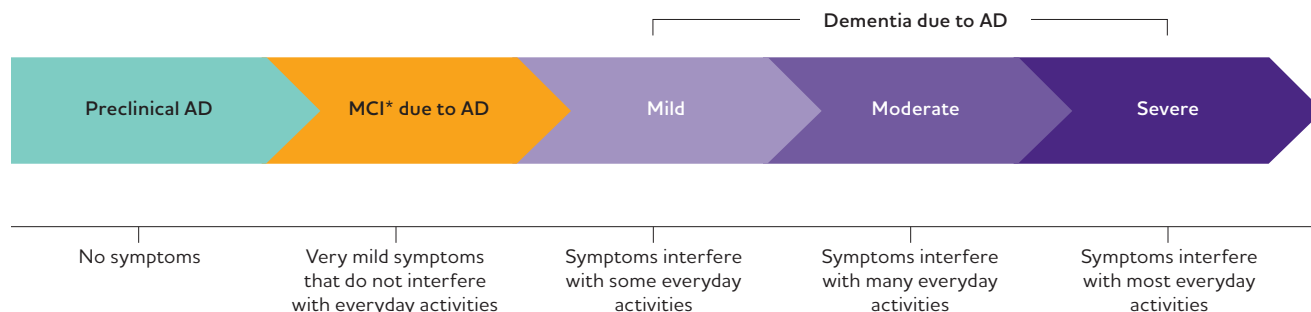
While we know the continuum starts with preclinical Alzheimer's and ends with severe Alzheimer's dementia, how long individuals spend in each part of the continuum varies. The length of each phase of the continuum is influenced by age, genetics, gender and other factors.²⁴

Preclinical Alzheimer's Disease

In this phase, individuals have measurable brain changes that indicate the earliest signs of Alzheimer's disease (biomarkers), but they have not yet developed symptoms such as memory loss. Examples of measurable brain changes include abnormal levels of beta-amyloid as shown on positron emission tomography (PET) scans and in analysis of cerebrospinal fluid (CSF), and decreased metabolism of glucose as shown on PET scans. When the early changes of Alzheimer's occur, the brain compensates for them, enabling individuals to continue to function normally.

FIGURE 1

Alzheimer's Disease (AD) Continuum



*Mild cognitive impairment

While research settings have the tools and expertise to identify some of the early brain changes of Alzheimer's, additional research is needed to fine-tune the tools' accuracy before they become available for widespread use in hospitals, doctors' offices and other clinical settings. It is important to note that not all individuals with evidence of Alzheimer's-related brain changes go on to develop symptoms of MCI or dementia due to Alzheimer's.²⁵⁻²⁶ For example, some individuals have beta-amyloid plaques at death but did not have memory or thinking problems in life.

MCI Due to Alzheimer's Disease

People with MCI due to Alzheimer's disease have biomarker evidence of Alzheimer's brain changes (for example, abnormal levels of beta-amyloid) plus subtle problems with memory and thinking. These cognitive problems may be noticeable to family members and friends, but not to others, and they do not interfere with individuals' ability to carry out everyday activities. The mild changes in thinking abilities occur when the brain can no longer compensate for the damage and death of nerve cells caused by Alzheimer's disease.

Among those with MCI, one analysis found that after 2 years' follow-up, 15% of individuals older than 65 had developed dementia.²⁷ Another study found that 32% of individuals with MCI developed Alzheimer's dementia within 5 years' follow-up.²⁸ A third study found that among individuals with MCI who were tracked for 5 years or longer, 38% developed dementia.²⁹ However, in some individuals MCI reverts to normal cognition or remains stable. In other cases, such as when a medication inadvertently causes cognitive changes, MCI is mistakenly diagnosed and cognitive changes can be reversed with medication changes. Identifying which individuals with MCI are more likely to develop Alzheimer's or other dementias is a major goal of current research.

Dementia Due to Alzheimer's Disease

Dementia due to Alzheimer's disease is characterized by noticeable memory, thinking or behavioral symptoms that impair a person's ability to function in daily life, along with evidence of Alzheimer's-related brain changes. Individuals with Alzheimer's dementia experience multiple symptoms that change over a period of years. These symptoms reflect the degree of damage to nerve cells in different parts of the brain. The pace at which symptoms of dementia advance from mild to moderate to severe differs from person to person.

Mild Alzheimer's Dementia

In the mild stage of Alzheimer's dementia, most people are able to function independently in many areas but are likely to require assistance with some activities to maximize independence and remain safe. They may still be able to drive, work and participate in favorite activities.

Moderate Alzheimer's Dementia

In the moderate stage of Alzheimer's dementia, which is often the longest stage, individuals may have difficulties communicating and performing routine tasks, including activities of daily living (such as bathing and dressing); become incontinent at times; and start having personality and behavioral changes, including suspiciousness and agitation.

Severe Alzheimer's Dementia

In the severe stage of Alzheimer's dementia, individuals need help with activities of daily living and are likely to require around-the-clock care. The effects of Alzheimer's disease on individuals' physical health become especially apparent in this stage. Because of damage to areas of the brain involved in movement, individuals become bed-bound. Being bed-bound makes them vulnerable to conditions including blood clots, skin infections and sepsis, which triggers body-wide inflammation that can result in organ failure. Damage to areas of the brain that control swallowing makes it

difficult to eat and drink. This can result in individuals swallowing food into the trachea (windpipe) instead of the esophagus (food pipe). Because of this, food particles may be deposited in the lungs and cause lung infection. This type of infection is called aspiration pneumonia, and it is a contributing cause of death among many individuals with Alzheimer's (see Mortality and Morbidity section, page 26).

When Dementia-Like Symptoms Are Not Dementia

It is important to note that some individuals have dementia-like symptoms without the progressive brain changes of Alzheimer's or other degenerative brain diseases. Causes of dementia-like symptoms include depression, untreated sleep apnea, delirium, side effects of medications, Lyme disease, thyroid problems, certain vitamin deficiencies and excessive alcohol consumption. Unlike Alzheimer's and other dementias, these conditions often may be reversed with treatment. Consulting a medical professional to determine the cause of symptoms is critical to one's physical and emotional well-being.

The differences between normal age-related cognitive changes and the cognitive changes of Alzheimer's dementia can be subtle (see Table 2, page 10). People experiencing cognitive changes should seek medical help to determine if the changes are normal for one's age, reversible or a symptom of Alzheimer's or another dementia. The Medicare Annual Wellness Visit, which includes a cognitive evaluation, is an opportune time for individuals age 65 or older to discuss cognitive changes with their physician.

Diagnosis of Dementia Due to Alzheimer's Disease

There is no single test for dementia due to Alzheimer's disease. Instead, physicians (often with the help of specialists such as neurologists, neuropsychologists, geriatricians and geriatric psychiatrists) use a variety of approaches and tools to help make a diagnosis. They include the following:

- Obtaining a medical and family history from the individual, including psychiatric history and history of cognitive and behavioral changes.
- Asking a family member to provide input about changes in thinking skills and behavior.
- Conducting problem-solving, memory and other cognitive tests, as well as physical and neurologic examinations.
- Having the individual undergo blood tests and brain imaging to rule out other potential causes of dementia symptoms, such as a tumor or certain vitamin deficiencies.

- In some circumstances, using PET imaging of the brain to find out if the individual has high levels of beta-amyloid, a hallmark of Alzheimer's; normal levels would suggest Alzheimer's is not the cause of dementia.³⁰
- In some circumstances, using lumbar puncture to determine the levels of beta-amyloid and certain types of tau in CSF; normal levels would suggest Alzheimer's is not the cause of dementia.³¹

Although physicians can almost always determine if a person has dementia, it may be difficult to identify the exact cause. Alzheimer's disease is the most common cause of dementia, but there are other causes as well.³²⁻³³ As shown in Table 1 (see page 6), different causes of dementia are associated with distinct symptom patterns and brain abnormalities. Many people with dementia have brain changes associated with more than one cause of dementia.^{9,34-38} This is called mixed dementia. Some studies⁹⁻¹⁰ report that the majority of people with the brain changes of Alzheimer's also have the brain changes of a second cause of dementia on autopsy.

As discussed in the Prevalence section (see page 17), many individuals who would meet the diagnostic criteria for Alzheimer's and other dementias are not diagnosed by a physician,³⁹⁻⁴² and fewer than half of Medicare beneficiaries who have a diagnosis of Alzheimer's or another dementia in their Medicare billing records report (or their caregiver reports, if the beneficiary's cognitive impairment prevented him or her from responding) being told of the diagnosis.⁴³⁻⁴⁶ It is important that individuals who are living with dementia receive a diagnosis and are aware of the diagnosis. It is also important that individuals receive an *accurate* diagnosis to ensure they receive treatment or follow-up care appropriate to their specific cause of dementia.

Treatment of Alzheimer's Dementia

Pharmacologic Treatment

None of the pharmacologic treatments (medications) available today for Alzheimer's dementia slow or stop the damage and destruction of neurons that cause Alzheimer's symptoms and make the disease fatal. The U.S. Food and Drug Administration (FDA) has approved five drugs for the treatment of Alzheimer's — rivastigmine, galantamine, donepezil, memantine, and memantine combined with donepezil. With the exception of memantine, these drugs temporarily improve cognitive symptoms by increasing the amount of chemicals called neurotransmitters in the brain. Memantine blocks certain receptors in the brain from excess stimulation that can damage nerve cells. The effectiveness of these drugs varies from person to person and is limited in duration.

TABLE 2

Signs of Alzheimer’s or Other Dementias Compared with Typical Age-Related Changes*

Signs of Alzheimer’s or Other Dementias	Typical Age-Related Changes
<p>Memory loss that disrupts daily life: One of the most common signs of Alzheimer’s is memory loss, especially forgetting recently learned information. Others include forgetting important dates or events, asking for the same information over and over, and increasingly needing to rely on memory aids (for example, reminder notes or electronic devices) or family members for things that used to be handled on one’s own.</p>	<p>Sometimes forgetting names or appointments, but remembering them later.</p>
<p>Challenges in planning or solving problems: Some people experience changes in their ability to develop and follow a plan or work with numbers. They may have trouble following a familiar recipe, keeping track of monthly bills or counting change. They may have difficulty concentrating and take much longer to do things than they did before.</p>	<p>Making occasional errors when balancing a checkbook.</p>
<p>Difficulty completing familiar tasks at home, at work or at leisure: People with Alzheimer’s often find it hard to complete daily tasks. Sometimes, people have trouble driving to a familiar location, managing a budget at work or remembering the rules of a favorite game.</p>	<p>Occasionally needing help to use the settings on a microwave or record a television show.</p>
<p>Confusion with time or place: People with Alzheimer’s can lose track of dates, seasons and the passage of time. They may have trouble understanding something if it is not happening immediately. Sometimes they forget where they are or how they got there.</p>	<p>Getting confused about the day of the week but figuring it out later.</p>
<p>Trouble understanding visual images and spatial relationships: For some people, having vision problems is a sign of Alzheimer’s. They may have difficulty reading, judging distance and determining color or contrast, which may cause problems with driving.</p>	<p>Vision changes related to cataracts, glaucoma or age-related macular degeneration.</p>
<p>New problems with words in speaking or writing: People with Alzheimer’s may have trouble following or joining a conversation. They may stop in the middle of a conversation and have no idea how to continue or they may repeat themselves. They may struggle with vocabulary, have problems finding the right word or call things by the wrong name (e.g., calling a watch a “hand clock”).</p>	<p>Sometimes having trouble finding the right word.</p>
<p>Misplacing things and losing the ability to retrace steps: People with Alzheimer’s may put things in unusual places, and lose things and be unable to go back over their steps to find them again. Sometimes, they accuse others of stealing. This may occur more frequently over time.</p>	<p>Misplacing things from time to time and retracing steps to find them.</p>
<p>Decreased or poor judgment: People with Alzheimer’s may experience changes in judgment or decision-making. For example, they may use poor judgment when dealing with money, giving large amounts to telemarketers. They may pay less attention to grooming or keeping themselves clean.</p>	<p>Making a bad decision once in a while.</p>
<p>Withdrawal from work or social activities: People with Alzheimer’s may start to remove themselves from hobbies, social activities, work projects or sports. They may have trouble keeping up with a favorite sports team or remembering how to complete a favorite hobby. They may also avoid being social because of the changes they have experienced.</p>	<p>Sometimes feeling weary of work, family and social obligations.</p>
<p>Changes in mood and personality: The mood and personalities of people with Alzheimer’s can change. They can become confused, suspicious, depressed, fearful or anxious. They may be easily upset at home, at work, with friends or in places where they are out of their comfort zones.</p>	<p>Developing very specific ways of doing things and becoming irritable when a routine is disrupted.</p>

*For more information about the symptoms of Alzheimer’s, visit alz.org/10signs.

No drugs are specifically approved by the FDA to treat behavioral and psychiatric symptoms that may develop in the moderate and severe stages of Alzheimer's dementia. If non-pharmacologic therapy is not successful and these symptoms have the potential to cause harm to the individual or others, physicians may prescribe medications approved for similar symptoms in people with other conditions. A type of medication called antipsychotics may be prescribed to treat hallucinations, aggression and agitation. However, research has shown that some antipsychotics are associated with an increased risk of stroke and death in individuals with dementia.⁴⁷⁻⁴⁸ The decision to use antipsychotics must be considered with extreme caution. The FDA has ordered manufacturers to label such drugs with a "black box warning" about their risks and a reminder that they are not approved to treat dementia symptoms.

Many factors contribute to the difficulty of developing effective treatments for Alzheimer's. These factors include the slow pace of recruiting sufficient numbers of participants and sufficiently diverse participants to clinical studies, gaps in knowledge about the precise molecular changes and biological processes in the brain that cause Alzheimer's disease, and the relatively long time needed to observe whether an investigational treatment affects disease progression.

Researchers believe that future treatments to slow or stop the progression of Alzheimer's disease and preserve brain function may be most effective when administered early in the disease continuum, either at the MCI due to Alzheimer's or preclinical Alzheimer's phase. Biomarker tests will be essential to identify which individuals are in these phases of the continuum and should receive treatments when they are available. Biomarkers also will be critical for monitoring the effects of treatment. Biomarker tests are already playing an important role in drug development because they enable researchers to recruit into clinical trials only those individuals with the Alzheimer's brain changes that a drug has been designed to affect.⁴⁹ The most effective biomarker test or combination of tests may differ depending on where the individual is on the disease continuum and other factors.⁵⁰

Non-Pharmacologic Therapy

Non-pharmacologic therapies are those that do not involve medication. They are often used for people with Alzheimer's dementia with the goal of maintaining or improving cognitive function, overall quality of life or the ability to perform activities of daily living. They also may be used with the goal of reducing behavioral symptoms such as depression, apathy, wandering, sleep disturbances, agitation and aggression. A recent

review and analysis of non-pharmacologic treatments for agitation and aggression in people with dementia concluded that non-pharmacologic interventions seemed to be more effective than pharmacologic interventions for reducing aggression and agitation.⁵¹ Examples include computerized memory training, listening to favorite music as a way to stir recall, and using special lighting to lessen sleep disorders. As with current pharmacologic therapies, non-pharmacologic therapies do not slow or stop the damage and destruction of neurons that cause Alzheimer's symptoms and make the disease fatal.

Determining the effectiveness of non-pharmacologic therapies can be difficult because of the large number of unique therapies tested; the diversity of therapeutic aims (from improved overall quality of life to improvements in specific symptoms); the diverse dementia stages represented (from mild to moderate to severe); the diverse types of dementia that may be present among participants in a particular study given the pervasiveness of mixed dementia; and the lack of a standard method for carrying out any individual therapy. With these multiple factors to consider, it is challenging to group together and compare non-pharmacologic therapies.

Nevertheless, researchers have pooled data from multiple studies of non-pharmacologic therapies to provide insight into their potential effectiveness.

- A meta-analysis⁵² found that aerobic exercise and a combination of aerobic and non-aerobic exercise had positive effects on cognitive function in people living with Alzheimer's dementia. A systematic review⁵³ found that exercise has a positive effect on overall cognitive function and may slow the rate of cognitive decline in people with Alzheimer's dementia.
- A systematic review⁵⁴ found that cognitive stimulation had beneficial effects on cognitive function and some aspects of well-being in people with Alzheimer's dementia. Another systematic review⁵⁵ reported that cognitive stimulation was associated with improved scores on tests of depression in people with mild-to-moderate Alzheimer's dementia. A 2019 summary⁵⁶ of systematic reviews reported that cognitive stimulation, music-based therapies and psychological treatment (for example, cognitive behavioral therapy) improved depression, anxiety and quality of life in people with dementia.
- A 2019 summary of systematic reviews⁵⁷ of cognitive training for people with mild-to-moderate dementia found cognitive training may show some benefits in overall cognition that may last for at least a few months.

Active Management of Alzheimer's Dementia

Studies have consistently shown that active management of Alzheimer's and other dementias can improve the quality of life of affected individuals and their caregivers.⁵⁸⁻⁶⁰ Active management includes:

- Appropriate use of available treatment options.
- Effective management of coexisting conditions.
- Providing family caregivers with effective training in managing the day-to-day life of the care recipient.
- Coordination of care among physicians, other health care professionals and lay caregivers.
- Participation in activities that are meaningful to the individual with dementia and bring purpose to his or her life.
- Having opportunities to connect with others living with dementia; support groups and supportive services are examples of such opportunities.
- Becoming educated about the disease.
- Planning for the future.

To learn more about Alzheimer's disease, as well as practical information for living with Alzheimer's and being a caregiver, visit alz.org.

Risk Factors for Alzheimer's Dementia

The vast majority of people who develop Alzheimer's dementia are age 65 or older. This is called late-onset Alzheimer's. Experts believe that Alzheimer's, like other common chronic diseases, develops as a result of multiple factors rather than a single cause. Exceptions are cases of Alzheimer's related to uncommon genetic changes that increase risk (see page 15).

Age, Genetics and Family History

The greatest risk factors for late-onset Alzheimer's are older age,⁶¹⁻⁶² genetics⁶³⁻⁶⁴ and having a family history of Alzheimer's.⁶⁵⁻⁶⁸

Age

Age is the greatest of these three risk factors. As noted in the Prevalence section (see page 17), the percentage of people with Alzheimer's dementia increases dramatically with age: 3% of people age 65-74, 17% of people age 75-84 and 32% of people age 85 or older have Alzheimer's dementia.⁶² It is important to note that Alzheimer's dementia is not a normal part of aging,⁶⁹ and older age alone is not sufficient to cause Alzheimer's dementia.

Genetics

Researchers have found several genes that increase the risk of Alzheimer's. The apolipoprotein-e4 (APOE-e4) gene is the gene with the strongest impact on risk of

TABLE 3

Percentage of Blacks/African Americans and European Americans with Specified APOE Pairs

APOE Pair	Blacks/African Americans*	European Americans
e3/e3	45.2	63.4
e3/e4	28.6	21.4
e3/e2	15.1	10.2
e2/e4	5.7	2.4
e4/e4	4.5	2.4
e2/e2	0.7	0.2

Created from data from Rajan et al.⁷⁰

*Percentages do not total 100 due to rounding.

late-onset Alzheimer's. APOE-e4 provides the blueprint for a protein that transports cholesterol in the bloodstream. Everyone inherits one of three forms (alleles) of the APOE gene — e2, e3 or e4 — from each parent, resulting in six possible APOE pairs: e2/e2, e2/e3, e2/e4, e3/e3, e3/e4 and e4/e4. Researchers have found differences in the frequency of these pairs in different racial and ethnic groups. For example, data show that a higher percentage of blacks/African Americans than European Americans have at least one copy of the e4 allele (see Table 3).⁷⁰⁻⁷²

Having the e4 form of APOE increases one's risk of developing Alzheimer's compared with having the e3 form, but does not guarantee that an individual will develop Alzheimer's. Having the e2 form may decrease one's risk compared with having the e3 form. Those who inherit one copy of the e4 form have about three times the risk of developing Alzheimer's compared with those with two copies of the e3 form, while those who inherit two copies of the e4 form have an eight- to 12-fold risk.⁷³⁻⁷⁵ In addition, those with the e4 form are more likely to have beta-amyloid accumulation⁷⁶ and Alzheimer's dementia at a younger age than those with the e2 or e3 forms of the APOE gene.⁷⁷ A meta-analysis including 20 published articles describing the frequency of the e4 form among people in the United States who had been diagnosed with Alzheimer's found that 56% had one copy of the APOE-e4 gene, and 11% had two copies of the APOE-e4 gene.⁷⁸ Another study found that among 1,770 diagnosed individuals from 26 Alzheimer's Disease Centers across the United States, 65% had at least one copy of the APOE-e4 gene.⁷⁹

However, studies of Alzheimer's risk based on APOE status among blacks/African Americans have had inconsistent results. For example, some have found that having the e4 allele did not increase risk among blacks/African Americans,^{71-72,80} while other studies have found that it significantly increased risk.⁸¹⁻⁸² More research is needed to better understand the genetic mechanisms involved in Alzheimer's risk among different racial and ethnic groups.

Family History

A family history of Alzheimer's is not necessary for an individual to develop the disease. However, individuals who have a parent or sibling (first-degree relative) with Alzheimer's dementia are more likely to develop the disease than those who do not have a first-degree relative with Alzheimer's.^{65,73} Those who have more than one first-degree relative with Alzheimer's are at even higher risk.⁶⁸ A large, population-based study found that having a parent with dementia increases risk independent of known genetic risk factors such as APOE-e4.⁸³ When diseases run in families, heredity (genetics) and shared non-genetic factors (for example, access to healthy foods and habits related to physical activity) may play a role.

Modifiable Risk Factors

Although age, genetics and family history cannot be changed, other risk factors can be changed or modified to reduce the risk of cognitive decline and dementia.

In 2019, the World Health Organization (WHO) published recommendations⁸⁴ to reduce risk of cognitive decline and dementia. WHO strongly recommends physical activity, quitting smoking, and managing hypertension and diabetes to reduce the risk of cognitive decline and dementia. A report⁸⁵ evaluating the state of the evidence on the effects of modifiable risk factors on cognitive decline and dementia concluded that there is sufficiently strong evidence, from a population-based perspective, that regular physical activity and management of cardiovascular risk factors (especially diabetes, obesity, smoking and hypertension) is associated with reduced risk of cognitive decline and may be associated with reduced risk of dementia. It also concluded that there is sufficiently strong evidence that a healthy diet, lifelong learning and cognitive training are associated with reduced risk of cognitive decline. A report from the National Academy of Medicine (formerly the Institute of Medicine) examined the evidence regarding modifiable risk factors for cognitive decline and reached similar conclusions.⁸⁶ More research is needed to understand the biological mechanisms by which these factors reduce risk.

It is important to note that "reducing risk" of cognitive decline and dementia is not synonymous with preventing cognitive decline and dementia. Individuals who take measures to reduce risk may still develop dementia, but may be less likely to develop it, or may develop it later in life than they would have if they had not taken steps to reduce their risk. It is also important to note that factors that increase or decrease the risk of cognitive decline and dementia may not necessarily do so by directly affecting the brain changes associated with Alzheimer's disease.⁸⁰ For example, it is possible that smoking may contribute to cerebrovascular disease, which in turn increases the risk of dementia, but it may not directly contribute to the development of the amyloid plaques and tau tangles that characterize Alzheimer's disease.

Cardiovascular Disease Risk Factors

Brain health is affected by the health of the heart and blood vessels. Although it makes up just 2% of body weight, the brain consumes 20% of the body's oxygen and energy supplies.⁸⁷ A healthy heart ensures that enough blood is pumped to the brain, while healthy blood vessels enable the oxygen- and nutrient-rich blood to reach the brain so it can function normally.

Many factors that increase the risk of cardiovascular disease are also associated with a higher risk of dementia.⁸⁸ These factors include smoking⁸⁹⁻⁹³ and diabetes.⁹⁴⁻⁹⁷ Some studies propose that impaired glucose processing (a precursor to diabetes) may also result in an increased risk for dementia.⁹⁸⁻¹⁰⁰ The age at which some risk factors develop appears to affect dementia risk. For example, midlife obesity,^{98,101-104} hypertension,^{98,105-109} prehypertension (systolic blood pressure from 120 to 139 mm Hg or diastolic pressure from 80 to 89 mm Hg)¹⁰⁹ and high cholesterol¹¹⁰⁻¹¹¹ are associated with an increased risk of dementia. However, late-life obesity¹¹² and hypertension onset after age 80¹¹³ are associated with decreased risk of dementia. More research is needed to understand why the effects of some modifiable risk factors may change with age. Regarding blood pressure, there is now evidence from a large-scale clinical trial that intensive medical treatment to reduce blood pressure may safely decrease the occurrence of MCI and dementia in older adults who have hypertension.¹¹⁴

Building on the connection between heart health and brain health, researchers have found that factors that protect the heart may also protect the brain and reduce the risk of developing Alzheimer's or other dementias. Physical activity¹¹⁵⁻¹²⁵ appears to be one of these factors. Although researchers have studied a wide variety of

exercises, they do not yet know which specific types of exercises, what frequency of exercise or what duration of activity may be most effective in reducing risk. In addition to physical activity, emerging evidence suggests that consuming a heart-healthy diet may be associated with reduced dementia risk.¹²⁶⁻¹³⁰ A heart-healthy diet emphasizes fruits, vegetables, whole grains, fish, chicken, nuts and legumes while limiting saturated fats, red meat and sugar. A systematic review¹³¹ of the use of supplements, including (but not limited to) vitamins C, D and E, omega-3 fatty acids, and ginkgo biloba, found little to no benefit in preventing cognitive decline, MCI or Alzheimer's dementia.

Researchers have begun studying combinations of health factors and lifestyle behaviors (for example, blood pressure as a health factor and physical activity as a lifestyle behavior) to learn whether combinations of risk factors better identify Alzheimer's and dementia risk than individual risk factors. They are also studying whether intervening on multiple risk factors simultaneously is more effective at reducing risk than addressing a single risk factor. Indeed, one such study,¹³² the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER), found that a multidomain lifestyle intervention was associated with beneficial effects on cognitive function in older adults at high risk for cognitive decline and dementia. The success of FINGER has led to the launch of multidomain lifestyle intervention studies in other countries, including the Alzheimer's Association U.S. Study to Protect Brain Health Through Lifestyle Intervention to Reduce Risk (U.S. POINTER).¹³³

Education

People with more years of formal education are at lower risk for Alzheimer's and other dementias than those with fewer years of formal education.^{71,134-138} Some researchers believe that having more years of education builds "cognitive reserve." Cognitive reserve refers to the brain's ability to make flexible and efficient use of cognitive networks (networks of neuron-to-neuron connections) to enable a person to continue to carry out cognitive tasks despite brain changes¹³⁹⁻¹⁴⁰ such as beta-amyloid and tau accumulation. The number of years of formal education is not the only determinant of cognitive reserve. Having a mentally stimulating job and engaging in other mentally stimulating activities may also help build cognitive reserve.¹⁴¹⁻¹⁴⁴

A recent study¹⁴⁵ found that individuals with the APOE-e4 risk gene had a decreased risk of developing dementia if they had more years of early life education, had mentally challenging work in midlife, participated in leisure activities in late life, and/or had strong social networks in late life.

It is important to note that the underlying reason for the relationship between formal education and reduced Alzheimer's risk is unclear. It is possible that the generally higher socioeconomic status of individuals with more years of formal education is a protective factor. Having fewer years of formal education is associated with lower socioeconomic status,¹⁴⁶ which may:

- Increase one's likelihood of experiencing poor nutrition.
- Decrease one's ability to afford health care or medical treatments, such as treatments for cardiovascular disease risk factors that are so closely linked to brain health.
- Limit one's access to physically safe housing and employment, which could increase risk of being exposed to substances that are toxic to the nervous system such as air pollution,¹⁴⁷ lead¹⁴⁸ and pesticides.¹⁴⁹

In addition, people with fewer years of education tend to have more cardiovascular risk factors for Alzheimer's, including being less physically active,¹⁵⁰ having a higher risk of diabetes,¹⁵¹⁻¹⁵³ and being more likely to have hypertension¹⁵⁴ and to smoke.¹⁵⁵

Social and Cognitive Engagement

Additional studies suggest that remaining socially and mentally active throughout life may support brain health and possibly reduce the risk of Alzheimer's and other dementias.^{116,156-167} Remaining socially and mentally active might help build cognitive reserve, but the exact mechanism by which this may occur is unknown. It is possible that the association observed between social and cognitive engagement and reduced dementia risk reflects something else. Specifically, the presence of cognitive impairment could decrease one's interest in and ability to participate in activities involving social and cognitive skills. Therefore, the association may reflect the effect of cognitive impairment on social and cognitive engagement rather than the effect of engagement on dementia risk. More research is needed to better understand how social and cognitive engagement may affect biological processes that influence risk.

Traumatic Brain Injury (TBI)

TBI is the disruption of normal brain function caused by a blow or jolt to the head or penetration of the skull by a foreign object. TBI increases the risk of dementia.¹⁶⁸

According to the Centers for Disease Control and Prevention (CDC), approximately 2.87 million TBI-related emergency department visits, hospitalizations and deaths occurred in 2014, the latest year for which information is available.¹⁶⁹ The leading causes of TBI that resulted in emergency department visits were falls, being struck by an object and motor vehicle crashes.¹⁶⁹

Two ways to classify the severity of TBI are by the duration of loss of consciousness or post-traumatic amnesia¹⁷⁰ and by the individual's initial score on the 15-point Glasgow Coma Scale.¹⁷¹

- *Mild TBI* (also known as a concussion) is characterized by loss of consciousness or post-traumatic amnesia lasting 30 minutes or less, or an initial Glasgow score of 13-15; about 75% of TBIs are mild.¹⁷²
- *Moderate TBI* is characterized by loss of consciousness or post-traumatic amnesia lasting more than 30 minutes but less than 24 hours, or an initial Glasgow score of 9-12.
- *Severe TBI* is characterized by loss of consciousness or post-traumatic amnesia lasting 24 hours or more, or an initial Glasgow score of 8 or less.

The risk of dementia increases with the number of TBIs sustained.¹⁶⁸ Even those who experience mild TBI are at increased risk of dementia compared with those who have not had a TBI. A recent study found that mild TBI is associated with a two-fold increase in the risk of dementia diagnosis.¹⁷³ Another study found that people with a history of TBI who develop Alzheimer's do so at a younger age than those without a history of TBI.¹⁷⁴ Whether TBI causes Alzheimer's disease, other conditions that lead to dementia, or both, is still being investigated.

Chronic traumatic encephalopathy (CTE) is a neuropathologic diagnosis (meaning it is characterized by brain changes that can only be identified at autopsy) associated with repeated blows to the head, such as those that may occur while playing contact sports. Among former amateur and professional football players, the risk of developing CTE, which is associated with dementia, increases 30% per year played.¹⁷⁵ Currently, there is no test to determine if someone has CTE-related brain changes during life. A review article indicates that the greatest risk factor for developing CTE-related brain changes is repetitive brain trauma

— repeated, forceful blows to the head that do not, individually, result in symptoms.¹⁷⁶ Like Alzheimer's disease, CTE is characterized by tangles of an abnormal form of the protein tau in the brain. Unlike Alzheimer's, beta-amyloid plaques are uncommon in CTE.¹⁷⁷⁻¹⁷⁸ How the brain changes associated with CTE are linked to cognitive or behavioral changes is unclear.

Uncommon Genetic Changes That Increase Risk

Certain genetic mutations and the extra copy of chromosome 21 that characterizes Down syndrome are uncommon genetic factors that strongly influence Alzheimer's risk.

Genetic Mutations

A small percentage of Alzheimer's cases (an estimated 1% or less)¹⁷⁹ develop as a result of mutations to any of three specific genes. A genetic mutation is an abnormal change in the sequence of chemical pairs that make up genes. These mutations involve the gene for the amyloid precursor protein (APP) and the genes for the presenilin 1 and presenilin 2 proteins. Those inheriting an Alzheimer's mutation to these genes are virtually guaranteed to develop the disease if they live a normal life span.¹⁸⁰ Symptoms tend to develop before age 65, sometimes as young as age 30, while the vast majority of individuals with Alzheimer's have late-onset Alzheimer's.

Trisomy in Down Syndrome

In Down syndrome, an individual is born with three copies of chromosome 21 (called trisomy 21) instead of two. People with Down syndrome have an increased risk of developing Alzheimer's, and this is believed to be related to trisomy 21. Chromosome 21 includes the gene that encodes for the production of APP, which in people with Alzheimer's is cut into beta-amyloid fragments that accumulate into plaques. Having an extra copy of chromosome 21 may increase the production of beta-amyloid fragments produced in the brain.

Overall, people with Down syndrome develop Alzheimer's at an earlier age than people without Down syndrome. By age 40, most people with Down syndrome have significant levels of beta-amyloid plaques and tau tangles in their brains.¹⁸¹ As with all adults, advancing age increases the likelihood that a person with Down syndrome will exhibit symptoms of Alzheimer's. According to the National Down Syndrome Society, about 30% of people with Down syndrome who are in their 50s have Alzheimer's dementia.⁵⁸ About 50% of people with Down syndrome who are in their 60s have Alzheimer's dementia.¹⁸²

Looking to the Future

The identification of biomarkers for Alzheimer's enables early detection of the disease and will accelerate the development of new therapies by ensuring that appropriate people are enrolled in clinical trials. With the discovery that Alzheimer's may begin 20 years or more before the onset of symptoms, a substantial window of time has been opened to intervene in the progression of the disease. In the future, more will be understood about which therapies will be most effective at which points in the Alzheimer's disease continuum.

A fuller understanding of Alzheimer's — from its causes to how to prevent it, how to manage it and how to treat it — depends on other crucial factors. Among these factors is the inclusion of participants from diverse racial and ethnic groups in all realms of Alzheimer's research. Consistent with studies of other top 10 causes of death, studies of Alzheimer's disease in underrepresented ethnic and racial groups are relatively sparse. This reflects the urgent need for current and future research to include increased numbers of blacks/African Americans, Hispanics/Latinos, Asian Americans/Pacific Islanders and Native Americans in clinical trials, observational studies and other investigations so everyone benefits from advances in Alzheimer's science.

Prevalence



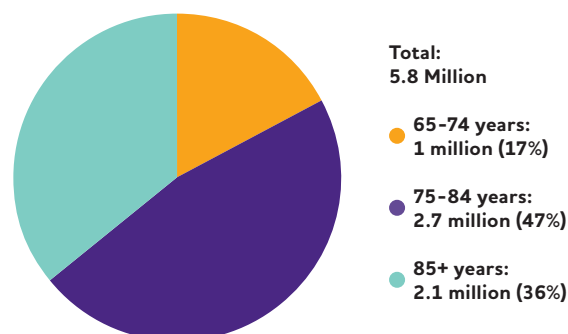
By 2050, the number of people age 65 and older with Alzheimer's dementia is projected to reach **13.8 million**.

Millions of Americans have Alzheimer’s or other dementias. As the size of the U.S. population age 65 and older continues to increase, the number of Americans with Alzheimer’s or other dementias will grow. Both the number and proportion will escalate rapidly in coming years, as the population of Americans age 65 and older is projected to grow from 56 million in 2020 to 88 million by 2050.¹⁸³⁻¹⁸⁴ The baby boom generation has already begun to reach age 65 and beyond,¹⁸⁵ the age range of greatest risk of Alzheimer’s dementia¹⁸⁶; in fact, the oldest members of the baby boom generation turn age 74 in 2020.

This section reports on the number and proportion of people with Alzheimer’s dementia to describe the magnitude of the burden of Alzheimer’s on the community and health care system. The prevalence of Alzheimer’s dementia refers to the number and proportion of people in a population who have Alzheimer’s dementia at a given point in time. Incidence refers to the number or rate of new cases per year. Estimates from selected studies on the number and proportion of people with Alzheimer’s or other dementias vary depending on how each study was conducted. Data from several studies are used in this section.

FIGURE 2

Number and Ages of People 65 or Older with Alzheimer’s Dementia, 2020



Created from data from Hebert et al.^{A2,62}

Prevalence of Alzheimer’s and Other Dementias in the United States

An estimated 5.8 million Americans age 65 and older are living with Alzheimer’s dementia in 2020.^{A1,62} Eighty percent are age 75 or older (Figure 2).^{A2,62}

Out of the total U.S. population:

- One in 10 people (10%) age 65 and older has Alzheimer’s dementia.^{A3,62,184}
- The percentage of people with Alzheimer’s dementia increases with age: 3% of people age 65-74, 17% of people age 75-84, and 32% of people age 85 and older have Alzheimer’s dementia.⁶² People younger than 65 can also develop Alzheimer’s dementia, but it is much less common and prevalence is uncertain.

The estimated number of people age 65 and older with Alzheimer’s dementia comes from a study using the latest data from the 2010 U.S. Census and the Chicago Health and Aging Project (CHAP), a population-based study of chronic health conditions of older people.⁶²

National estimates of the prevalence of all dementias are not available from CHAP, but they are available from other population-based studies including the Aging, Demographics, and Memory Study (ADAMS), a nationally representative sample of older adults.^{A4,187-188} Based on estimates from ADAMS, 14% of people age 71 and older in the United States have dementia.¹⁸⁷

Prevalence Estimates

These estimates refer to people who have Alzheimer's dementia based on symptoms such as memory loss and difficulty planning or solving problems. Biomarker-based prevalence estimates could significantly affect the reported number of people with Alzheimer's disease.¹⁸⁹⁻¹⁹⁰ The estimated 5.8 million people with Alzheimer's dementia would be lower, but the total number of people in the continuum of Alzheimer's disease (see page 7) would be higher.

Some individuals now counted as having Alzheimer's dementia may not have the biological brain changes associated with Alzheimer's disease because their diagnosis was based on clinical symptoms rather than confirmed by biomarkers. Both autopsy studies and clinical trials have found that 15% to 30% of individuals who met the criteria for Alzheimer's dementia based on symptoms did not have the required Alzheimer's-related brain changes at death.^{9,69,191-193} That is, these individuals had dementia caused by something other than Alzheimer's disease.

At the same time, a biomarker-based prevalence estimate would comprise people throughout the continuum of Alzheimer's disease, including those with mild cognitive impairment (MCI) due to Alzheimer's disease and preclinical Alzheimer's disease who are not counted in current Alzheimer's prevalence estimates, which are limited to those with Alzheimer's dementia.

Underdiagnosis of Alzheimer's and other Dementias in the Primary Care Setting

Prevalence studies such as CHAP and ADAMS are designed so that everyone in the study undergoes evaluation for dementia. But outside of research settings, a substantial portion of those who would meet the diagnostic criteria for Alzheimer's and other dementias are not diagnosed with dementia by a physician.³⁹⁻⁴² Furthermore, fewer than half of Medicare beneficiaries who have a diagnosis of Alzheimer's or another dementia in their Medicare billing records (or their caregiver, if the beneficiary's cognitive impairment prevented him or her from responding) report being told of the diagnosis.⁴³⁻⁴⁶ Because Alzheimer's dementia is often underdiagnosed — and if it is diagnosed, people are often unaware of their diagnosis — a large

portion of Americans with Alzheimer's may not know they have it. A recent survey¹⁹⁴ by the Alzheimer's Association found that on average, primary care physicians inform their patients 92% of the time when cognitive impairment is detected, and 64% of the physicians reported they always inform patients. Of the 36% of surveyed physicians who do not always inform their patients, 73% say it is because it is premature to do so before a full diagnostic workup, and 41% say brief cognitive assessments have high rates of false positives or false negatives.

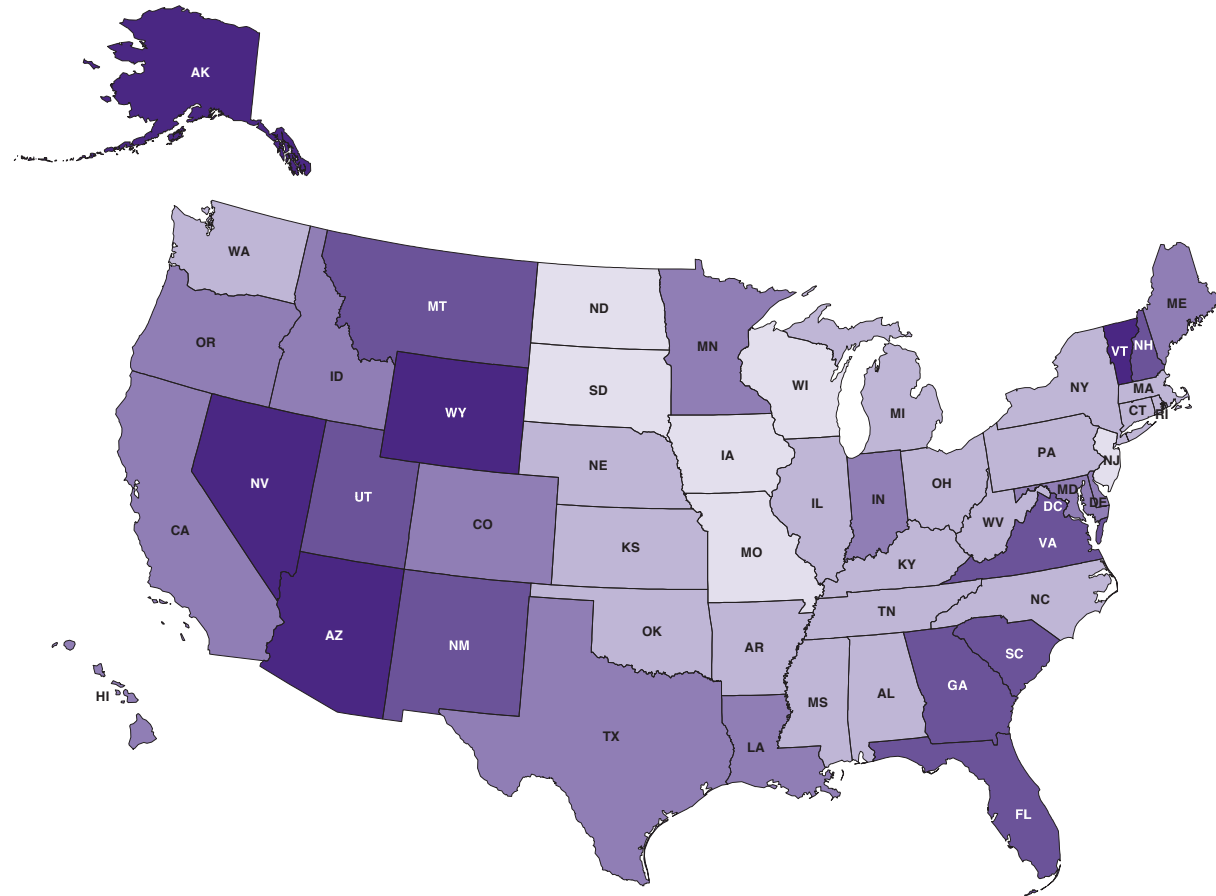
Since 2011, the Medicare Annual Wellness Visit has included a required cognitive evaluation. The same survey by the Alzheimer's Association found that only one in three older adults were aware that these visits should include a cognitive assessment.¹⁹⁴ Furthermore, while 82% of older adults believe it is important to have their memory and thinking checked, only 16% report having their memory and thinking checked. Most (93%) older adults said they trust their doctor to recommend testing for memory and thinking problems; however, despite 94% of primary care physicians stating that it is important to assess all older patients for cognitive impairment, fewer than half (47%) say it is their standard protocol to do so. The primary reasons given by surveyed physicians for not assessing older patients for cognitive impairment are the patient presents with no symptoms or complaints (68%) and lack of time (58%).

Prevalence of Subjective Cognitive Decline

The experience of worsening or more frequent confusion or memory loss (often referred to as subjective cognitive decline) is one of the earliest warning signs of Alzheimer's disease and may be a way to identify people who are at high risk of developing Alzheimer's or other dementias as well as MCI.¹⁹⁵⁻¹⁹⁹ Subjective cognitive decline refers to self-perceived worsening of memory and other thinking abilities by an individual, separate from cognitive testing, clinical diagnosis or anyone else noticing. There is a correlation between subjective cognitive decline and worse performance on cognitive tests, as recently reported using data from the National Health and Nutrition Examination Survey, a nationally representative sample of U.S. older adults.²⁰⁰ Not all of those who experience subjective cognitive decline go on to develop MCI or dementia, but many do.²⁰¹⁻²⁰³ One study showed those who over time consistently reported subjective cognitive decline that they found worrisome were at higher risk for developing Alzheimer's dementia.²⁰⁴ The Behavioral Risk Factor Surveillance System survey, which includes questions on subjective cognitive decline, found that in the United States, 11% of Americans age 45 and older reported subjective cognitive decline, but 54% of those who reported it had not consulted a health care professional.²⁰⁵ Individuals concerned about declines in memory and other cognitive abilities should consult a health care professional.

FIGURE 3

Projected Increases Between 2020 and 2025 in Alzheimer's Dementia Prevalence by State



Change from 2020 to 2025 for Washington, D.C.: 1.1%

Created from data provided to the Alzheimer's Association by Weuve et al.^{A5,206}

Estimates of the Number of People with Alzheimer's Dementia by State

Table 4 (see page 21) lists the estimated number of people age 65 and older with Alzheimer's dementia by state for 2020, the projected number for 2025, and the projected percentage change in the number of people with Alzheimer's between 2020 and 2025.^{A5,206}

As shown in Figure 3, between 2020 and 2025 every state across the country is expected to experience an increase of at least 6.7% in the number of people with Alzheimer's. These projected increases in the number of people with Alzheimer's are due solely to projected

increases in the population age 65 and older in these states. Because risk factors for dementia such as midlife obesity and diabetes can vary dramatically by region and state, the regional patterns of future burden may be different than reported here. Based on these projections, the West and Southeast are expected to experience the largest percentage increases in people with Alzheimer's dementia between 2020 and 2025. These increases will have a marked impact on states' health care systems, as well as the Medicaid program, which covers the costs of long-term care and support for many older residents with dementia, including more than a quarter of Medicare beneficiaries with Alzheimer's or other dementias.²⁰⁷

TABLE 4

Projections of Total Numbers of Americans Age 65 and Older with Alzheimer's Dementia by State

State	Projected Number with Alzheimer's (in thousands)		Percentage Increase	State	Projected Number with Alzheimer's (in thousands)		Percentage Increase
	2020	2025	2020-2025		2020	2025	2020-2025
District of Columbia	8.9	9	1.1	Montana	22	27	22.7
Alabama	96	110	14.6	Nebraska	35	40	14.3
Alaska	8.5	11	29.4	Nevada	49	64	30.6
Arizona	150	200	33.3	New Hampshire	26	32	23.1
Arkansas	58	67	15.5	New Jersey	190	210	10.5
California	690	840	21.7	New Mexico	43	53	23.3
Colorado	76	92	21.1	New York	410	460	12.2
Connecticut	80	91	13.8	North Carolina	180	210	16.7
Delaware	19	23	21.1	North Dakota	15	16	6.7
Florida	580	720	24.1	Ohio	220	250	13.6
Georgia	150	190	26.7	Oklahoma	67	76	13.4
Hawaii	29	35	20.7	Oregon	69	84	21.7
Idaho	27	33	22.2	Pennsylvania	280	320	14.3
Illinois	230	260	13.0	Rhode Island	24	27	12.5
Indiana	110	130	18.2	South Carolina	95	120	26.3
Iowa	66	73	10.6	South Dakota	18	20	11.1
Kansas	55	62	12.7	Tennessee	120	140	16.7
Kentucky	75	86	14.7	Texas	400	490	22.5
Louisiana	92	110	19.6	Utah	34	42	23.5
Maine	29	35	20.7	Vermont	13	17	30.8
Maryland	110	130	18.2	Virginia	150	190	26.7
Massachusetts	130	150	15.4	Washington	120	140	16.7
Michigan	190	220	15.8	West Virginia	39	44	12.8
Minnesota	99	120	21.2	Wisconsin	120	130	8.3
Mississippi	57	65	14.0	Wyoming	10	13	30.0
Missouri	120	130	8.3				

Created from data provided to the Alzheimer's Association by Weuve et al.^{A5,206}

Incidence of Alzheimer's Dementia

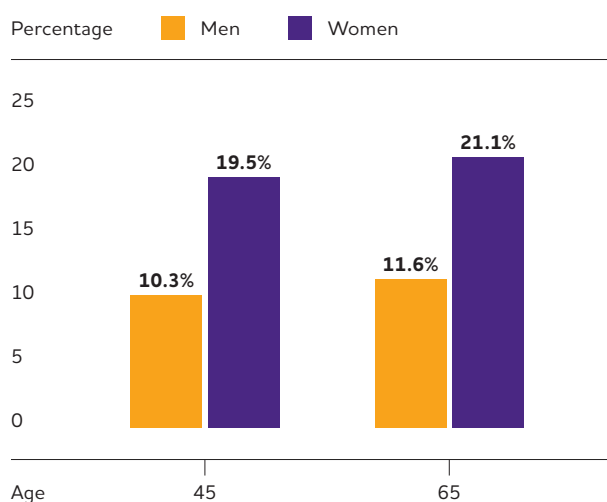
While prevalence refers to *existing* cases of a disease in a population at a given time, incidence refers to *new* cases of a disease that develop in a given period of time in a defined population — in this case, the U.S. population age 65 or older. Incidence provides a measure of risk for developing a disease. According to one study using data from the Established Populations for Epidemiologic Study of the Elderly, approximately 491,000 people age 65 or older will develop Alzheimer's dementia in the United States in 2020.²⁰⁸ Other studies have arrived at incidence estimates that are much higher. For example, according to CHAP estimates, approximately 910,000 people age 65 or older developed Alzheimer's dementia in the United States in 2011, a number that would be expected to be even higher in 2020 if CHAP estimates were available for that year.²⁰⁹ A study using data from the Adult Changes in Thought study, a cohort of members of Kaiser Permanente (formerly Group Health), a health care delivery system in the Northwest United States, reported similar incidence rates to the CHAP study.²¹⁰ The number of new cases of Alzheimer's increases dramatically with age: according to estimates from CHAP, in 2011 the average annual incidence in people age 65-74 was 0.4% (meaning four of every 1,000 people age 65-74 developed Alzheimer's dementia in 2011); in people age 75-84, the annual incidence was 3.2% (32 of every 1,000 people); and for age 85 and older (the "oldest-old"), the incidence was 7.6% (76 of every 1,000 people).²⁰⁹ Because of the increasing number of people age 65 and older in the United States, particularly the oldest-old, the annual number of new cases of Alzheimer's and other dementias is projected to double by 2050.²⁰⁸

Lifetime Risk of Alzheimer's Dementia

Lifetime risk is the probability that someone of a given age who does not have a particular condition will develop the condition during his or her remaining life span. Data from the Framingham Heart Study were used to estimate lifetime risks of Alzheimer's dementia by age and sex.^{A6,211} As shown in Figure 4, the study found that the estimated lifetime risk for Alzheimer's dementia at age 45 was approximately one in five (20%) for women and one in 10 (10%) for men. The risks for both sexes were slightly higher at age 65.²¹¹

FIGURE 4

Estimated Lifetime Risk for Alzheimer's Dementia, by Sex, at Ages 45 and 65



Created from data from Chene et al.²¹¹

Differences Between Women and Men in the Prevalence and Risk of Alzheimer's and Other Dementias

More women than men have Alzheimer's or other dementias. Almost two-thirds of Americans with Alzheimer's are women.^{A7,62} Of the 5.8 million people age 65 and older with Alzheimer's in the United States, 3.6 million are women and 2.2 million are men.^{A7,62} Based on estimates from ADAMS, among people age 71 and older, 16% of women have Alzheimer's or other dementias compared with 11% of men.¹⁸⁷

The prevailing reason that has been stated for the higher prevalence of Alzheimer's and other dementias in women is that women live longer than men on average, and older age is the greatest risk factor for Alzheimer's.²¹¹⁻²¹³ But when it comes to differences in the actual risk of developing Alzheimer's or other dementias for men and women of the same age, findings have been mixed. Most studies of incidence in the United States have found no significant difference between men and women in the proportion who develop Alzheimer's or other dementias at any given age.^{71,210,213-215} However, some European studies have reported a higher incidence among women at older ages,²¹⁶⁻²¹⁷ and one study from the United Kingdom reported higher incidence for men.²¹⁸ Differences in the risk of dementia between men and women may therefore depend on age and/or geographic region.²¹⁹⁻²²⁰

If there is a difference in the risk of Alzheimer's or other dementias between men and women, there are a number of potential biological and social explanations.^{219,221} One explanation may be differences in the distribution of or even the effect of risk factors for dementia between men and women. If women's risk for Alzheimer's or other dementias is higher, it is possible that lower educational attainment in women than in men born in the first half of the 20th century could account for some of the elevated risk, as limited formal education is a risk factor for dementia.²²² This explanation requires more research, but there is evidence that increases in educational attainment over time in the United States — which have been more substantial for women than men — have led to decreased risk for dementia.²²³ Interestingly, European studies have found that the relationship of lower education with dementia outcomes may actually be stronger in women than men.²²⁴⁻²²⁵ Some studies have attributed an observed difference in risk for dementia between men and women to differences in health factors. A study using Framingham Heart Study data suggested that men in the study appear to have a lower risk for dementia due to “survival bias,” in which the men who survived beyond age 65 and were included in the study were the ones with a healthier cardiovascular risk profile (men have a higher rate of death from cardiovascular disease in middle age than women) and thus a lower risk for dementia.²¹² More research is needed to support this interpretation.

Other research is assessing whether the risk of Alzheimer's could actually be higher for women at any given age due to genetic differences or different susceptibility to Alzheimer's pathology.²²⁶ A number of studies have shown that the APOE-ε4 genotype, the best known genetic risk factor for Alzheimer's dementia, may have a stronger association with Alzheimer's dementia²²⁷⁻²²⁸ and neurodegeneration²²⁹ in women than in men. However, a recent meta-analysis found no difference between men and women in the association between APOE genotype and Alzheimer's dementia overall, though there was an elevated risk for women with the APOE-ε4 genotype at certain age ranges.²³⁰ It is unknown why the APOE gene could convey different risk for women, but some evidence suggests that it may be due to an interaction between the APOE genotype and the sex hormone estrogen.²³¹⁻²³² Finally, there is some evidence that women show more rapid cognitive decline and neurodegeneration than men despite having similar levels of beta-amyloid and tau, meaning the hallmark proteins of Alzheimer's disease may have more negative effects for women than men.²³³⁻²³⁵

Racial and Ethnic Differences in the Prevalence of Alzheimer's and Other Dementias

Although there are more non-Hispanic whites living with Alzheimer's and other dementias than any other racial or ethnic group in the United States (because non-Hispanic whites are the largest racial/ethnic group in the country), older blacks/African Americans and Hispanics/Latinos are disproportionately more likely than older whites to have Alzheimer's or other dementias.^{16-17,236-239} Most studies indicate that older blacks/African Americans are about twice as likely to have Alzheimer's or other dementias as older whites.^{18-19,209} Some studies indicate older Hispanics/Latinos are about one and one-half times as likely to have Alzheimer's or other dementias as older whites.^{18,19,240-241} However, Hispanics/Latinos comprise a very diverse group in terms of cultural history, genetic ancestry and health profiles, and there is evidence that prevalence may differ from one specific Hispanic/Latino ethnic group to another (for example, Mexican Americans compared with Caribbean Americans).²⁴²⁻²⁴³

The higher prevalence of Alzheimer's dementia in minority racial and ethnic groups compared with whites appears to be due to a higher incidence of dementia in these groups.²⁴⁴ Variations in medical conditions, health-related behaviors and socioeconomic risk factors across racial groups likely account for most of the differences in risk of Alzheimer's and other dementias.²³⁹ Despite some evidence that the influence of genetic risk factors on Alzheimer's and other dementias may differ by race,^{80,82,245} genetic factors do not appear to account for the large differences in prevalence or incidence among racial groups.^{244,246} Instead, health conditions such as cardiovascular disease and diabetes, which are associated with an increased risk for Alzheimer's and other dementias, are believed to account for these differences, as they are more prevalent in black/African American and Hispanic/Latino people.²⁴⁷⁻²⁴⁸ Socioeconomic characteristics, including lower levels and quality of education, higher rates of poverty, and greater exposure to adversity and discrimination, may also increase risk in black/African American and Hispanic/Latino communities (and may in turn contribute to the health conditions mentioned above).^{80,247-249} Some studies suggest that differences based on race and ethnicity do not persist in rigorous analyses that account for such factors.^{135,187,244}

There is evidence that missed diagnoses of Alzheimer's and other dementias are more common among older blacks/African Americans and Hispanics/Latinos than among older whites.²⁵⁰⁻²⁵¹ Based on data for Medicare beneficiaries age 65 and older, it has been estimated that Alzheimer's or another dementia had been diagnosed in 10.3% of whites, 12.2% of Hispanics/Latinos and 13.8% of blacks/African Americans.²⁵² Although rates of diagnosis were higher among blacks/African Americans than among whites, according to prevalence studies that detect all people who have dementia irrespective of their use of the health care system, the rates should be even higher for blacks/African Americans.

There are fewer data from population-based cohort studies regarding the national prevalence of Alzheimer's and other dementias in racial and ethnic groups other than whites, blacks/African Americans and Hispanics/Latinos. However, a study examining electronic medical records of members of a large health plan in California indicated that dementia incidence — determined by the presence of a dementia diagnosis in members' medical records — was highest in blacks/African Americans, intermediate for Latinos (the term used in the study for those who self-reported as Latino or Hispanic) and whites, and lowest for Asian Americans.²⁵³ A follow-up study with the same cohort showed heterogeneity within Asian-American subgroups, but all subgroups studied had lower dementia incidence than whites.²⁵⁴ A recent systematic review of the literature found that Japanese Americans were the only Asian-American subgroup with reliable prevalence data, and that they had the lowest prevalence of dementia compared with all other ethnic groups.²⁴³ More studies, especially those involving population-based cohorts, are necessary to draw conclusions about the prevalence of Alzheimer's and other dementias in different racial groups and subgroups.

Trends in the Prevalence and Incidence of Alzheimer's Dementia Over Time

A growing number of studies indicate that the prevalence^{223,255-263} and incidence^{218,259,263-270} of Alzheimer's and other dementias in the United States and other higher-income Western countries may have declined in the past 25 years,^{218,223,258-269} though results are mixed.^{61,209,271-272} These declines have been attributed to increasing levels of education and improved control of cardiovascular risk factors.^{223,258,264,267,273-274} Such findings are promising and suggest that identifying and reducing risk factors

for Alzheimer's and other dementias may be effective. Although these findings indicate that a person's risk of dementia at any given age may be decreasing slightly, the total number of people with Alzheimer's or other dementias in the United States and other high-income Western countries is expected to continue to increase dramatically because of the increase in the number of people at the oldest ages.

It is unclear whether these encouraging trends will continue into the future given worldwide trends showing increases in diabetes and obesity — potential risk factors for Alzheimer's dementia — which may lead to a rebound in dementia risk in coming years,^{102,257,259,275-276} or if these positive trends pertain to all racial and ethnic groups.^{209,255,273-274,277} Thus, while recent findings are promising, the social and economic burden of Alzheimer's and other dementias will continue to grow. Moreover, 68% of the projected increase in the global prevalence and burden of dementia by 2050 will take place in low- and middle-income countries, where there is currently no evidence that the risk of Alzheimer's and other dementias has been declining.²⁷⁸

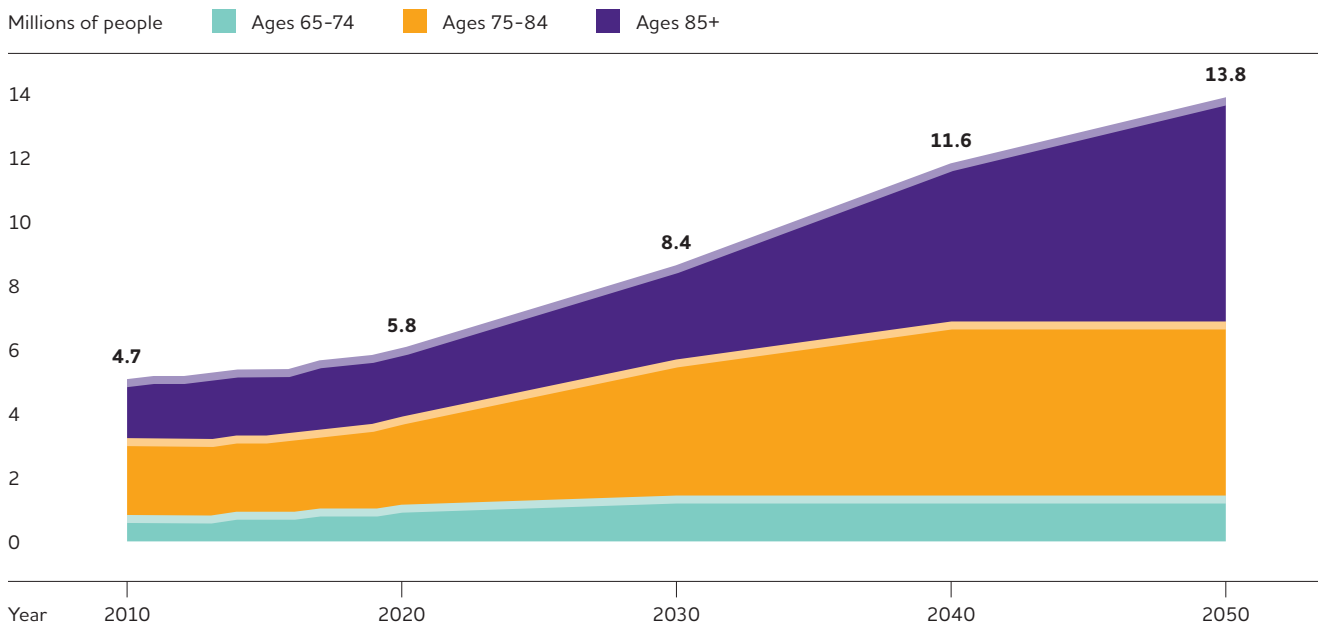
Looking to the Future: Aging of the Baby Boom Generation

A large segment of the American population — the baby boom generation — has reached age 65 and older, when the risk for Alzheimer's and other dementias is elevated. By 2030, the segment of the U.S. population age 65 and older will increase substantially, and the projected 74 million older Americans will make up over 20% of the total population (up from 16% in 2020).^{184,279} As the number of older Americans grows rapidly, so too will the numbers of new and existing cases of Alzheimer's dementia, as shown in Figure 5.^{A9,62}

- By 2025, the number of people age 65 and older with Alzheimer's dementia is projected to reach 7.1 million — almost a 22% increase from the 5.8 million age 65 and older affected in 2020.^{A10,62}
- By 2050, the number of people age 65 and older with Alzheimer's dementia is projected to reach 13.8 million, barring the development of medical breakthroughs to prevent, slow or cure Alzheimer's disease.^{A9,62}

FIGURE 5

Projected Number of People Age 65 and Older (Total and by Age) in the U.S. Population with Alzheimer's Dementia, 2010 to 2050



Created from data from Hebert et al.^{A9,62}

Growth of the Oldest-Old Population

The number of Americans surviving into their 80s, 90s and beyond is expected to grow dramatically due to medical advances, as well as social and environmental conditions.²⁷⁹ Longer life expectancies and the aging of the large baby boom cohort will lead to an increase in the number and percentage of Americans who will be 85 and older, the oldest-old. Between now and 2050, the oldest-old are expected to comprise an increasing proportion of the U.S. population age 65 and older — from 10% in 2020 to 19% in 2050.²⁷⁹ This will result in an additional 4.8 million oldest-old people — individuals at the highest risk for developing Alzheimer's dementia.²⁷⁹

- In 2020, about 2.1 million people who have Alzheimer's dementia are age 85 or older, accounting for 35% of all people with Alzheimer's dementia.⁶²
- When the first wave of baby boomers reaches age 85 (in 2031), it is projected that more than 3 million people age 85 and older will have Alzheimer's dementia.⁶²
- By 2050, 7 million people age 85 and older are projected to have Alzheimer's dementia, accounting for about half (51%) of all people 65 and older with Alzheimer's dementia.⁶²

Mortality and Morbidity



1 in 3 seniors dies
with Alzheimer's or
another dementia.

Alzheimer's disease is officially listed as the sixth-leading cause of death in the United States.²⁸⁰ It is the fifth-leading cause of death for those age 65 and older.²⁸¹ However, it may cause even more deaths than official sources recognize. Alzheimer's is also a leading cause of disability and poor health (morbidity). Before a person with Alzheimer's dies, he or she lives through years of morbidity as the disease progresses.

Deaths from Alzheimer's Disease

It is difficult to determine how many deaths are caused by Alzheimer's disease each year because of the way causes of death are recorded. According to data from the Centers for Disease Control and Prevention (CDC), 122,019 people died from Alzheimer's disease in 2018, the latest year for which data are available.²⁸¹ The CDC considers a person to have died *from* Alzheimer's if the death certificate lists Alzheimer's as the underlying cause of death, defined as "the disease or injury which initiated the train of events leading directly to death."²⁸²

In the United States, Alzheimer's disease is counted as a cause of death that can be ranked against other leading causes of death such as cancer and heart disease, but deaths due to other types of clinically diagnosed dementia are not ranked in this manner. The number of deaths from dementia of any type is much higher than the number of reported Alzheimer's deaths. In 2018, some form of dementia was the officially recorded underlying cause of death for 266,957 individuals (this includes the 122,019 from Alzheimer's disease).^{281,283} Therefore, the number of deaths from all causes of dementia, even as listed on death certificates, is more than twice as high as the number of reported Alzheimer's deaths alone.

To add further complexity, the vast majority of death certificates listing Alzheimer's disease or dementia as an underlying cause of death are not verified by autopsy, and research has shown that about 30% of those diagnosed with Alzheimer's dementia during life do not in fact have dementia due to Alzheimer's disease, but have dementia due to another cause (see Table 1, page 6). Therefore, an underlying cause of death listed as Alzheimer's disease may not be accurate. In this section, "deaths from Alzheimer's disease" refers to what is officially reported on death certificates, with the understanding that the person filling out the report believed dementia due to Alzheimer's disease was the underlying cause of death, usually without pathologic confirmation.

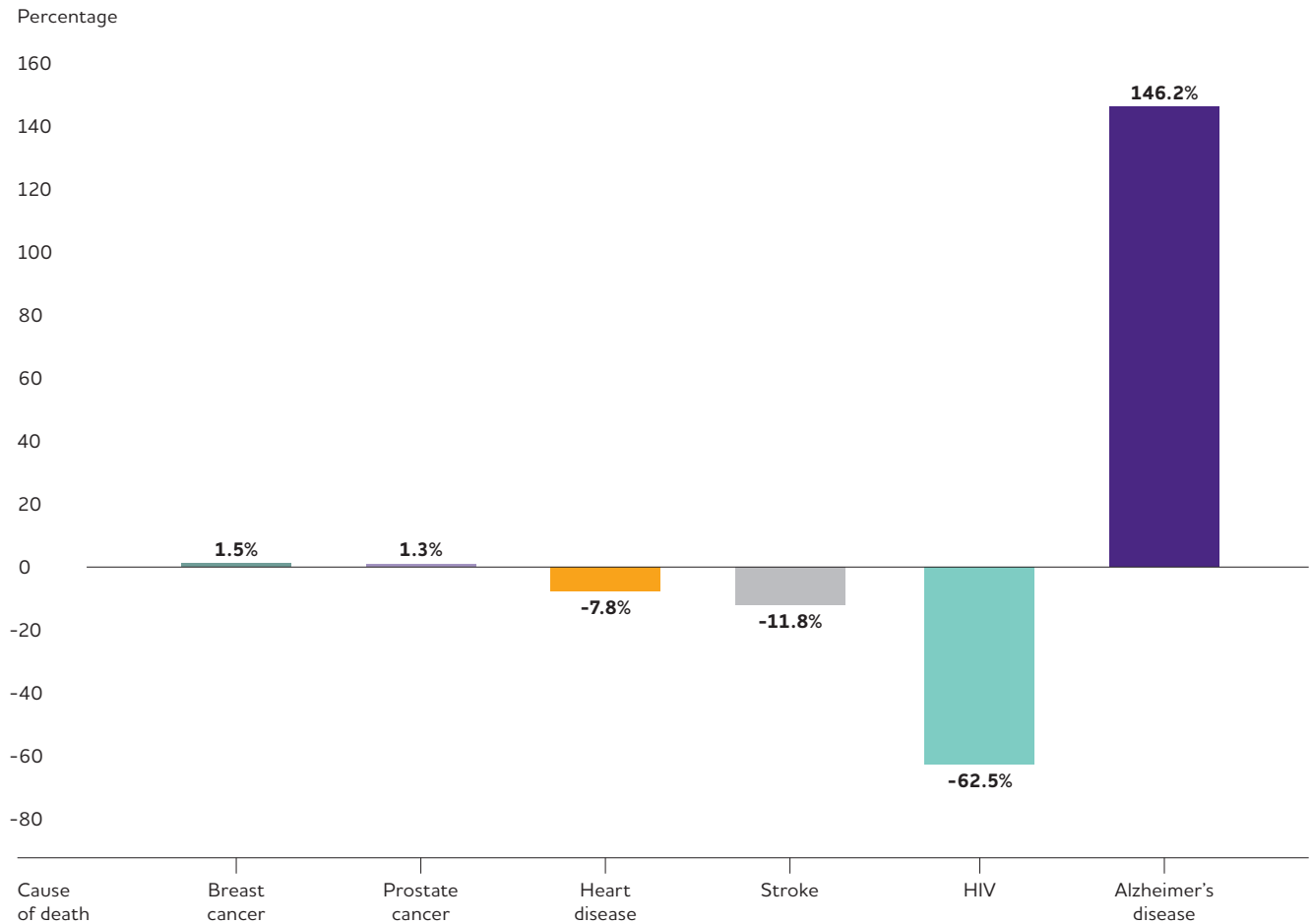
Severe dementia frequently causes complications such as immobility, swallowing disorders and malnutrition that significantly increase the risk of serious acute conditions that can cause death. One such condition is pneumonia (infection of the lungs), which is the most commonly identified immediate cause of death among older adults with Alzheimer's or other dementias.²⁸⁴⁻²⁸⁵ One autopsy study found that respiratory system diseases were the immediate cause of death in more than half of people with Alzheimer's dementia, followed by circulatory system disease in about a quarter.²⁸⁵ Death certificates for individuals with Alzheimer's often list acute conditions such as pneumonia as the primary cause of death rather than Alzheimer's.²⁸⁶⁻²⁸⁸ As a result, people with Alzheimer's dementia who die due to these acute conditions may not be counted among the number of people who die from Alzheimer's disease, even though Alzheimer's disease may well have caused the acute condition listed on the death certificate. This difficulty in using death certificates to determine the number of deaths from Alzheimer's and other dementias has been referred to as a "blurred distinction between death *with* dementia and death *from* dementia."²⁸⁹

Another way to determine the number of deaths from Alzheimer's dementia is through calculations that compare the estimated risk of death in those who have Alzheimer's dementia with the estimated risk of death in those who do not have Alzheimer's dementia. A study using data from the Rush Memory and Aging Project and the Religious Orders Study estimated that 500,000 deaths among people age 75 and older in the United States in 2010 could be attributed to Alzheimer's dementia (estimates for people age 65 to 74 were not available), meaning that those deaths would not be expected to occur in that year if those individuals did not have Alzheimer's dementia.²⁹⁰

The true number of deaths caused by Alzheimer's is somewhere between the number of deaths from Alzheimer's recorded on death certificates and the number of people who have Alzheimer's disease when they die. According to 2014 Medicare claims data, about one-third of all Medicare beneficiaries who die in a given year have been diagnosed with Alzheimer's or another dementia.²⁹¹ Based on data from the Chicago Health and Aging Project (CHAP) study, in 2020 an estimated 700,000 people age 65 and older in the United States will have Alzheimer's when they die.²⁹² Although some older adults who have Alzheimer's disease at the time of death die from causes that are unrelated to Alzheimer's, many of them die from Alzheimer's disease itself or from conditions in which Alzheimer's was a contributing cause, such as pneumonia.

FIGURE 6

Percentage Changes in Selected Causes of Death (All Ages) Between 2000 and 2018



Created from data from the National Center for Health Statistics.^{281,294}

Irrespective of the cause of death, among people age 70, 61% of those with Alzheimer's dementia are expected to die before age 80 compared with 30% of people without Alzheimer's dementia.²⁹³

Public Health Impact of Deaths from Alzheimer's Disease

Although deaths from other major causes have *decreased* significantly or remained approximately the same, official records indicate that deaths from Alzheimer's disease have *increased* significantly. Between 2000 and 2018, the number of deaths from Alzheimer's disease as recorded on death certificates has more than doubled, increasing 146%, while the number of deaths from the number one cause of death (heart disease) decreased 7.8% (Figure 6).^{281,294} The increase in the number of death certificates listing Alzheimer's as the underlying cause of death probably reflects both a real increase in the actual number of deaths from Alzheimer's due

in large part to Alzheimer's becoming a more common cause of death as the population ages, as well as increased reporting of Alzheimer's deaths on death certificates over time by physicians, coroners and others who assign causes of death.²⁹⁵

State-by-State Deaths from Alzheimer's Disease

Table 5 provides information on the number of deaths due to Alzheimer's by state in 2018, the most recent year for which state-by-state data are available. This information was obtained from death certificates and reflects the condition identified by the physician as the underlying cause of death. The table also provides annual mortality rates by state to compare the risk of death due to Alzheimer's disease across states with varying population sizes. For the United States as a whole, in 2018, the mortality rate for Alzheimer's disease was 37.3 deaths per 100,000 people.^{A11,281}

TABLE 5

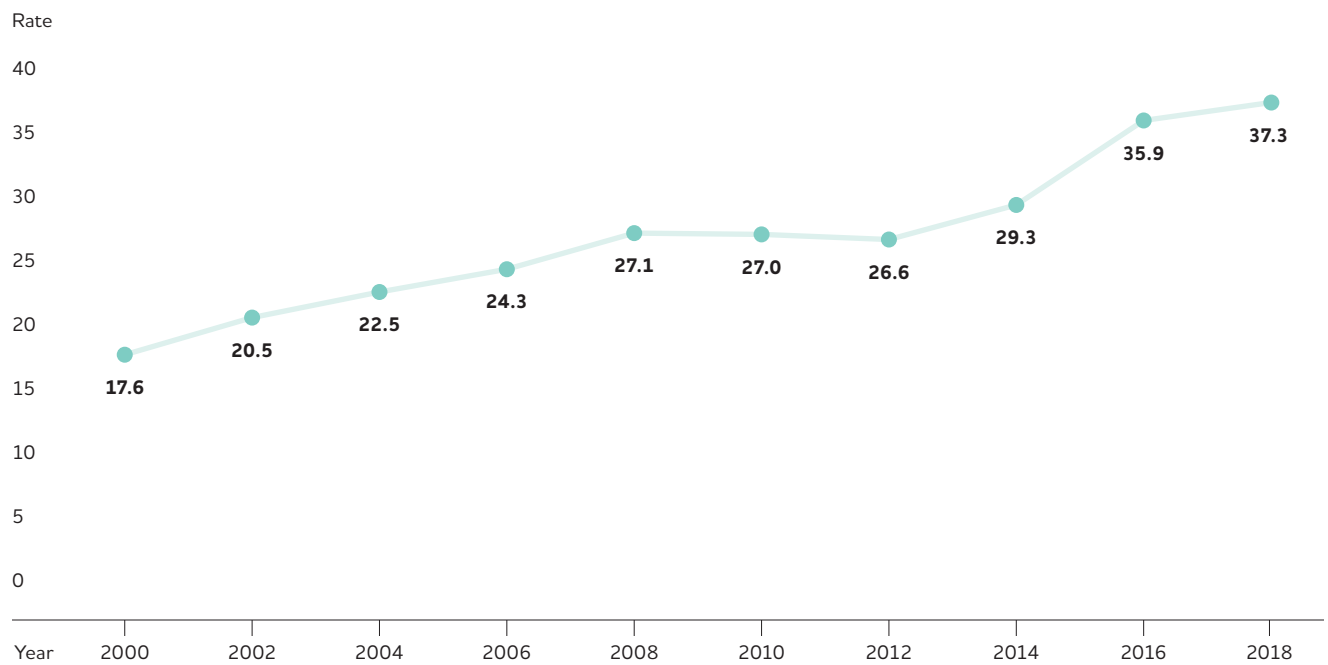
Number of Deaths and Annual Mortality Rate (per 100,000 People) Due to Alzheimer's Disease by State, 2018

State	Number of Deaths	Mortality Rate	State	Number of Deaths	Mortality Rate
Alabama	2,616	53.5	Montana	310	29.2
Alaska	131	17.8	Nebraska	683	35.4
Arizona	3,012	42.0	Nevada	704	23.2
Arkansas	1,457	48.3	New Hampshire	487	35.9
California	16,627	42.0	New Jersey	2,710	30.4
Colorado	1,649	29.0	New Mexico	583	27.8
Connecticut	986	27.6	New York	3,755	19.2
Delaware	412	42.6	North Carolina	4,495	43.3
District of Columbia	105	14.9	North Dakota	356	46.8
Florida	6,725	31.6	Ohio	5,391	46.1
Georgia	4,513	42.9	Oklahoma	1,739	44.1
Hawaii	480	33.8	Oregon	1,868	44.6
Idaho	666	38.0	Pennsylvania	4,064	31.7
Illinois	4,030	31.6	Rhode Island	470	44.5
Indiana	2,668	39.9	South Carolina	2,616	51.5
Iowa	1,439	45.6	South Dakota	437	49.5
Kansas	899	30.9	Tennessee	3,488	51.5
Kentucky	1,674	37.5	Texas	9,763	34.0
Louisiana	2,166	46.5	Utah	1,024	32.4
Maine	580	43.3	Vermont	333	53.2
Maryland	1,122	18.6	Virginia	2,592	30.4
Massachusetts	1,823	26.4	Washington	3,752	49.8
Michigan	4,474	44.8	West Virginia	791	43.8
Minnesota	2,436	43.4	Wisconsin	2,453	42.2
Mississippi	1,547	51.8	Wyoming	277	47.9
Missouri	2,641	43.1	U.S. Total	122,019	37.3

Created from data from the National Center for Health Statistics.^{A11.281}

FIGURE 7

U.S. Annual Alzheimer’s Death Rate (per 100,000 People) by Year



Created from data from the National Center for Health Statistics.²⁸¹

TABLE 6

U.S. Annual Alzheimer’s Death Rates (per 100,000 People) by Age and Year

Age	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018
45-54	0.2	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.3
55-64	2.0	1.9	1.8	2.1	2.2	2.1	2.2	2.1	2.7	2.9
65-74	18.7	19.6	19.5	19.9	21.1	19.8	17.9	19.6	23.6	24.7
75-84	139.6	157.7	168.5	175.0	192.5	184.5	175.4	185.6	214.1	213.9
85+	667.7	790.9	875.3	923.4	1,002.2	987.1	936.1	1,006.8	1,216.9	1,225.3

Created from data from the National Center for Health Statistics.²⁸¹

Alzheimer's Death Rates

As shown in Figure 7, the rate of deaths due to Alzheimer's has risen substantially since 2000.²⁸¹ Table 6 shows that the rate of death from Alzheimer's increases dramatically with age, especially after age 65.^{A11,281} The increase in the Alzheimer's death rate over time has disproportionately affected the oldest-old.²⁹⁴ Between 2000 and 2018, the death rate from Alzheimer's increased 32% for people age 65 to 74, but increased 53% for people age 75 to 84 and 84% for people age 85 and older.²⁸¹ A report by the CDC determined that even after adjusting for differences in age distributions over time, the annual Alzheimer's death rate in the United States increased substantially between 1999 and 2014.²⁹⁵ Therefore, the growing proportion of older adults in the country is not the only explanation for the increase in Alzheimer's death rates. Other possible reasons include fewer deaths from other common causes of death in old age such as heart disease and stroke; increased diagnosis of Alzheimer's dementia; and increased reporting of Alzheimer's as a cause of death by physicians and others who fill out death certificates.²⁹⁵

Duration of Illness from Diagnosis to Death

Studies indicate that people age 65 and older survive an average of 4 to 8 years after a diagnosis of Alzheimer's dementia, yet some live as long as 20 years with Alzheimer's dementia.^{210,296-303} This reflects the slow, insidious and uncertain progression of Alzheimer's. A person who lives from age 70 to age 80 with Alzheimer's dementia will spend an average of 40% of this time in the severe stage.²⁹³ Much of this time will be spent in a nursing home. At age 80, approximately 75% of people with Alzheimer's dementia live in a nursing home compared with only 4% of the general population age 80.²⁹³ In all, an estimated two-thirds of those who die of dementia do so in nursing homes, compared with 20% of people with cancer and 28% of people dying from all other conditions.³⁰⁴

Burden of Alzheimer's Disease

The long duration of illness before death contributes significantly to the public health impact of Alzheimer's disease because much of that time is spent in a state of disability and dependence. Scientists have developed methods to measure and compare the burden of different diseases on a population in a way that takes into account not only the number of people with the condition, but also the number of years of life lost due to that disease and the number of healthy years of life lost by virtue of being in a state of disability. The primary measure of disease burden is called disability-adjusted life years (DALYs), which is the sum of the number of years of life lost due to premature mortality (YLLs) and the number of years lived with disability (YLDs), totaled across all those with the disease or injury. These measures indicate that Alzheimer's is a very burdensome disease, not only to the individuals with the disease, but also to their families and informal caregivers, and that the burden of Alzheimer's has increased more dramatically in the United States than the burden of other diseases in recent years. According to the most recent Global Burden of Disease classification system, Alzheimer's disease rose from the 12th most burdensome disease or injury in the United States in 1990 to the sixth in 2016 in terms of DALYs. In 2016, Alzheimer's disease was the fourth highest disease or injury in terms of YLLs and the 19th in terms of YLDs.³⁰⁵

Taken together, these statistics indicate that not only is Alzheimer's disease responsible for the deaths of more and more Americans, but also that the disease is contributing to more and more cases of poor health and disability in the United States.

Caregiving



Family members and friends provided nearly **\$244 billion** in unpaid care to people with Alzheimer's and other dementias in 2019.

Caregiving refers to attending to another person's health needs and well-being. Caregiving often includes assistance with one or more activities of daily living (ADLs), including bathing and dressing, as well as multiple instrumental activities of daily living (IADLs), such as paying bills, shopping and using transportation.³⁰⁶⁻³⁰⁷ Caregivers also provide emotional support to people with Alzheimer's as well as many other forms of help (for example, communicating and coordinating care with other family members and health care providers, ensuring safety at home and elsewhere, and managing health conditions; see Table 7, page 34). In addition to providing descriptive information about caregivers of people with Alzheimer's or other dementias, this section compares caregivers of people with dementia to either caregivers of people with other medical conditions or, if that comparison is not available, to non-caregivers.

Unpaid Caregivers

Eighty-three percent of the help provided to older adults in the United States comes from family members, friends or other unpaid caregivers.³⁰⁸ Nearly half of all caregivers (48%) who provide help to older adults do so for someone with Alzheimer's or another dementia.³⁰⁹ More than 16 million Americans provide unpaid care for people with Alzheimer's or other dementias.^{A12}

In 2019, caregivers of people with Alzheimer's or other dementias provided an estimated 18.6 billion hours of informal (that is, unpaid) assistance, a contribution to the nation valued at \$244 billion. This is approximately 47% of the net value of Walmart's total revenue in 2019 (\$514.4 billion)³¹⁰ and 11 times the total revenue of McDonald's in 2018 (\$21 billion).³¹¹ The total lifetime cost of care for someone with dementia was estimated at \$357,297 in 2019 dollars. Seventy percent of the lifetime cost of care is borne by family caregivers in the forms of unpaid caregiving and out-of-pocket expenses for items ranging from medications to food for the person with dementia.³¹²⁻³¹³ Current estimates of the lifetime costs of care may underestimate the impact of a relative's dementia on family caregivers' health and workplace productivity.³¹⁴

Calculating the Number of Caregivers

It is important to note that the number of caregivers for people with Alzheimer's or other dementias is calculated using a model that incorporates, in part, data from 2009, the most recent date for which the data are available. There are indications that over the past decade, the number of family caregivers for all older Americans may have declined. The Alzheimer's Association is examining new data and recently released state-specific data on dementia caregivers and is working with experts to revise the model to take into account these recent trends. Preliminary evaluation indicates that, compared with the past, there are fewer family caregivers in total, but each individual caregiver is experiencing a greater burden by providing significantly more hours of care. If this preliminary analysis holds, future estimates of the number of Alzheimer's and dementia caregivers nationally and for each state will be lower than current estimates.

Three of the main reasons caregivers provide care and assistance to a person with Alzheimer's or another dementia are 1) the desire to keep a family member or friend at home (65%), 2) proximity to the person with dementia (48%) and 3) the caregiver's perceived obligation to the person with dementia (38%).^{A13} Caregivers often indicate love and a sense of duty and obligation when describing what motivates them to assume care responsibilities for a relative or friend living with dementia.³¹⁵ Individuals with dementia living in the community are more likely than older adults without dementia to rely on multiple unpaid caregivers (often family members); 30% of older adults with dementia rely on three or more unpaid caregivers, whereas 23% of older adults without dementia rely on three or more unpaid caregivers.³¹⁶ Only a small percentage of older adults with dementia do not receive help from family members or other informal care providers (8%). Of these individuals, nearly half live alone, perhaps making it more difficult to ask for and receive informal care.³¹⁶ Of caregivers of spouses with dementia who are at the end of life, close to half provide care without the help of other family or friends.³¹⁷ Living alone with dementia may be a particular challenge for certain subgroups, such as lesbian, gay, bisexual and transgender (LGBT) individuals, who may

TABLE 7

Dementia Caregiving Tasks

<p>Helping with instrumental activities of daily living (IADLs), such as household chores, shopping, preparing meals, providing transportation, arranging for doctor's appointments, managing finances and legal affairs, and answering the telephone.</p>
<p>Helping the person take medications correctly, either via reminders or direct administration of medications.</p>
<p>Helping the person adhere to treatment recommendations for dementia or other medical conditions.</p>
<p>Assisting with personal activities of daily living (ADLs), such as bathing, dressing, grooming and feeding and helping the person walk, transfer from bed to chair, use the toilet and manage incontinence.</p>
<p>Managing behavioral symptoms of the disease such as aggressive behavior, wandering, depressive mood, agitation, anxiety, repetitive activity and nighttime disturbances.</p>
<p>Finding and using support services such as support groups and adult day service programs.</p>
<p>Making arrangements for paid in-home, nursing home or assisted living care.</p>
<p>Hiring and supervising others who provide care.</p>
<p>Assuming additional responsibilities that are not necessarily specific tasks, such as:</p> <ul style="list-style-type: none"> • Providing overall management of getting through the day. • Addressing family issues related to caring for a relative with Alzheimer's disease, including communication with other family members about care plans, decision-making and arrangements for respite for the main caregiver. • Managing other health conditions (i.e., "comorbidities"), such as arthritis, diabetes or cancer. • Providing emotional support and a sense of security.

experience greater isolation for reasons ranging from social stigma to a diminished social network of available family or friend caregivers.³¹⁸

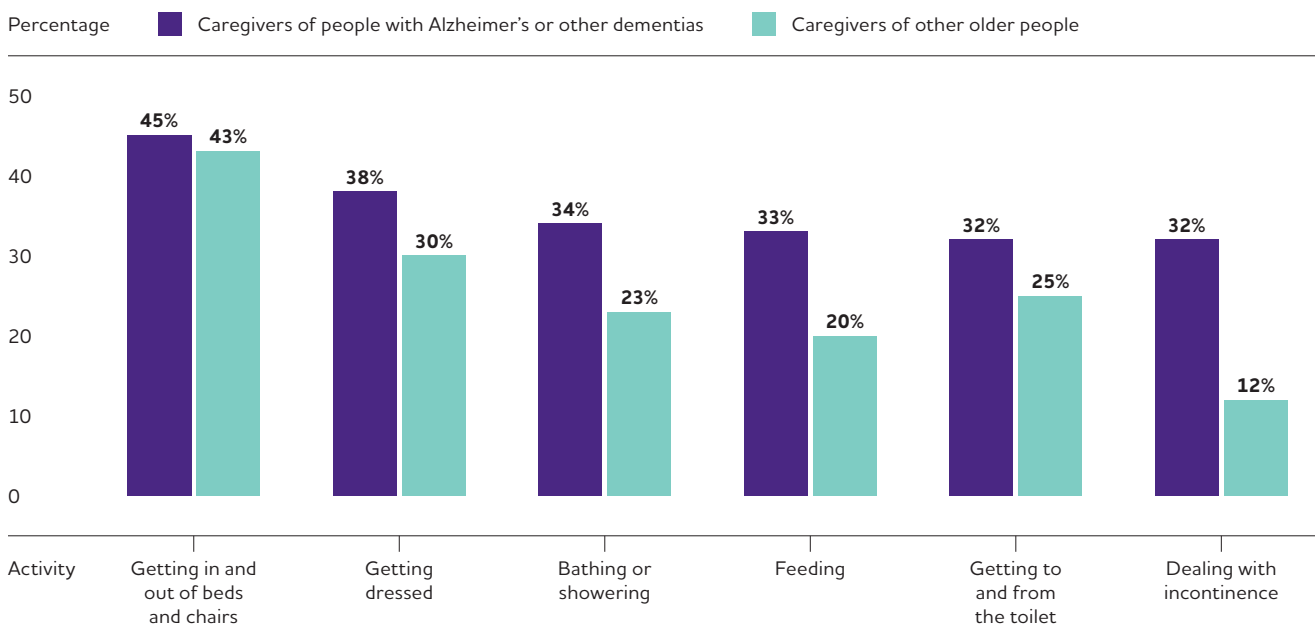
Who Are the Caregivers?

Several sources have examined the demographic background of family caregivers of people with Alzheimer's or other dementias in the United States. They have found the following^{A13,319-323}:

- Approximately two-thirds of dementia caregivers are women.^{A13,319-320}
- About 30% of caregivers are age 65 or older.^{A13}
- Over 60% of caregivers are married, living with a partner or in a long-term relationship.^{A13,320}
- Over half of caregivers are providing assistance to a parent or in-law with dementia.³²³ Approximately 10% of caregivers provide help to a spouse with Alzheimer's disease or another dementia.³²³⁻³²⁴
- Two-thirds of caregivers are non-Hispanic white,^{A13,320,323} while 10% are black/African American, 8% are Hispanic/Latino and 5% are Asian.^{A13} The remaining 10% represent a variety of other racial/ethnic groups.
- Approximately 40% of dementia caregivers have a college degree or more education.^{A13,320,323}
- Forty-one percent of caregivers have a household income of \$50,000 or less.^{A13}
- Among primary caregivers (individuals who indicate having the most responsibility for helping their relatives) of people with dementia, over half take care of their parents.^{322,325-326}
- Most caregivers (66%) live with the person with dementia in the community.³¹⁶
- Approximately one-quarter of dementia caregivers are "sandwich generation" caregivers — meaning that they care not only for an aging parent, but also for a child.^{A13,323-324}

Caregiving and Women

The responsibilities of caring for someone with dementia often fall to women. As mentioned earlier, approximately two-thirds of dementia caregivers are women.^{A13,319-320,325-326} Over one-third of dementia caregivers are daughters.^{308,316} It is more common for wives to provide informal care for a husband than vice versa.³²⁷ On average, female caregivers spend more time caregiving than male caregivers.³¹⁶ According to the 2014 Alzheimer's Association Women and Alzheimer's Poll, which surveyed both men and women, of those providing care for 21 hours or more per week, 67% were women.³²⁸ Similarly, the 2015-2017 Behavioral Risk Factor Surveillance System (BRFSS) surveys found that of all dementia caregivers who spend more than 40 hours per week providing care, 73% were women.³²⁴ Two and a half times as many women as men

FIGURE 8**Proportion of Caregivers of People with Alzheimer’s or Other Dementias Versus Caregivers of Other Older People Who Provide Help with Specific Activities of Daily Living, United States, 2015**

Created from data from the National Alliance for Caregiving and AARP.³²³

reported living with the person with dementia full time.³²⁸ Of those providing care to someone with dementia for more than 5 years, 63% are women.³²⁴ Similarly, caregivers who are women may experience slightly higher levels of burden, impaired mood, depression and impaired health than men, with evidence suggesting that these differences arise because female caregivers tend to spend more time caregiving, assume more caregiving tasks, and care for someone with more cognitive, functional and/or behavioral problems.³²⁹⁻³³⁰ Of dementia caregivers who indicate a need for individual counseling or respite care, the large majority are women (individual counseling, 85%, and respite care, 84%).³²⁴

Caregiving Tasks

The care provided to people with Alzheimer’s or other dementias is wide-ranging and in some instances all-encompassing. Table 7 summarizes some of the most common types of dementia care provided.

Though the care provided by family members of people with Alzheimer’s or other dementias is somewhat similar to the help provided by caregivers of people with other conditions, dementia caregivers tend to provide more extensive assistance. Family caregivers of people with dementia are more likely to monitor the health of the care recipient than are caregivers of people without

dementia (79% versus 66%).³³¹ Data from the 2011 National Health and Aging Trends Study indicated that caregivers of people with dementia are more likely than caregivers of people without dementia to provide help with self-care and mobility (85% versus 71%) and health or medical care (63% versus 52%).^{309,319} Figure 8 illustrates how family caregivers of people with dementia are more likely than caregivers of other older people to assist with ADLs.

In addition to assisting with ADLs, more caregivers of people with Alzheimer’s or other dementias advocate for these individuals with community agencies and care providers (65%) and manage finances (68%) compared with caregivers of people without dementia (46% and 50%, respectively).³²³ More caregivers of people with Alzheimer’s or other dementias arrange for outside services (46%) and communicate with health care professionals (80%) compared with caregivers of people without dementia (27% and 59%, respectively).³²³ One in five caregivers of people with Alzheimer’s or other dementias (22%) report problems dealing with a bank or credit union when helping to manage the finances of people living with dementia, compared with 9% of caregivers of people without dementia.³²³ Caring for a person with dementia also means managing symptoms that caregivers of people with other diseases may not

TABLE 8

Number of Caregivers of People with Alzheimer's or Other Dementias, Hours of Unpaid Care and Economic Value of Unpaid Care by State, 2019*

State	Number of Caregivers (in thousands)	Hours of Unpaid Care (in millions)	Value of Unpaid Care (in millions of dollars)	State	Number of Caregivers (in thousands)	Hours of Unpaid Care (in millions)	Value of Unpaid Care (in millions of dollars)
Alabama	306	349	\$4,576	Montana	51	58	\$757
Alaska	33	38	495	Nebraska	83	95	1,240
Arizona	346	394	5,165	Nevada	153	175	2,289
Arkansas	178	203	2,663	New Hampshire	68	78	1,016
California	1,624	1,849	24,245	New Jersey	448	510	6,684
Colorado	256	292	3,825	New Mexico	108	123	1,617
Connecticut	178	203	2,655	New York	1,011	1,151	15,089
Delaware	55	63	822	North Carolina	479	545	7,151
District of Columbia	29	33	433	North Dakota	30	35	454
Florida	1,152	1,312	17,206	Ohio	604	688	9,018
Georgia	540	615	8,063	Oklahoma	226	257	3,371
Hawaii	65	74	975	Oregon	188	214	2,810
Idaho	87	99	1,299	Pennsylvania	677	771	10,104
Illinois	587	668	8,759	Rhode Island	54	61	800
Indiana	342	390	5,112	South Carolina	318	362	4,749
Iowa	136	155	2,036	South Dakota	39	44	575
Kansas	152	173	2,268	Tennessee	444	506	6,628
Kentucky	274	312	4,089	Texas	1,449	1,650	21,628
Louisiana	231	264	3,456	Utah	159	181	2,366
Maine	70	79	1,042	Vermont	30	34	449
Maryland	294	335	4,389	Virginia	467	532	6,970
Massachusetts	340	387	5,075	Washington	353	402	5,268
Michigan	518	590	7,733	West Virginia	105	120	1,574
Minnesota	257	293	3,838	Wisconsin	195	223	2,918
Mississippi	207	235	3,085	Wyoming	28	31	413
Missouri	319	363	4,755	U.S. Total	16,343	18,611	\$243,994

*State totals may not add to the U.S. total due to rounding.

Created from data from the 2009 Behavioral Risk Factor Surveillance System survey, U.S. Census Bureau, Centers for Medicare & Medicaid Services, National Alliance for Caregiving, AARP and U.S. Department of Labor.^{A12, A14, A15}

face, such as neuropsychiatric symptoms (for example, anxiety, apathy and lack of inhibition) and severe behavioral problems. Family caregivers of people with Alzheimer's or other dementias are more likely than family caregivers of people without dementia to help with emotional or mental health problems (41% versus 16%) and behavioral issues (15% versus 4%).³²³ People with dementia tend to have larger networks of family and friends involved in their care compared with people without dementia. Family members and friends in dementia care networks tend to provide help for a larger number of tasks than do those in non-dementia care networks, where family members and friends are more likely to focus on specific care tasks.³³²

When a person with Alzheimer's or another dementia moves to an assisted living residence or a nursing home, the help provided by his or her family caregiver usually changes from the comprehensive care summarized in Table 7 (see page 34) to providing emotional support, interacting with facility staff and advocating for appropriate care. However, some family caregivers continue to help with bathing, dressing and other ADLs.³³³⁻³³⁵

Duration of Caregiving

Eighty-six percent of dementia caregivers have provided care and assistance for at least the past year, according to the national 2014 Alzheimer's Association Women and Alzheimer's Poll.^{A13} According to another study, well over half (57%) of family caregivers of people with Alzheimer's or other dementias in the community had provided care for 4 or more years.³¹⁶ More than six in 10 (63%) Alzheimer's caregivers expect to continue having care responsibilities for the next 5 years compared with less than half of caregivers of people without dementia (49%).³²³

Hours of Unpaid Care and Economic Value of Caregiving

In 2019, the 16.3 million family and other unpaid caregivers of people with Alzheimer's or other dementias provided an estimated 18.6 billion hours of unpaid care. This number represents an average of 21.9 hours of care per caregiver per week, or 1,139 hours of care per caregiver per year.^{A14} With this care valued at \$13.11 per hour,^{A15} the estimated economic value of care provided by family and other unpaid caregivers of people with dementia across the United States was nearly \$244 billion in 2019. Table 8 shows the total hours of unpaid care as well as the value of care provided by family and other unpaid caregivers for the United States and each state. Unpaid caregivers of people with Alzheimer's or other dementias provided care valued at more than \$4 billion in each of 22 states. Unpaid caregivers in each of the four most populous states — California, Florida, New York and Texas — provided care

valued at more than \$15 billion. A longitudinal study of the monetary value of family caregiving for people with dementia found that the overall value of daily family care increased 18% with each additional year of providing care, and that the value of this care further increased as the care recipient's cognitive abilities declined.³³⁶⁻³³⁷ Additional research is needed to estimate the future value of family care for people with Alzheimer's disease and other dementias as the U.S. population continues to age.

Apart from its long duration, the immediate demands of caregiving are also time-intensive. Caregivers of people with dementia report providing 27 hours more care per month on average (92 hours versus 65 hours) than caregivers of people without dementia.³¹⁹ An analysis of national caregiving trends from 1999 to 2015 found that the average hours of care per week increased from 45 in 1999 to 48 in 2015 for dementia caregivers; over the same time period, weekly hours of care decreased for non-dementia caregivers from 34 to 24.³³⁸

Impact of Alzheimer's Caregiving

Caring for a person with Alzheimer's or another dementia poses special challenges. For example, people in the middle to later stages of Alzheimer's experience losses in judgment, orientation, and the ability to understand and communicate effectively. Family caregivers must often help people with Alzheimer's manage these issues. The personality and behavior of a person with Alzheimer's are affected as well, and these changes are often among the most challenging for family caregivers.³³⁹⁻³⁴¹ Individuals with Alzheimer's also require increasing levels of supervision and personal care as the disease progresses. As symptoms worsen, the care required by family members can result in increased emotional stress and depression among caregivers; new or exacerbated health problems; and depleted income and finances due in part to disruptions in employment and paying for health care or other services for themselves and people living with dementia.³⁴²⁻³⁵⁰

Caregiver Emotional and Social Well-Being

The intimacy, shared experiences and memories that are often part of the relationship between a caregiver and person living with dementia may be threatened due to the memory loss, functional impairment and psychiatric/behavioral disturbances that can accompany the progression of Alzheimer's. In a national poll, however, 45% of caregivers of people with dementia indicated that providing help to someone with cognitive impairment was very rewarding.³²⁶ Although caregivers report positive feelings about caregiving, such as family togetherness and the satisfaction of helping others,^{A13,351-357} they also frequently report higher levels of stress.

Burden and Stress

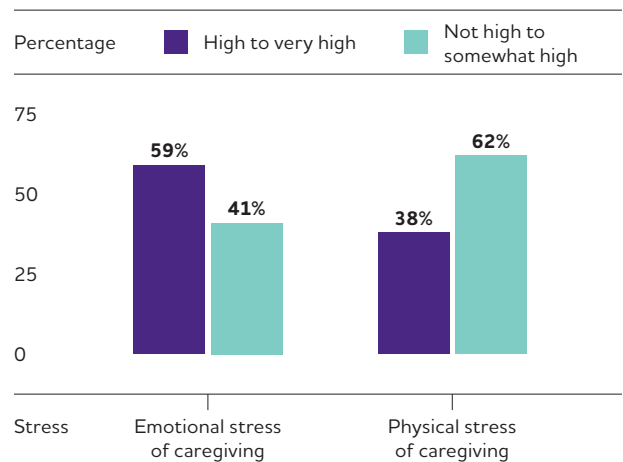
- More dementia caregivers were classified as having a high level of burden than caregivers of people without dementia (46% versus 38%) based on the 2015 National Alliance for Caregiving/AARP survey's Burden of Care Index, which combined the number of hours of care and the number of ADL tasks performed by the caregiver into a single numerical score.³²³
- Compared with caregivers of people without dementia, twice as many caregivers of those with dementia indicate substantial emotional, financial and physical difficulties.³¹⁹
- Fifty-nine percent of family caregivers of people with Alzheimer's or other dementias rated the emotional stress of caregiving as high or very high (Figure 9).^{A13} Nearly half of dementia caregivers (49%) indicate that providing help is highly stressful compared with 35% of caregivers of people without dementia.³²³

Depression and Mental Health

- A meta-analysis reported that caregivers of people with dementia were significantly more likely to experience depression and anxiety than non-caregivers.³³⁰ Approximately 30% to 40% of family caregivers of people with dementia report depression, compared with 5% to 17% of non-caregivers of similar ages.³⁵⁸⁻³⁶²
- The prevalence of depression is higher among dementia caregivers (30% to 40%) than other caregivers, such as those who provide help to individuals with schizophrenia (20%) or stroke (19%).³⁶²⁻³⁶⁵
- In a meta-analysis, the type of relationship was the strongest predictor of caregiver depression; caregivers of spouses had two and a half times higher odds of having depression than caregivers of people who were not spouses.³⁶²
- The prevalence of anxiety among dementia caregivers is 44%, which is higher than among caregivers of people with stroke (31%).³⁶²⁻³⁶³
- Caregivers of individuals with Alzheimer's report more subjective cognitive problems (for example, problems with memory) and experience greater declines in cognition over time than non-caregivers matched on age and other characteristics.³⁶⁶⁻³⁶⁷
- Caring for people with dementia who have four or more behavioral and psychological symptoms (for example, aggression, self-harm and wandering) represents a "tipping point" for family caregivers, as they are more likely to report clinically meaningful depression and burden (that is, negative emotional reactions to providing care).³⁶⁸

FIGURE 9

Proportion of Caregivers of People with Alzheimer's or Other Dementias Who Report High to Very High Emotional and Physical Stress Due to Caregiving



Created from data from the Alzheimer's Association.^{A13}

Strain

- Caregivers of people with Alzheimer's or other dementias were twice as likely as caregivers of individuals without dementia (22% compared with 11%) to report that completing medical/nursing-related tasks (for example, injections, tube feedings and catheter/colostomy care) was difficult.³³¹
- About half of caregivers (51%) of people with Alzheimer's or another dementia report having no experience performing medical/nursing-related tasks,³³¹ and they often lack the information or resources necessary to manage complex medication regimens.³⁶⁹⁻³⁷²
- According to the 2014 Alzheimer's Association poll of caregivers, respondents often believed they had no choice in taking on the role of caregiver.^{A13}
- The poll also found that more than half of women with children under age 18 felt that caregiving for someone with dementia was more challenging than caring for children (53%).^{A13}
- Many caregivers of people with Alzheimer's or other dementias provide help alone. Forty-one percent of dementia caregivers in the 2014 Alzheimer's Association poll reported that no one else provided unpaid assistance.^{A13}
- A population-based sample of caregivers found that although dementia caregivers indicated greater strain than non-dementia caregivers, no substantial differences in strain between white and black/African American dementia caregivers were evident.³⁷³

Stress of Care Transitions

- Admitting a relative to a residential care facility has mixed effects on the emotional and psychological well-being of family caregivers. Some studies suggest that distress remains unchanged or even increases after a relative is admitted to a residential care facility, but other studies have found that distress declines following admission.^{335,374-375}
- The demands of caregiving may intensify as people with dementia approach the end of life.³⁷⁶ In the year before the death of the person living with dementia, 59% of caregivers felt they were “on duty” 24 hours a day, and many felt that caregiving during this time was extremely stressful.³⁷⁷ The same study found that 72% of family caregivers experienced relief when the person with Alzheimer’s or another dementia died.³⁷⁷

Caregiver Physical Health

For some caregivers, the demands of caregiving may cause declines in their own health. Evidence suggests that the stress of providing dementia care increases caregivers’ susceptibility to disease and health complications.³⁷⁸ As shown in Figure 9, 38% of Alzheimer’s and other dementia caregivers indicate that the physical stress of caregiving is high to very high.^{A13} Building on this, a recent analysis found that 29% of caregivers of people with Alzheimer’s or other dementias report that providing care results in high physical strain compared with 17% of caregivers of people without dementia.³²³ The distress associated with caring for a relative with Alzheimer’s or another dementia has also been shown to negatively influence the quality of family caregivers’ sleep.³⁷⁹⁻³⁸¹ Compared with those of the same age who were not caregivers, caregivers of people with dementia are estimated to lose between 2.4 hours and 3.5 hours of sleep a week.³⁸¹

General Health

Seventy-four percent of caregivers of people with Alzheimer’s or other dementias reported that they were “somewhat concerned” to “very concerned” about maintaining their own health since becoming a caregiver.^{A13} Forty-two percent of caregivers of people with Alzheimer’s or another dementia report that their health is excellent or very good, which is lower than caregivers of people without dementia (50%).³²³ In addition, 35% of caregivers of people with Alzheimer’s or another dementia report that their health has worsened due to care responsibilities compared with 19% of caregivers of people without dementia.³²³ A 2017 poll reported that 27% of dementia caregivers delayed or did not do things

they should to maintain their own health.³²⁶ Dementia caregivers indicate lower health-related quality of life than non-caregivers and are more likely than non-caregivers or other caregivers to report that their health is fair or poor.^{344,348,382-384} Data from the Health and Retirement Study showed that dementia caregivers who provided care to spouses were much more likely (41% increased odds) than other spousal caregivers of similar age to become increasingly frail during the time between becoming a caregiver and their spouse’s death.³⁸⁵ Other studies, however, suggest that caregiving tasks have the positive effect of keeping older caregivers more physically active than non-caregivers.³⁸⁶

Recent research has examined variations in self-rated health among dementia caregivers of diverse racial and ethnic backgrounds. Support from family and friends is associated with better self-rated health for black/African American dementia caregivers, but not for white or Mexican American caregivers. A more positive perceived relationship between the caregiver and person with dementia was associated with better self-rated health among black/African American and white caregivers.³⁸⁷

Physiological Changes

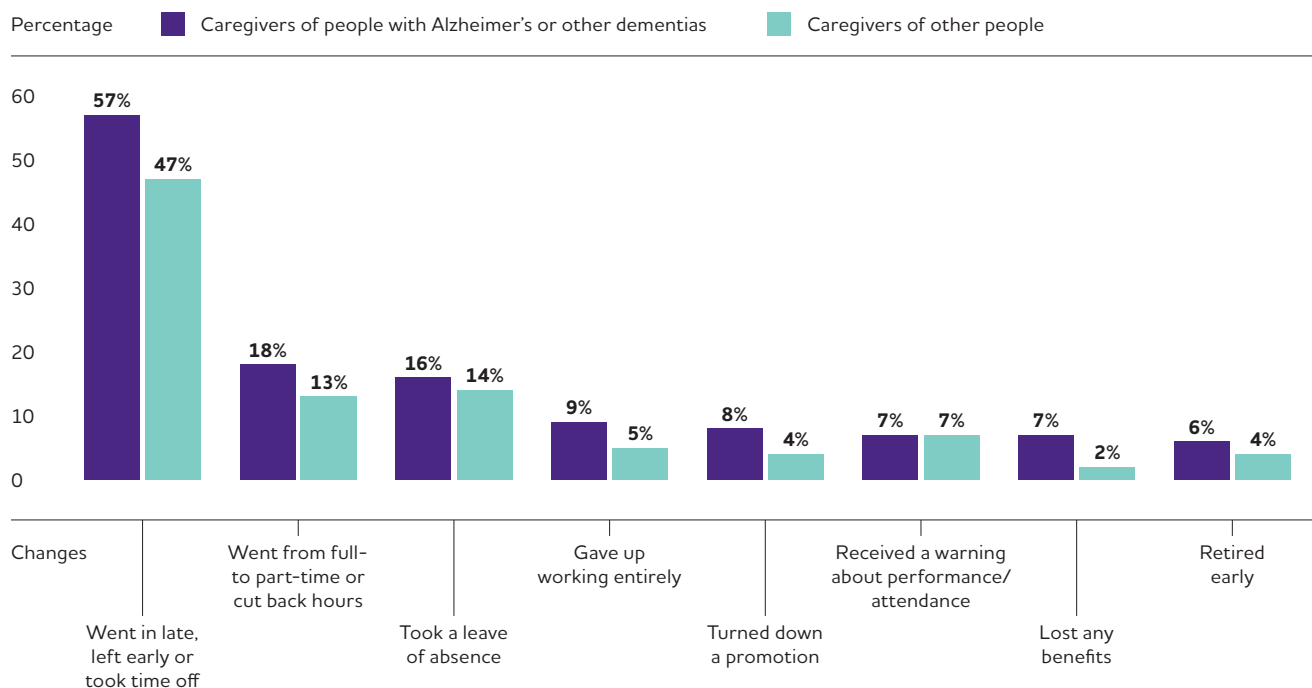
The chronic stress of caregiving may be associated with an increased incidence of hypertension^{342,388-395} and a number of physiological changes that could increase the risk of developing chronic conditions, including high levels of stress hormones,³⁸⁸ impaired immune function,^{342,389} slow wound healing³⁹⁰ and coronary heart disease.³⁹¹ A recent meta-analysis of studies examining the associations between family caregiving, inflammation and immune function suggests that dementia caregivers had slight reductions in immune function and modestly elevated inflammation.³⁹⁶ Additional studies of physiological changes before and after the start of caregiving in diverse populations are needed to better understand the physiological effects of caregiving.

Health Care

Caregivers of people with dementia who are depressed, have behavioral disturbances or have low functional status are more likely to be hospitalized and have emergency department visits³⁹⁷⁻³⁹⁸ than caregivers of people with dementia who do not have these symptoms. Increased depressive symptoms among caregivers over time are linked to more frequent doctor visits, increased outpatient tests and procedures, and greater use of over-the-counter and prescription medications.³⁹⁸

FIGURE 10

Work-Related Changes Among Caregivers of People with Alzheimer’s or Other Dementias Who Had Been Employed at Any Time Since They Began Caregiving



Created from data from the National Alliance for Caregiving and AARP.³²³

Mortality

Studies of how the health of people with dementia affects their caregivers’ risk of dying have had mixed findings.³⁹⁹⁻⁴⁰⁰ For example, caregivers of spouses who were hospitalized and had dementia were more likely to die in the following year than caregivers whose spouses were hospitalized but did not have dementia (after accounting for differences in caregiver age).⁴⁰¹ In addition, caregivers who perceive higher strain due to care responsibilities were at higher risk for death than caregivers who perceive little or no strain.⁴⁰² In contrast, a longitudinal study of participants in the Health and Retirement Study found that dementia caregivers were less likely to die than non-caregivers of similar age over a 12-year period. These results are consistent with a protective effect of dementia care, at least as it pertains to death.³⁹⁹ The findings are also consistent with the possibility that individuals who assume dementia care roles do so in part because their initial health allows them to do so. Eighteen percent of spousal caregivers die before their partners with dementia.⁴⁰³

Caregiver Employment and Finances

Six in 10 caregivers of people with Alzheimer’s or another dementia were employed or had been employed in the prior year while providing care.³²³ These individuals worked an average of 35 hours per week while caregiving.³²³ Among people who were employed in the past year while providing care to someone with Alzheimer’s or another dementia, 57% reported sometimes needing to go in late or leave early compared with 47% of non-dementia caregivers. Eighteen percent of dementia caregivers reduced their work hours due to care responsibilities, compared with 13% of non-dementia caregivers. Other work-related changes among dementia and non-dementia caregivers who had been employed in the past year are summarized in Figure 10.³²³

Costs of dementia caregiving for employers may include replacement costs for employees who quit due to their caregiving responsibilities and costs of absenteeism and workday interruptions.⁴⁰⁴ In 2010, employers lost \$13 billion due to employees’ elder care responsibilities.⁴⁰⁵⁻⁴⁰⁶

TABLE 9

Type and Focus of Caregiver Interventions

Type	Focus
Case management	Provides assessment, information, planning, referral, care coordination and/or advocacy for family caregivers.
Psychoeducational approaches	Include structured programs that provide information about the disease, resources and services, and about how to expand skills to effectively respond to symptoms of the disease (for example, cognitive impairment, behavioral symptoms and care-related needs). Include lectures, discussions and written materials and are led by professionals with specialized training.
Counseling	Aims to resolve pre-existing personal problems that complicate caregiving to reduce conflicts between caregivers and care recipients and/or improve family functioning.
Psychotherapeutic approaches	Involve the establishment of a therapeutic relationship between the caregiver and a professional therapist (for example, cognitive-behavioral therapy for caregivers to focus on identifying and modifying beliefs related to emotional distress, developing new behaviors to deal with caregiving demands, and fostering activities that can promote caregiver well-being).
Respite	Provides planned, temporary relief for the caregiver through the provision of substitute care; examples include adult day services and in-home or institutional respite care for a certain number of weekly hours.
Support groups	Are less structured than psychoeducational or psychotherapeutic interventions. Support groups provide caregivers the opportunity to share personal feelings and concerns to overcome feelings of isolation.
Multicomponent approaches	Are characterized by intensive support strategies that combine multiple forms of interventions, such as education, support and respite, into a single, long-term service (often provided for 12 months or more).

Created from data from Pinquart et al. and Gaugler et al.^{346,409}

In 2019, it is estimated that dementia caregivers bore nearly twice the average out-of-pocket costs (for example, medical care, personal care and household expenses for the person with dementia and personal expenses and respite services for the caregiver) of non-dementia caregivers (\$11,372 versus \$6,121).⁴⁰⁷ Data from the 2016 Alzheimer’s Association Family Impact of Alzheimer’s Survey indicated that among care contributors (a friend or relative who paid for dementia expenses and/or provided care for someone with dementia at least once a month in the prior year), 48% cut back on spending and 43% cut back on saving due to the out-of-pocket costs of providing help to someone with dementia.³⁴⁹ Due to care responsibilities in the year prior to the survey, close to four in 10 care contributors indicated that the “food they bought just didn’t last, and they didn’t have money to get more,” and three in 10 ate less because of care-related costs.³⁴⁹

Effects of Caregiver Stress on People with Dementia

Research has emerged on the effects of caregiver stress on people with dementia and their use of health care services. For example, distress on the part of family caregivers is associated with increased odds of institutionalization of the person with dementia, exacerbated behavioral and psychological challenges in the person with dementia, and increased likelihood of people with dementia being abused.⁴⁰⁸ See the Use and Costs of Health Care, Long-Term Care, and Hospice section (page 45) for additional information.

Interventions Designed to Assist Caregivers

For more than 30 years, strategies to support family caregivers of people with dementia have been developed and evaluated. The types and focus of these strategies (often called “interventions”) are summarized in Table 9.^{347,409}

In general, the goal of interventions is to improve the health and well-being of dementia caregivers by relieving the negative aspects of caregiving. Some also aim to delay nursing home admission of the person with dementia by

providing caregivers with skills and resources (emotional, social, psychological and/or technological) to continue helping their relatives or friends at home. Specific approaches used in various interventions include providing education to caregivers, helping caregivers manage dementia-related symptoms, improving social support for caregivers and providing caregivers with respite from caregiving duties.

According to a publication on dementia caregiver interventions that reviewed seven meta-analyses and 17 systematic reviews of randomized controlled trials, the following characteristics distinguish interventions that are effective: family caregivers are actively involved in the intervention, in contrast to passively receiving information; the intervention is tailored and flexible to meet the changing needs of family caregivers during the course of a relative's dementia; and the intervention meets the needs not only of caregivers, but of people living with dementia as well.⁴¹⁰ A 2012 report examined randomized, controlled studies of caregiver interventions and identified 44 interventions that benefited individuals with dementia as well as caregivers. More such interventions are emerging each year.⁴¹¹⁻⁴¹⁶ A meta-analysis examining the components of dementia caregiver interventions that are most beneficial found that interventions that initially enhance caregiving competency, gradually address the care needs of the person with dementia, and offer emotional support for loss and grief when needed appeared most effective.⁴¹⁷

Interventions for dementia caregivers that have demonstrated efficacy in scientific evaluations have been gradually implemented in the community, but are still not widespread or available to all family caregivers.⁴¹⁸⁻⁴³² When interventions are implemented, they are generally successful at improving how caregiver services are delivered, and have the potential to reach a large number of families while also helping caregivers cope with their responsibilities.⁴³³ In one example, researchers utilized an "agile implementation" process to more rapidly select, localize, evaluate and replicate a collaborative care model for dementia care. This care model has successfully operated for nearly a decade in an Indianapolis health care system.⁴³⁴ Other efforts have attempted to broaden the reach and accessibility of interventions for dementia caregivers through the use of technologies (for instance, video-phone delivery and online training),⁴³⁵⁻⁴⁴² while others integrated evidence-based dementia care interventions into community-based, long-term service programs.⁴⁴³ In 2019, the National Institute on Aging (NIA) awarded funding to create the NIA Imbedded Pragmatic AD/ADRD Clinical Trials (IMPACT) Collaboratory. The Collaboratory includes experts from more than 30 top research institutions and will support

up to 40 pilot trials to test non-drug, care-based interventions for people living with dementia in the next five years. The goal of IMPACT is to expedite the timeline of research implementation in real-world settings to improve care for people living with dementia and their caregivers.

Because caregivers and the settings in which they provide care are diverse, more studies are required to define which interventions are most effective for specific situations and how these interventions are successful.⁴⁴⁴⁻⁴⁴⁷ Improved tools and measures to personalize services for caregivers to maximize their benefits represent an emerging area of research.⁴⁴⁸⁻⁴⁵⁴ More studies are also needed to adapt proven interventions or develop new intervention approaches for families from different racial, ethnic and socioeconomic backgrounds and in different geographic settings.⁴⁵⁵⁻⁴⁶⁹ Additional research on interventions focused on disease stages is also needed, as well as research on specific intervention needs for LGBT caregivers.³¹⁸

Paid Caregivers

Direct-Care Workers for People with Alzheimer's or Other Dementias

Direct-care workers, such as nurse aides, home health aides, and personal and home care aides, provide most of the paid long-term care to older adults living at home or in residential settings.⁴⁷⁰⁻⁴⁷¹ In nursing homes, nursing assistants make up the majority of staff who work with cognitively impaired residents.⁴⁷²⁻⁴⁷⁴ Nursing assistants help with bathing, dressing, housekeeping, food preparation and other activities. Most nursing assistants are women, and they come from increasingly diverse ethnic, racial and geographic backgrounds.

Direct-care workers have difficult jobs, and they may not receive the training necessary to provide dementia care.^{473,475-477} Turnover rates are high among direct-care workers, and recruitment and retention are persistent challenges.^{476,478} Inadequate education and challenging work environments have also contributed to higher turnover rates among nursing staff across care environments.⁴⁷⁹ Studies have shown that staff training programs to improve the quality of dementia care in nursing homes and hospitals have modest benefits.^{475,480-484} The National Academies of Sciences, Engineering, and Medicine have recommended changes to federal requirements for general direct-care worker training, including an increase in training hours from 75 to 120, and instructional content that focuses more on knowledge and skills related to caring for individuals with Alzheimer's and other dementias.⁴⁷⁶⁻⁴⁷⁷

Shortage of Geriatric Health Care Professionals

Professionals who may receive special training in caring for older adults include physicians, nurse practitioners, registered nurses, social workers, pharmacists, physician assistants and case workers.⁴⁷⁶ It is estimated that the United States has approximately half the number of certified geriatricians that it currently needs.⁴⁸⁵ As of 2016, there were 7,293 certified geriatricians in the United States, or one geriatrician for every 1,924 Americans age 65 or older in need of care.⁴⁸⁶ The American Geriatrics Society estimates that, due to the increase in vulnerable older Americans who require geriatric care, an additional 23,750 geriatricians should be trained between now and 2030 to meet the needs of an aging U.S. population⁴⁸⁷ (see the Special Report, page 63, for additional information). There were 272,000 nurse practitioners in the United States in 2019. Eleven percent of nurse practitioners had special expertise in gerontological care.⁴⁸⁸ Less than 1% of registered nurses, physician assistants and pharmacists identify themselves as specializing in geriatrics.⁴⁷⁶ Although 73% of social workers serve clients age 55 and older, only 4% have formal certification in geriatric social work.⁴⁷⁶ Furthermore, the overall aging of the long-term care workforce may affect the number of paid caregivers.⁴⁷⁹

Enhancing Health Care for Family Caregivers

There is a growing consensus that professionals caring for people with Alzheimer's and other dementias should acknowledge the role family caregivers play in facilitating the treatment of dementia, and that professionals should assess the well-being of family caregivers to improve overall disease management of the person with dementia.⁴⁸⁹⁻⁴⁹³ The complex care challenges of people with dementia also require interprofessional collaboration and education.⁴⁹⁴⁻⁴⁹⁷ Ongoing efforts have attempted to integrate innovative care management practices with traditional primary care for people with dementia. One example involves a skilled professional who serves as the care manager of the person with dementia. The care manager collaborates with primary care physicians and nurse practitioners to develop personalized care plans. These plans can provide support to family caregivers, help people with dementia manage care transitions (for example, a change in care provider or site of care) and ensure the person with dementia has access to appropriate community-based services. Other models include addressing the needs of family caregivers simultaneously with comprehensive disease management of people living with dementia to improve the quality of life of both.⁴⁹⁸ Several evaluations have suggested that such approaches have considerable potential for improving outcomes for people with dementia and their

family caregivers (for example, delayed nursing home admission and reduction in caregiver distress).⁴⁹⁹⁻⁵⁰⁸

Current research is attempting to determine the feasibility of these models beyond the specialty settings in which they currently operate.⁵⁰⁹⁻⁵¹²

In 2016, the National Academies of Sciences, Engineering, and Medicine released *Families Caring for an Aging America*, a seminal report that includes a number of recommendations to refocus national health care reform efforts from models of care that center on the patient (person-centered care) to models of care that also explicitly engage and support the patient's family (family-centered care).⁴⁰⁴ These service models recognize the important role family members play in providing care and incorporate family caregivers during the delivery of health care to their relatives with dementia. Furthermore, these models encourage health care providers to deliver evidence-based services and support to both caregivers and people living with dementia.^{404,513}

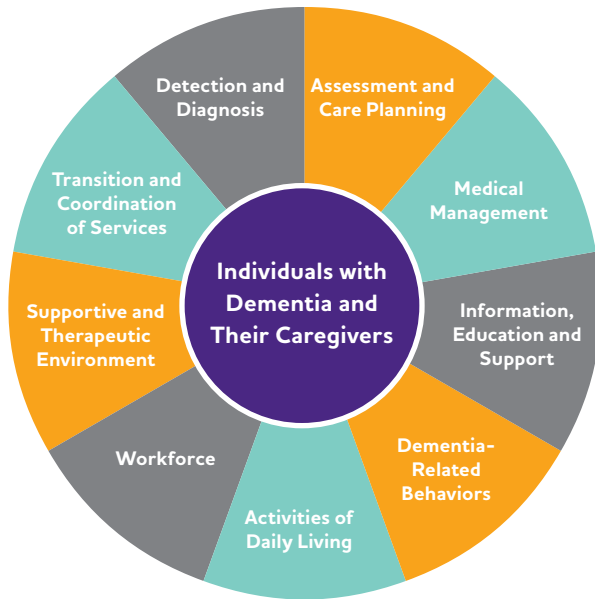
In January 2017, Medicare began reimbursing physicians, physician assistants, nurse practitioners and clinical nurse specialists for health care visits that result in a comprehensive dementia care plan. Comprehensive care planning is a core element of effective dementia care management and can result in the delivery of services that potentially enhance quality of life for people with dementia and their caregivers. In the first year the care planning benefit was available (2017), less than 1% of those with Alzheimer's disease or other dementias received a comprehensive dementia care plan. In seven states (Alaska, Montana, New Hampshire, North Dakota, Rhode Island, South Dakota and Vermont) and the District of Columbia, no fee-for-service Medicare beneficiaries received a comprehensive dementia care plan. Use of the Medicare care planning benefit did increase throughout the year, and the rate of use was 3.3 times greater in the fourth quarter of 2017 compared with the first quarter of 2017.⁵¹⁴ The Alzheimer's Association has developed a care planning kit (alz.org/careplanning) to help guide providers to deliver effective care planning for people with dementia and their family caregivers.

Trends in Dementia Caregiving

There is some indication that families are now better at managing the care they provide to relatives with dementia than in the past. From 1999 to 2015, dementia caregivers were significantly less likely to report physical difficulties (from 30% in 1999 to 17% in 2015) and financial difficulties (from 22% in 1999 to 9% in 2015) related to care provision. In addition, use of respite care by dementia

FIGURE 11

Person-Centered Care Delivery



Created from data from the Alzheimer's Association.⁵¹⁶

caregivers increased substantially (from 13% in 1999 to 27% in 2015).³³⁸ However, as noted earlier, more work is needed to ensure that interventions for dementia caregivers are available and accessible to those who need them. A 2016 study of the Older Americans Act's National Family Caregiver Support Program found that over half (52%) of Area Agencies on Aging did not offer evidence-based family caregiver interventions.⁵¹⁵

The Alzheimer's Association has undertaken several efforts to improve how dementia care is studied and delivered. Its recent dementia care practice recommendations⁵¹⁶ place individuals with dementia and their caregivers at the center of how care should be delivered (see Figure 11). Essential to this model is the need to reconsider how we measure and design care for people with dementia by moving away from an approach that focuses on loss of abilities due to dementia to an approach that emphasizes the individual's unique needs, personal experiences and strengths. This person-centered care philosophy not only values and respects the individual with dementia, but also promotes well-being and health.⁵¹⁷ This new framework is designed to shift how researchers and care providers think about dementia, and may point the way to a greater understanding of the resilience, adaptability, and the possibilities of maintenance or even improvement of skills and abilities when living with dementia.⁵¹⁸⁻⁵¹⁹ A core element of this and other frameworks is to ensure that every experience and interaction is seen as an opportunity to have meaningful engagement, which in turn helps create a better quality of life for the person with dementia.

Use and Costs of Health Care, Long-Term Care and Hospice



In 2020, the total national cost of caring for people with Alzheimer's and other dementias is projected to reach **\$305 billion***.

*Does not include nearly \$244 billion in unpaid caregiving by family and friends.

The costs of health care and long-term care for individuals with Alzheimer’s or other dementias are substantial, and dementia is one of the costliest conditions to society.⁵²⁰ Total payments in 2020 (in 2020 dollars) for all individuals with Alzheimer’s or other dementias are estimated at \$305 billion (Figure 12), not including the value of informal caregiving that is described in the Caregiving section (see page 32). Medicare and Medicaid are expected to cover \$206 billion, or 67%, of the total health care and long-term care payments for people with Alzheimer’s or other dementias. Out-of-pocket spending is expected to be \$66 billion, or 22% of total payments.^{A16} Throughout the rest of this section, all costs are reported in 2019 dollars unless otherwise indicated.^{A17}

Total Cost of Health Care and Long-Term Care

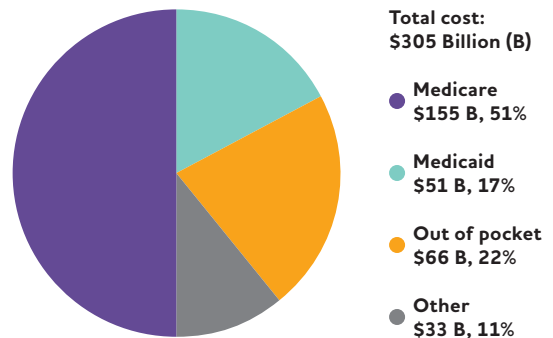
Table 10 reports the average annual per-person payments for health care and long-term care services for Medicare beneficiaries age 65 and older with and without Alzheimer’s or other dementias. Total per-person health care and long-term care payments in 2019 from all sources for Medicare beneficiaries with Alzheimer’s or other dementias were over three times as great as payments for other Medicare beneficiaries in the same age group (\$50,201 per person for those with dementia compared with \$14,326 per person for those without dementia).^{A18,207}

Twenty-seven percent of older individuals with Alzheimer’s or other dementias who have Medicare also have Medicaid coverage, compared with 11% of individuals without dementia.²⁰⁷ Medicaid pays for nursing home and other long-term care services for some people with very low income and low assets, and the high use of these services by people with dementia translates into high costs to Medicaid. Average annual Medicaid payments per person for Medicare beneficiaries with Alzheimer’s or other dementias (\$8,779) were 23 times as great as average Medicaid payments for Medicare beneficiaries without Alzheimer’s or other dementias (\$374) (Table 10).²⁰⁷

Despite these and other sources of financial assistance, individuals with Alzheimer’s or other dementias still incur high out-of-pocket costs. These costs are for Medicare, other health insurance premiums, deductibles,

FIGURE 12

Distribution of Aggregate Costs of Care by Payment Source for Americans Age 65 and Older with Alzheimer’s or Other Dementias, 2020*



*Data are in 2020 dollars.

Percentages do not total 100 due to rounding.

Created from data from the Lewin Model.^{A16} “Other” payment sources include private insurance, health maintenance organizations, other managed care organizations and uncompensated care.

TABLE 10

Average Annual Per-Person Payments by Payment Source for Health Care and Long-Term Care Services, Medicare Beneficiaries Age 65 and Older, with and without Alzheimer’s or Other Dementias, in 2019 Dollars

Payment Source	Beneficiaries with Alzheimer’s or Other Dementias	Beneficiaries without Alzheimer’s or Other Dementias
Medicare	\$25,213	\$7,750
Medicaid	8,779	374
Uncompensated	390	392
Health maintenance organization	1,293	1,583
Private insurance	2,309	1,458
Other payer	961	248
Out of pocket	11,068	2,395
Total*	50,201	14,326

*Payments from sources do not equal total payments exactly due to the effects of population weighting. Payments for all beneficiaries with Alzheimer’s or other dementias include payments for community-dwelling and facility-dwelling beneficiaries.

Created from unpublished data from the Medicare Current Beneficiary Survey for 2011.²⁰⁷

copayments and services not covered by Medicare, Medicaid or additional sources of support. On average, Medicare beneficiaries age 65 and older with Alzheimer’s or other dementias paid \$11,068 out of pocket annually for health care and long-term care services not covered by other sources (Table 10).²⁰⁷

Researchers have evaluated the additional or “incremental” health care, residential long-term care and family caregiving costs of dementia (that is, the costs specifically attributed to dementia when comparing people with and without dementia who have the same coexisting medical conditions and demographic characteristics).^{312,520-522} In a recent systematic review of studies of older adults with Alzheimer’s and other dementias enrolled in private Medicare managed care plans, researchers found a wide range of incremental costs attributable to Alzheimer’s and other dementias.⁵²³ One group of researchers found that the incremental health care and nursing home costs for those with dementia were \$28,501 per person per year in 2010 dollars (\$36,400 in 2019 dollars).^{A19,520} Another group of

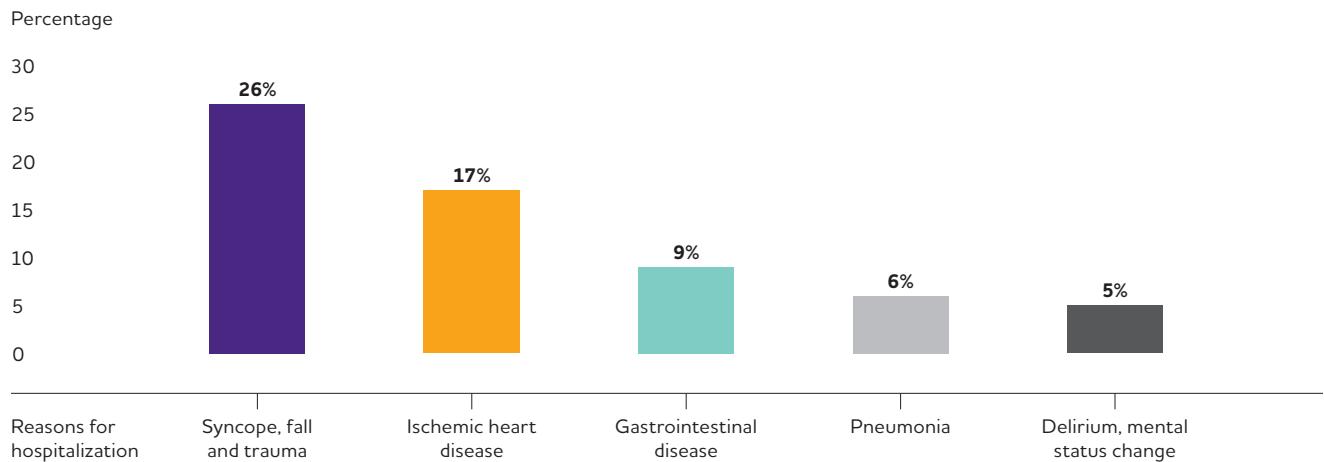
researchers found that the incremental lifetime cost of Alzheimer’s dementia was substantially higher for women than men, due to a greater lifetime risk of developing Alzheimer’s dementia (see Prevalence section, page 17).⁵²⁴ Additionally, because women are more likely to be widowed and living in poverty, the incremental Medicaid costs associated with Alzheimer’s dementia were 70% higher for women than men. A third group of researchers found that the lifetime cost of care, including out-of-pocket costs, Medicare and Medicaid expenditures, and the value of informal caregiving, was \$321,780 per person with Alzheimer’s dementia in 2015 dollars (\$357,297 in 2019 dollars).³¹² The lifetime cost of care for individuals with Alzheimer’s dementia was more than twice the amount incurred by individuals without Alzheimer’s dementia, translating into an incremental lifetime cost of Alzheimer’s dementia of \$184,500 (\$204,864 in 2019 dollars).

Several groups of researchers have examined the additional out-of-pocket costs borne by individuals with Alzheimer’s or other dementias. In a recent analysis of the lifetime incremental cost of dementia, researchers found that individuals with dementia spent \$38,540 (in 2014 dollars; \$43,920 in 2019 dollars) more out-of-pocket between age 65 and death, due to nursing home care.⁵²⁵ Another group of researchers found that community-dwelling individuals age 65 and older with Alzheimer’s dementia had \$1,101 (in 2012 dollars; \$1,316 in 2019 dollars) higher annual out-of-pocket health care spending than individuals without Alzheimer’s dementia, after controlling for differences in patient characteristics, with the largest portion of the difference being due to higher spending on home health care and prescription drugs.⁵²⁶ Furthermore, individuals with Alzheimer’s dementia spend 12% of their income on out-of-pocket health care services compared with 7% for individuals without Alzheimer’s dementia.⁵²⁷ Another research team found that the five-year incremental cost of dementia was \$15,704 (in 2017 dollars; \$16,389 in 2019 dollars), with the additional costs of care in the first year after diagnosis representing 46% of the five-year incremental costs.⁵²⁷

Other researchers compared end-of-life costs for individuals with and without dementia and found that the total cost in the last 5 years of life was \$287,038 per person for individuals with dementia in 2010 dollars and \$183,001 per person for individuals without dementia (\$366,593 and \$233,721, respectively, in 2019 dollars), a difference of 57%.⁵²⁸ Additionally, out-of-pocket costs represented a substantially larger proportion of total wealth for those with dementia than for people without dementia (32% versus 11%).

FIGURE 13

Reasons for Hospitalization of Individuals with Alzheimer's Dementia: Percentage of Hospitalized Individuals by Admitting Diagnosis*



*All hospitalizations for individuals with a clinical diagnosis of probable or possible Alzheimer's were used to calculate percentages. The remaining 37% of hospitalizations were due to other reasons.

Created from data from Rudolph et al.⁵³⁰

Use and Costs of Health Care Services

Use of Health Care Services

People with Alzheimer's or other dementias have twice as many hospital stays per year as other older people.²⁹¹ Moreover, the use of health care services by people with other serious medical conditions is strongly affected by the presence or absence of dementia. In particular, people with coronary artery disease, diabetes, chronic kidney disease, chronic obstructive pulmonary disease (COPD), stroke or cancer who also have Alzheimer's or other dementias have higher use and costs of health care services than people with these medical conditions but no coexisting dementia.

In addition to having more hospital stays, older people with Alzheimer's or other dementias have more skilled nursing facility stays and home health care visits per year than other older people.

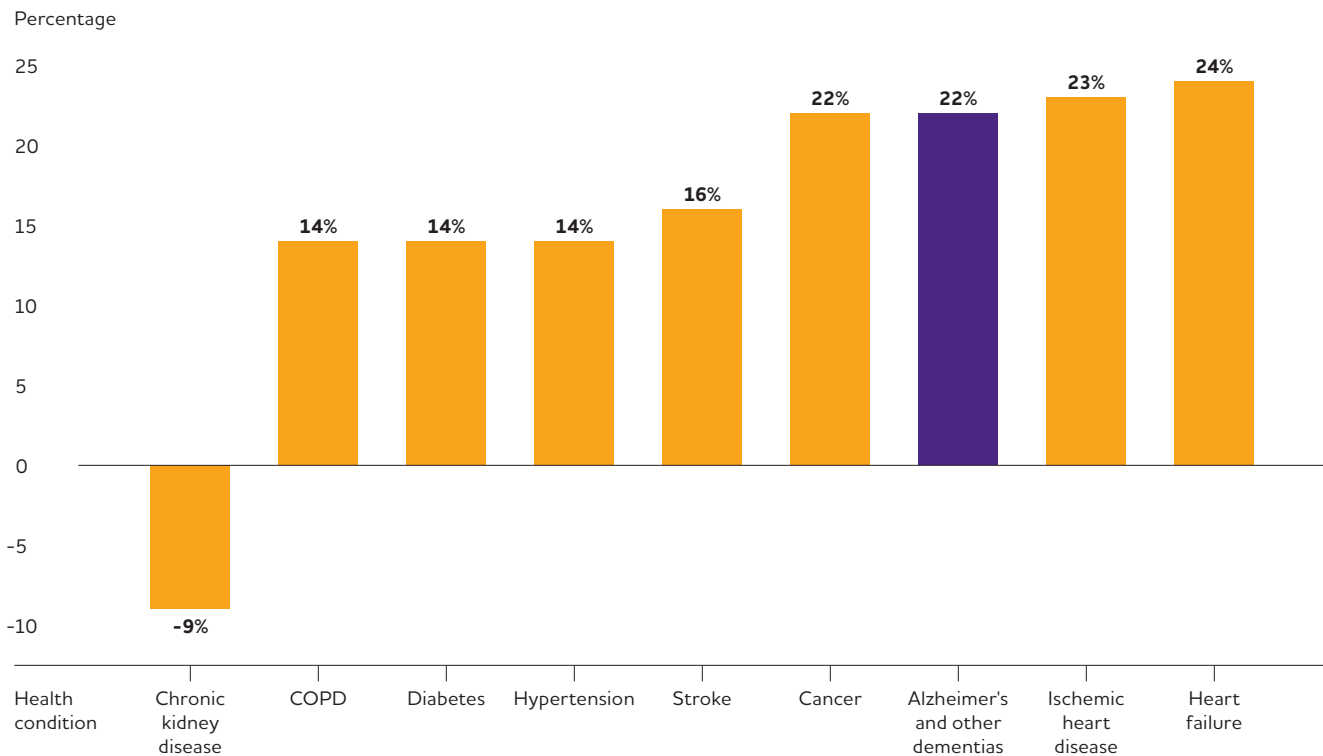
- **Hospital.** There are 538 hospital stays per 1,000 Medicare beneficiaries age 65 and older with Alzheimer's or other dementias compared with 266 hospital stays per 1,000 Medicare beneficiaries age 65 and older without these conditions.²⁹¹ A person with dementia in 2012 had, on average, 23 inpatient days — defined as days in a hospital or skilled nursing facility — compared with 5 days for the Medicare population as a whole.⁵²⁹ The most common reasons for hospitalization of people with Alzheimer's dementia

are syncope (fainting), fall and trauma (26%); ischemic heart disease (17%); and gastrointestinal disease (9%) (Figure 13).⁵³⁰ In a study of inpatient hospitalizations of adults age 60 and older, those with Alzheimer's dementia were at 7% greater risk of dying during the hospital stay and stayed nearly a day longer than individuals without Alzheimer's dementia.⁵³¹ Among Medicare beneficiaries with Alzheimer's or other dementias, 22% of hospital stays are followed by a readmission within 30 days.⁵³² While not directly comparable, one study of a portion of Medicare beneficiaries found an overall readmission rate of 18%.⁵³³ The proportion of hospital stays followed by a readmission within 30 days remained relatively constant between 2007 and 2017 (23% in 2007 versus 22% in 2017).

- **Emergency department.** There are 1,548 emergency department visits per 1,000 Medicare beneficiaries with Alzheimer's or other dementias per year.⁵³² While not directly comparable, there were 640 emergency department visits per 1,000 Medicare beneficiaries per year based on a review of utilization patterns of a subset of Medicare beneficiaries.⁵³³ Emergency department visits for people with Alzheimer's or other dementias per 1,000 Medicare beneficiaries increased 22% between 2007 and 2017 (from 1,265 to 1,548), similar to the increases in emergency department visits for individuals with cancer, ischemic heart disease and heart failure (Figure 14, page 49).⁵³²

FIGURE 14

Percentage Changes in Emergency Department Visits per 1,000 Fee-for-Service Medicare Beneficiaries for Selected Health Conditions* Between 2007 and 2017



*Includes Medicare beneficiaries with a claims-based diagnosis of each chronic condition. Beneficiaries may have more than one chronic condition.

Created from data from U.S. Centers for Medicare & Medicaid Services.⁵³²

- **Skilled nursing facility.** Skilled nursing facilities provide direct medical care that is performed or supervised by registered nurses, such as giving intravenous fluids, changing dressings and administering tube feedings.⁵³⁴ There are 283 skilled nursing facility stays per 1,000 beneficiaries with Alzheimer's or other dementias per year compared with 73 stays per 1,000 beneficiaries without these conditions — a rate nearly four times as great.²⁹¹
- **Home health care.** Twenty-five percent of Medicare beneficiaries age 65 and older with Alzheimer's or other dementias have at least one home health visit during the year, compared with 10% of Medicare beneficiaries age 65 and older without Alzheimer's or other dementias.²⁹¹ Medicare covers home health services, such as part-time skilled nursing care, home health aide (personal hands-on) care, therapies, and medical social services in the home, but does not include homemaker or personal care services.

Costs of Health Care Services

Average per-person payments for health care services (hospital, physician and other medical provider, nursing home, skilled nursing facility, hospice and home health care) and prescription medications were higher for Medicare beneficiaries with Alzheimer's or other dementias than for other Medicare beneficiaries in the same age group (see Table 11, page 50).²⁰⁷

Use and Costs of Health Care Service by State

Substantial geographic variation exists in health care utilization and Medicare payments by individuals with Alzheimer's or other dementias (see Table 12, page 51), similar to the geographic variation observed for Medicare beneficiaries with other medical conditions.⁵³⁵ Emergency department visits range from 1,134 per 1,000 beneficiaries in South Dakota to 1,828 per 1,000 beneficiaries in West Virginia, and the percentage of hospital stays followed by hospital readmission within

TABLE 11

Average Annual Per-Person Payments by Type of Service for Health Care and Long-Term Care Services, Medicare Beneficiaries Age 65 and Older, with and without Alzheimer's or Other Dementias, in 2019 Dollars

Service	Beneficiaries with Alzheimer's or Other Dementias	Beneficiaries without Alzheimer's or Other Dementias
Inpatient hospital	\$11,465	\$3,703
Medical provider*	5,762	3,589
Skilled nursing facility	7,213	493
Nursing home	16,523	800
Hospice	2,126	161
Home health care	2,661	386
Prescription medications**	3,481	2,986

*"Medical provider" includes physician, other provider and laboratory services, and medical equipment and supplies.

**Information on payments for prescription medications is only available for people who were living in the community, that is, not in a nursing home or an assisted living facility.

Created from unpublished data from the Medicare Current Beneficiary Survey for 2011.²⁰⁷

30 days ranges from 15.4% in Utah to 26.8% in the District of Columbia. Medicare spending per capita ranges from \$17,572 in North Dakota to \$34,875 in Nevada (in 2019 dollars).⁵³²

Use and Costs of Health Care Services Across the Spectrum of Cognitive Impairment

Health care costs increase with the presence of dementia. In a population-based study of adults age 70 to 89, annual health care costs were significantly higher for individuals with dementia than for those with either mild cognitive impairment (MCI) or without cognitive impairment.⁵³⁶ Annual health care costs for individuals with MCI were not significantly different, however, from costs for individuals without cognitive impairment.

Several groups of researchers have found that both health care and prescription drug spending are significantly higher in the year prior to diagnosis,⁵³⁷⁻⁵³⁹ 2 years prior to diagnosis,⁵⁴⁰ and one year after diagnosis,^{527,537-538} compared with otherwise similar individuals not diagnosed with Alzheimer's or another

dementia, although there are differences in the sources of increased spending. In one study, the largest differences were in inpatient and post-acute care,⁵³⁸ while in another study the differences in spending were primarily due to outpatient care, home care and medical day services.⁵³⁹ In a third study, the differences were due to home health care, skilled nursing care and durable medical equipment.⁵⁴⁰ Additionally, three groups of researchers have found that spending in the year after diagnosis was higher than for individuals not diagnosed with the disease, by amounts ranging from \$7,264 in 2017 dollars, based on individuals with fee-for-service Medicare coverage (\$7,581 in 2019 dollars)⁵²⁷ to \$17,852 in additional costs in 2014 dollars, based on another group of individuals with Medicare fee-for-service coverage (\$20,344 in 2019 dollars).⁵³⁸ One group of researchers, however, found no difference in health care spending in the 2 years after diagnosis.⁵⁴⁰ One possible explanation for the spike in health care costs in the year immediately prior to and after diagnosis of Alzheimer's or another dementia relates to delays in timely diagnosis. One group of researchers found that individuals with cognitive decline who sought care from a specialist (that is, a neurologist, psychiatrist or geriatrician) had a shorter time to diagnosis of Alzheimer's disease.⁵⁴¹ Additionally, individuals diagnosed with cognitive impairment by a specialist had lower Medicare costs in the year after receiving a diagnosis of Alzheimer's dementia than those diagnosed by a non-specialist. One research team found that health care costs were higher in each of the first four years after a dementia diagnosis, but were not significantly different in the fifth year after diagnosis.⁵²⁷

Impact of Alzheimer's and Other Dementias on the Use and Costs of Health Care in People with Coexisting Medical Conditions

Medicare beneficiaries with Alzheimer's or other dementias are more likely than those without dementia to have other chronic conditions.²⁹¹ While 26% of Medicare beneficiaries age 65 and older with Alzheimer's or other dementias have five or more chronic conditions (including Alzheimer's or other dementias), only 4% of Medicare beneficiaries without Alzheimer's or other dementias have five or more chronic conditions.²⁹¹ Table 13 reports the percentage of people with Alzheimer's or other dementias who had certain coexisting medical conditions. In 2014, the latest year for which information is available, 38% of Medicare beneficiaries age 65 and older with dementia also had coronary artery disease, 37% had diabetes, 29% had chronic kidney disease, 28% had congestive heart failure and 25% had chronic obstructive pulmonary disease.²⁹¹

TABLE 12

Emergency Department (ED) Visits, Hospital Readmissions and Per Capita Medicare Payments in 2019 Dollars by Medicare Beneficiaries with Alzheimer’s or Other Dementias by State, 2017

State	Number of ED Visits per 1,000 Beneficiaries	Percentage of Hospital Stays Followed by Readmission within 30 Days	Per Capita Medicare Payments	State	Number of ED Visits per 1,000 Beneficiaries	Percentage of Hospital Stays Followed by Readmission within 30 Days	Per Capita Medicare Payments
Alabama	1,426.8	21.5	22,555	Montana	1,307.1	17.5	18,664
Alaska	1,447.9	19.6	24,801	Nebraska	1,166.5	18.1	21,012
Arizona	1,491.3	20.6	25,490	Nevada	1,712.2	25.4	34,875
Arkansas	1,563.6	21.8	22,373	New Hampshire	1,508.9	21.6	25,147
California	1,497.6	23.1	32,940	New Jersey	1,459.8	23.0	30,930
Colorado	1,437.1	18.3	23,060	New Mexico	1,566.1	20.7	22,711
Connecticut	1,568.0	22.0	28,461	New York	1,446.1	23.7	31,353
Delaware	1,600.0	21.8	28,260	North Carolina	1,699.3	21.5	23,226
District of Columbia	1,698.5	26.8	31,993	North Dakota	1,193.4	19.2	17,572
Florida	1,564.9	23.4	28,606	Ohio	1,633.7	22.6	26,502
Georgia	1,568.5	21.9	24,228	Oklahoma	1,700.7	21.5	26,351
Hawaii	1,225.2	17.4	20,009	Oregon	1,582.9	18.5	21,210
Idaho	1,401.8	17.0	21,051	Pennsylvania	1,477.7	22.4	26,839
Illinois	1,611.9	23.1	28,485	Rhode Island	1,614.9	22.8	26,876
Indiana	1,510.5	21.0	25,572	South Carolina	1,563.8	21.4	23,917
Iowa	1,344.7	18.5	18,715	South Dakota	1,134.0	19.1	19,070
Kansas	1,394.1	19.4	22,787	Tennessee	1,574.3	22.1	24,199
Kentucky	1,718.4	23.0	24,991	Texas	1,544.9	22.0	30,383
Louisiana	1,770.8	22.1	29,001	Utah	1,205.4	15.4	22,229
Maine	1,666.3	19.8	21,787	Vermont	1,485.6	19.2	22,588
Maryland	1,525.6	24.6	30,331	Virginia	1,637.2	22.0	23,846
Massachusetts	1,618.0	24.3	30,535	Washington	1,483.7	18.5	22,007
Michigan	1,711.5	24.1	28,325	West Virginia	1,827.7	23.6	24,762
Minnesota	1,447.9	21.0	22,830	Wisconsin	1,510.4	20.1	21,516
Mississippi	1,723.3	22.6	26,566	Wyoming	1,436.6	16.1	21,815
Missouri	1,515.1	22.4	23,441	U.S. Average	1,547.7	22.3	27,101*

*The average per capita Medicare payments differ slightly from the figure in Table 10 due to different underlying sources of data.

Created from data from the U.S. Centers for Medicare & Medicaid Services.⁵³²

TABLE 13**Percentage of Medicare Beneficiaries Age 65 and Older with Alzheimer's or Other Dementias Who Have Specified Coexisting Conditions**

Coexisting Condition	Percentage
Coronary artery disease	38
Diabetes	37
Chronic kidney disease	29
Congestive heart failure	28
Chronic obstructive pulmonary disease	25
Stroke	22
Cancer	13

Created from unpublished data from the National 5% Sample Medicare Fee-for-Service Beneficiaries for 2014.²⁹¹

Medicare beneficiaries who have Alzheimer's or other dementias and a coexisting medical condition have higher average per-person payments for most health care services than Medicare beneficiaries with the same medical condition but without dementia. Table 14 (see page 53) shows the average per-person Medicare payments for seven specific medical conditions among beneficiaries who have Alzheimer's or other dementias and beneficiaries who do not have Alzheimer's or another dementia.²⁹¹ Medicare beneficiaries with Alzheimer's or other dementias have higher average per-person payments in all categories except hospital care payments for individuals with congestive heart failure. One group of researchers found that individuals with dementia and behavioral disturbances, such as agitation, had more psychiatric comorbidities than individuals with dementia but without behavioral disturbances.⁵⁴² Additionally, larger proportions of individuals with dementia and behavioral disturbances used medications including antihypertensives, dementia treatments, antipsychotics, antidepressants, antiepileptics and hypnotics.

Use and Costs of Long-Term Care Services

An estimated 70% of older adults with Alzheimer's or other dementias live in the community, compared with 98% of older adults without Alzheimer's or other dementias.²⁰⁷ Of those with dementia who live in the community, 74% live with someone and the remaining 26% live alone.²⁰⁷ As their disease progresses, people with Alzheimer's or other dementias generally receive more care from family

members and other unpaid caregivers. Many people with dementia also receive paid services at home; in adult day centers, assisted living facilities or nursing homes; or in more than one of these settings at different times during the often long course of the disease. Medicaid is the only public program that covers the long nursing home stays that most people with dementia require in the late stages of their illnesses.

Use of Long-Term Care Services by Setting

Most people with Alzheimer's or other dementias who live at home receive unpaid help from family members and friends, but some also receive paid home- and community-based services, such as personal care and adult day care. People with Alzheimer's or other dementias make up a large proportion of all elderly people who receive adult day services and nursing home care.

- **Home health services.** Thirty-two percent of individuals using home health services have Alzheimer's or other dementias.⁵⁴³
- **Adult day services.** Thirty-one percent of individuals using adult day services have Alzheimer's or other dementias.⁵⁴³ Overall, 69% of adult day service programs offer specific programs for individuals with Alzheimer's or other dementias, and 14% of adult day service centers primarily serve individuals with Alzheimer's or other dementias.⁵⁴⁴
- **Residential care facilities.** Forty-two percent of residents in residential care facilities (that is, housing that includes services to assist with everyday activities, such as medication management and meals), including assisted living facilities, have Alzheimer's or other dementias.⁵⁴³ Small residential care facilities (four to 25 beds) have a larger proportion of residents with Alzheimer's or other dementias than larger facilities (51% in facilities with four to 25 beds compared with 44% in facilities with 26 to 50 beds and 39% in facilities with more than 50 beds).⁵⁴⁵ Fifty-eight percent of residential care facilities offer programs for residents with Alzheimer's or other dementias.⁵⁴⁵
- **Nursing home care.** Overall, 48% of nursing home residents have Alzheimer's or other dementias,⁵⁴³ while 37% of short-stay (less than 100 days) nursing home residents have Alzheimer's or other dementias, and 59% of long stay (100 days or longer) residents have these conditions. In 2014, 61% of nursing home residents with Alzheimer's or other dementias had moderate or severe cognitive impairment.⁵⁴⁶ Four percent of Medicare beneficiaries with Alzheimer's or other dementias reside in a nursing home,⁵¹⁶ and nursing home admission by age 80 is expected for 75% of people with Alzheimer's dementia compared with only 4% of the general population.²⁹³

TABLE 14

Average Annual Per-Person Payments by Type of Service and Coexisting Medical Condition for Medicare Beneficiaries Age 65 and Older, with and without Alzheimer's or Other Dementias, in 2019 Dollars*

Medical Condition by Alzheimer's/Dementia (A/D) Status	Average Per-Person Medicare Payment					
	Total Medicare Payments	Hospital Care	Physician Care	Skilled Nursing Facility Care	Home Health Care	Hospice Care
Coronary artery disease						
With A/D	\$28,136	\$8,644	\$2,401	\$4,832	\$2,516	\$3,087
Without A/D	17,560	6,226	1,709	1,553	1,043	402
Diabetes						
With A/D	27,237	8,225	2,351	4,673	2,434	2,780
Without A/D	15,036	5,152	1,506	1,350	906	273
Congestive heart failure						
With A/D	30,872	9,714	2,521	5,282	2,635	3,706
Without A/D	26,193	9,862	2,265	2,860	1,871	866
Chronic kidney disease						
With A/D	30,045	9,308	2,462	5,141	2,490	3,302
Without A/D	21,542	7,694	1,941	2,075	1,290	508
Chronic obstructive pulmonary disease						
With A/D	29,825	9,335	2,492	5,094	2,575	3,424
Without A/D	20,346	7,476	1,883	1,927	1,289	646
Stroke						
With A/D	28,549	8,531	2,377	5,028	2,420	3,435
Without A/D	20,567	6,940	1,914	2,527	1,562	649
Cancer						
With A/D	27,046	8,093	2,302	4,334	2,226	3,073
Without A/D	17,154	5,320	1,579	1,157	743	520

*This table does not include payments for all kinds of Medicare services, and as a result the average per-person payments for specific Medicare services do not sum to the total per-person Medicare payments.

Created from unpublished data from the National 5% Sample Medicare Fee-for-Service Beneficiaries for 2014.²⁹¹

- Alzheimer's special care units and dedicated facilities. An Alzheimer's special care unit is a dedicated unit, wing or floor in a nursing home or other residential care facility that has tailored services for individuals with Alzheimer's or other dementias. Fifteen percent of nursing homes and 14% of other residential care facilities have a dementia special care unit,⁵⁴³ even though 72% of Medicare beneficiaries with Alzheimer's dementia have a nursing home stay in the last 90 days of life.⁵⁴⁷ Additionally, 9% of residential care facilities exclusively provide care to individuals with dementia, while less than 1% (0.4%) of nursing homes exclusively provide care to individuals with dementia.

Long-Term Care Services Provided at Home and in the Community

Nationally, state Medicaid programs are shifting long-term care services from institutional care to home- and community-based services as a means to both reduce unnecessary costs and meet the growing demand for these services by older adults. The federal and state governments share the management and funding of the program, and states differ greatly in the services covered by their Medicaid programs. In 2016, home- and community-based services represented the majority (57%) of Medicaid spending on long-term services and supports, with institutional care representing the remaining 43%.⁵⁴⁸ Between 2013 and 2016, Medicaid spending on home- and community-based services increased 26% overall, while spending on institutional care increased only 1.5% over the same period. Additionally, total spending on home care for Medicare beneficiaries with Alzheimer's or other dementias nearly doubled between 2004 and 2011, although increases in spending may be due to a variety of factors, including more people being diagnosed with Alzheimer's dementia, more people using home care, an increase in the number of coexisting medical conditions, more intensive use of home care services and an increase in Medicaid coverage by older adults.^{207,549} In two recent systematic reviews of the cost-effectiveness of home support interventions for individuals with dementia, researchers found some evidence to support occupational therapy, home-based exercise and some psychological and behavioral treatments as potentially cost-effective approaches, although the research that has evaluated both the costs and benefits of home support interventions is scant.⁵⁵⁰⁻⁵⁵¹

Transitions Between Care Settings

Individuals with dementia often move between a nursing facility, hospital and home, rather than remaining solely in a nursing facility. In a longitudinal study of primary care

patients with dementia, researchers found that individuals discharged from a nursing facility were nearly equally as likely to be discharged home (39%) as discharged to a hospital (44%).⁵⁵² Individuals with dementia may also transition between a nursing facility and hospital or between a nursing facility, home and hospital, creating challenges for caregivers and providers to ensure that care is coordinated across settings. Other researchers have shown that nursing home residents frequently have burdensome transitions at the end of life, including admission to an intensive care unit in the last month of life and late enrollment in hospice.⁵⁵³ The number of care transitions for nursing home residents with advanced cognitive impairment varies substantially across geographic regions of the United States.⁵⁵⁴

Costs of Long-Term Care Services

Long-term care services include home- and community-based services, assisted living and nursing home care. The following estimates are for all users of these services.

- Home care. The median cost for a paid non-medical home health aide is \$23 per hour and \$1,012 per week.⁵⁵⁵ Home care costs increased by 3.1% annually on average over the past 5 years.
- Adult day centers. The median cost of adult day services is \$75 per day.⁵⁵⁵ The cost of adult day services has increased 2.9% annually on average over the past 5 years.
- Assisted living facilities. The median cost for care in an assisted living facility is \$4,051 per month, or \$48,612 per year.⁵⁵⁵ The cost of assisted living has increased 3% annually on average over the past 5 years.
- Nursing homes. The average cost for a private room in a nursing home is \$280 per day, or \$102,200 per year, and the average cost of a semi-private room is \$247 per day, or \$90,155 per year.⁵⁵⁵ The cost of nursing home care has increased 3.1% annually on average over the past 5 years for both private and semi-private rooms.

Affordability of Long-Term Care Services

Few individuals with Alzheimer's or other dementias have sufficient long-term care insurance or can afford to pay out of pocket for long-term care services for as long as the services are needed.

- Income and asset data are not available for people with Alzheimer's or other dementias specifically, but 50% of Medicare beneficiaries have incomes of \$26,200 or less in 2016 dollars (\$27,852 in 2019 dollars), and 25% have incomes of \$15,250 or less in 2016 dollars (\$16,212 in 2019 dollars).⁵⁵⁶

- Fifty percent of Medicare beneficiaries had total savings of \$74,450 or less in 2016 dollars (\$79,145 in 2019 dollars), 25% had savings of \$14,550 or less in 2016 dollars (\$15,468 in 2019 dollars), and 8% had no savings or were in debt. Median savings were substantially lower for black/African American and Hispanic/Latino beneficiaries than for white Medicare beneficiaries.⁵⁵⁶

Long-Term Care Insurance

Long-term care insurance typically covers the cost of care provided in a nursing home, assisted living facility and Alzheimer's special care facility, as well as community-based services such as adult day care and services provided in the home, including nursing care and help with personal care.⁵⁵⁷ Results from the 2016 Alzheimer's Association Family Impact of Alzheimer's Survey revealed that 28% of adults believed Medicare covered the cost of nursing home care for people with Alzheimer's, and 37% did not know whether it covered the cost of nursing home care.³⁴⁹ Although Medicare covers care in a long-term care hospital, skilled nursing care in a skilled nursing facility and hospice care, it does not cover long-term care in a nursing home.⁵⁵⁸

Industry reports estimate that approximately 7.2 million Americans had long-term care insurance in 2014.⁵⁵⁹ The median income for individuals purchasing long-term care insurance was \$87,500 in 2010 dollars (\$102,373 in 2019 dollars), with 77% having an annual income greater than \$50,000 (\$58,499 in 2019 dollars) and 82% having assets greater than \$75,000 (\$87,748 in 2019 dollars).⁵⁵⁹ Private health care and long-term care insurance policies funded only about 8% of total long-term care spending in 2013, representing \$24.8 billion of the \$310 billion total in 2013 dollars (\$27.2 billion of the \$340 billion in 2019 dollars).⁵⁶⁰ The private long-term care insurance market is highly concentrated and has consolidated since 2000. In 2000, 41% of individuals with a long-term care policy were insured by one of the five largest insurers versus 56% in 2014.⁵⁵⁹

To address the dearth of private long-term care insurance options and high out-of-pocket cost of long-term care services, Washington became the first state in the country to pass a law that will create a public state-operated long-term care insurance program.⁵⁶¹ The Long-Term Services and Supports Trust Program will be funded by a payroll tax on employees of 58 cents per \$100 earned that begins in 2022, and self-employed individuals will be able to opt in to the program. The program is currently structured to pay up to \$36,500 in lifetime benefits, beginning in 2025.

Medicaid Costs

Medicaid covers nursing home care and long-term care services in the community for individuals who meet program requirements for level of care, income and assets. To receive coverage, beneficiaries must have low incomes. Most nursing home residents who qualify for Medicaid must spend all of their Social Security income and any other monthly income, except for a very small personal needs allowance, to pay for nursing home care. Medicaid only makes up the difference if the nursing home resident cannot pay the full cost of care or has a financially dependent spouse. Although Medicaid covers the cost of nursing home care, its coverage of many long-term care and support services, such as assisted living care, home-based skilled nursing care and help with personal care, varies by state.

Total Medicaid spending for people with Alzheimer's or other dementias is projected to be \$51 billion in 2020 (in 2020 dollars).^{A16} Estimated state-by-state Medicaid spending on people with Alzheimer's or other dementias in 2020 (in 2020 dollars) is included in Table 15 (see page 56). Total per-person Medicaid payments for Medicare beneficiaries age 65 and older with Alzheimer's or other dementias were 23 times as great as Medicaid payments for other Medicare beneficiaries.²⁰⁷ Much of the difference in payments for beneficiaries with Alzheimer's or other dementias and other beneficiaries is due to the costs associated with long-term care (nursing homes and other residential care facilities, such as assisted living facilities) and the greater percentage of people with dementia who are eligible for Medicaid.

Use and Costs of Care at the End of Life

Hospice care provides medical care, pain management, and emotional and spiritual support for people who are dying, including people with Alzheimer's or other dementias, either in a facility or at home. Hospice care also provides emotional and spiritual support and bereavement services for families of people who are dying. The main purpose of hospice is to allow individuals to die with dignity and without pain and other distressing symptoms that often accompany terminal illness. Medicare is the primary source of payment for hospice care, but private insurance, Medicaid and other sources also pay for hospice care. Based on data from the National Hospice Survey for 2008 to 2011, nearly all (99%) hospices cared for individuals with dementia, although only 67% of hospices cared for individuals with a primary diagnosis of dementia.⁵⁶² Fifty-two percent of individuals in for-profit hospices had either a primary or

TABLE 15

Total Medicaid Payments for Americans Age 65 and Older Living with Alzheimer’s or Other Dementias by State*

State	2020 (in millions of dollars)	2025 (in millions of dollars)	Percentage Increase	State	2020 (in millions of dollars)	2025 (in millions of dollars)	Percentage Increase
Alabama	\$925	\$1,127	21.8	Montana	\$166	\$203	22.2
Alaska	76	110	44.6	Nebraska	372	411	10.3
Arizona	414	545	31.7	Nevada	203	277	36.5
Arkansas	396	454	14.6	New Hampshire	254	335	31.9
California	4,197	5,235	24.7	New Jersey	2,186	2,614	19.6
Colorado	635	789	24.1	New Mexico	227	279	22.9
Connecticut	1,022	1,187	16.1	New York	5,453	6,306	15.6
Delaware	253	313	23.6	North Carolina	1,332	1,628	22.2
District of Columbia	126	135	6.8	North Dakota	190	215	13.2
Florida	2,689	3,453	28.4	Ohio	2,534	2,940	16.0
Georgia	1,265	1,594	26.0	Oklahoma	516	611	18.3
Hawaii	240	285	18.7	Oregon	253	317	25.4
Idaho	149	196	31.2	Pennsylvania	3,658	4,029	10.2
Illinois	1,787	2,199	23.1	Rhode Island	470	565	20.1
Indiana	1,054	1,233	17.1	South Carolina	652	818	25.4
Iowa	676	792	17.2	South Dakota	182	212	16.6
Kansas	473	543	14.6	Tennessee	1,109	1,377	24.2
Kentucky	803	949	18.2	Texas	3,202	3,949	23.3
Louisiana	765	934	22.1	Utah	185	235	27.0
Maine	212	274	29.5	Vermont	116	146	26.4
Maryland	1,231	1,535	24.7	Virginia	1,000	1,266	26.6
Massachusetts	1,753	2,031	15.9	Washington	547	689	26.0
Michigan	1,487	1,738	16.9	West Virginia	445	521	17.1
Minnesota	905	1,087	20.1	Wisconsin	777	924	18.9
Mississippi	606	729	20.4	Wyoming	86	111	28.8
Missouri	973	1,137	16.8	U.S. Average	\$51,226	\$61,581	20.2

*All cost figures are reported in 2020 dollars. State totals may not add to the U.S. total due to rounding.

Created from data from the Lewin Model.^{A16}

TABLE 16

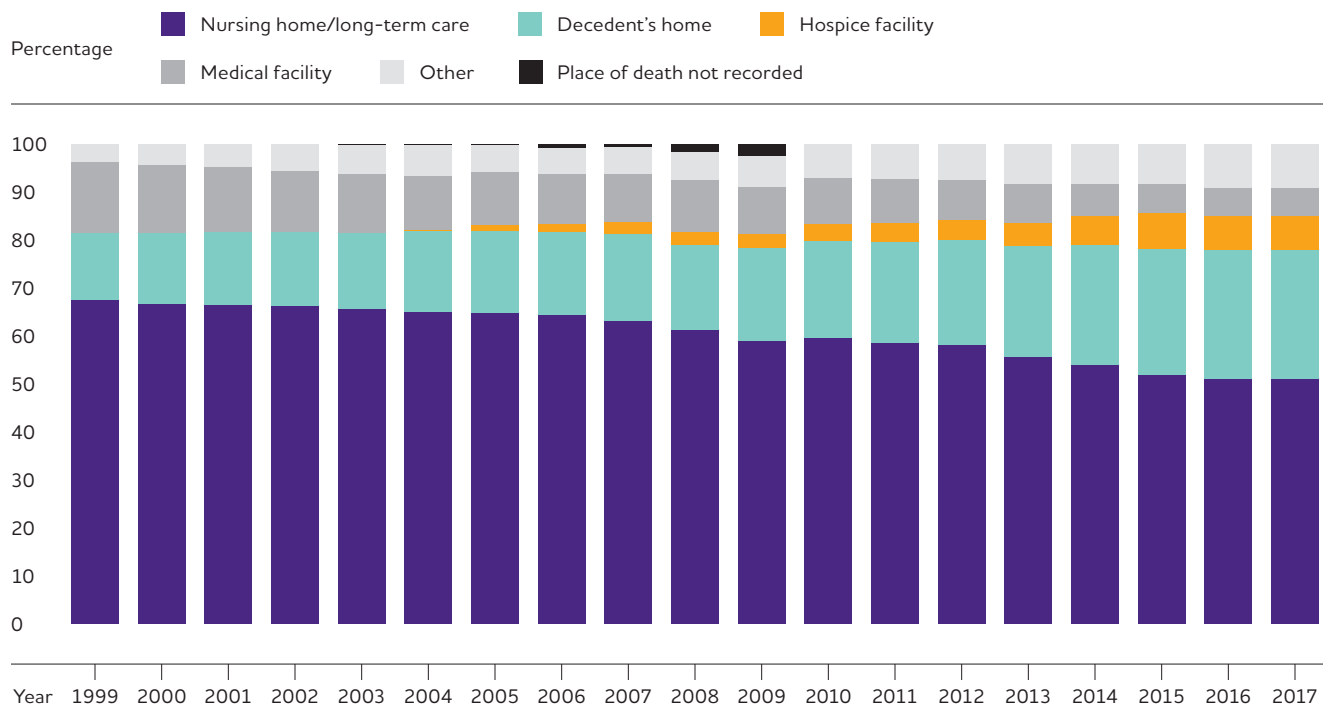
Number and Percentage of Medicare Beneficiaries Admitted to Hospice with a Primary Diagnosis of Dementia by State, 2017

State	Number of Beneficiaries	Percentage of Beneficiaries	State	Number of Beneficiaries	Percentage of Beneficiaries
Alabama	5,867	18	Montana	507	11
Alaska	95	14	Nebraska	1,648	18
Arizona	7,229	18	Nevada	2,167	17
Arkansas	3,133	18	New Hampshire	1,007	17
California	30,045	20	New Jersey	8,207	23
Colorado	3,254	15	New Mexico	1,523	15
Connecticut	2,380	15	New York	7,669	16
Delaware	716	12	North Carolina	8,486	17
District of Columbia	263	18	North Dakota	468	18
Florida	19,897	15	Ohio	12,656	17
Georgia	10,435	21	Oklahoma	4,102	18
Hawaii	943	16	Oregon	3,565	17
Idaho	1,566	17	Pennsylvania	12,384	17
Illinois	9,795	18	Rhode Island	1,657	25
Indiana	5,922	17	South Carolina	6,038	20
Iowa	3,278	17	South Dakota	421	13
Kansas	2,770	18	Tennessee	6,435	19
Kentucky	2,895	15	Texas	26,672	22
Louisiana	4,786	19	Utah	2,506	19
Maine	1,494	19	Vermont	543	17
Maryland	4,072	17	Virginia	6,440	19
Massachusetts	7,245	23	Washington	5,459	20
Michigan	9,001	16	West Virginia	1,552	15
Minnesota	5,399	21	Wisconsin	5,086	16
Mississippi	3,547	20	Wyoming	89	7
Missouri	5,991	17	U.S. Total	278,192	18

Created from data from the U.S. Centers for Medicare & Medicaid Services.⁵⁶⁴

FIGURE 15

Place of Death Due to Alzheimer's Disease, 1999 to 2017



Created from data from the National Center for Health Statistics.⁵⁷⁵

comorbid diagnosis of dementia, while 41% of individuals in nonprofit hospices had a diagnosis of dementia. More research is needed to understand the underlying reasons for the differences in the percentage of people with dementia in for-profit versus nonprofit hospices.

Nineteen percent of Medicare beneficiaries with Alzheimer's and other dementias have at least one hospice claim annually compared with 2% of Medicare beneficiaries without Alzheimer's or other dementias.²⁹¹ Expansion of hospice care is associated with fewer individuals with dementia having more than two hospitalizations for any reason or more than one hospitalization for pneumonia, urinary tract infection, dehydration or sepsis in the last 90 days of life.⁵⁶³ In 2017, there were 4,254 hospice companies in the United States that provided hospice care in the home, assisted living facilities, long-term care facilities, unskilled nursing facilities, skilled nursing facilities, inpatient hospitals, inpatient hospice facilities and other facilities.⁵⁶⁴ Additionally, 18% of Medicare beneficiaries who received hospice care had a primary diagnosis of dementia, including Alzheimer's dementia (Table 16).⁵⁶⁴ Dementia was the second most common primary diagnosis for Medicare beneficiaries admitted to hospice overall, with

cancer being the most common primary diagnosis. Forty-five percent of hospice users in 2014 had a primary or secondary diagnosis of Alzheimer's or other dementias, suggesting that a large proportion of hospice users have Alzheimer's as a comorbid condition.⁵⁶⁵ The average length of hospice stay for individuals with a primary diagnosis of dementia was more than 50% longer than for individuals with other primary diagnoses, based on data from the 2008 to 2011 National Hospice Survey.⁵⁶² Individuals with a primary diagnosis of dementia stayed an average of 112 days versus 74 days for individuals with other primary diagnoses.

Per-person hospice payments among all individuals with Alzheimer's dementia averaged \$2,126 compared with \$161 for all other Medicare beneficiaries.²⁰⁷ In 2016 Medicare reimbursement for home hospice services changed from a simple daily rate for each setting to a two-tiered approach that provides higher reimbursement for days 1-60 than for subsequent days and a service intensity add-on payment for home visits by a registered nurse or social worker in the last 7 days of life. In fiscal year 2020, the routine home care rates are \$194.50 per day for days 1-60 and \$153.72 per day for days 61 and beyond.⁵⁶⁶ In a simulation to evaluate whether the reimbursement

TABLE 17

Average Annual Per-Person Payments by Type of Service and Race/Ethnicity for Medicare Beneficiaries Age 65 and Older, with Alzheimer’s or Other Dementias, in 2019 Dollars

Race/Ethnicity	Total Medicare Payments Per Person	Hospital Care	Physician Care	Skilled Nursing Facility Care	Home Health Care	Hospice Care
White	\$21,174	\$5,683	\$1,637	\$3,710	\$1,832	\$3,382
Black/African American	28,633	9,566	2,219	4,599	2,239	2,503
Hispanic/Latino	22,694	7,690	1,930	3,535	1,932	1,864
Other	27,548	8,649	2,171	3,703	3,969	2,756

Created from unpublished data from the National 5% Sample Medicare Fee-for-Service Beneficiaries for 2014.²⁹¹

change will reduce costs for Medicare, a group of researchers found that the new reimbursement approach is anticipated to reduce costs for Medicare, although individuals with dementia who receive hospice care will have higher Medicare spending overall than individuals with dementia who do not receive hospice care.⁵⁶⁷

For Medicare beneficiaries with advanced dementia who receive skilled nursing facility care in the last 90 days of life, those who are enrolled in hospice are less likely to die in the hospital.⁵⁶⁸ Additionally, those enrolled in hospice care are less likely to be hospitalized in the last 30 days of life⁵⁶⁹ and more likely to receive regular treatment for pain.⁵⁷⁰⁻⁵⁷¹ Nearly half of individuals with dementia die while receiving hospice care.⁵⁴⁷ Satisfaction with medical care is higher for families of individuals with dementia who are enrolled in hospice care than for families of individuals with dementia not enrolled in hospice care.⁵⁷²

Feeding Tube Use at the End of Life

Individuals with frequent transitions between health care settings are more likely to have feeding tubes at the end of life, even though feeding tube placement does not prolong life or improve outcomes.⁵²⁹ The odds of having a feeding tube inserted at the end of life vary across the country and are not explained by severity of illness, restrictions on the use of artificial hydration and nutrition, ethnicity or gender. Researchers found that feeding tube use was highest for people with dementia whose care was managed by a subspecialist physician or both a subspecialist and a general practitioner. By contrast, feeding tube use was lower among people with dementia whose care was managed by a general practitioner.⁵⁷³⁻⁵⁷⁴ With the expansion of Medicare-supported hospice care, the use of feeding tubes in the last 90 days of life has decreased for

individuals with Alzheimer’s or other dementias.⁵⁶³ Finally, with the increased focus on the lack of evidence supporting feeding tube use for people with advanced dementia, the proportion of nursing home residents receiving a feeding tube in the 12 months prior to death decreased from nearly 12% in 2000 to less than 6% in 2014.⁵⁷⁴

Place of Death for Individuals with Alzheimer’s or Other Dementias

Between 1999 and 2017, the proportion of individuals with Alzheimer’s who died in a nursing home decreased from 68% to 51%, and the proportion who died in a medical facility decreased from 15% to 5%.⁵⁷⁵ During the same period, the proportion of individuals who died at home increased from 14% to 28% (Figure 15).⁵⁷⁵

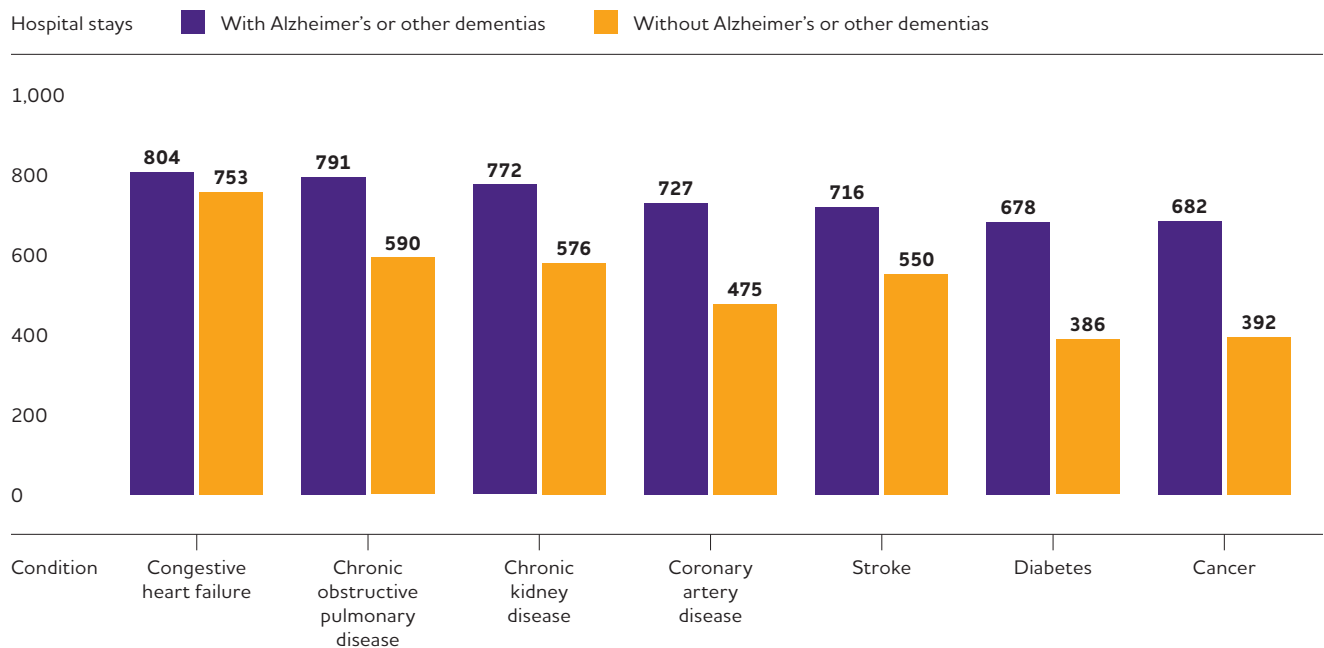
Use and Costs of Health Care and Long-Term Care Services by Race/Ethnicity

Among Medicare beneficiaries with Alzheimer’s or other dementias, blacks/African Americans had the highest Medicare payments per person per year, while whites had the lowest payments (\$28,633 versus \$21,174, respectively) (Table 17). The largest difference in payments was for hospital care, with blacks/African Americans incurring 1.7 times as much in hospital care costs as whites (\$9,566 versus \$5,683).²⁹¹

In a study of Medicaid beneficiaries with a diagnosis of Alzheimer’s dementia that included both Medicaid and Medicare claims data, researchers found significant differences in the costs of care by race/ethnicity.⁵⁷⁶ These results demonstrated that blacks/African Americans had significantly higher costs of care than whites or Hispanics, primarily due to more inpatient care and more comorbidities. These differences may be

FIGURE 16

Hospital Stays Per 1,000 Medicare Beneficiaries Age 65 and Older with Specified Coexisting Medical Conditions, with and without Alzheimer's or Other Dementias, 2014



Created from unpublished data from the National 5% Sample Medicare Fee-for-Service Beneficiaries for 2014.²⁹¹

attributable to later-stage diagnosis, which may lead to higher levels of disability while receiving care; delays in accessing timely primary care; lack of care coordination; duplication of services across providers; or inequities in access to care. However, more research is needed to understand the reasons for this health care disparity.

Avoidable Use of Health Care and Long-Term Care Services

Preventable Hospitalizations

Preventable hospitalizations are one common measure of health care quality. Preventable hospitalizations are hospitalizations for conditions that could have been avoided with better access to, or quality of, preventive and primary care. Unplanned hospital readmissions within 30 days are another type of hospitalization that potentially could have been avoided with appropriate post-discharge care. In 2013, 21% of hospitalizations for fee-for-service Medicare enrollees with Alzheimer's or other dementias were either for unplanned readmissions within 30 days or for an ambulatory care sensitive condition (that is, a condition that was potentially avoidable with timely and effective ambulatory care). The total cost to Medicare of these potentially preventable hospitalizations was \$4.7 billion (in 2013 dollars; \$5.4 billion in 2019 dollars).⁵⁷⁷

Of people with dementia who had at least one hospitalization, 18% were readmitted within 30 days. Of those who were readmitted within 30 days, 27% were readmitted two or more times. Ten percent of Medicare enrollees had at least one hospitalization for an ambulatory care-sensitive condition, and 14% of total hospitalizations for Medicare enrollees with Alzheimer's or other dementias were for ambulatory care sensitive conditions.

Based on Medicare administrative data from 2010 to 2015, preventable hospitalizations represented 23.5% of the total hospitalizations for individuals with Alzheimer's or other dementias.⁵⁷⁸ Black/African American older adults had a substantially higher proportion of preventable hospitalizations (32%) compared with Hispanic/Latino and white older adults (22%).

Based on data from the Health and Retirement Study and from Medicare, after controlling for demographic, clinical and health risk factors, individuals with dementia had a 30% greater risk of having a preventable hospitalization than those without a neuropsychiatric disorder (that is, dementia, depression or cognitive impairment without dementia). Moreover, individuals with both dementia and depression had a 70% greater risk of preventable hospitalization than those without a neuropsychiatric disorder.⁵⁷⁹ Another group of researchers

found that individuals with dementia and a caregiver with depression had 73% higher rates of emergency department use over 6 months than individuals with dementia and a caregiver who did not have depression.⁵⁸⁰

Medicare beneficiaries who have Alzheimer's or other dementias and a serious coexisting medical condition (for example, congestive heart failure) are more likely to be hospitalized than people with the same coexisting medical condition but without dementia (Figure 16).²⁹¹ One research team found that individuals hospitalized with heart failure are more likely to be readmitted or die after hospital discharge if they also have cognitive impairment.⁵⁸¹ Another research team found that Medicare beneficiaries with Alzheimer's or other dementias have more potentially avoidable hospitalizations for diabetes complications and hypertension, meaning that the hospitalizations could possibly be prevented through proactive care management in the outpatient setting.⁵⁸² A third research team found that having depression, rheumatoid arthritis or osteoarthritis was associated with higher emergency department use in Medicare beneficiaries with possible or probable dementia and two more chronic conditions.⁵⁸³

Differences in health care use between individuals with and without dementia are most prominent for those residing in the community. Based on data from the Health and Retirement Study, community-residing individuals with dementia were more likely to have a potentially preventable hospitalization, an emergency department visit that was potentially avoidable, and/or an emergency department visit that resulted in a hospitalization.⁵⁸⁴ For individuals residing in a nursing home, there were no differences in the likelihood of being hospitalized or having an emergency department visit.

Initiatives to Reduce Avoidable Health Care and Nursing Home Use

Recent research has demonstrated that two types of programs have potential for reducing avoidable health care and nursing home use, with one type of program focusing on the caregiver and the other focusing on the care delivery team. The Caregiving section (see page 32) describes a number of caregiver support programs, and some of these also hold promise for reducing transitions to residential care for individuals with Alzheimer's or other dementias. Additionally, collaborative care models — models that include not only geriatricians, but also social workers, nurses and medical assistants, for example — can improve care coordination, thereby reducing health care costs associated with hospitalizations, emergency department visits and other outpatient visits.⁵⁰² For example, an interprofessional memory care clinic was shown to reduce per-person health care costs by \$3,474 in 2012 dollars (\$4,153 in 2019 dollars) over a year for

individuals with memory problems compared with others with memory problems whose care was overseen by a primary care provider only.⁵⁰² More than half of the cost savings was attributed to lower inpatient hospital costs. The program was relatively low cost per person, with an average annual cost of \$618 (\$739 in 2019 dollars) — a nearly 6-to-1 return on investment. Another group of researchers, however, found that a dementia care program that used nurse practitioners and physicians to co-manage patients was cost neutral after taking into account the costs of the program and cost savings due to fewer long-term care nursing home admissions.⁵⁸⁵ However, in a recent systematic review and meta-analysis of 17 randomized controlled trials from seven countries aimed at reducing avoidable acute hospital care by persons with dementia, none of the interventions reduced acute hospital use, such as emergency department visits, hospital admissions, or hospital days.⁵⁸⁶

A group of researchers found that individuals with dementia whose care was concentrated within a smaller number of clinicians had fewer hospitalizations and emergency department visits and lower health care spending overall compared with individuals whose care was dispersed across a larger number of clinicians.⁵⁸⁷ More research is needed to understand whether continuity of care is a strategy for decreasing unnecessary health care use for people with Alzheimer's or other dementias.

Projections for the Future

Total annual payments for health care, long-term care and hospice care for people with Alzheimer's or other dementias are projected to increase from \$305 billion in 2020 to more than \$1.1 trillion in 2050 (in 2020 dollars). This dramatic rise includes nearly four-fold increases both in government spending under Medicare and Medicaid and in out-of-pocket spending.^{A16}

Potential Impact of Changing the Trajectory of Alzheimer's Disease

While there are currently no FDA-approved pharmacologic treatments that prevent or cure Alzheimer's disease or slow its progression, several groups of researchers have estimated the cost savings of future interventions that either slow the onset of dementia or reduce the symptoms.^{312,588-590} One group of researchers estimated that a treatment introduced in 2025 that delays the onset of Alzheimer's by 5 years would reduce total health care payments by 33% and out-of-pocket payments by 44% in 2050.⁵⁸⁸ A second group of researchers estimated the cost savings of delaying the onset of Alzheimer's disease by 1 to 5 years. For individuals age 70 and older, they projected a 1-year

delay would reduce total health care payments by 14% in 2050, a 3-year delay would reduce total health care payments by 27%, and a 5-year delay would reduce health care payments by 39%.⁵⁸⁹ They also projected that a delay in onset may increase per capita health care payments through the end of life due to longer life, although the additional health care costs may be offset by lower informal care costs. A third group of researchers estimated that a treatment that slows the rate of functional decline by 10% would reduce average per-person lifetime costs by \$3,880 in 2015 dollars (\$4,308 in 2019 dollars), while a treatment that reduces the number of behavioral and psychological symptoms by 10% would reduce average per-person lifetime costs by \$680 (\$755 in 2019 dollars).³¹²

The Alzheimer's Association commissioned a study of the potential cost savings of early diagnosis,⁵⁹⁰ assuming that 88% of individuals who will develop Alzheimer's disease would be diagnosed in the MCI phase rather than the dementia phase or not at all. Approximately \$7 trillion could be saved in medical and long-term care costs for individuals who were alive in 2018 and will develop Alzheimer's disease. Cost savings were due to a smaller spike in costs immediately before and after diagnosis due to 1) the diagnosis being made during the MCI phase rather than the dementia phase, which has higher costs, and 2) lower medical and long-term care costs for individuals who have diagnosed and managed MCI and dementia compared with individuals with unmanaged MCI and dementia.

A treatment that prevents, cures or slows the progression of the disease could result in substantial savings to the U.S. health care system. Without changes to the structure of the U.S. health care system, however, access to new treatments for Alzheimer's may be severely restricted by capacity constraints. For example, one group of researchers developed a model of capacity constraints that estimated that individuals would wait an average of 19 months for treatment in 2020 if a new treatment is introduced by then.⁵⁹¹ Under this model, approximately 2.1 million individuals with MCI due to Alzheimer's disease would develop Alzheimer's dementia between 2020 and 2040 while on waiting lists for treatment. This model assumed both that the hypothetical treatment would require infusions at infusion centers and that it would depend on people being evaluated with amyloid PET scans. While the introduction of new treatments that prevent, cure or slow the progress of Alzheimer's could have a dramatic effect on the incidence and severity of Alzheimer's, it is clear that their effectiveness could be limited by constraints on both health care system capacity and health insurance reimbursement.

Special Report

On the Front Lines: Primary Care Physicians and Alzheimer's Care in America



82% of primary care physicians say they are on the front lines of providing dementia care.

Alzheimer's and other dementias represent a growing crisis in America. As reported in the Prevalence section (see page 17) of this year's *Alzheimer's Disease Facts and Figures*, there are currently more than 5 million Americans living with Alzheimer's dementia, a number which is projected to increase to nearly 14 million by the year 2050. Meanwhile, there is a shortage of specialty physicians to provide care for the large and increasing number of people with Alzheimer's dementia in the United States. As a result, the responsibility for medical care rests mainly with primary care physicians. This Special Report examines the current gaps and projected future shortages in specialty care for Alzheimer's and other dementias. It also explores the challenges primary care physicians face in caring for those currently living with dementia and in meeting the future care needs of an aging U.S. population. This report concludes with recommendations to address these shortages and challenges so more Americans have access to dementia care.

Who Diagnoses and Provides Medical Care?

Medical care for people with Alzheimer's and other dementias involves a broad array of practitioners, including physicians, nurses, neuropsychologists and allied health care professionals such as occupational and physical therapists and home health aides. In this report, we focus on primary care physicians (family medicine, internal medicine, general practice) and specialists such as geriatricians, neurologists, geriatric psychiatrists and neuropsychologists. Given the complexity of diagnosing and managing treatment for people living with dementia, there is general agreement that having a robust workforce of specialists would be ideal to optimize their care. However, the shortage of such specialists means that the major responsibility for diagnosing and treating people living with dementia lies with primary care physicians.

For example, one recent study⁵⁹⁷ found that the vast majority of older Americans diagnosed with dementia never see a dementia care specialist and are overwhelmingly diagnosed and cared for by non-specialists. Specifically,

the study found that 85% of people first diagnosed with dementia were diagnosed by a non-dementia specialist physician, usually a primary care physician. The same study found that one year after diagnosis, less than a quarter of patients had seen a dementia specialist. After five years, the percentage of patients who had seen a dementia specialist had only increased to 36%. Specialty care follow-up was particularly low for Hispanic and Asian people.

Growing Need, Projected Shortages in Specialists

As noted in the Prevalence section, between 2020 and 2050 the size of America's older population (those 65 and over) is expected to increase dramatically. As the size of the older population grows, the number of individuals living with Alzheimer's dementia will also increase. Today approximately one in 10 people age 65 and older has Alzheimer's dementia. At the same time, however, the workforce to care for the older population is currently, and is likely to continue to be, inadequate.

According to the National Center for Health Workforce Analysis⁵⁹⁸, there was already a shortage of geriatricians in 2013, and although a modest increase in supply was projected by 2025, it was not expected to meet demand. Trends in medical training also point to a growing shortage of geriatricians into the future. For example, geriatrics-related graduate medical education programs grew only 1.1% from the 2001-2002 academic year to the 2017-2018 academic year.⁵⁹⁹ Similarly, a study of the current and future U.S. neurology workforce projected a 19% shortage of neurologists by 2025.⁶⁰⁰

We project large increases in the need for specialists to care for people living with Alzheimer's dementia in 2050. Table 18 shows state-by-state projections for the number of geriatricians needed in 2050. As a nation, we need to triple the number of geriatricians who were practicing in 2019 to have enough geriatricians to care for those 65 and older who are projected to have Alzheimer's dementia in 2050 (approximately 10% of the population age 65 and older). However, the number must increase nine times to have enough geriatricians to care for the 30% of the population age 65 and older estimated by the National Center for Health Workforce Analysis to need geriatrician care. Similar analyses also show large projected needs for neurologists, geriatric psychiatrists and neuropsychologists, specialists who provide critical expertise in dementia diagnosis and care.

These shortages will affect states differently. The gaps are small in some states. For example, New York, Hawaii and Washington, D.C., appear well-positioned to achieve the relatively modest increases they need. In contrast, 14 states need to at least quintuple the number of

TABLE 18

Projected Geriatrician Needs in 2050 by State

State	Number of Geriatricians in 2019	Number of Geriatricians Needed in 2050 to Serve 10% of Those 65 and Older	Number of Geriatricians Needed in 2050 to Serve 30% of Those 65 and Older	State	Number of Geriatricians in 2019	Number of Geriatricians Needed in 2050 to Serve 10% of Those 65 and Older	Number of Geriatricians Needed in 2050 to Serve 30% of Those 65 and Older
Alabama	44	228	684	Montana	8	59	177
Alaska	6	31	92	Nebraska	23	84	253
Arizona	89	363	1,089	Nevada	40	158	474
Arkansas	51	134	402	New Hampshire	30	72	217
California	590	1,676	5,029	New Jersey	205	398	1,193
Colorado	89	289	867	New Mexico	29	93	279
Connecticut	99	166	497	New York	605	818	2,454
Delaware	17	55	165	North Carolina	159	535	1,606
District of Columbia	37	28	83	North Dakota	15	34	103
Florida	348	1,365	4,096	Ohio	163	537	1,611
Georgia	96	492	1,476	Oklahoma	28	171	512
Hawaii	61	64	192	Oregon	62	232	695
Idaho	10	87	261	Pennsylvania	278	601	1,803
Illinois	218	517	1,551	Rhode Island	32	49	147
Indiana	65	299	897	South Carolina	66	288	865
Iowa	24	142	426	South Dakota	10	44	131
Kansas	23	121	364	Tennessee	40	343	1,029
Kentucky	34	207	622	Texas	342	1,255	3,766
Louisiana	31	198	595	Utah	21	114	341
Maine	37	71	213	Vermont	5	32	95
Maryland	150	288	865	Virginia	103	406	1,218
Massachusetts	206	347	1,042	Washington	132	399	1,198
Michigan	169	465	1,394	West Virginia	19	83	250
Minnesota	93	270	811	Wisconsin	84	273	820
Mississippi	25	124	373	Wyoming	4	26	79
Missouri	103	283	849	U.S. Total	5,218	15,417	46,252

The 10% column shows how many geriatricians will be needed to serve only those age 65 and older projected to have Alzheimer’s dementia in 2050, assuming the percentage of people age 65 and older with Alzheimer’s dementia in that age group remains at 10%. The 30% column shows how many geriatricians will be needed to serve the 30% of people age 65 and older in 2050 who need geriatrician care, regardless of whether they have dementia, according to the National Center for Health Workforce Analysis.⁵⁹⁸ The number of practicing geriatricians in 2019 was provided by IQVIA and includes physicians with geriatrics as either their primary or secondary specialty. Calculations for 2050 assume each geriatrician can care for up to 700 patients.⁵⁹⁸ The underlying state-by-state estimates of the 2050 population age 65 and older were provided by Claritas Pop-Facts 2020.

practicing geriatricians by 2050 to care for those 65 and older projected to have Alzheimer's dementia, or increase the number by 15 times to care for the 30% of the population age 65 and older projected to need geriatrician care. Two states, Tennessee and Idaho, will need to increase the number of geriatricians by nine times just to meet the care needs of those projected to have Alzheimer's dementia, or by 26 times to meet the needs of all those projected to need geriatrician care.

Primary Care Physicians

With a shortage of medical specialists to meet the current and future needs for Alzheimer's dementia care in the United States, primary care physicians (PCPs) will play an increasingly important role in caring for individuals across the disease continuum — from identifying warning signs, to providing competent diagnoses, to meeting the ongoing care and support needs for patients living with a complex, progressive and ultimately fatal disease.

While PCPs are clearly on the front lines, little is known about the extent of PCPs' preparedness to meet the growing demands for dementia care in the clinical setting. To learn more about PCPs' experiences, exposure and attitudes about their medical education and training in dementia care, the Alzheimer's Association commissioned Versta Research to conduct surveys of 1) PCPs,^{A20} 2) recent medical school graduates currently completing a residency in primary care^{A21} and 3) recent primary care residency graduates.^{A22} All surveys were conducted December 11-26, 2019.

The Alzheimer's Association surveys revealed:

- PCPs recognize they are on the front lines of diagnosing and providing care for Alzheimer's and other dementias.
- Half of PCPs believe the medical profession is not prepared to meet the expected increase in demand.
- More than half of PCPs say there are not enough specialists to receive patient referrals.
- Medical school and residency programs in primary care offer very limited coursework and patient contact related to Alzheimer's and other dementias.
- PCPs feel a duty and are committed to staying current on the latest information about the care of patients with Alzheimer's and other dementias, particularly disease management and treatment, screening and testing, and diagnosis.
- Despite this, fewer than half of PCPs have pursued additional training in dementia care since medical school and residency, noting challenges associated with obtaining such training.

Alzheimer's Association Surveys

Physicians included in the Alzheimer's Association Primary Care Physician Dementia Training Survey^{A20} were recruited via WebMD's Medscape Physician Panel, which includes 68% of all practicing primary care physicians (PCPs) in the United States. To qualify for the survey, PCPs had to have been in practice for at least two years, spend at least 50% of their time in direct patient care, and have a practice in which at least 10% of their patients were age 65 or older. A total of 1,000 PCPs, balanced by age, gender, years in practice, type of practice, specialty and region to match the total U.S. population of PCPs, were included in the survey.^{A20}

A total of 202 current PCP residents in general, family or internal medicine who completed their medical school training within the last two years were recruited to participate in the Alzheimer's Association Recent Medical School Graduate Dementia Training Survey^{A21} through WebMD's Medscape Healthcare Professional Panel.

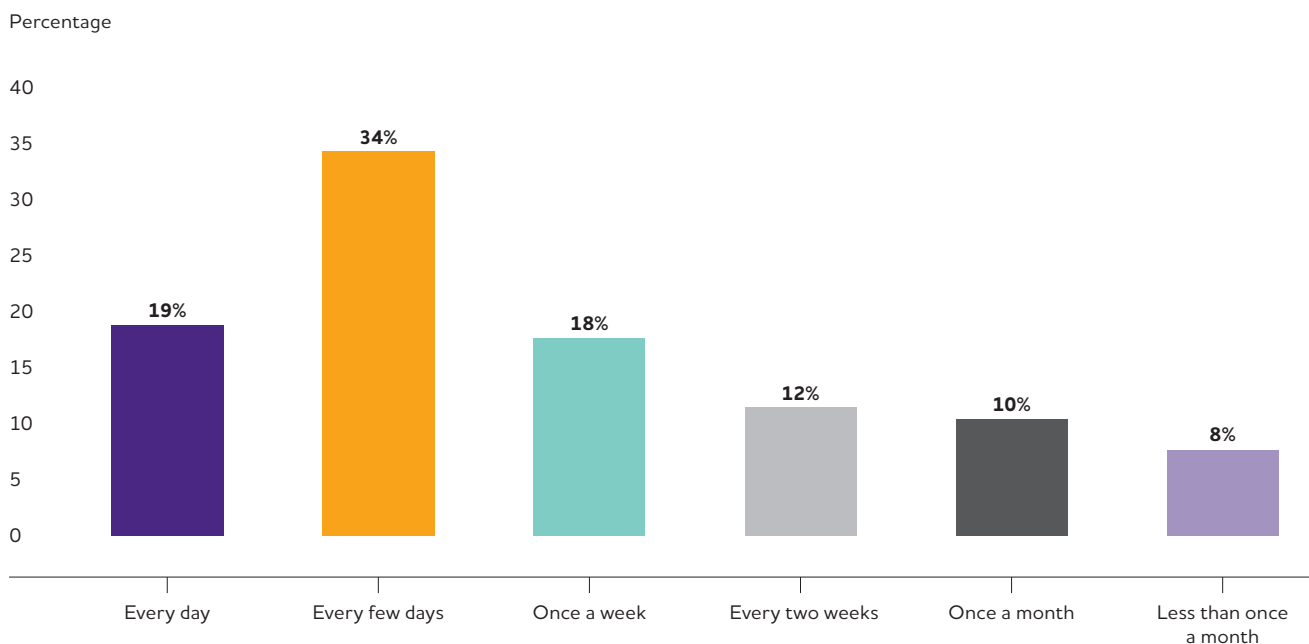
PCPs who had completed their residency within the last two years were recruited to participate in the Alzheimer's Association Recent Primary Care Resident Dementia Training Survey^{A22} through WebMD's Medscape Physician Panel. The sample included 200 PCPs and was matched to the full population of PCPs who are in their first two years of practice based on age, gender, specialty and region.^{A22}

- Nearly two in five PCPs say their own experience in treating patients has been one of the most important teachers, second only to continuing medical education (CME) courses.

Overall, the results of the Alzheimer's Association surveys underscore the important role PCPs play in providing critical dementia care. Findings also highlight the need for additional dementia care training opportunities for PCPs, both during medical school and residency and in subsequent clinical practice.

FIGURE 17

Frequency of Primary Care Physicians Receiving Questions about Alzheimer's or Other Dementias from Patients Age 65 and Older



Created from data from the Alzheimer's Association Primary Care Physician Dementia Training Survey.^{A20}

Survey Results

Patient Population

The Alzheimer's Association Primary Care Physician Dementia Care Training Survey revealed that more than four in five PCPs (82%) believe they are on the front lines of providing critical elements of dementia care for their patients. PCPs reported that, on average, 40% of their patients are age 65 and older and, of these, 13% have been diagnosed with Alzheimer's or other dementias.

The survey also demonstrated that the topic of dementia is one that comes up frequently during patient visits.

The majority (53%) of PCPs receive questions related to Alzheimer's or other dementias from their patients age 65 and older, or their families, every few days or more, with nearly one in five (19%) receiving these questions on a daily basis (Figure 17).

PCPs report the number of patients with Alzheimer's disease is growing. Almost nine in 10 PCPs (87%) expect the number of patients they see with dementia to increase over the next five years, and one-third (33%) expect the number of diagnosed patients to increase "a lot."

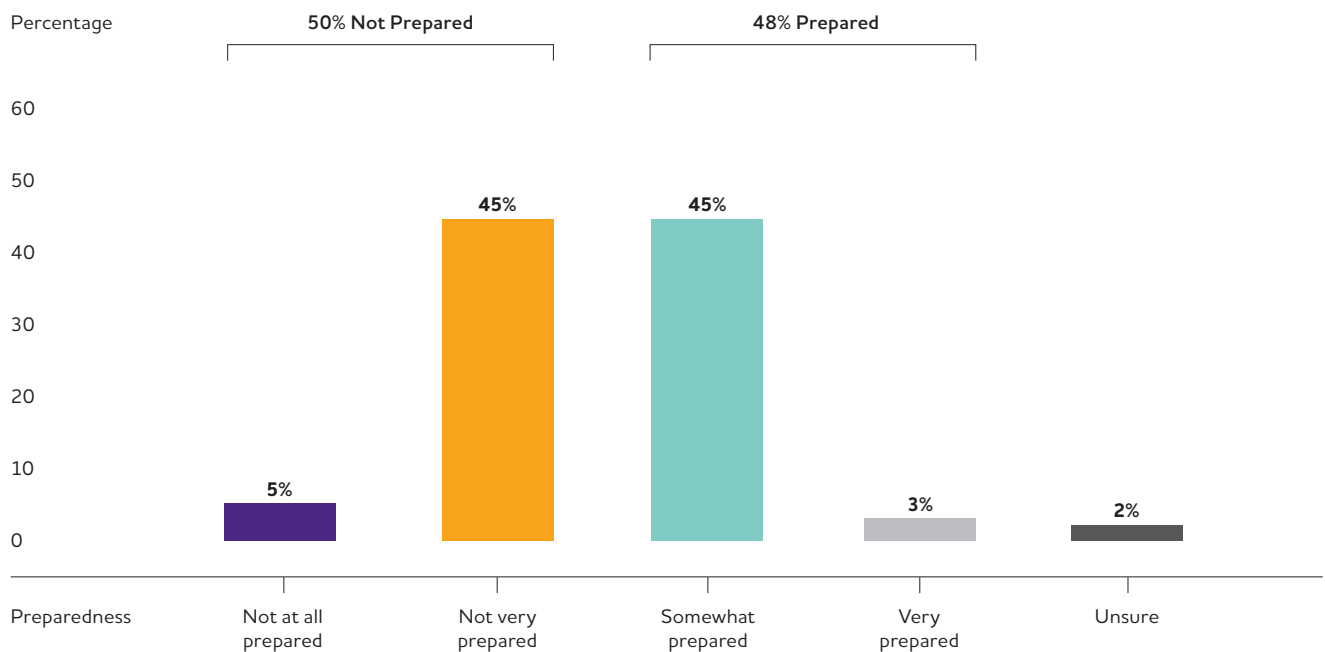
Management of Patients

Despite knowing they are on the front lines of dementia care, a significant number of PCPs surveyed reported that they do not feel adequately prepared to care for patients with Alzheimer's and other dementias. More than one-quarter (27%) report being only sometimes or never comfortable answering patient questions about Alzheimer's or other dementias. Moreover, even though the vast majority of diagnoses are made by PCPs, nearly four in 10 PCPs (39%) report never or only sometimes being comfortable personally making a diagnosis of Alzheimer's or other dementias. In addition, half of PCPs say that the medical profession is either "not very prepared" or "not at all prepared" to care for the growing number of people living with Alzheimer's or other dementias (Figure 18, see page 68).

To care for their patients optimally, nearly one-third (32%) of PCPs make specialist referrals for their dementia patients at least once a month. However, most PCPs (55%) report that there are not enough specialists in their area to meet patient demand (Figure 19, see page 69). There was a substantial difference in PCPs' report of specialist availability depending on whether their practice was located in an urban or rural setting. While 44% of PCPs in a large city and 54% of those

FIGURE 18

Medical Profession's Preparedness to Care for People Living with Alzheimer's and Other Dementias



Created from data from the Alzheimer's Association Primary Care Physician Dementia Training Survey.^{A20}

located in a suburb near a large city reported that there are not enough specialists in their area, 63% of PCPs in a small city or town and 71% of those in a rural area said the same.

Medical School and Residency Training in Dementia Care

The vast majority of PCPs (91%) had at least some training in the diagnosis and care of people with Alzheimer's and other dementias in medical school, but most of those (66%) describe it as being "very little." Almost one-quarter (22%) of all PCPs had no residency training in dementia diagnosis and care. Of the 78% who did undergo training, 65% reported the amount was "very little."

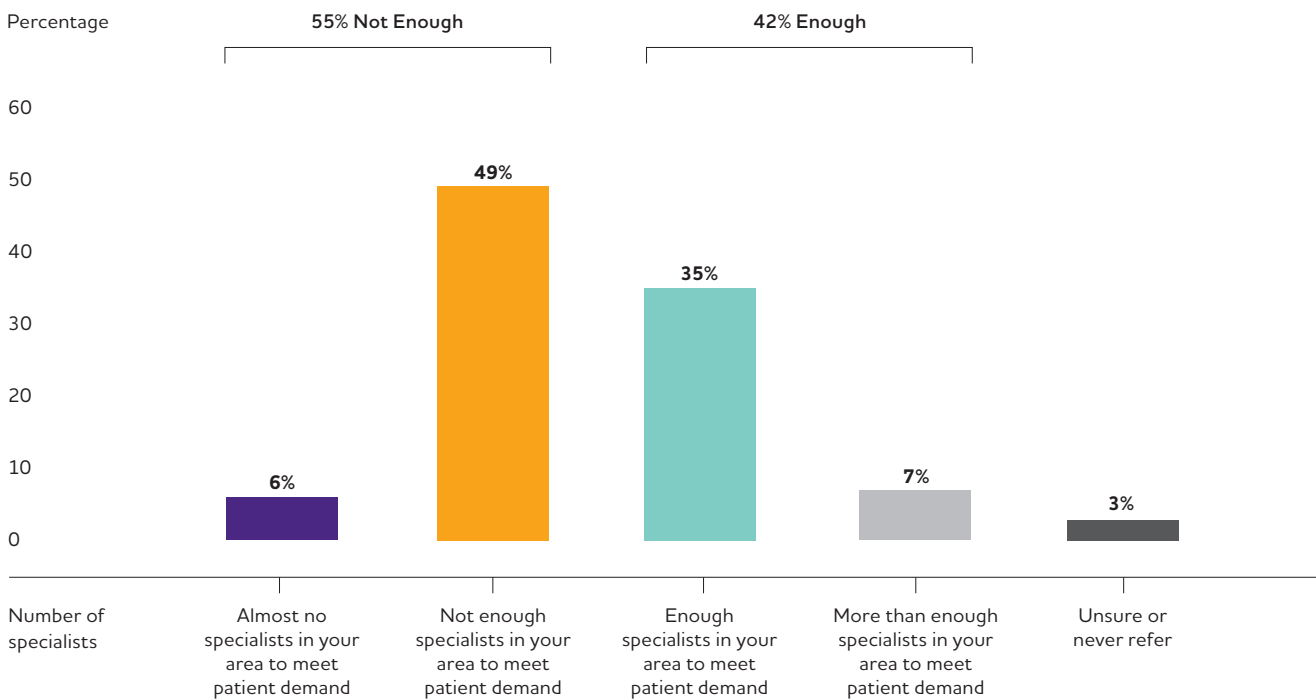
Encouragingly, this trend seems to be changing. A greater proportion of recently trained PCPs report medical school and residency training in dementia care compared with PCPs with a greater number of years in practice. Ninety-eight percent of PCPs in practice for 2-9 years report at least some dementia training in medical school, compared with 81% of those with 30 or more years in practice. Similarly, 85% of PCPs in practice for 2-9 years report receiving dementia training during residency, compared with 65% of PCPs with 30 years or more of practice. However, regardless of how much training they had, most PCPs (78%) said that medical school and residency can never fully prepare a physician for dementia care.

To better understand the dementia training new PCPs undergo, the Alzheimer's Association also surveyed recent medical school and residency graduates. The survey of first- and second-year PCP residents revealed an average of 41 hours of medical school coursework that specifically focused on dementia, including Alzheimer's. However more than one in five (21%) reported having fewer than 20 hours of dementia coursework during medical school. During their clinical training in medical school, they reported seeing an average of just 20 patients with dementia.

The survey of recent residents (currently in their first or second year of practice) revealed that residents had an average of eight hours of formal curricular training focused specifically on Alzheimer's or other dementias, and one-quarter (26%) reported having fewer than two hours. On average, recent residents saw and helped 50 patients with dementia during their residency training. However, they were only involved in diagnostic workup for 10 people with dementia who were undiagnosed when initially seen. Only 18% of recent residents report feeling "very prepared" to provide dementia care in practice, compared with 82% who feel "somewhat," "not very" or "not at all" prepared.

FIGURE 19

Availability of Dementia Specialists for Patient Referral



Created from data from the Alzheimer's Association Primary Care Physician Dementia Training Survey.^{A20}

Keeping Current

Finding New Developments

The Alzheimer's Association surveys revealed that virtually all PCPs (99%) believe it is important to stay current on new developments in dementia care. Similar responses were found among recent medical school graduates (99%) and recent residents (100%). PCPs also expressed the following:

- 93% feel a duty to patients to keep up with new developments in diagnosis and care.
- 92% believe patients and caregivers expect them to know the latest thinking and best practices around dementia care.
- 92% believe dementia care is a rapidly evolving area of medicine that requires ongoing learning and training.

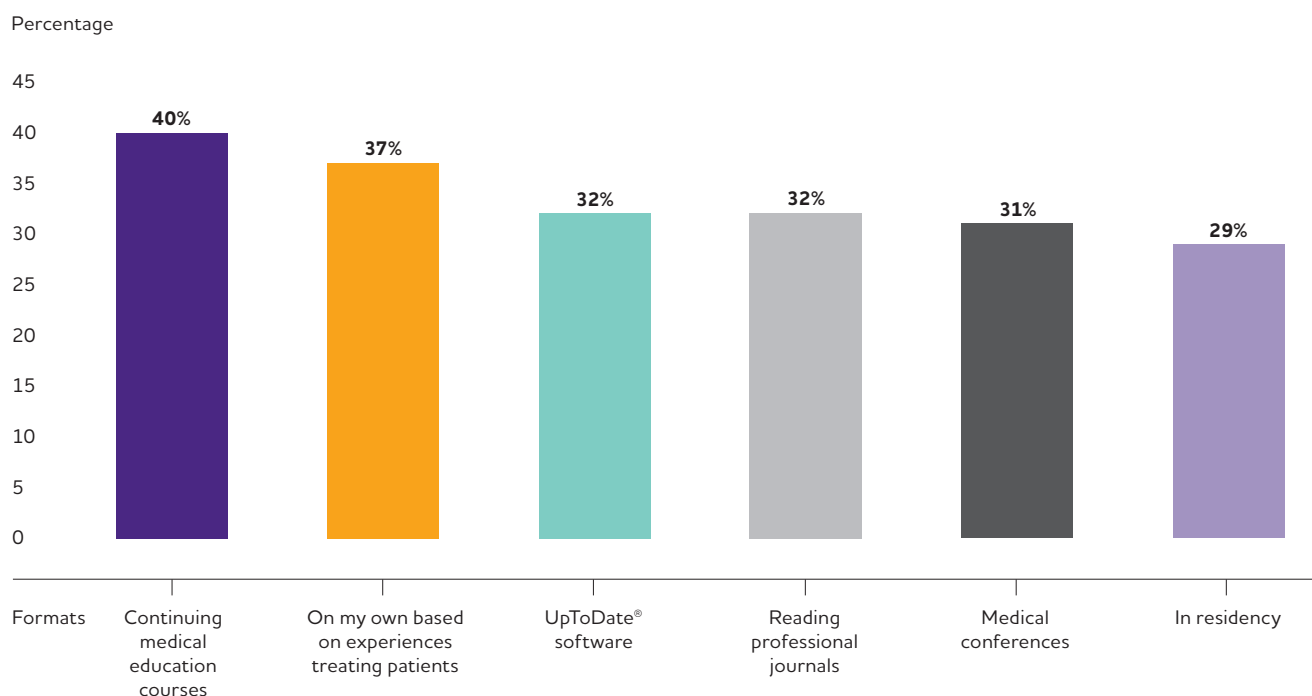
In addition, the surveys found that more than two-thirds of PCPs (69%) say they are always learning about the diagnosis and care of people with Alzheimer's and other dementias, and half (50%) say they put in a lot of time and effort keeping up with new developments. However, more than three in five (63%) feel they don't have enough time to keep up with all of the new developments and half (53%) say the extent to which they are keeping up with the new developments in dementia care is "only a little" or "not at all."

PCPs have enormous demands on their time and energy, across all health-related domains, so ensuring that PCPs have readily accessible, high quality training opportunities is an important challenge for the field.

The most important areas where PCPs want to stay current on Alzheimer's and other dementias include management and treatment (83%), screening and testing (69%), and diagnosis (64%). These same three areas also ranked as most important in the surveys of recent medical school graduates and recent residents. Additional areas where PCPs want to stay current include: prevention (49%), family support (49%), managing dementia alongside other conditions (46%), signs and symptoms (44%), reducing risk (41%), patient support (40%), end-of-life care (31%), palliative care and hospice (28%), coordinating care with other health care providers (24%), quality improvement measures (20%), pathophysiology (19%) and clinical trials (16%).

Additional Training Opportunities

To keep up to date, PCPs are following new developments in dementia care mainly by scanning journals or content summaries for newly published research (77%) or scanning CME offerings for new training opportunities (66%).^{A23} However, only two of five PCPs (42%) have completed

FIGURE 20**Where Primary Care Physicians Learned the Most about Dementia Diagnosis and Care**

Created from data from the Alzheimer's Association Primary Care Physician Dementia Training Survey.^{A20}

additional training specifically on dementia care since their residency. The most common formats for additional training are CME courses (91%), medical conferences (68%), reading professional journals (67%) and UpToDate® software that provides clinical resources to support physician practice (53%).^{A24} The vast majority (89%) of PCPs feel that staying current with dementia diagnosis and care developments requires more than just fulfilling CME requirements, and when learning, the majority (55%) try to go deeper than what most CME offers.

When asked specifically about additional training opportunities, 58% of PCPs feel that the quality of existing training options is either good or excellent, though challenges in obtaining the training were noted. Nearly a third (31%) say the current options are difficult to access, and half (49%) say there are too few options for continuing education and training on dementia care. In fact, 37% reported that they learned the most about dementia care from their own experiences treating patients, second only to the 40% who reported learning the most from CME courses (Figure 20).

This finding highlights a need for better dementia training programs for PCPs. Additional sources where PCPs have learned the most about dementia diagnosis and care include UpToDate® (32%), professional journals (32%), medical conferences (31%) and in residency (29%).^{A25}

The reasons provided by PCPs for pursuing additional dementia care training include general ongoing patient needs given their patient population (70%), specific patient problems or needs they are trying to solve (64%), a professional obligation to stay current (60%), or their own personal or professional interest in the topic (53%). Few PCPs have pursued additional training due to requirements for medical licensing (11%), health insurance companies or other payers (3%), or their employer (1%).

PCPs who haven't pursued additional training say it's because they don't have time (38%) and typically refer patients with Alzheimer's or other dementias to other physicians (35%). Just 19% of those who haven't pursued additional training say it's because they feel confident in how their dementia patients are being managed.^{A26}

Meeting Future Demand

This Alzheimer's Association dementia care analysis and surveys should sound an alarm regarding the future of dementia care in America. This report indicates a shortage of dementia care specialists and a PCP community committed, but not always adequately prepared, to meet the increased demands of an aging population.

One way to address shortages in the workforce is through scholarship and loan forgiveness programs offered by federal and state governments. Studies have found that loan repayment programs are correlated with increasing the number of physicians practicing in rural areas⁶⁰¹ and directly influence the decision of osteopathic medical graduates to become primary care physicians.⁶⁰² A large increase between 2002 and 2009 in the number of young people choosing nursing as a career followed the large increase in federal funding for nursing workforce development, which includes loan repayment and scholarships.⁶⁰³ A report on the geriatric workforce by the Institute of Medicine (now known as the National Academy of Medicine) concluded that "programs that link financial support to service have been effective in increasing the numbers of health care professionals that serve in underserved areas of the country" and that such programs "serve as good models for the development of similar programs to address shortages of geriatric providers."⁴⁷⁶

Another approach that may increase the number of providers available to diagnose and treat those with Alzheimer's and other dementias is through educational funding. For example, federal funding of departments of family medicine at U.S. medical schools is associated with an expansion of the primary care workforce.⁶⁰⁴ In addition, a recent demonstration project by the Centers for Medicare & Medicaid Services (CMS) found that funding for clinical education of Advanced Practice Registered Nurses (APRN) resulted in a 54% increase in APRN student enrollment, with graduations increasing 67%.⁶⁰⁵

In addition to policies that strengthen the specialty workforce, federal and state support is needed for programs that build capacity in primary care. One example is Project ECHO® (Extension for Community Healthcare Outcomes), a highly successful tele-mentoring program for health care providers developed by the University of New Mexico. Project ECHO has been shown to improve primary care for multiple diseases, including hepatitis C⁶⁰⁶ and complex diabetes.⁶⁰⁷ The Alzheimer's Association is launching a global initiative to build primary care capacity for dementia care through expanded use of this model.

Another approach to bridging the gap is to expand collaborative and coordinated care programs, which rely heavily on non-specialists. Pilot programs for individuals

with dementia have reduced hospital and emergency room visits^{502,608} and nursing home placement.⁵⁸⁵ In the UCLA Alzheimer's and Dementia Care Program, dementia care management is provided by a nurse practitioner supervised by a primary care physician. After one year in the program, 58% of people living with dementia and 63% of their caregivers showed clinical benefit on validated instruments,⁵⁰⁸ and the gross savings to Medicare on an annual basis totaled \$2,404 per patient per year.⁵⁸⁵

A similar collaborative care model in Indiana — the Healthy Aging Brain Center (HABC) — resulted in gross savings of \$3,474 per patient per year.⁵⁰² While the HABC included a specialist (either a geriatrician or behavioral neurologist) as part of the care team, the bulk of the team were not physicians, and included a registered nurse, a medical assistant, a technician and a social worker. And among 780 individuals with dementia who participated in the Care Ecosystem — which uses a trained navigator, an advanced practice nurse, a social worker and a pharmacist — there were 120 fewer emergency room visits, 16 fewer ambulance use events, and 13 fewer hospitalizations than would otherwise be expected over a 12-month period.⁶⁰⁸ Individuals in these care models still sometimes received care from specialists, but the improvement in quality care can be attributed to the well-trained, largely primary care teams.

The Alzheimer's Association also offers a variety of resources to support health systems and clinicians throughout the disease continuum, including early detection and diagnosis of Alzheimer's and other dementias, management of these conditions, and care planning and support services following a diagnosis.

For a complete listing of available Alzheimer's Association resources to support health systems and clinicians, visit alz.org/professionals/health-systems-clinicians.

Conclusion

This Special Report underscores the urgent need to develop the medical workforce to meet current and future demands for quality diagnosis and care of people living with Alzheimer's or other dementias. Current and projected future shortages in specialist care — geriatricians, neurologists, geriatric psychiatrists and neuropsychologists — place the burden of the vast majority of patient care on PCPs. However, while PCPs recognize that they are on the front lines of this crisis and feel a duty to provide the highest quality care, they report that the medical profession is not prepared to adequately face the problem, acknowledge that there is a shortage of specialists to receive patient referrals, and note that their training opportunities are lacking or difficult to access. The severity of these needs requires solutions that develop the specialty workforce while also improving capacity in primary care.

End Notes

- A1. Estimated number (prevalence) of Americans age 65 and older with Alzheimer's dementia for 2020 (prevalence of Alzheimer's in 2020): The number 5.8 million is from published prevalence estimates based on incidence data from the Chicago Health and Aging Project (CHAP) and population estimates from the 2010 U.S. Census.⁶²
- A2. Percentage of total Alzheimer's dementia cases by age groups: Percentages for each age group are based on the estimated 200,000 people under 65,⁶² plus the estimated numbers for people age 65 to 74 (1 million), 75 to 84 (2.7 million), and 85+ (2.1 million) based on prevalence estimates for each age group and incidence data from the CHAP study.
- A3. Proportion of Americans age 65 and older with Alzheimer's dementia: The 10% of the age 65 and older population is calculated by dividing the estimated number of people age 65 and older with Alzheimer's dementia (5.8 million) by the U.S. population age 65 and older in 2020, as projected by the U.S. Census Bureau (56.4 million) = approximately 10%.¹⁸⁴
- A4. Differences between CHAP and ADAMS estimates for Alzheimer's dementia prevalence: ADAMS estimated the prevalence of Alzheimer's dementia to be lower than CHAP, at 2.3 million Americans age 71 and older in 2002,¹⁸⁷ while the CHAP estimate for 2000 was 4.5 million.⁵⁹² At a 2009 conference convened by the National Institute on Aging and the Alzheimer's Association, researchers determined that this discrepancy was mainly due to two differences in diagnostic criteria: (1) a diagnosis of dementia in ADAMS required impairments in daily functioning and (2) people determined to have vascular dementia in ADAMS were not also counted as having Alzheimer's, even if they exhibited clinical symptoms of Alzheimer's.¹⁸⁸ Because the more stringent threshold for dementia in ADAMS may miss people with mild Alzheimer's dementia and because clinical-pathologic studies have shown that mixed dementia due to both Alzheimer's and vascular pathology in the brain is very common,³⁷ the Association believes that the larger CHAP estimates may be a more relevant estimate of the burden of Alzheimer's dementia in the United States.
- A5. State-by-state prevalence of Alzheimer's dementia: These state-by-state prevalence numbers are based on an analysis of incidence data from CHAP, projected to each state's population, with adjustments for state-specific age, gender, years of education, race and mortality.²⁰⁶ Specific prevalence numbers for 2020 were derived from this analysis and provided to the Alzheimer's Association by a team led by Liesi Hebert, Sc.D., from Rush University Institute on Healthy Aging.
- A6. Criteria for identifying people with Alzheimer's or other dementias in the Framingham Study: From 1975 to 2009, 7,901 people from the Framingham Study who had survived free of dementia to at least age 45, and 5,937 who had survived free of dementia until at least age 65 were followed for incidence of dementia.²¹¹ Diagnosis of dementia was made according to the *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV)* criteria and required that the participant survive for at least 6 months after onset of symptoms. Standard diagnostic criteria (the NINCDS-ADRDA criteria from 1984) were used to diagnose Alzheimer's dementia. The definition of Alzheimer's and other dementias used in the Framingham Study was very strict; if a definition that included milder disease and disease of less than 6 months' duration were used, lifetime risks of Alzheimer's and other dementias would be higher than those estimated by this study.
- A7. Number of women and men age 65 and older with Alzheimer's dementia in the United States: The estimates for the number of U.S. women (3.6 million) and men (2.2 million) age 65 and older with Alzheimer's in 2020 is from unpublished data from CHAP. For analytic methods, see Hebert et al.⁶²
- A8. Prevalence of Alzheimer's and other dementias in older whites, blacks/African Americans and Hispanics/Latinos: The statement that blacks/African Americans are twice as likely and Hispanics/Latinos one and one-half times as likely as whites to have Alzheimer's or other dementias is the conclusion of an expert review of a number of multiracial and multiethnic data sources, as reported in detail in the Special Report of the Alzheimer's Association's 2010 *Alzheimer's Disease Facts and Figures*.
- A9. Projected number of people with Alzheimer's dementia: This figure comes from the CHAP study.⁶² Other projections are somewhat lower (see, for example, Brookmeyer et al.⁵⁹³) because they relied on more conservative methods for counting people who currently have Alzheimer's dementia.⁴⁴ Nonetheless, these estimates are statistically consistent with each other, and all projections suggest substantial growth in the number of people with Alzheimer's dementia over the coming decades.
- A10. Projected number of people age 65 and older with Alzheimer's dementia in 2025: The number 7.1 million is based on a linear extrapolation from the projections of prevalence of Alzheimer's for the years 2020 (5.8 million) and 2030 (8.4 million) from CHAP.⁶²
- A11. Annual mortality rate due to Alzheimer's disease by state: Unadjusted death rates are presented rather than age-adjusted death rates in order to provide a clearer depiction of the true burden of mortality for each state. States such as Florida with larger populations of older people will have a larger burden of mortality due to Alzheimer's — a burden that appears smaller relative to other states when the rates are adjusted for age.
- A12. Number of family and other unpaid caregivers of people with Alzheimer's or other dementias: To calculate this number, the Alzheimer's Association started with data from the BRFSS survey. In 2009, the BRFSS survey asked respondents age 18 and over whether they had provided any regular care or assistance during the past month to a family member or friend who had a health problem, long-term illness or disability. To determine the number of family and other unpaid caregivers nationally and by state, we applied the proportion of caregivers nationally and for each state from the 2009 BRFSS (as provided by the CDC, Healthy Aging Program, unpublished data) to the number of people age 18 and older nationally and in each state from the U.S. Census Bureau report for July 2019. Available at: <https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-detail.html>. Accessed on January 6, 2020. To calculate the proportion of family and other unpaid caregivers who provide care for a person with Alzheimer's or another dementia, the Alzheimer's Association used data from the results of a national telephone survey also conducted in 2009 for the National Alliance for Caregiving (NAC)/AARP.⁵⁹⁴ The NAC/AARP survey asked respondents age 18 and over whether they were providing unpaid care for a relative or friend age 18 or older or had provided such care during the past 12 months. Respondents who answered affirmatively were then asked about the health problems of the person for whom they provided care. In response, 26% of caregivers said that: (1) Alzheimer's or another dementia was the main problem of the person for whom they provided care, or (2) the person had Alzheimer's or other mental confusion in addition to his or her main problem. The 26% figure was applied to the total number of caregivers nationally and in each state, resulting in a total of 16.343 million Alzheimer's and dementia caregivers.

A13. The 2014 Alzheimer's Association Women and Alzheimer's Poll:

This poll questioned a nationally-representative sample of 3,102 American adults about their attitudes, knowledge and experiences related to Alzheimer's and dementia from Jan. 9, 2014, to Jan. 29, 2014. An additional 512 respondents who provided unpaid help to a relative or friend with Alzheimer's or a related dementia were asked questions about their care provision. Random selections of telephone numbers from landline and cell phone exchanges throughout the United States were conducted. One individual per household was selected from the landline sample, and cell phone respondents were selected if they were 18 years old or older. Interviews were administered in English and Spanish. The poll "oversampled" Hispanics/Latinos, selected from U.S. Census tracts with higher than an 8% concentration of this group. A list sample of Asian Americans was also utilized to oversample this group. A general population weight was used to adjust for number of adults in the household and telephone usage; the second stage of this weight balanced the sample to estimated U.S. population characteristics. A weight for the caregiver sample accounted for the increased likelihood of female and white respondents in the caregiver sample. Sampling weights were also created to account for the use of two supplemental list samples. The resulting interviews comprise a probability-based, nationally representative sample of U.S. adults. A caregiver was defined as an adult over age 18 who, in the past 12 months, provided unpaid care to a relative or friend age 50 or older with Alzheimer's or another dementia. Questionnaire design and interviewing were conducted by Abt SRBI of New York.

A14. Number of hours of unpaid care: To calculate this number, the Alzheimer's Association used data from a follow-up analysis of results from the 2009 NAC/AARP national telephone survey (data provided under contract by Matthew Greenwald and Associates, Nov. 11, 2009). These data show that caregivers of people with Alzheimer's or other dementias provided an average of 21.9 hours a week of care, or 1,139 hours per year. The number of family and other unpaid caregivers (16.343 million)^{A12} was multiplied by the average hours of care per year, which totals 18.611 billion hours of care. This is slightly lower than the product of multiplying 1,139 by 16.343 million because of rounding.

A15. Value of unpaid caregiving: To calculate this number, the Alzheimer's Association used the method of Amo and colleagues.⁵⁹⁵ This method uses the average of the federal minimum hourly wage (\$7.25 in 2019) and the mean hourly wage of home health aides (\$18.97 in July 2019).⁵⁹⁶ The average is \$13.11, which was multiplied by the number of hours of unpaid care (18.611 billion) to derive the total value of unpaid care (243.994 billion); this is slightly higher than the product of multiplying \$13.11 by 18.611 billion because 18.611 billion is a rounded number for the hours of unpaid care).

A16. Lewin Model on Alzheimer's and dementia costs: These numbers come from a model created for the Alzheimer's Association by the Lewin Group. The model estimates total payments for health care, long-term care and hospice — as well as state-by-state Medicaid spending — for people with Alzheimer's and other dementias. The model was updated by the Lewin Group in January 2015 (updating previous model) and June 2015 (addition of state-by-state Medicaid estimates). Detailed information on the model, its long-term projections and its methodology are available at alz.org/trajectory. For the purposes of the data presented in this report, the following parameters of the model were changed relative to the methodology outlined at alz.org/trajectory: (1) cost data from the 2011 Medicare Current Beneficiary Survey (MCBS) were used rather than data from the 2008 MCBS; (2) prevalence among older adults was assumed to equal the

prevalence levels from Hebert and colleagues⁶² and included in this report (5.8 million in 2019),^{A2} rather than the prevalence estimates derived by the model itself; (3) estimates of inflation and excess cost growth reflect the most recent relevant estimates from the cited sources (Centers for Medicare & Medicaid Services [CMS] actuaries and the Congressional Budget Office); and (4) the most recent (2014) state-by-state data from CMS on the number of nursing home residents and percentage with moderate and severe cognitive impairment were used in lieu of 2012 data.

A17. All cost estimates were inflated to year 2019 dollars using the Consumer Price Index (CPI): All cost estimates were inflated using the seasonally adjusted average prices for medical care services from all urban consumers. The relevant item within medical care services was used for each cost element. For example, the medical care item within the CPI was used to inflate total health care payments; the hospital services item within the CPI was used to inflate hospital payments; and the nursing home and adult day services item within the CPI was used to inflate nursing home payments.

A18. Medicare Current Beneficiary Survey Report: These data come from an analysis of findings from the 2011 Medicare Current Beneficiary Survey (MCBS). The analysis was conducted for the Alzheimer's Association by Avalere Health.²⁰⁷ The MCBS, a continuous survey of a nationally representative sample of about 15,000 Medicare beneficiaries, is linked to Medicare claims. The survey is supported by the U.S. Centers for Medicare & Medicaid Services (CMS). For community-dwelling survey participants, MCBS interviews are conducted in person three times a year with the Medicare beneficiary or a proxy respondent if the beneficiary is not able to respond. For survey participants who are living in a nursing home or another residential care facility, such as an assisted living residence, retirement home or a long-term care unit in a hospital or mental health facility, MCBS interviews are conducted with a staff member designated by the facility administrator as the most appropriate to answer the questions. Data from the MCBS analysis that are included in *2020 Alzheimer's Disease Facts and Figures* pertain only to Medicare beneficiaries age 65 and older. For this MCBS analysis, people with dementia are defined as:

- Community-dwelling survey participants who answered yes to the MCBS question, "Has a doctor ever told you that you had Alzheimer's disease or dementia?" Proxy responses to this question were accepted.
- Survey participants who were living in a nursing home or other residential care facility and had a diagnosis of Alzheimer's disease or dementia in their medical record.
- Survey participants who had at least one Medicare claim with a diagnostic code for Alzheimer's or other dementias in 2008. The claim could be for any Medicare service, including hospital, skilled nursing facility, outpatient medical care, home health care, hospice or physician, or other health care provider visit. The diagnostic codes used to identify survey participants with Alzheimer's or other dementias are 331.0, 331.1, 331.11, 331.19, 331.2, 331.7, 331.82, 290.0, 290.1, 290.10, 290.11, 290.12, 290.13, 290.20, 290.21, 290.3, 290.40, 290.41, 290.42, 290.43, 291.2, 294.0, 294.1, 294.10 and 294.11.

Costs from the MCBS analysis are based on responses from 2011 and reported in 2019 dollars.

A19. Differences in estimated costs reported by Hurd and colleagues: Hurd and colleagues⁵²⁰ estimated per-person costs using data from participants in ADAMS, a cohort in which all individuals underwent diagnostic assessments for dementia. *2020 Alzheimer's Disease Facts and Figures* estimated per-person costs using data from the Medicare Current Beneficiary Survey (MCBS) to be \$50,201. One reason that the per-person costs estimated by Hurd and colleagues are lower than those reported in *Facts and Figures* is that ADAMS, with its diagnostic evaluations

of everyone in the study, is more likely than MCBS to have identified individuals with less severe or undiagnosed Alzheimer's. By contrast, the individuals with Alzheimer's registered by MCBS are likely to be those with more severe, and therefore more costly, illness. A second reason is that the Hurd et al. estimated costs reflect an effort to isolate the incremental costs associated with Alzheimer's and other dementias (those costs attributed only to dementia), while the per-person costs in *2020 Alzheimer's Disease Facts and Figures* incorporate all costs of caring for people with the disease (regardless of whether the expenditure was related to dementia or a coexisting condition).

A20. Alzheimer's Association Primary Care Physician Dementia

Training Survey: In sampling from the Medscape physician panel, data from the American Medical Association (AMA) master file of all practicing physicians in the United States were used to stratify sampling and weight final data, ensuring a representative sample based on age, gender, years in practice, type of practice, specialty and region. Of the 1,000 respondents of the survey, 18% spent less than 90% of their professional time in direct patient care, while 82% spent between 90 and 100% of their time in direct patient care. On average, 50% of their patients were age 18-64 and 40% were age 65 and older. Sixty percent of respondents were male and 39% were female. Twenty-nine percent of respondents had been in practice for 10-19 years, 28% for 20-29 years, 24% for 35 years or more, and 19% for fewer than 10 years. Eighty-three percent had office-based practices, and 14% had hospital-based practices. Fifty percent had a primary medical specialty of family medicine, 47% specialized in internal medicine, and three percent were general practitioners. Thirty-four percent of respondents practiced in the South, 25% in the West, 22% in the Midwest and 19% in the Northeast.

A21. Alzheimer's Association Recent Medical School Graduate

Dementia Training Survey: Of the 202 respondents of the survey, 55% were in their first year of residency and 45% were in their second year. Ninety-seven percent of respondents were under age 40 and three percent were age 40-49. Sixty-nine percent of respondents were male and 31% were female. Sixty-eight percent had a primary medical specialty of internal medicine, 31% specialized in family medicine, and less than one percent were general practitioners. Thirty-two percent of respondents were in residency in the South, 25% in the Northeast, 23% in the Midwest and 20% in the West.

In estimating total hours of training from the survey data, 48 work weeks were assumed per year, with 5 hours of formal curriculum training each week, over the course of a three-year PCP residency.

A22. Alzheimer's Association Recent Primary Care Resident Dementia

Training Survey: Data from the AMA master file were used to weight final data to ensure a sample that closely matches the full population of PCPs who are in their first two years of practice based on age, gender, specialty and region. Of the 200 respondents of the survey, 43% spent less than 90% of their professional time in direct patient care, while 57 percent spent between 90 and 100% of their time in direct patient care. Fifty-eight percent had finished residency and begun an independent practice within the last year, and 42% had done so within the last two years. Fifty-two percent of respondents were male and 48% were female. Sixty-one percent had office-based practices, and 34% had hospital-based practices. Fifty-seven percent had a primary medical specialty of family medicine, 42% specialized in internal medicine, and one percent were general practitioners. Thirty-one percent of respondents practiced in the South, 27% in the West, 25% in the Midwest and 16% in the Northeast.

To estimate total hours of training from the survey data, it was assumed that each one-week block of coursework involved 45 hours of classroom and study time.

A23. Other ways PCPs follow new developments in the diagnosis and care of Alzheimer's and other dementias: Additional responses, ranked by the percentage of participants who selected that choice, are detailed below. Participants were allowed to select more than one answer, so percentages do not add up to 100. Email or social media alerts that track new developments or offerings (31%); listening to podcasts hosted by medical professionals that focus on Alzheimer's and dementia (25%); subscribing to publications focused on disorders of the nervous system (17%); participating in online groups of physicians who discuss Alzheimer's and dementia (13%); subscribing to an online community focused on Alzheimer's and dementia (9%); other ways (12%).

A24. Other formats for additional training in dementia: Additional responses, ranked by the percentage of participants who selected that choice, are detailed below. Participants were allowed to select more than one answer, so percentages do not add up to 100. Lectures (including grand rounds, noon conferences, etc.) (38%); other online resources (such as AAN, NIH, CDC, etc.) (20%); workshops (11%); YouTube videos or other resources found on social media platforms (4%); geriatric fellowship (2%); another format (4%).

A25. Other sources where PCPs have learned the most about dementia diagnosis and care: Additional responses, ranked by the percentage of participants who selected that choice, are detailed below. Participants were allowed to select more than one answer, so percentages do not add up to 100. Own research to learn about the topic (17%); in medical school (15%); lectures (including grand rounds, noon conferences, etc.) (13%); professional discussion groups (8%); other online resources (such as AAN, NIH, CDC, etc.) (6%); workshops (5%); YouTube videos or other resources found on social media platforms (1%); another format (1%); geriatric fellowship (less than 1%).

A26. Other reasons for not pursuing additional training in dementia diagnosis and care: Additional responses, ranked by the percentage of participants who selected that choice, are detailed below. Participants were allowed to select more than one answer, so percentages do not add up to 100. Decided to focus practice on another area of medicine (17%); dementia care is less relevant than other topics (15%); do not have good access to resources for additional training (14%); do not see much Alzheimer's or other dementia among patients (7%); medical school and residency training was sufficient (5%); not much has changed in dementia care so there is no need (5%); other reasons (1%).

References

1. Villemagne VL, Burnham S, Bourgeat P, Brown B, Ellis KA, Salvado O, et al. Amyloid β deposition, neurodegeneration, and cognitive decline in sporadic Alzheimer's disease: A prospective cohort study. *Lancet Neurol* 2013;12(4):357-67.
2. Reiman EM, Quiroz YT, Fleisher AS, Chen K, Velez-Pardos C, Jimenez-Del-Rio M, et al. Brain imaging and fluid biomarker analysis in young adults at genetic risk for autosomal dominant Alzheimer's disease in the presenilin 1 E280A kindred: A case-control study. *Lancet Neurol* 2012;11(2):1048-56.
3. Jack CR, Lowe VJ, Weigand SD, Wiste HJ, Senjem ML, Knopman DS, et al. Serial PiB and MRI in normal, mild cognitive impairment and Alzheimer's disease: Implications for sequence of pathological events in Alzheimer's disease. *Brain* 2009;132:1355-65.
4. Bateman RJ, Xiong C, Benzinger TL, Fagan AM, Goate A, Fox NC, et al. Clinical and biomarker changes in dominantly inherited Alzheimer's disease. *N Engl J Med* 2012;367(9):795-804.
5. Gordon BA, Blazey TM, Su Y, Hari-Raj A, Dincer A, Flores S, et al. Spatial patterns of neuroimaging biomarker change in individuals from families with autosomal dominant Alzheimer's disease: A longitudinal study. *Lancet Neurol* 2018;17(3):241-50.
6. Braak H, Thal DR, Ghebremedhin E, Del Tredici K. Stages of the pathologic process in Alzheimer disease: age categories from 1 to 100 years. *J Neuropathol Exp Neurol* 2011;70(11):960-9.
7. Sato C, Barthélemy NR, Mawuenyega KG, Patterson BW, Gordon BA, Jockel-Balsarotti J, et al. Tau kinetics in neurons and the human central nervous system. *Neuron* 2018;98(4):861-4.
8. Hanseeuw, BJ; Betensky RA, Jacobs HIL, Schultz AP, Sepulcre J, Becker JA, et al. Association of amyloid and tau with cognition in preclinical Alzheimer disease. *JAMA Neurol* 2019;76(8):915-24.
9. Kapasi A, DeCarli C, Schneider JA. Impact of multiple pathologies on the threshold for clinically overt dementia. *Acta Neuropathol* 2017;134(2):171-86.
10. Brenowitz WD, Hubbard RA, Keene CD, Hawes SE, Longstreth WT, Woltjer, et al. Mixed neuropathologies and estimated rates of clinical progression in a large autopsy sample. *Alzheimers Dement*. 2017;13(6):654-62.
11. National Institute on Aging. What are frontotemporal disorders? Available at: <https://www.nia.nih.gov/health/what-are-frontotemporal-disorders>. Accessed November 17, 2019.
12. Hogan DB, Jette N, Fiest KM, Roberts JI, Pearson D, Smith EE, et al. The prevalence and incidence of frontotemporal dementia: a systematic review. *Can J Neurol Sci* 2016;43(suppl):S96-109.
13. Stojkowska I, Krainc D, Mazzulli JR. Molecular mechanisms of α -synuclein and GBA1 in Parkinson's disease. *Cell Tissue Res* 2018;373(1):51-60.
14. De Reuck J, Maurage CA, Deramecourt V, Pasquier F, Cordonnier C, Leys D, et al. Aging and cerebrovascular lesions in pure and in mixed neurodegenerative and vascular dementia brains: A neuropathological study. *Folia Neuropathol* 2018;56(2):81-7.
15. James BD, Bennett DA, Boyle PA, Leurgans S, Schneider JA. Dementia from Alzheimer disease and mixed pathologies in the oldest old. *JAMA* 2012;307(17):1798-1800.
16. Dilworth-Anderson P, Hendrie HC, Manly JJ, Khachaturian AS, Fazio S. Diagnosis and assessment of Alzheimer's disease in diverse populations. *Alzheimers Dement* 2008;4(4):305-9.
17. Steenland K, Goldstein FC, Levey A, Wharton W. A meta-analysis of Alzheimer's disease incidence and prevalence comparing African-Americans and caucasians. *J Alzheimers Dis* 2015;50(1):71-6.
18. Potter GG, Plassman BL, Burke JR, Kabeto MU, Langa KM, Llewellyn DJ, et al. Cognitive performance and informant reports in the diagnosis of cognitive impairment and dementia in African Americans and whites. *Alzheimers Dement* 2009;5(6):445-53.
19. Gurland BJ, Wilder DE, Lantigua R, Stern Y, Chen J, Killeffer EH, et al. Rates of dementia in three ethnorracial groups. *Int J Geriatr Psychiatry* 1999;14(6):481-93.
20. Sperling RA, Aisen PS, Beckett LA, Bennett DA, Craft S, Fagan AM, et al. Toward defining the preclinical stages of Alzheimer's disease: Recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers Dement* 2011;7(3):280-92.
21. Albert MS, DeKosky ST, Dickson D, Dubois B, Feldman HH, Fox N, et al. The diagnosis of mild cognitive impairment due to Alzheimer's disease: Recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers Dement* 2011;7(3):270-9.
22. McKhann GM, Knopman DS, Chertkow H, Hyman BT, Jack CR, Kawas CH, et al. The diagnosis of dementia due to Alzheimer's disease: Recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers Dement* 2011;7(3):263-9.
23. Jack CR, Albert MS, Knopman DS, McKhann GM, Sperling RA, Carrillo MC, et al. Introduction to the recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers Dement* 2011;7(3):257-62.
24. Vermunt L, Sikkes SAM, van den Hout A, Handels R, Bos I, van der Flier WM, et al. Duration of preclinical, prodromal, and dementia stages of Alzheimer's disease in relation to age, sex, and APOE genotype. *Alzheimers Dement* 2019;15:888-98.
25. Bennett DA, Schneider JA, Arvanitakis Z, Kelly JF, Aggarwal NT, Shah RC, et al. Neuropathology of older persons without cognitive impairment from two community-based studies. *Neurology* 2006;66:1837-44.
26. Knopman DS, Parisi JE, Salviati A, Floriach-Robert M, Boeve BF, Ivnik RJ, et al. Neuropathology of cognitively normal elderly. *J Neuropathol Exp Neurol* 2003;62:1087-95.
27. Petersen RC, Lopez O, Armstrong MJ, Getchius TSD, Ganguli M, Gloss D, et al. Practice guideline update summary: Mild cognitive impairment. *Neurology* 2018;90(3):126-35.
28. Ward A, Tardiff S, Dye C, Arrighi HM. Rate of conversion from prodromal Alzheimer's disease to Alzheimer's dementia: A systematic review of the literature. *Dement Geriatr Cogn Disord Extra* 2013;3:320-32.
29. Mitchell AJ, Shiri-Feshki M. Rate of progression of mild cognitive impairment to dementia: Meta-analysis of 41 robust inception cohort studies. *Acta Psychiatr Scand* 2009;119:252-65.
30. Johnson KA, Minoshima S, Bohnen NI, Donohoe KJ, Foster NL, Herscovitch P, et al. Appropriate use criteria for amyloid PET: A report of the Amyloid Imaging Task Force, the Society of Nuclear Medicine and Molecular Imaging, and the Alzheimer's Association. *Alzheimers Dement* 2013;9(1):e1-e16.
31. Shaw LM, Arias J, Blennow K, Galasko D, Molinuevo JL, Salloway S, et al. Appropriate use criteria for lumbar puncture and cerebrospinal fluid testing in the diagnosis of Alzheimer's disease. *Alzheimers Dement* 2018;14:1505-21.
32. Wilson RS, Segawa E, Boyle PA, Anagnos SE, Hizez LP, Bennett DA. The natural history of cognitive decline in Alzheimer's disease. *Psychol Aging* 2012;27(4):1008-17.
33. Barker WW, Luis CA, Kashuba A, Luis M, Harwood DG, Loewenstein D, et al. Relative frequencies of Alzheimer's disease, Lewy body, vascular and frontotemporal dementia, and hippocampal sclerosis in the State of Florida Brain Bank. *Alzheimer Dis Assoc Disord* 2002;16(4):203-12.
34. Viswanathan A, Rocca WA, Tzourio C. Vascular risk factors and dementia: How to move forward? *Neurology* 2009;72:368-74.
35. Schneider JA, Arvanitakis Z, Bang W, Bennett DA. Mixed brain pathologies account for most dementia cases in community-dwelling older persons. *Neurology* 2007;69:2197-204.
36. Schneider JA, Arvanitakis Z, Leurgans SE, Bennett DA. The neuropathology of probable Alzheimer disease and mild cognitive impairment. *Ann Neurol* 2009;66(2):200-8.

37. Jellinger KA, Attems J. Neuropathological evaluation of mixed dementia. *J Neurol Sci* 2007;257(1-2):80-7.
38. Jellinger KA. The enigma of mixed dementia. *Alzheimers Dement* 2007;3(1):40-53.
39. Boustani M, Peterson B, Hanson L, Harris R, Lohr KN. Screening for dementia in primary care: A summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med* 2003;138(11):927-37.
40. Bradford A, Kunik ME, Schultz P, Williams SP, Singh H. Missed and delayed diagnosis of dementia in primary care: Prevalence and contributing factors. *Alz Dis Assoc Disord* 2009;23(4):306-14.
41. Kotagal V, Langa KM, Plassman BL, Fisher GG, Giordani BJ, Wallace RB, et al. Factors associated with cognitive evaluations in the United States. *Neurology* 2015;84(1):64-71.
42. Taylor DH, Jr., Ostbye T, Langa KM, Weir D, Plassman BL. The accuracy of Medicare claims as an epidemiological tool: The case of dementia revisited. *J Alzheimers Dis* 2009;17(4):807-15.
43. Barrett AM, Orange W, Keller M, Damgaard P, Swerdlow RH. Short-term effect of dementia disclosure: How patients and families describe the diagnosis. *J Am Geriatr Soc* 2006;54(12):1968-70.
44. Zaleta AK, Carpenter BD, Porensky EK, Xiong C, Morris JC. Agreement on diagnosis among patients, companions, and professionals after a dementia evaluation. *Alzheimer Dis Assoc Disord* 2012;26(3):232-7.
45. Amjad H, Roth DL, Samus QM, Yasar S, Wolff JL. Potentially unsafe activities and living conditions of older adults with dementia. *J Am Geriatr Soc* 2016;64(6):1223-32.
46. Alzheimer's Association. 2015 Alzheimer's Disease Facts and Figures. *Alzheimer Dement* 2015;11(3):332-84.
47. Ralph SJ, Espinet AJ. Increased all-cause mortality by antipsychotic drugs: Updated review and meta-analysis in dementia and general mental health care. *J Alzheimers Dis Rep* 2018;2:1-26.
48. Maust DT, Kim HM, Seyfried LS, Chiang C, Kavanagh J, Schneider LS, et al. Antipsychotics, other psychotropics, and the risk of death in patients with dementia: number needed to harm. *JAMA Psychiatry* 2015;72:438-45.
49. McKhann GM, Albert MS, Sperling RA. Changing diagnostic concepts of Alzheimer's disease. In: Hampel H, Carrillo MC, eds. *Alzheimer's disease — Modernizing concept, biological diagnosis and therapy*. Basel, Switzerland: Karger; 2012: p. 115-21.
50. Bloudek LM, Spackman ED, Blankenburg M, Sullivan SD. Review and meta-analysis of biomarkers and diagnostic imaging in Alzheimer's disease. *J Alzheimers Dis* 2011;26:627-45.
51. Watt JA, Goodarzi Z, Veroniki AA, Nincic V, Khan PA, Ghassemi M, et al. Comparative efficacy of interventions for aggressive and agitated behaviors in dementia. *Ann Internal Med* October 2019.doi:10.7326/M19-0993.
52. Groot C, Hooghiemstra AM, Raijmakers PG, van Berckel BN, Scheltens P, Scherder E, et al. The effect of physical activity on cognitive function in patients with dementia: A meta-analysis of randomized control trials. *Ageing Res Rev* 2016;25:13-23.
53. Farina N, Rusted J, Tabet N. The effect of exercise interventions on cognitive outcome in Alzheimer's disease: A systematic review. *Int Psychogeriatr* 2014;26(1):9-18.
54. Aguirre E, Woods RT, Spector A, Orrell M. Cognitive stimulation for dementia: A systematic review of the evidence of effectiveness from randomised controlled trials. *Ageing Res Rev* 2013;12(1):253-62.
55. Fukushima RLM, do Carmo EG, do Valle Pedroso R, Micali PN, Donadelli PS, Fuzaro G, et al. Effects of cognitive stimulation on neuropsychiatric symptoms in elderly with Alzheimer's disease: A systematic review. *Dement Neuropsychol* 2016;10(3):178-84.
56. Bahar-Fuchs A, Martyr A, Goh AMY, Sabates J, Clare L. Cognitive training for people with mild to moderate dementia. *Cochrane Database of Systematic Reviews* 2019, Issue 3. Art. No.: CD013069. doi: 10.1002/14651858.CD013069.pub2.
57. Kishita N, Backhouse T, Mioshi E. Nonpharmacological interventions to improve depression, anxiety, and quality of life (QoL) in people with dementia: An overview of systematic reviews. *J Geriatr Psychiatry Neurol*. 2020;33(1):28-41.
58. Vickrey BG, Mittman BS, Connor KI, Pearson ML, Della Penna RD, Ganiats TG, et al. The effect of a disease management intervention on quality and outcomes of dementia care: A randomized, controlled trial. *Ann Intern Med* 2006;145(10):713-26.
59. Voisin T, Vellas B. Diagnosis and treatment of patients with severe Alzheimer's disease. *Drugs Aging* 2009;26(2):135-44.
60. Grossberg GT, Christensen DD, Griffith PA, Kerwin DR, Hunt G, Hall EJ. The art of sharing the diagnosis and management of Alzheimer's disease with patients and caregivers: Recommendations of an expert consensus panel. *Prim Care Companion J Clin Psychiatry* 2010;12(1):PCC.09cs00833.
61. Hebert LE, Bienias JL, Aggarwal NT, Wilson RS, Bennett DA, Shah RC, et al. Change in risk of Alzheimer disease over time. *Neurology* 2010;75:786-91.
62. Hebert LE, Weuve J, Scherr PA, Evans DA. Alzheimer disease in the United States (2010-2050) estimated using the 2010 Census. *Neurology* 2013;80(19):1778-83.
63. Saunders AM, Strittmatter WJ, Schmechel D, George-Hyslop PH, Pericak-Vance MA, Joo SH, et al. Association of apolipoprotein E allele epsilon 4 with late-onset familial and sporadic Alzheimer's disease. *Neurology* 1993;43:1467-72.
64. Farrer LA, Cupples LA, Haines JL, Hyman B, Kukull WA, Mayeux R, et al. Effects of age, sex, and ethnicity on the association between apolipoprotein E genotype and Alzheimer disease: A meta-analysis. *JAMA* 1997;278:1349-56.
65. Green RC, Cupples LA, Go R, Benke KS, Edeki T, Griffith PA, et al. Risk of dementia among white and African American relatives of patients with Alzheimer disease. *JAMA* 2002;287(3):329-36.
66. Fratiglioni L, Ahlbom A, Viitanen M, Winblad B. Risk factors for late-onset Alzheimer's disease: A population-based, case-control study. *Ann Neurol* 1993;33(3):258-66.
67. Mayeux R, Sano M, Chen J, Tatemichi T, Stern Y. Risk of dementia in first-degree relatives of patients with Alzheimer's disease and related disorders. *Arch Neurol* 1991;48(3):269-73.
68. Lautenschlager NT, Cupples LA, Rao VS, Auerbach SA, Becker R, Burke J, et al. Risk of dementia among relatives of Alzheimer's disease patients in the MIRAGE Study: What is in store for the oldest old? *Neurology* 1996;46(3):641-50.
69. Nelson PT, Head E, Schmitt FA, Davis PR, Neltner JH, Jicha GA, et al. Alzheimer's disease is not "brain aging": Neuropathological, genetic, and epidemiological human studies. *Acta Neuropathol* 2011;121:571-87.
70. Rajan KB, Barnes LL, Wilson RS, McAninch EA, Weuve J, Singhoko D, et al. Racial differences in the association between apolipoprotein E risk alleles and overall and total cardiovascular mortality over 18 years. *JAGS* 2017;65:2425-30.
71. Evans DA, Bennett DA, Wilson RS, Bienias JL, Morris MC, Scherr PA, et al. Incidence of Alzheimer disease in a biracial urban community: Relation to apolipoprotein E allele status. *Arch Neurol* 2003;60(2):185-9.
72. Tang M, Stern Y, Marder K, Bell K, Gurland B, Lantigua R, et al. The APOE-e4 allele and the risk of Alzheimer disease among African Americans, whites, and Hispanics. *JAMA* 1998;279:751-5.
73. Loy CT, Schofield PR, Turner AM, Kwok JBJ. Genetics of dementia. *Lancet* 2014;383:828-40.
74. Holtzman DM, Herz J, Bu G. Apolipoprotein E and apolipoprotein E receptors: Normal biology and roles in Alzheimer disease. *Cold Spring Harb Perspect Med* 2012;2(3):a006312.
75. Michaelson DM. APOE ε4: The most prevalent yet understudied risk factor for Alzheimer's disease. *Alzheimers Dement* 2014;10:861-8.
76. Jansen WJ, Ossenkoppele R, Knol KL, Tijms BM, Scheltens P, Verhey FRJ, et al. Prevalence of cerebral amyloid pathology in persons without dementia. *JAMA* 2015;313(19):1924-38.

77. Spinney L. Alzheimer's disease: The forgetting gene. *Nature* 2014;510(7503):26-8.
78. Ward A, Crean S, Mercaldi CJ, Collins JM, Boyd D, Cook MN, et al. Prevalence of apolipoprotein e4 genotype and homozygotes (APOE ε4/ε4) among patients diagnosed with Alzheimer's disease: A systematic review and meta-analysis. *Neuroepidemiology* 2012;38:1-17.
79. Mayeux R, Saunders AM, Shea S, Mirra S, Evans D, Roses AD, et al. Utility of the apolipoprotein E genotype in the diagnosis of Alzheimer's disease. *N Engl J Med* 1998;338:506-11.
80. Weuve J, Barnes LL, Mendes de Leon CF, Rajan KB, Beck T, Aggarwal NT, et al. Cognitive aging in black and white Americans: Cognition, cognitive decline, and incidence of Alzheimer disease dementia. *Epidemiology* 2018;29(1):151-9.
81. Hendrie HC, Murrell J, Baiyewu O, Lane KA, Purnell C, Ogunniyi A, et al. APOE ε4 and the risk for Alzheimer disease and cognitive decline in African Americans and Yoruba. *Int Psychogeriatr* 2014;26(6):977-85.
82. Reitz C, Jun G, Naj A, Rajbhandary R, Vardarajan BN, Wang LS, et al. Variants in the ATP-binding cassette transporter (ABCA7), apolipoprotein E epsilon 4, and the risk of late-onset Alzheimer disease in African Americans. *JAMA* 2013;309(14):1483-92.
83. Wolters FJ, van der Lee SJ, Koudstaal PJ, van Duijn CM, Hofman A, Ikam MK, et al. Parental family history of dementia in relation to subclinical brain disease and dementia risk. *Neurology* 2017;88:1642-9.
84. World Health Organization. Risk reduction of cognitive decline and dementia: WHO guidelines. https://www.who.int/mental_health/neurology/dementia/guidelines_risk_reduction/en/. Accessed September 13, 2019.
85. Baumgart M, Snyder HM, Carrillo MC, Fazio S, Kim H, Johns H. Summary of the evidence on modifiable risk factors for cognitive decline and dementia: A population-based perspective. *Alzheimers Dement* 2015;11(6):718-26.
86. Institute of Medicine. *Cognitive Aging: Progress in Understanding and Opportunity for Action*. Washington, D.C.: The National Academies Press; 2015.
87. Mergenthaler P, Lindauer U, GA Dienel, Meisel A. Sugar for the brain: The role of glucose in physiological and pathological brain function. *Trends Neurosci* 2013;36(10):587-97.
88. Samieri C, Perier MC, Gaye B, Proust-Lima C, Helmer C, Dartigues JF, et al. Association of cardiovascular health level in older age with cognitive decline and incident dementia. *JAMA* 2018;320(7):657-64.
89. Anstey KJ, von Sanden C, Salim A, O'Kearney R. Smoking as a risk factor for dementia and cognitive decline: A meta-analysis of prospective studies. *Am J Epidemiol* 2007;166(4):367-78.
90. Rusanen M, Kivipelto M, Quesenberry CP, Zhou J, Whitmer RA. Heavy smoking in midlife and long-term risk of Alzheimer disease and vascular dementia. *Arch Intern Med* 2011;171(4):333-9.
91. Beydoun MA, Beydoun HA, Gamaldo AA, Teel A, Zonderman AB, Wang Y. Epidemiologic studies of modifiable factors associated with cognition and dementia: Systematic review and meta-analysis. *BMC Public Health* 2014;14:643.
92. Ohara T, Ninomiya T, Hata J, Ozawa M, Yoshida D, Mukai N, et al. Midlife and late-life smoking and risk of dementia in the community: The Hisayama Study. *J Am Geriatr Soc* 2015;63(11):2332-9.
93. Choi D, Choi S, Park SM. Effect of smoking cessation on the risk of dementia: A longitudinal study. *Ann Clin Transl Neurol* 2018;5(10):1192-9.
94. Wu W, Brickman AM, Luchsinger J, Ferrazzano P, Pichiale P, Yoshita M, et al. The brain in the age of old: The hippocampal formation is targeted differentially by diseases of late life. *Ann Neurol* 2008;64:698-706.
95. Gudala K, Bansal D, Schifano F, Bhansali A. Diabetes mellitus and risk of dementia: A meta-analysis of prospective observational studies. *Diabetes Investig* 2013;4(6):640-50.
96. Vagelatos NT, Eslick GD. Type 2 diabetes as a risk factor for Alzheimer's disease: The confounders, interactions, and neuropathology associated with this relationship. *Epidemiol Rev* 2013;35(1):152-60.
97. Reitz C, Brayne C, Mayeux R. Epidemiology of Alzheimer disease. *Nat Rev Neurol* 2011;7(3):137-52.
98. Rönnemaa E, Zethelius B, Lannfelt L, Kilander L. Vascular risk factors and dementia: 40-year follow-up of a population-based cohort. *Dement Geriatr Cogn Disord* 2011;31(6):460-6.
99. Crane PK, Walker R, Hubbard RA, Li G, Nathan DM, Zheng H, et al. Glucose levels and risk of dementia. *N Engl J Med* 2013;369(6):540-8.
100. Sajeev G, Weuve J, McQueen MB, Blacker D. Diabetes. The AlzRisk Database. *Alzheimer Research Forum*. Available at: <http://www.alzrisk.org>. Accessed November 17, 2019.
101. Kivimäki M, Luukkonen R, Batty GD, Ferrie JE, Pentti J, Nyberg ST, et al. Body mass index and risk of dementia: Analysis of individual-level data from 1.3 million individuals. *Alzheimers Dement* 2018;14:601-9.
102. Loef M, Walach H. Midlife obesity and dementia: Meta-analysis and adjusted forecast of dementia prevalence in the United States and China. *Obesity (Silver Spring)* 2013;21(1):E51-5.
103. Anstey KJ, Cherbuin N, Budge M, Young J. Body mass index in midlife and late-life as a risk factor for dementia: A meta-analysis of prospective studies. *Obes Rev* 2011;12(5):E426-37.
104. Gottesman RF, Schneider AL, Zhou Y, Coresh J, Green E, Gupta N, et al. Association between midlife vascular risk factors and estimated brain amyloid deposition. *JAMA* 2017;17(14):1443-50.
105. Abell JG, Kivimäki M, Dugravot A, Tabak AG, Fayosse A, Shipley M, et al. Association between systolic blood pressure and dementia in the Whitehall II cohort study: Role of age, duration, and threshold used to define hypertension. *Eur Heart J* 2018;39(33):3119-25.
106. Ninomiya T, Ohara T, Hiraoka Y, Yoshida D, Doi Y, Hata J, et al. Midlife and late-life blood pressure and dementia in Japanese elderly: The Hisayama Study. *Hypertension* 2011;58(1):22-8.
107. Debette S, Seshadri S, Beiser A, Au R, Himali JJ, Palumbo C, et al. Midlife vascular risk factor exposure accelerates structural brain aging and cognitive decline. *Neurology* 2011;77:461-8.
108. Livingston G, Sommerlad A, Orgeta V, Costafreda SG, Huntley H, Ames D, et al. Dementia prevention, intervention, and care. *Lancet* 2017;390:2673-734.
109. Gottesman RF, Albert MS, Alonso A, Coker LH, Coresh J, Davis SM, et al. Associations between midlife vascular risk factors and 25-year incident dementia in the Atherosclerosis Risk in Communities (ARIC) cohort. *JAMA Neurol* 2017;74(10):1246-54.
110. Solomon A, Kivipelto M, Wolozin B, Zhou J, Whitmer, RA. Midlife serum cholesterol and increased risk of Alzheimer's and vascular dementia three decades later. *Dement and Geriatr Disord* 2009;28:75-80.
111. Meng XF, Yu JT, Wang HF, Tan MS, Wang C, Tan CC, et al. Midlife vascular risk factors and the risk of Alzheimer's disease: A systematic review and meta-analysis. *J Alzheimers Dis* 2014;42(4):1295-310.
112. Fitzpatrick A, Kuller LH, Lopez OL, Diehr P, O'Meara ES, Longstreth WT, et al. Mid- and late-life obesity: Risk of dementia in the Cardiovascular Health Cognition Study. *Arch Neurol* 2009;66:336-42.
113. Corrada MM, Hayden KM, Paganini-Hill A, Bullain SS, DeMoss J, Aguirre C, et al. Age of onset of hypertension and risk of dementia in the oldest-old: The 90+ Study. *Alzheimer Dement* 2017;(13):103-10.
114. The SPRINT MIND Investigators for the SPRINT Research Group. Effect of intensive vs standard blood pressure control on probable dementia: A randomized clinical trial. *JAMA* 2019;321(6):553-61.
115. Ogino E, Manly JJ, Schupf N, Mayeux R, Gu Y. Current and past leisure time physical activity in relation to risk of Alzheimer's disease in older adults. *Alzheimers Dement* 2019;15(12):1603-11.

116. Najjar J, Ostling S, Gudmundsson P, Sundh V, Johansson L, Kern S, et al. Cognitive and physical activity and dementia: A 44-year longitudinal population study of women. *Neurology* 2019;92(12):e1322-e1330.
117. Buchman AS, Yu L, Wilson RS, Lim A, Dawe RJ, Gaiteri C, et al. Physical activity, common brain pathologies, and cognition in community-dwelling older adults. *Neurology* 2019;92(8):e811-e822.
118. Harrington M, Weuve J, Jackson JW, Blacker D. Physical Activity. The AlzRisk Database. Alzheimer Research Forum. Available at: <http://www.alzrisk.org>. Accessed November 17, 2019.
119. Tan ZS, Spartano NL, Beiser AS, DeCarli C, Auerbach SH, Vasan RS, et al. Physical activity, brain volume, and dementia risk: The Framingham Study. *J Gerontol A Biol Sci Med Sci* 2017;72:789-95.
120. Willey JZ, Gardener H, Caunca MR, Moon YP, Dong C, Cheung YK, et al. Leisure-time physical activity associates with cognitive decline: The Northern Manhattan Study. *Neurology* 2016;86(20):1897-903.
121. Stephen R, Hongisto K, Solomon A, Lonroos E. Physical Activity and Alzheimer's Disease: A systematic review. *J Gerontol A Biol Sci Med Sci* 2017;72(6):733-9.
122. Blondell SJ, Hammersley-Mather R, Veerman JL. Does physical activity prevent cognitive decline and dementia? A systematic review and meta-analysis of longitudinal studies. *BMC Public Health* 2014;14:510.
123. Koscak TB. Physical activity improves cognition: Possible explanations. *Biogerontology* 2017;18(4):477-83.
124. Guure CB, Ibrahim NA, Adam MB, Said SM. Impact of physical activity on cognitive decline, dementia, and its subtypes: Meta-analysis of prospective studies. *Biomed Res Int* 2017;2017:9016924.
125. Soni M, Orrell M, Bandelow S, Steptoe A, Rafnsson S, d'Orsi E, et al. Physical activity pre- and post-dementia: English Longitudinal Study of Ageing. *Aging Ment Health* 2017;17:1-7.
126. Barberger-Gateau P, Raffaitin C, Letenneur L, Berr C, Tzourio C, Dartigues JF, et al. Dietary patterns and risk of dementia: The Three-City Cohort Study. *Neurology* 2007;69(20):1921-30.
127. Hardman RJ, Kennedy G, Macpherson H, Scholey AB, Pipingas A. Adherence to a Mediterranean-style diet and effects on cognition in adults: A qualitative evaluation and systematic review of longitudinal and prospective trials. *Front Nutr* 2016;3:22.
128. Lourida I, Soni M, Thompson-Coon J, Purandare N, Lang IA, Ukoumunne OC, et al. Mediterranean diet, cognitive function, and dementia: A systematic review. *Epidemiology* 2013;24:479-89.
129. Morris MC, Tangney CC, Wang Y, Sacks FM, Barnes LL, Bennett DA, et al. MIND diet slows cognitive decline with aging. *Alzheimers Dement* 2015;11(9):1015-22.
130. Morris MC, Tangney CC, Wang Y, Sacks FM, Bennett DA, Aggarwal NT. MIND diet associated with reduced incidence of Alzheimer's disease. *Alzheimers Dement* 2015;11:1007-14.
131. Butler M, Nelson VA, Davila H, Ratner E, Fink HA, Hemmy LS, et al. Over-the-counter supplement interventions to prevent cognitive decline, mild cognitive impairment, and clinical Alzheimer-type dementia. *Ann Intern Med* 2018;168:52-62.
132. Rosenberg A, Ngandu T, Rusanen M, Antikainen R, Bäckman L, Havulinna S, et al. Multidomain lifestyle intervention benefits a large elderly population at risk for cognitive decline and dementia regardless of baseline characteristics: The FINGER trial. *Alzheimers Dement* 2018;14(3):263-70.
133. Kulmala J, Ngandu T, Kivipelto M. Prevention matters: Time for global action and effective implementation. *J Alzheimers Dis* 2018;64(s1):S191-8.
134. Fitzpatrick AL, Kuller LH, Ives DG, Lopez OL, Jagust W, Breitner JC, et al. Incidence and prevalence of dementia in the Cardiovascular Health Study. *J Am Geriatr Soc* 2004;52(2):195-204.
135. Kukull WA, Higdon R, Bowen JD, McCormick WC, Teri L, Schellenberg GD, et al. Dementia and Alzheimer disease incidence: A prospective cohort study. *Arch Neurol* 2002;59(11):1737-46.
136. Stern Y. Cognitive reserve in ageing and Alzheimer's disease. *Lancet Neurol* 2012;11(11):1006-12.
137. Sando SB, Melquist S, Cannon A, Hutton M, Sletvold O, Saltvedt I, et al. Risk-reducing effect of education in Alzheimer's disease. *Int J Geriatr Psychiatry* 2008;23(11):1156-62.
138. Hendrie HC, Smith-Gamble V, Lane KA, Purnell C, Clark DO, Gao S. The Association of early life factors and declining incidence rates of dementia in an elderly population of African Americans. *J Gerontol B Psychol Sci Soc Sci* 2018;16(73, suppl 1):S82-9.
139. Stern Y. What is cognitive reserve? Theory and research application of the reserve concept. *J Int Neuropsychol Soc* 2002;8:448-60.
140. Stern Y, Arenaza-Urquijo EM, Bartres-Faz D, Belleville S, Cantilon M, Chetelat G, et al. Whitepaper: Defining and investigating cognitive reserve, brain reserve, and brain maintenance. *Alzheimers Dement* 2018;pii:S1552-5260(18)33491-5.
141. Grzywacz JG, Segel-Karpas D, Lachman ME. Workplace exposures and cognitive function during adulthood: Evidence from National Survey of Midlife Development and the O*NET. *J Occup Environ Med* 2016;58(6):535-41.
142. Pool LR, Weuve J, Wilson RS, Bültmann U, Evans DA, Mendes de Leon CF. Occupational cognitive requirements and late-life cognitive aging. *Neurology* 2016;86(15):1386-92.
143. Then FS, Luck T, Luppa M, Arelin K, Schroeter ML, Engel C, et al. Association between mental demands at work and cognitive functioning in the general population: Results of the health study of the Leipzig Research Center for Civilization Diseases. *J Occup Med Toxicol* 2014;9:23.
144. Fisher GG, Stachowski A, Infurna FJ, Faul JD, Grosch J, Tetrack LE. Mental work demands, retirement, and longitudinal trajectories of cognitive functioning. *J Occup Health Psychol* 2014;19(2):231-42.
145. Dekhtyar S, Marseglia A, Xu W, Darin-Mattsson A, Wang H, Fratiglioni L. Genetic risk of dementia mitigated by cognitive reserve: A cohort study. *Ann Neurol* 2019;86(1):68-78.
146. McDowell I, Xi G, Lindsay J, Tierney M. Mapping the connections between education and dementia. *J Clin Exp Neuropsychol* 2007;29(2):127-41.
147. Ihab M, Benson AF, Lubin TJ, Sacks JD, Richmond-Bryant J. Disparities in distribution of particulate matter emission sources by race and poverty status. *Am J Public Health* 2018;108:480-5.
148. Bernard SM, McGeehin MA. Prevalence of blood lead levels ≥ 5 micro g/dL among US children 1 to 5 years of age and socioeconomic and demographic factors associated with blood of lead levels of 5 to 10 micro g/dL, Third National Health and Nutrition Examination Survey, 1988-1994. *Pediatrics* 2003;112(6 Pt 1):1308-13.
149. Griffith M, Tajik M, Wing S. Patterns of agricultural pesticide use in relation to socioeconomic characteristics of the population in the rural U.S. South. *Int J Health Serv* 2007;37(2):259-77.
150. Harris CD, Watson KB, Carlson SA, Fulton JE, Dorn JM, Elam-Evans L. Adult participation in aerobic and muscle-strengthening physical activities — United States, 2011. *Morb Mortal Wkly Rep* 2013;62(17):326-30.
151. Menke A, Casagrande S, Geiss L, Cowie CC. Prevalence of and trends in diabetes among adults in the United States, 1988-2012. *JAMA* 2015;314(10):1021-9.
152. Sims M, Diez Roux AV, Boykin S, Sarpong D, Gebreab SY, Wyatt SB, et al. The socioeconomic gradient of diabetes prevalence, awareness, treatment, and control among African Americans in the Jackson Heart Study. *Ann Epidemiol* 2011;21(12):892-8.
153. Lee TC, Glynn RJ, Peña JM, Paynter NP, Conen D, Ridker PM, et al. Socioeconomic status and incident type 2 diabetes mellitus: Data from the Women's Health Study. *PLoS One* 2011;6(12):E27670.
154. Gillespie CD, Hurvitz KA. Prevalence of hypertension and controlled hypertension — United States, 2007-2010. *MMWR Suppl* 2013 Nov 22;62(3):144-8.

155. Centers for Disease Control and Prevention. Current Cigarette Smoking Among Adults in the United States. Available at: https://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/index.htm. Accessed November 4, 2019.
156. Staf RT, Hogan MJ, Williams DS, Whalley LJ. Intellectual engagement and cognitive ability in later life (the "use it or lose it" conjecture): Longitudinal, prospective study. *BMJ* 2018;363:k4925.
157. Wang H-X, Xu W, Pei J-J. Leisure activities, cognition and dementia. *BBA-Mol Basis Dis* 2012;1822(3):482-91.
158. Wang H-X, Karp A, Winblad B, Fratiglioni L. Late-life engagement in social and leisure activities is associated with a decreased risk of dementia: A longitudinal study from the Kungsholmen Project. *Am J Epidemiol* 2002;155(12):1081-7.
159. Saczynski JS, Pfeifer LA, Masaki K, Korf ES, Laurin D, White L, et al. The effect of social engagement on incident dementia: The Honolulu-Asia Aging Study. *Am J Epidemiol* 2006;163(5):433-40.
160. Karp A, Paillard-Borg S, Wang H-X, Silverstein M, Winblad B, Fratiglioni L. Mental, physical and social components in leisure activities equally contribute to decrease dementia risk. *Dement Geriatr Cogn Disord* 2005;21(2):65-73.
161. Di Marco LY, Marzo A, Muñoz-Ruiz M, Ikram MA, Kivipelto M, Ruefenacht D, et al. Modifiable lifestyle factors in dementia: A systematic review of longitudinal observational cohort studies. *J Alzheimers Dis* 2014;42(1):119-35.
162. James BD, Wilson RS, Barnes LL, Bennett DA. Late-life social activity and cognitive decline in old age. *J Int Neuropsychol Soc* 2011;17(6):998-1005.
163. Yates LA, Ziser S, Spector A, Orrell M. Cognitive leisure activities and future risk of cognitive impairment and dementia: Systematic review and meta-analysis. *Int Psychogeriatr* 2016;9:1-16.
164. Ball K, Berch DB, Helmers KF, Jobe JB, Leveck MD, Marsiske M, et al. Effects of cognitive training interventions with older adults: A randomized controlled trial. *JAMA* 2002;288(18):2271-81.
165. Hall CB, Lipton RB, Sliwinski M, Katz MJ, Derby CA, Verghese J. Cognitive activities delay onset of memory decline in persons who develop dementia. *Neurology* 2009;73:356-61.
166. Sanjeev G, Weuve J, Jackson JW, VanderWeele TJ, Bennett DA, Grodstein F, et al. Late-life cognitive activity and dementia. *Epidemiology* 2016;27(5):732-42.
167. Wilson RS, Bennett DA, Bienias JL, Aggarwal NT, Mendes De Leon CF, Morris MC, et al. Cognitive activity and incident AD in a population-based sample of older persons. *Neurology* 2002;59(12):1910-4.
168. Fann JR, Ribe AR, Pedersen HS, Fenger-Grøn M, Christensen J, Benros ME, et al. Long-term risk of dementia among people with traumatic brain injury in Denmark: A population-based observational cohort study. *Lancet Psychiatry* 2018;5(5):424-31.
169. Centers for Disease Control and Prevention. Surveillance Report of Traumatic Brain Injury-related Emergency Department Visits, Hospitalizations, and Deaths: United States, 2014. Available at https://www.cdc.gov/traumaticbraininjury/pdf/TBI-Surveillance-Report-FINAL_508.pdf. Accessed February 10, 2020.
170. Plassman BL, Havlik RJ, Steffens DC, Helms MJ, Newman TN, Drosdick D, et al. Documented head injury in early adulthood and risk of Alzheimer's disease and other dementias. *Neurology* 2000;55(8):1158-66.
171. Teasdale G, Jennett B. Assessment of coma and impaired consciousness: A practical scale. *Lancet* 1974;2(7872):81-4.
172. Centers for Disease Control and Prevention. Traumatic Brain Injury & Concussion. Potential Effects. Available at: <https://www.cdc.gov/traumaticbraininjury/outcomes.html>. Accessed December 5, 2019.
173. Barnes DE, Byers AL, Gardner RC Seal KH, Boscardin WJ, Yaffe K. Association of mild traumatic brain injury with and without loss of consciousness with dementia in U.S. military veterans. *JAMA Neurol* 2018;75(9):1055-61.
174. LoBue C, Wadsworth H, Wilmoth K, Clem M, Hart J Jr, Womack KB. Traumatic brain injury history is associated with earlier age of onset of Alzheimer disease. *Clin Neuropsychol* 2017;31(1):85-98.
175. Mez J, Daneshvar DH, Abdolmohammadi B, Chua AS, Alosco ML, Kiernan PT, et al. Duration of American football play and chronic traumatic encephalopathy. *Ann Neurol* 2019.doi:10.1002/ana.25611.
176. Asken BM, Sullan MJ, DeKosky ST, Jaffee MS, Bauer RM. Research gaps and controversies in chronic traumatic encephalopathy: A review. *JAMA Neurol* 2017;74(10):1255-62.
177. McKee AC, Stein TD, Kiernan PT, Alvarez VE. The neuropathology of chronic traumatic encephalopathy. *Brain Pathol* 2015;25(3):350-64.
178. McKee AC, Cairns NJ, Dickson DW, Folkerth RD, Keene CD, Litvan I, et al. The first NINDS/NIBIB consensus meeting to define neuropathological criteria for the diagnosis of chronic traumatic encephalopathy. *ACTA Neuropathol* 2016;131(1):75-86.
179. Bekris LM, Yu CE, Bird TD. Genetics of Alzheimer disease. *J Geriatr Psychiatry Neurol* 2010;23(4):213-27.
180. Goldman JS, Hahn SE, Bird T. Genetic counseling and testing for Alzheimer disease: Joint practice guidelines of the American College of Medical Genetics and the National Society of Genetic Counselors. *Genet Med* 2011;13:597-605.
181. Lott IT, Dierssen M. Cognitive deficits and associated neurological complications in individuals with Down's syndrome. *Lancet Neurol* 2010;9(6):623-33.
182. National Down Syndrome Society. Alzheimer's Disease and Down Syndrome. Available at: <https://www.ndss.org/resources/alzheimers/>. Accessed September 26, 2019.
183. He W, Goodkind D, Kowal P. U.S. Census Bureau, International Population Reports, P95/16-1, An Aging World: 2015, U.S. Government Publishing Office, Washington, D.C., 2016. Available at: <http://www.census.gov/content/dam/Census/library/publications/2016/demo/p95-16-1.pdf>. Accessed December 4, 2019.
184. U.S. Census Bureau. 2014 National Population Projections: Downloadable Files. Available at: <https://www.census.gov/data/datasets/2014/demo/popproj/2014-popproj.html>. Accessed December 4, 2019.
185. Administration on Aging, Administration for Community Living, U.S. Department of Health and Human Services. A Profile of Older Americans: 2016. Available at: <https://acl.gov/sites/default/files/Aging%20and%20Disability%20in%20America/2016-Profile.pdf>. Accessed February 4, 2020.
186. Guerreiro R, Bras J. The age factor in Alzheimer's disease. *Genome Med* 2015;7:106. doi: 10.1186/s13073-015-0232-5.
187. Plassman BL, Langa KM, Fisher GG, Heeringa SG, Weir DR, Ofstedal MB, et al. Prevalence of dementia in the United States: The Aging, Demographics, and Memory Study. *Neuroepidemiology* 2007;29(1-2):125-32.
188. Wilson RS, Weir DR, Leurgans SE, Evans DA, Hebert LE, Langa KM, et al. Sources of variability in estimates of the prevalence of Alzheimer's disease in the United States. *Alzheimers Dement* 2011;7(1):74-9.
189. Brookmeyer R, Abdalla N, Kawas CH, Corrada MM. Forecasting the prevalence of preclinical and clinical Alzheimer's disease in the United States. *Alzheimers Dement* 2018;14(2):121-9.
190. Jack CR Jr, Therneau TM, Weigand SD, Wiste HJ, Knopman DS, Vemuri P, et al. Prevalence of biologically vs clinically defined Alzheimer spectrum entities using the National Institute on Aging-Alzheimer's Association Research Framework. *JAMA Neurol* 2019;76(10):1174-83.
191. James BD, Wilson RS, Boyle PA, Trojanowski JQ, Bennett DA, Schneider JA. TDP-43 stage, mixed pathologies, and clinical Alzheimer's-type dementia. *Brain* 2016;139(11):2983-93.
192. Serrano-Pozo A, Qian J, Monsell SE, Blacker D, Gomez-Isla T, Betensky RA, et al. Mild to moderate Alzheimer dementia with insufficient neuropathological changes. *Ann Neurol* 2014;75:597-601.

193. Barnes LL, Leurgans S, Aggarwal NT, Shah RC, Arvanitakis Z, James BD, et al. Mixed pathology is more likely in black than white decedents with Alzheimer dementia. *Neurology* 2015;85:528-34.
194. Alzheimer's Association. 2019 Alzheimer's Disease Facts and Figures. *Alzheimer Dement* 2019;15:321-87.
195. Reisberg B, Gauthier S. Current evidence for subjective cognitive impairment (SCI) as the pre-mild cognitive impairment (MCI) stage of subsequently manifest Alzheimer's disease. *Int Psychogeriatr* 2008;20(1):1-16.
196. Jessen F, Wolfsgruber S, Wiese B, Bickel H, Mösch E, Kaduszkiewicz H, et al. AD dementia risk in late MCI, in early MCI, and in subjective memory impairment. *Alzheimers Dement* 2014;10(1):76-83.
197. Jessen F, Amariglio RE, van Boxtel M, Breteler M, Ceccaldi M, Chételat G, et al. A conceptual framework for research on subjective cognitive decline in preclinical Alzheimer's disease. *Alzheimers Dement* 2014;10(6):844-52.
198. Buckley RF, Maruff P, Ames D, Bourgeat P, Martins RN, Masters CL, et al. Subjective memory decline predicts greater rates of clinical progression in preclinical Alzheimer's disease. *Alzheimers Dement* 2016;12(7):796-804.
199. Gifford KA, Liu D, Lu Z, Tripodis Y, Cantwell NG, Palmisano J, et al. The source of cognitive complaints predicts diagnostic conversion differentially among nondemented older adults. *Alzheimers Dement* 2014;10(3):319-27.
200. Brody DJ, Kramarow EA, Taylor CA, McGuire LC. Cognitive performance in adults aged 60 and over: National Health and Nutrition Examination Survey, 2011-2014. *National Health Statistics Reports*; no 126. Hyattsville, MD: National Center for Health Statistics. 2019.
201. Kaup AR, Nettiksimmons J, LeBlanc ES, Yaffe K. Memory complaints and risk of cognitive impairment after nearly 2 decades among older women. *Neurology* 2015;85(21):1852-8.
202. Reisberg B, Shulman MB, Torossian C, Leng L, Zhu W. Outcome over seven years of healthy adults with and without subjective cognitive impairment. *Alzheimers Dement* 2010;6(1):11-24.
203. Fernandez-Blazquez MA, Avila-Villanueva M, Maestu F, Medina M. Specific features of subjective cognitive decline predict faster conversion to mild cognitive impairment. *J Alzheimers Dis* 2016;52(1):271-81.
204. Wolfsgruber S, Kleineidam L, Wagner M, Mösch E, Bickel H, Lühmann D, et al. Differential risk of incident Alzheimer's disease dementia in stable versus unstable patterns of subjective cognitive decline. *J Alzheimers Dis* 2016;54(3):1135-46.
205. Unpublished data from the 2015-2018 Behavioral Risk Factor Surveillance System survey, analyzed and provided to the Alzheimer's Association by the Alzheimer's Disease and Healthy Aging Program, Centers for Disease Control and Prevention.
206. Weuve J, Hebert LE, Scherr PA, Evans DA. Prevalence of Alzheimer disease in U.S. states. *Epidemiology* 2015;26(1):E4-6.
207. Unpublished tabulations based on data from the Medicare Current Beneficiary Survey for 2011. Prepared under contract by Avalere Health, March 2016.
208. Hebert LE, Beckett LA, Scherr PA, Evans DA. Annual incidence of Alzheimer disease in the United States projected to the years 2000 through 2050. *Alzheimer Dis Assoc Disord* 2001;15(4):169-73.
209. Rajan KB, Weuve J, Barnes LL, Wilson RS, Evans DA. Prevalence and incidence of clinically diagnosed Alzheimer's disease dementia from 1994 to 2012 in a population study. *Alzheimers Dement* 2019;15(1):1-7. doi:10.1016/j.jalz.2018.07.216 1.
210. Tom SE, Hubbard RA, Crane PK, Haneuse SJ, Bowen J, McCormick WC, et al. Characterization of dementia and Alzheimer's disease in an older population: Updated incidence and life expectancy with and without dementia. *Am J Public Health* 2015;105(2):408-13.
211. Chene G, Beiser A, Au R, Preis SR, Wolf PA, Dufouil C, et al. Gender and incidence of dementia in the Framingham Heart Study from mid-adult life. *Alzheimers Dement* 2015;11(3):310-20.
212. Seshadri S, Wolf PA, Beiser A, Au R, McNulty K, White R, et al. Lifetime risk of dementia and Alzheimer's disease. The impact of mortality on risk estimates in the Framingham Study. *Neurology* 1997;49(6):1498-504.
213. Hebert LE, Scherr PA, McCann JJ, Beckett LA, Evans DA. Is the risk of developing Alzheimer's disease greater for women than for men? *Am J Epidemiol* 2001;153(2):132-6.
214. Zahodne LB, Schofield PW, Farrell MT, Stern Y, Manly JJ. Bilingualism does not alter cognitive decline or dementia risk among Spanish-speaking immigrants. *Neuropsychology* 2014;28(2):238-46.
215. Kawas C, Gray S, Brookmeyer R, Fozard J, Zonderman A. Age-specific incidence rates of Alzheimer's disease: The Baltimore Longitudinal Study of Aging. *Neurology* 2000;54(11):2072-7.
216. Fratiglioni L, Viitanen M, von Strauss E, Tontodonati V, Herlitz A, Winblad B. Very old women at highest risk of dementia and Alzheimer's disease: Incidence data from the Kungsholmen Project, Stockholm. *Neurology* 1997;48:132-8.
217. Letenneur L, Gilleron V, Commenges D, Helmer C, Orgogozo JM, Dartigues JF. Are sex and educational level independent predictors of dementia and Alzheimer's disease? Incidence data from the PAQUID project. *J Neurol Neurosurg Psychiatry* 1999;66:177-83.
218. Matthews FE, Stephan BC, Robinson L, Jagger C, Barnes LE, Arthur A, et al. A two decade dementia incidence comparison from the Cognitive Function and Ageing Studies I and II. *Nat Commun* 2016;7:11398.
219. Mielke MM, Ferretti MT, Iulita MF, Hayden K, Khachaturian AS. Sex and gender in Alzheimer's disease — Does it matter? *Alzheimers Dement* 2018;14(9):1101-3.
220. Rocca WA. Time, Sex, gender, history, and dementia. *Alzheimer Dis Assoc Disord* 2017;31(1):76-9.
221. Mielke MM, Vemuri P, Rocca WA. Clinical epidemiology of Alzheimer's disease: Assessing sex and gender differences. *Clin Epidemiol* 2014;6:37-48.
222. Rocca WA, Mielke MM, Vemuri P, Miller VM. Sex and gender differences in the causes of dementia: A narrative review. *Maturitas* 2014;79(2):196-201.
223. Langa KM, Larson EB, Crimmins EM, Faul JD, Levine DA, Kabeto MU, et al. A comparison of the prevalence of dementia in the United States in 2000 and 2012. *JAMA Intern Med* 2017;177(1):51-8.
224. Launer LJ, Andersen K, Dewey ME, Letenneur L, Ott A, Amaducci LA, et al. Rates and risk factors for dementia and Alzheimer's disease: results from EURODEM pooled analyses. EURODEM Incidence Research Group and Work Groups. *European Studies of Dementia. Neurology* 1999;52(1):78-84.
225. Russ TC, Stamatakis E, Hamer M, Starr JM, Kivimaki M, Batty GD. Socioeconomic status as a risk factor for dementia death: individual participant meta-analysis of 86 508 men and women from the UK. *Br J Psychiatry* 2013;203(1):10-17.
226. Carter CL, Resnick EM, Mallampalli M, Kalbarczyk A. Sex and gender differences in Alzheimer's disease: Recommendations for future research. *J Womens Health* 2012;21(10):1018-23.
227. Altmann A, Tian L, Henderson VW, Greicius MD, Alzheimer's Disease Neuroimaging Initiative Investigators. Sex modifies the APOE-related risk of developing Alzheimer disease. *Ann Neurol* 2014;75(4):563-73.
228. Ungar L, Altmann A, Greicius MD. Apolipoprotein E, gender, and Alzheimer's disease: An overlooked, but potent and promising interaction. *Brain Imaging Behav* 2014;8(2):262-73.
229. Hohman TJ, Dumitrescu L, Barnes LL, Thambisetty M, Beecham G, Kunkle B, et al. Sex-specific association of apolipoprotein E with cerebrospinal fluid levels of tau. *JAMA Neurol* 2018;75(8):989-98.
230. Neu SC, Pa J, Kukull W, Beekly D, Kuzma A, Gangadharan P, et al. Apolipoprotein E genotype and sex risk factors for Alzheimer disease: A meta-analysis. *JAMA Neurol* 2017;74(10):1178-89.

231. Yaffe K, Haan M, Byers A, Tangen C, Kuller L. Estrogen use, APOE, and cognitive decline: Evidence of gene-environment interaction. *Neurology* 2000;54(10):1949-54.
232. Kang JH, Grodstein F. Postmenopausal hormone therapy, timing of initiation, APOE and cognitive decline. *Neurobiol Aging* 2012;33(7):1129-37.
233. Barnes LL, Wilson RS, Bienias JL, Schneider JA, Evans DA, Bennett DA. Sex differences in the clinical manifestations of Alzheimer disease pathology. *Arch Gen Psychiatry* 2005;62(6):685-91.
234. Koran MEI, Wagener M, Hohman TJ. Alzheimer's Neuroimaging Initiative. Sex differences in the association between AD biomarkers and cognitive decline. *Brain Imaging Behav* 2017;11(1):205-13.
235. Buckley RF, Mormino EC, Amariglio RE, Properzi MJ, Rabin JS, Lim YY, et al. Sex, amyloid, and APOE epsilon4 and risk of cognitive decline in preclinical Alzheimer's disease: Findings from three well-characterized cohorts. *Alzheimers Dement* 2018;14(9):1193-203.
236. Manly JJ, Mayeux R. Ethnic differences in dementia and Alzheimer's disease. In: Anderson N, Bulatao R, Cohen B, eds. *Critical perspectives on racial and ethnic differentials in health in late life*. Washington, D.C.: National Academies Press; 2004: p. 95-141.
237. Demirovic J, Prineas R, Loewenstein D, Bean J, Duara R, Sevush S, et al. Prevalence of dementia in three ethnic groups: The South Florida Program on Aging and Health. *Ann Epidemiol* 2003;13(6):472-78.
238. Harwood DG, Ownby RL. Ethnicity and dementia. *Curr Psych Report* 2000;2(1):40-5.
239. Perkins P, Annegers JF, Doody RS, Cooke N, Aday L, Vernon SW. Incidence and prevalence of dementia in a multiethnic cohort of municipal retirees. *Neurology* 1997;49(1):44-50.
240. Haan MN, Mungas DM, Gonzalez HM, Ortiz TA, Acharya A, Jagust WJ. Prevalence of dementia in older Latinos: The influence of type 2 diabetes mellitus, stroke and genetic factors. *J Am Geriatr Soc* 2003;51:169-77.
241. Samper-Ternent R, Kuo YF, Ray LA, Ottenbacher KJ, Markides KS, Al Snih S. Prevalence of health conditions and predictors of mortality in oldest old Mexican Americans and non-Hispanic whites. *J Am Med Dir Assn* 2012;13(3):254-9.
242. González HM, Tarraf W, Schneiderman N, Fornage M, Vásquez PM, Zeng D, et al. Prevalence and correlates of mild cognitive impairment among diverse Hispanics/Latinos: Study of Latinos-Investigation of Neurocognitive Aging results. *Alzheimers Dement* 2019;pii:S1552-5260(19)35376-2. doi:10.1016/j.jalz.2019.08.202. [Epub ahead of print].
243. Mehta KM, Yeo GW. Systematic review of dementia prevalence and incidence in United States race/ethnic populations. *Alzheimers Dement* 2017;13(1):72-83.
244. Yaffe K, Falvey C, Harris TB, Newman A, Satterfield S, Koster A, et al. Effect of socioeconomic disparities on incidence of dementia among biracial older adults: Prospective study. *BMJ* 2013;347:f7051.
245. Froehlich TE, Bogardus Jr. ST, Inouye SK. Dementia and race: Are there differences between African Americans and Caucasians? *J Am Geriatr Soc* 2001;49(4):477-84.
246. Chin AL, Negash S, Hamilton R. Diversity and disparity in dementia: The impact of ethnoracial differences in Alzheimer disease. *Alzheimer Dis Assoc Disord* 2011;25(3):187-95.
247. Lines LM, Sherif NA, Wiener JM. Racial and ethnic disparities among individuals with Alzheimer's disease in the United States: A literature review. Research Triangle Park, NC: RTI Press; 2014.
248. Glymour MM, Manly JJ. Lifecourse social conditions and racial and ethnic patterns of cognitive aging. *Neuropsychol Rev* 2008;18(3):223-54.
249. Zhang Z, Hayward MD, Yu YL. Life course pathways to racial disparities in cognitive impairment among older Americans. *J Health Soc Behav* 2016;57(2):184-99.
250. Clark PC, Kutner NG, Goldstein FC, Peterson-Hazen S, Garner V, Zhang R, et al. Impediments to timely diagnosis of Alzheimer's disease in African Americans. *J Am Geriatr Soc* 2005;53(11):2012-7.
251. Fitten LJ, Ortiz F, Ponton M. Frequency of Alzheimer's disease and other dementias in a community outreach sample of Hispanics. *J Am Geriatr Soc* 2001;49(10):1301-8.
252. Matthews KA, Xu W, Gaglioti AH, Holt JB, Croft JB, Mack D, et al. Racial and ethnic estimates of Alzheimer's disease and related dementias in the United States (2015-2060) in adults aged ≥ 65 years. *Alzheimers Dement* 2019;15(1):17-24.
253. Mayeda ER, Glymour MM, Quesenberry CP, Whitmer RA. Inequalities in dementia incidence between six racial and ethnic groups over 14 years. *Alzheimers Dement* 2016;12(3):216-24.
254. Mayeda ER, Glymour MM, Quesenberry CP, Jr., Whitmer RA. Heterogeneity in 14-year dementia incidence between Asian American subgroups. *Alzheimer Dis Assoc Disord* 2017;31(3):181-6.
255. Sheffield KM, Peek MK. Changes in the prevalence of cognitive impairment among older Americans, 1993-2004: Overall trends and differences by race/ethnicity. *Am J Epidemiol* 2011;174(3):274-83.
256. Hudomiet P, Hurd M, Rohwedder S. Dementia prevalence in the United States in 2000 and 2012: Estimates based on a nationally representative study. *J Gerontol B Psychol Sci Soc Sci* 2018;73(Suppl 1):S10-19.
257. Freedman VA, Kasper JD, Spillman BC, Plassman BL. Short-term changes in the prevalence of probable dementia: An analysis of the 2011-2015 National Health and Aging Trends Study. *J Gerontol B Psychol Sci Soc Sci* 2018;73(Suppl 1):S48-56.
258. Matthews FE, Arthur A, Barnes LE, Bond J, Jagger C, Robinson L, et al. A two-decade comparison of prevalence of dementia in individuals aged 65 years and older from three geographical areas of England: Results of the Cognitive Function and Ageing Study I and II. *Lancet* 2013;382(9902):1405-12.
259. Rocca WA, Petersen RC, Knopman DS, Hebert LE, Evans DA, Hall KS, et al. Trends in the incidence and prevalence of Alzheimer's disease, dementia, and cognitive impairment in the United States. *Alzheimers Dement* 2011;7(1):80-93.
260. Wiberg P, Waern M, Billstedt E, Östling S, Skoog I. Secular trends in the prevalence of dementia and depression in Swedish septuagenarians 1976-2006. *Psychol Med* 2013;43:2627-34.
261. Wimo A, Sjölund BM, Sköldunger A, Qiu C, Klarin I, Nordberg G, et al. Cohort effects in the prevalence and survival of people with dementia in a rural area in Northern Sweden. *J Alzheimers Dis* 2016;50:387-96.
262. Hall KS, Gao S, Baiyewu O, Lane KA, Gureje O, Shen J, et al. Prevalence rates for dementia and Alzheimer's disease in African Americans: 1992 versus 2000. *Alzheimers Dement* 2009;5(3):227-33.
263. Wu YT, Beiser AS, Breteler MMB, Fratiglioni L, Helmer C, Hendrie HC, et al. The changing prevalence and incidence of dementia over time: Current evidence. *Nat Rev Neurol* 2017;13(6):327-39.
264. Schrijvers EM, Verhaaren BF, Koudstaal PJ, Hofman A, Ikram MA, Breteler MM. Is dementia incidence declining? Trends in dementia incidence since 1990 in the Rotterdam Study. *Neurology* 2012;78(19):1456-63.
265. Qiu C, von Strauss E, Backman L, Winblad B, Fratiglioni L. Twenty-year changes in dementia occurrence suggest decreasing incidence in central Stockholm, Sweden. *Neurology* 2013;80(20):1888-94.
266. Satizabal CL, Beiser AS, Chouraki V, Chene G, Dufouil C, Seshadri S. Incidence of dementia over three decades in the Framingham Heart Study. *N Engl J Med* 2016;374:523-32.
267. Cerasuolo JO, Cipriano LE, Sposato LA, Kapral MK, Fang J, Gill SS, et al. Population-based stroke and dementia incidence trends: Age and sex variations. *Alzheimers Dement* 2017;13(10):1081-8.

268. Derby CA, Katz MJ, Lipton RB, Hall CB. Trends in dementia incidence in a birth cohort analysis of the Einstein Aging Study. *JAMA Neurol* 2017;74(11):1345-51.
269. Ahmadi-Abhari S, Guzman-Castillo M, Bandosz P, Shipley MJ, Muniz-Terrera G, Singh-Manoux A, et al. Temporal trend in dementia incidence since 2002 and projections for prevalence in England and Wales to 2040: Modelling study. *BMJ* 2017;358:j2856.
270. Sullivan KJ, Dodge HH, Hughes TF, Chang CH, Zhu X, Liu A, et al. Declining incident dementia rates across four population-based birth cohorts. *J Gerontol A Biol Sci Med Sci* 2018. doi: 10.1093/gerona/gly236. [Epub ahead of print].
271. van den Kommer TN, Deeg DJH, van der Flier WM, and Comijs HC. Time trend in persistent cognitive decline: Results from the longitudinal aging study Amsterdam. *J Gerontol B Psychol Sci Soc Sci* 2018;73(Suppl 1):S57-64.
272. Sekita A, Ninomiya T, Tanizaki Y, Doi Y, Hata J, Yonemoto K, et al. Trends in prevalence of Alzheimer's disease and vascular dementia in a Japanese community: The Hisayama Study. *Acta Psychiatr Scand* 2010;122(4):319-25.
273. Crimmins EM, Saito Y, Kim JK, Zhang Y, Sasson I, Hayward MD. Educational differences in the prevalence of dementia and life expectancy with dementia in the United States: Changes from 2000 to 2010. *J Gerontol B Psychol Sci Soc Sci* 2018;73(Suppl 1):S20-28.
274. Choi H, Schoeni RF, Martin LG, Langa K M. Trends in the prevalence and disparity in cognitive limitations of Americans 55-69 years old. *J Gerontol B Psychol Sci Soc Sci* 2018;73 (Suppl 1):S29-37.
275. Langa KM. Is the risk of Alzheimer's disease and dementia declining? *Alzheimers Res Ther* 2015;7(1):34.
276. Larson EB, Yaffe K, Langa KM. New insights into the dementia epidemic. *N Engl J Med* 2013;369(24):2275-7.
277. Weuve J, Rajan KB, Barnes LL, Wilson RS, Evans DA. Secular trends in cognitive performance in older black and white U.S. adults, 1993-2012: Findings from the Chicago Health and Aging Project. *J Gerontol B Psychol Sci Soc Sci* 2018;73 (Suppl 1):S73-81.
278. Prince MJ, Wimo A, Guerchet M, Ali G-C, Wu Y-T, Prina M. *World Alzheimer Report 2015: The Global Impact of Dementia: An Analysis of Prevalence, Incidence, Cost and Trends*; 2015.
279. U.S. Census Bureau. *2017 National Population Projections Tables*. Available at: <https://www.census.gov/data/tables/2017/demo/popproj/2017-summary-tables.html>. Accessed December 4, 2019.
280. Xu JQ, Murphy SL, Kochanek KD, Arias E. *Mortality in the United States, 2018*. NCHS Data Brief; No. 355. Hyattsville, MD: National Center for Health Statistics. 2020.
281. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. *CDC WONDER online database: About Underlying Cause of Death, 1999-2018*. Available at: <https://wonder.cdc.gov/ucd-icd10.html>. Accessed February 14, 2020.
282. World Health Organization. *International Statistical Classification of Diseases and Related Health Problems*. 10th revision. 2nd edition. WHO Press: Geneva, Switzerland; 2004.
283. Kramarow EA, Tejada-Vera B. *Dementia mortality in the United States, 2000-2017*. National Vital Statistics Reports; vol 68 no 2. Hyattsville, MD: National Center for Health Statistics. 2019. https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_02-508.pdf.
284. Burns A, Jacoby R, Luthert P, Levy R. Cause of death in Alzheimer's disease. *Age Ageing* 1990;19(5):341-4.
285. Brunnstrom HR, Englund EM. Cause of death in patients with dementia disorders. *Eur J Neurol* 2009;16(4):488-92.
286. Ives DG, Samuel P, Psaty BM, Kuller LH. Agreement between nosologist and Cardiovascular Health Study review of deaths: Implications of coding differences. *J Am Geriatr Soc* 2009;57(1):133-9.
287. Romero JP, Benito-Leon J, Mitchell AJ, Trincado R, Bermejo-Pareja F. Under reporting of dementia deaths on death certificates using data from a population-based study (NEDICES). *J Alzheimers Dis* 2014;39(4):741-8.
288. Romero JP, Benito-Leon J, Louis ED, Bermejo-Pareja F. Under reporting of dementia deaths on death certificates: A systematic review of population-based cohort studies. *J Alzheimers Dis* 2014;41(1):213-21.
289. Ganguli M, Rodriguez EG. Reporting of dementia on death certificates: A community study. *J Am Geriatr Soc* 1999;47(7):842-9.
290. James BD, Leurgans SE, Hebert LE, Scherr PA, Yaffe K, Bennett DA. Contribution of Alzheimer disease to mortality in the United States. *Neurology* 2014;82(12):1045-50.
291. Unpublished tabulations based on data from the National 5% Sample Medicare Fee-for-Service Beneficiaries for 2014. Prepared under contract by Avalere Health, January 2016.
292. Weuve J, Hebert LE, Scherr PA, Evans DA. Deaths in the United States among persons with Alzheimer's disease (2010-2050). *Alzheimers Dement* 2014;10(2):E40-6.
293. Arrighi HM, Neumann PJ, Lieberburg IM, Townsend RJ. Lethality of Alzheimer disease and its impact on nursing home placement. *Alzheimer Dis Assoc Disord* 2010;24(1):90-5.
294. Tejada-Vera B. *Mortality from Alzheimer's disease in the United States: Data for 2000 and 2010*. National Center for Health Statistics Data Brief, No. 116. National Center for Health Statistics, Hyattsville, MD; 2013.
295. Taylor C, Greenlund S, McGuire L, Lu H, Croft J. *Deaths from Alzheimer's Disease — United States, 1999-2014*. *MMWR Morb Mortal Wkly Rep* 2017;66:521-6.
296. Ganguli M, Dodge HH, Shen C, Pandav RS, DeKosky ST. Alzheimer disease and mortality: A 15-year epidemiological study. *Arch Neurol* 2005;62(5):779-84.
297. Waring SC, Doody RS, Pavlik VN, Massman PJ, Chan W. Survival among patients with dementia from a large multi-ethnic population. *Alzheimer Dis Assoc Disord* 2005;19(4):178-83.
298. Brookmeyer R, Corrada MM, Curriero FC, Kawas C. Survival following a diagnosis of Alzheimer disease. *Arch Neurol* 2002;59(11):1764-7.
299. Larson EB, Shadlen MF, Wang L, McCormick WC, Bowen JD, Teri L, et al. Survival after initial diagnosis of Alzheimer disease. *Ann Intern Med* 2004;140(7):501-9.
300. Helzner EP, Scarmeas N, Cosentino S, Tang MX, Schupf N, Stern Y. Survival in Alzheimer disease: A multiethnic, population-based study of incident cases. *Neurology* 2008;71(19):1489-95.
301. Xie J, Brayne C, Matthews FE. Survival times in people with dementia: Analysis from a population based cohort study with 14-year follow-up. *BMJ* 2008;336(7638):258-62.
302. Brodaty H, Seeher K, Gibson L. Dementia time to death: A systematic literature review on survival time and years of life lost in people with dementia. *Int Psychogeriatr* 2012;24(7):1034-45.
303. Todd S, Barr S, Roberts M, Passmore AP. Survival in dementia and predictors of mortality: A review. *Int J Geriatr Psychiatry* 2013;28(11):1109-24.
304. Mitchell SL, Teno JM, Miller SC, Mor V. A national study of the location of death for older persons with dementia. *J Am Geriatr Soc* 2005;53(2):299-305.
305. U.S. Burden of Disease Collaborators, Mokdad AH, Ballestreros K, et al. The state of U.S. health, 1990-2016: Burden of diseases, injuries, and risk factors among U.S. states. *JAMA* 2018;319(14):1444-72.
306. Gaugler JE, Kane RL, Kane RA. Family care for older adults with disabilities: Toward more targeted and interpretable research. *Int J Aging Hum Dev* 2002;54(3):205-31.
307. Schulz R, Quittner AL. Caregiving through the life-span: Overview and future directions. *Health Psychol* 1998;17:107-11.
308. Friedman EM, Shih RA, Langa KM, Hurd MD. U.S. prevalence and predictors of informal caregiving for dementia. *Health Aff* 2015;34(10):1637-41.
309. Spillman B, Wolff J, Freedman VA, Kasper JD. *Informal Caregiving for Older Americans: An Analysis of the 2011 National Health and Aging Trends Study*. Available at: <https://aspe.hhs.gov/pdf-report/informal-caregiving-older-americans-analysis-2011-national-health-and-aging-trends-study>. Accessed December 4, 2019.

310. Walmart: 2019 Annual Report. Available at: https://s2.q4cdn.com/056532643/files/doc_financials/2019/annual/Walmart-2019-AR-Final.pdf. Accessed December 4, 2019.
311. McDonald's Corporation Report 2018. Available at: https://corporate.mcdonalds.com/content/dam/gwscorp/nfl/investor-relations-content/annual-reports/McDonalds_2018_Annual_Report.pdf. Accessed December 4, 2019.
312. Jutkowitz E, Kane RL, Gaugler JE, MacLehose RF, Dowd B, Kuntz KM. Societal and family lifetime cost of dementia: Implications for policy. *J Am Geriatr Soc* 2017;65(10):2169-75.
313. Official Data Foundation. CPI inflation calculator. Available at: <http://www.in2013dollars.com/2017-dollars-in-2018?amount=139765>. Accessed December 4, 2019.
314. Deb A, Thornton JD, Sambamoorthi U, Innes K. Direct and indirect cost of managing alzheimer's disease and related dementias in the United States. *Expert Rev Pharmacoecon Outcomes Res* 2017;17(2):189-202.
315. Greenwood N, Smith R. Motivations for being informal carers of people living with dementia: A systematic review of qualitative literature. *BMC Geriatr* 2019;19(1):169.
316. Kasper JD, Freedman VA, Spillman BC, Wolff JL. The disproportionate impact of dementia on family and unpaid caregiving to older adults. *Health Aff* 2015;34(10):1642-49.
317. Ornstein KA, Wolff JL, Bollens-Lund E, Rahman OK, Kelley AS. Spousal caregivers are caregiving alone in the last years of life. *Health Aff (Millwood)* 2019;38(6):964-72.
318. Alzheimer's Association. Issues Brief: LGBT and Dementia. Available at: <https://www.alz.org/media/Documents/lgbt-dementia-issues-brief.pdf>. Accessed December 4, 2019.
319. Kasper JD, Freedman VA, Spillman BC. Disability and Care Needs of Older Americans by Dementia Status: An Analysis of the 2011 National Health and Aging Trends Study. U.S. Department of Health and Human Services; 2014. Available at: <http://aspe.hhs.gov/report/disability-and-care-needs-older-americans-dementia-status-analysis-2011-national-health-and-aging-trends-study>. Accessed December 4, 2019.
320. Rabarison KM, Bouldin ED, Bish CL, McGuire LC, Taylor CA, Greenlund KJ. The economic value of informal caregiving for persons with dementia: Results from 38 states, the District of Columbia, and Puerto Rico, 2015 and 2016 BRFSS. *Am J Public Health* 2018;108(10):1370-7.
321. Langa KM, Plassman BL, Wallace RB, Herzog AR, Heeringa SG, Ofstedal MB, et al. The Aging, Demographics, and Memory Study: Study design and methods. *Neuroepidemiology* 2005;25(4):181-91.
322. Fisher GG, Franks MM, Plassman BL, Brown SL, Potter GG, Llewellyn D, et al. Caring for individuals with dementia and cognitive impairment, not dementia: Findings from The Aging, Demographics, and Memory Study. *J Am Geriatr Soc* 2011;59(3):488-94.
323. National Alliance for Caregiving in Partnership with the Alzheimer's Association. Dementia Caregiving in the U.S. Bethesda, MD. Available at: http://www.caregiving.org/wp-content/uploads/2017/02/DementiaCaregivingFINAL_WEB.pdf. Accessed December 4, 2019.
324. Unpublished data from the 2015, 2016 and 2017 Behavioral Risk Factor Surveillance System survey, analyzed by and provided to the Alzheimer's Association by the Alzheimer's Disease and Healthy Aging Program (AD+HP), Centers for Disease Control and Prevention (CDC).
325. Riffin C, Van Ness PH, Wolff JL, Fried T. Family and other unpaid caregivers and older adults with and without dementia and disability. *J Am Geriatr Soc* 2017;65(8):1821-8.
326. National Poll on Healthy Aging. Dementia Caregivers: Juggling, Delaying and Looking Forward. Available at: http://www.healthyagingpoll.org/sites/default/files/2017-10/NPHA_Caregivers-Report-PROOF_101817_v2.pdf. Accessed December 4, 2019.
327. National Alliance for Caregiving and AARP. Caregiving in the U.S.: Unpublished data analyzed under contract for the Alzheimer's Association; 2009.
328. Alzheimer's Association. 2014 Alzheimer's Disease Facts and Figures. *Alzheimer Dement* 2014;10(2):e47-e92.
329. Pinquart M, Sörensen. Gender differences in caregiver stressors, social resources, and health: An updated meta-analysis. *J Gerontol B Psychol Sci Soc Sci* 2006;61(1):P33-45. Available at: <http://psychsocgerontology.oxfordjournals.org/content/61/1/P33.long>. Accessed December 4, 2019.
330. Ma M, Dorstyn D, Ward L, Prentice S. Alzheimer's disease and caregiving: A meta-analytic review comparing the mental health of primary carers to controls. *Aging Ment Health* 2017;5:1-11.
331. National Alliance for Caregiving and AARP. Caregiving in the U.S. (2015). Available at: http://www.caregiving.org/wp-content/uploads/2015/05/2015_CaregivingintheUS_Final-Report-June-4_WEB.pdf. Accessed December 4, 2019.
332. Spillman BC, Freedman VA, Kasper JD, Wolff JL. Change over time in caregiving networks for older adults with and without dementia. *J Gerontol B Psychol Sci Soc Sci* 2019 May 18. pii: gbz065. doi: 10.1093/geronb/gbz065. [Epub ahead of print].
333. Garity J. Caring for a family member with Alzheimer's disease: Coping with caregiver burden post-nursing home placement. *J Gerontol Nurs* 2006;32(6):39-48.
334. Port CL, Zimmerman S, Williams CS, Dobbs D, Preisser JS, Williams SW. Families filling the gap: Comparing family involvement for assisted living and nursing home residents with dementia. *Gerontologist* 2005;45(Special Issue 1):87-95.
335. Schulz R, Belle SH, Czaja SJ, McGinnis KA, Stevens A, Zhang S. Long-term care placement of dementia patients and caregiver health and well-being. *JAMA* 2004;292(8):961-7.
336. Rattinger GB, Schwartz S, Mullins CD, Corcoran C, Zuckerman IH, Sanders C, et al. Dementia severity and the longitudinal costs of informal care in the Cache County population. *Alzheimers Dement* 2015;11(8):946-54.
337. Rattinger GB, Fauth EB, Behrens S, Sanders C, Schwartz S, Norton MC, et al. Closer caregiver and care-recipient relationships predict lower informal costs of dementia care: The Cache County Dementia Progression Study. *Alzheimers Dement* 2016;12(8):917-24.
338. Wolff JL, Mulcahy J, Huang J, Roth DL, Covinsky K, Kasper JD. Family Caregivers of Older Adults, 1999-2015: Trends in characteristics, circumstances, and role-related appraisal. *Gerontologist* 2018;58(6):1021-32.
339. Ornstein K, Gaugler JE. The problem with "problem behaviors": A systematic review of the association between individual patient behavioral and psychological symptoms and caregiver depression and burden within the dementia patient-caregiver dyad. *Int Psychogeriatr* 2012;24(10):1536-52.
340. Vaingankar JA, Chong SA, Abidin E, Picco L, Shafie S, Seow E, et al. Psychiatric morbidity and its correlates among informal caregivers of older adults. *Compr Psychiatry* 2016;68:178-85.
341. Feast A, Moniz-Cook E, Stoner C, Charlesworth G, Orrell M. A systematic review of the relationship between behavioral and psychological symptoms (BPSD) and caregiver well-being. *Int Psychogeriatr* 2016;28(11):1761-74.
342. Kiecolt-Glaser JK, Glaser R, Gravenstein S, Malarkey WB, Sheridan J. Chronic stress alters the immune response to influenza virus vaccine in older adults. *Proc Natl Acad Sci* 1996;93:3043-7.
343. Schulz R, Beach SR. Caregiving as a risk factor for mortality: The Caregiver Health Effects Study. *JAMA* 1999;282:2215-60.
344. Vitaliano PP, Zhang J, Scanlan JM. Is caregiving hazardous to one's physical health? A meta-analysis. *Psychol Bull* 2003;129(6):946-72.
345. Liu W, Gallagher-Thompson D. Impact of dementia caregiving: Risks, strains, and growth. In: Qualls SH, Zarit SH, eds. *Aging families and caregiving*. Hoboken, NJ: John Wiley & Sons, Inc.; 2009: p. 85-112.
346. Pinquart M, Sörensen S. Associations of stressors and uplifts of caregiving with caregiver burden and depressive mood: A meta-analysis. *J Gerontol B Psychol Sci Soc Sci* 2003;58(2):112-28.

347. Sörensen S, Duberstein P, Gill D, Pinquart M. Dementia care: Mental health effects, intervention strategies, and clinical implications. *Lancet Neurol* 2006;5(11):961-73.
348. Goren A, Montgomery W, Kahle-Wroblewski K, Nakamura T, Ueda K. Impact of caring for persons with Alzheimer's disease or dementia on caregivers' health outcomes: Findings from a community based survey in Japan. *BMC Geriatr* 2016;16:122.
349. Alzheimer's Association. 2016 Alzheimer's Disease Facts and Figures. *Alzheimer Dement* 2016;12(4):459-509.
350. Jones RW, Lebec J, Kahle-Wroblewski K, Dell'Agnello G, Bruno G, Vellas B, et al. Disease progression in mild dementia due to Alzheimer disease in an 18-month observational study (GERAS): The impact on costs and caregiver outcomes. *Dement Geriatr Cogn Dis Extra* 2017;7(1):87-100.
351. Quinn C, Toms G. Influence of positive aspects of dementia caregiving on caregivers' well-being: A systematic review. *Gerontologist* 2018. doi:10.1093/geront/gny168.
352. Zarit SH. Positive aspects of caregiving: More than looking on the bright side. *Aging Ment Health* 2012;16(6):673-74.
353. Cheng ST, Mak EP, Lau RW, Ng NS, Lam LC. Voices of Alzheimer caregivers on positive aspects of caregiving. *Gerontologist* 2016;56(3):451-60.
354. Monin JK, Schulz R, Feeney BC. Compassionate love in individuals with Alzheimer's disease and their spousal caregivers: Associations with caregivers' psychological health. *Gerontologist* 2015;55(6):981-9.
355. Roth DL, Dilworth-Anderson P, Huang J, Gross AL, Gitlin LN. Positive aspects of family caregiving for dementia: Differential item functioning by race. *J Gerontol B Psychol Sci Soc Sci* 2015;70(6):813-9.
356. Lloyd J, Patterson T, Muers J. The positive aspects of caregiving in dementia: A critical review of the qualitative literature. *Dementia (London)* 2016;15(6):1534-61.
357. Yu DSF, Cheng ST, Wang J. Unravelling positive aspects of caregiving in dementia: An integrative review of research literature. *Int J Nurs Stud* 2018;79:1-26.
358. Schulz R, O'Brien AT, Bookwala J, Fleissner K. Psychiatric and physical morbidity effects of dementia caregiving: Prevalence, correlates, and causes. *Gerontologist* 1995;35(6):771-91.
359. Baumgarten M, Battista RN, Infante-Rivard C, Hanley JA, Becker R, Gauthier S. The psychological and physical health of family members caring for an elderly person with dementia. *J Clin Epidemiol* 1992;45(1):61-70.
360. Mausbach BT, Chattillion EA, Roepke SK, Patterson TL, Grant I. A comparison of psychosocial outcomes in elderly Alzheimer caregivers and noncaregivers. *Am J Geriatr Psychiatry* 2013;21(1):5-13.
361. Kessler RC, Chiu WT, Demler O, Merikangas KR, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry* 2005;62:617-27.
362. Sallim AB, Sayampanathan AA, Cuttilan A, Chun-Man Ho R. Prevalence of mental health disorders among caregivers of patients with Alzheimer disease. *J Am Med Dir Assoc* 2015;16(12):1034-41.
363. Atteih S, Mellon L, Hall P, Brewer L, Horgan F, Williams D, et al. Implications of stroke for caregiver outcomes: Findings from the ASPIRE-S Study. *Int J Stroke* 2015;10:918-23.
364. Thunyadee C, Sitthimongkol Y, Sangon S, Chai-Aroon T, Hegadoren KM. Predictors of depressive symptoms and physical health in caregivers of individuals with schizophrenia. *J Nurs Health Sci* 2015;17:412-9.
365. Collins RN, Kishita N. Prevalence of depression and burden among informal care-givers of people with dementia: A meta-analysis. *Ageing and Society*, 1-38. doi:10.1017/S0144686X19000527.
366. Vitaliano PP, Ustundag O, Borson S. Objective and subjective cognitive problems among caregivers and matched non-caregivers. *Gerontologist* 2017;57(4):637-47.
367. Dassel KB, Carr DC, Vitaliano P. Does caring for a spouse with dementia accelerate cognitive decline? Findings from the Health and Retirement Study. *Gerontologist* 2017;57(2):319-28.
368. Arthur PB, Gitlin LN, Kairalla JA, Mann WC. Relationship between the number of behavioral symptoms in dementia and caregiver distress: What is the tipping point? *Int Psychogeriatr* 2018;30(8):1099-107.
369. Gillespie R, Mullan J, Harrison L. Managing medications: The role of informal caregivers of older adults and people living with dementia: A review of the literature. *J Clin Nurs* 2014;23(23-24):3296-308.
370. Alsaeed D, Jamieson E, Gul MO, Smith FJ. Challenges to optimal medicines use in people living with dementia and their caregivers: A literature review. *Int J Pharm* 2016;512(2):396-404.
371. Polenick CA, Stanz SD, Leggett AN, Maust DT, Hodgson NA, Kales HC. Stressors and resources related to medication management: Associations with spousal caregivers' role overload. *Gerontologist* 2018. doi:10.1093/geront/gny130. [Epub ahead of print].
372. Aston L, Hilton A, Moutela T, Shaw R, Maidment I. Exploring the evidence base for how people with dementia and their informal carers manage their medication in the community: A mixed studies review. *BMC Geriatr* 2017;17(1):242.
373. Badana ANS, Marino V, Haley WE. Racial differences in caregiving: Variation by relationship type and dementia care status. *J Aging Health* 2019;31(6):925-46.
374. Gaugler JE, Mittelman MS, Hepburn K, Newcomer R. Clinically significant changes in burden and depression among dementia caregivers following nursing home admission. *BMC Medicine* 2010;8:85.
375. Mausbach BT, Chattillion EA, Ho J, Flynn LM, Tiznado D, von Känel R, et al. Why does placement of persons with Alzheimer's disease into long-term care improve caregivers' well-being? Examination of psychological mediators. *Psychol Aging* 2014;29(4):776-86.
376. Peacock SC. The experience of providing end-of-life care to a relative with advanced dementia: An integrative literature review. *Palliat Support Care* 2013;11(2):155-68.
377. Schulz R, Mendelsohn AB, Haley WE, Mahoney D, Allen RS, Zhang S, et al. End-of-life care and the effects of bereavement on family caregivers of persons with dementia. *N Engl J Med* 2003;349(20):1936-42.
378. Fonareva I, Oken BS. Physiological and functional consequences of caregiving for relatives with dementia. *Int Psychogeriatr* 2014;26(5):725-47.
379. von Känel R, Mausbach BT, Ancoli-Israel S, Mills PJ, Dimsdale JE, Patterson TL, et al. Positive affect and sleep in spousal Alzheimer caregivers: A longitudinal study. *Behav Sleep Med* 2014;12(5):358-72.
380. Peng H-L, Chang Y-P. Sleep disturbance in family caregivers of individuals with dementia: A review of the literature. *Perspect Psychiatr C* 2012;49(2):135-46.
381. Gao C, Chapagain NY, Scullin MK. Sleep Duration and Sleep Quality in caregivers of patients with dementia: A systematic review and meta-analysis. *JAMA Netw Open* 2019;2(8):e199891.
382. Välimäki TH, Martikainen JA, Hongisto K, Väättäin S, Sintonen H, Koivisto AM. Impact of Alzheimer's disease on the family caregiver's long-term quality of life: Results from an ALSOVA follow-up study. *Qual Life Res* 2016;25(3):687-97.
383. Bremer P, Cabrera E, Leino-Kilpi H, Lethin C, Saks K, Sutcliffe C. Informal dementia care: Consequences for caregivers' health and health care use in 8 European countries. *Health Policy* 2015;119(11):1459-71.
384. MetLife Mature Market Institute. The MetLife Study of Alzheimer's Disease: The Caregiving Experience; August 2006. Available at: <http://docplayer.net/20982840-The-metlife-study-of-alzheimer-s-disease-the-caregiving-experience.html>. Accessed December 4, 2019.
385. Dassel KB, Carr DC. Does dementia caregiving accelerate frailty? Findings from the Health and Retirement Study. *Gerontologist* 2016;56(3):444-50.

386. Fredman L, Bertrand RM, Martire LM, Hochberg M, Harris EL. Leisure-time exercise and overall physical activity in older women caregivers and non-caregivers from the Caregiver-SOF Study. *Prev Med* 2006;43:226-9.
387. Rote SM, Angel JL, Moon H, Markides K. Caregiving Across Diverse Populations: New Evidence From the National Study of Caregiving and Hispanic EPESE. *Innov Aging* 2019;3(2):igz033.
388. von Kanel R, Dimsdale JE, Mills PJ, Ancoli-Israel S, Patterson TL, Mausbach BT, et al. Effect of Alzheimer caregiving stress and age on frailty markers interleukin-6, C-reactive protein, and D-dimer. *J Gerontol A Biol Sci Med Sci* 2006;61(9):963-9.
389. Kiecolt-Glaser JK, Dura JR, Speicher CE, Trask OJ, Glaser R. Spousal caregivers of dementia victims: Longitudinal changes in immunity and health. *Psychosom Med* 1991;53:345-62.
390. Kiecolt-Glaser JK, Marucha PT, Mercado AM, Malarkey WB, Glaser R. Slowing of wound healing by psychological stress. *Lancet* 1995;346(8984):1194-6.
391. Vitaliano PP, Scanlan JM, Zhang J, Savage MV, Hirsch IB, Siegler I. A path model of chronic stress, the metabolic syndrome, and coronary heart disease. *Psychosom Med* 2002;64:418-35.
392. Mausbach BT, Romero-Moreno R, Bos T, von Kanel R, Ziegler MG, Allison MA, et al. Engagement in pleasant leisure activities and blood pressure: A 5-year longitudinal study in Alzheimer caregivers. *Psychosom Med* 2017;79(7):735-41.
393. Shaw WS, Patterson TL, Ziegler MG, Dimsdale JE, Semple SJ, Grant I. Accelerated risk of hypertensive blood pressure recordings among Alzheimer caregivers. *J Psychosom Res* 1999;46(3):215-27.
394. Mausbach BT, Roepke SK, Ziegler MG, Milic M, Von Kanel R, Dimsdale JE, et al. Association between chronic caregiving stress and impaired endothelial function in the elderly. *J Am Coll Cardiol* 2010;55(23):2599-606.
395. Allen AP, Curran EA, Duggan Á, Cryan JF, Chorcoráin AN, Dinan TG, et al. A systematic review of the psychobiological burden of informal caregiving for patients with dementia: Focus on cognitive and biological markers of chronic stress. *Neurosci Biobehav Rev* 2017;73:123-64.
396. Roth DL, Sheehan OC, Haley WE, Jenny NS, Cushman M, Walston JD. Is family caregiving associated with inflammation or compromised immunity? A meta-analysis. *Gerontologist* 2019;59(5):e521-e534.
397. Schubert CC, Boustani M, Callahan CM, Perkins AJ, Hui S, Hendrie HC. Acute care utilization by dementia caregivers within urban primary care practices. *J Gen Intern Med* 2008;23(11):1736-40.
398. Zhu CW, Scarmeas N, Ornstein K, Albert M, Brandt J, Blacker D, et al. Health-care use and cost in dementia caregivers: Longitudinal results from the Predictors Caregiver Study. *Alzheimers Dement* 2015;11(4):444-54.
399. Leggett AN, Sonnega AJ, Lohman MC. Till death do us part: Intersecting health and spousal dementia caregiving on caregiver mortality. *J Aging Health* 2019. doi: 10.1177/0898264319860975. [Epub ahead of print].
400. Roth DL, Fredman L, Haley WE. Informal caregiving and its impact on health: A reappraisal from population-based studies. *Gerontologist* 2015;55(2):309-19.
401. Christakis NA, Allison PD. Mortality after the hospitalization of a spouse. *N Engl J Med* 2006;354:719-30.
402. Perkins M, Howard VJ, Wadley VG, Crowe M, Safford MM, Haley WE, et al. Caregiving strain and all-cause mortality: Evidence from the REGARDS Study. *J Gerontol B Psychol Sci Soc Sci* 2013;68(4):504-12.
403. Gaugler JE, Jutkowitz E, Peterson CM, Zmora R. Caregivers dying before care recipients with dementia. *Alzheimers Dement (NY)* 2018;4:688-93.
404. National Academies of Sciences, Engineering, and Medicine. Families Caring for an Aging America. Washington, D.C.: The National Academies Press; 2016.
405. Albert SM, Schulz R. The MetLife Study of working caregivers and employer health care costs. New York, N.Y.: MetLife Mature Market Institute; 2010.
406. Gaugler JE, Pestka DL, Davila H, Sales R, Owen G, Baumgartner SA, et al. The complexities of family caregiving at work: A mixed-methods study. *Int J Aging Hum Dev* 2018;87(4):347-76.
407. AARP. Family Caregiving and Out-of-Pocket Costs: 2016 Report. Available at: https://www.aarp.org/content/dam/aarp/research/surveys_statistics/lrc/2016/family-caregiving-costs-fact-sheet.doi.10.26419%252Fres.00138.002.pdf. Accessed December 4, 2019.
408. Stall NM, Kim SJ, Hardacre KA, Shah PS, Straus SE, Bronskill SE, et al. Association of informal caregiver distress with health outcomes of community-dwelling dementia care recipients: A systematic review. *J Am Geriatr Soc* 2019;67(3):609-17.
409. Gaugler JE, Jutkowitz E, Shippee TP, Brasure M. Consistency of dementia caregiver intervention classification: An evidence-based synthesis. *Int Psychogeriatr* 2017;29(1):19-30.
410. Gitlin LN, Hodgson N. Caregivers as therapeutic agents in dementia care: The evidence-base for interventions supporting their role. In: Gaugler JE, Kane RL, eds. *Family caregiving in the new normal*. Philadelphia, Pa.: Elsevier, Inc.; 2015: p. 305-56.
411. Williams F, Moghaddam N, Ramsden S, De Boos D. Interventions for reducing levels of burden amongst informal carers of persons with dementia in the community. A systematic review and meta-analysis of randomised controlled trials. *Aging Ment Health* 2019;23(12):1629-42.
412. Kaddour L, Kishita N, Schaller A. A meta-analysis of low-intensity cognitive behavioral therapy-based interventions for dementia caregivers. *Int Psychogeriatr* 2018:1-16.
413. Nguyen H, Terry D, Phan H, Vickers J, McInerney F. Communication training and its effects on carer and care-receiver outcomes in dementia settings: A systematic review. *J Clin Nurs* 2019;28(7-8):1050-69.
414. Jütten LH, Mark RE, Wicherts JM, Sitskoorn MM. The effectiveness of psychosocial and behavioral interventions for informal dementia caregivers: Meta-analyses and meta-regressions. *J Alzheimers Dis* 2018;66(1):149-72.
415. Maslow K. *Translating Innovation to Impact: Evidence-Based Interventions to Support People with Alzheimer's Disease and their Caregiver at Home and in the Community*. Washington, D.C.: Administration on Aging; 2012. Available at: https://nadr.acl.gov/sites/default/files/uploads/docs/TranslatingInnovationtoImpactAlzheimersDisease_0.pdf. Accessed December 4, 2019.
416. Rosalynn Carter Institute for Caregiving. Caregiver Intervention Database. Available at: <https://www.rosalynncarter.org/research/caregiver-intervention-database/>. Accessed December 4, 2019.
417. Liew TM, Lee CS. Reappraising the efficacy and acceptability of multicomponent interventions for caregiver depression in dementia: The utility of network meta-analysis. *Gerontologist* 2019;59(4):e380-e392.
418. Teri L, Logsdon RG, McCurry SM, Pike KC, McGough EL. Translating an evidence-based multicomponent intervention for older adults with dementia and caregivers. *Gerontologist* 2018;Oct 9. doi: 10.1093/geront/gny122. [Epub ahead of print].
419. Menne HL, Bass DM, Johnson JD, Primitica B, Kearney KR, Bollin S, et al. Statewide implementation of "reducing disability in Alzheimer's disease": Impact on family caregiver outcomes. *J Gerontol Soc Work* 2014;57(6-7):626-39.
420. Teri L, McKenzie G, Logsdon RG, McCurry SM, Bollin S, Mead J, et al. Translation of two evidence-based programs for training families to improve care of persons with dementia. *Gerontologist* 2012;52(4):452-9.
421. Gitlin LN, Jacobs M, Earland TV. Translation of a dementia caregiver intervention for delivery in homecare as a reimbursable Medicare service: Outcomes and lessons learned. *Gerontologist* 2010;50(6):847-54.
422. Burgio LD, Collins IB, Schmid B, Wharton T, McCallum D, Decoster J. Translating the REACH caregiver intervention for use by area agency on aging personnel: The REACH OUT program. *Gerontologist* 2009;49(1):103-16.

423. Mittelman MS, Bartels SJ. Translating research into practice: Case study of a community-based dementia caregiver intervention. *Health Aff* 2014;33(4):587-95.
424. Cheung KS, Lau BH, Wong PW, Leung AY, Lou VW, Chan GM, et al. Multicomponent intervention on enhancing dementia caregiver well-being and reducing behavioral problems among Hong Kong Chinese: A translational study based on REACH II. *Int J Geriatr Psychiatry* 2015;30(5):460-9.
425. Samia LW, Abouessa AM, Halloran J, Hepburn K. The Maine Savvy Caregiver Project: Translating an evidence-based dementia family caregiver program within the RE-AIM Framework. *J Gerontol Soc Work* 2014;57(6-7):640-61.
426. Lykens K, Moayad N, Biswas S, Reyes-Ortiz C, Singh KP. Impact of a community based implementation of REACH II program for caregivers of Alzheimer's patients. *PLoS One* 2014;9(2):e89290.
427. Menne HL, Bass DM, Johnson JD, Kearney KR, Bollin S, Teri L. Program components and outcomes of individuals with dementia: Results from the replication of an evidence-based program. *J Appl Gerontol* 2017;36(5):537-52.
428. Primitica B, Menne HL, Bollin S, Teri L, Molea M. Evidence-Based Program replication: Translational activities, experiences, and challenges. *J Appl Gerontol* 2015;34(5):652-70.
429. Fortinsky RH, Gitlin LN, Pizzi LT, Piersol CV, Grady J, Robison JT, et al. Translation of the care of persons with dementia in their environments (COPE) intervention in a publicly-funded home care context: Rationale and research design. *Contemp Clin Trials* 2016;49:155-65.
430. Nichols LO, Martindale-Adams J, Burns R, Zuber J, Graney MJ. REACH VA: Moving from translation to system implementation. *Gerontologist* 2016;56(1):135-44.
431. McCurry SM, Logsdon RG, Pike KC, LaFazia DM, Teri L. Training Area Agencies on Aging case managers to improve physical function, mood, and behavior in persons with dementia and caregivers: Examples from the RDAD-Northwest Study. *J Gerontol Soc Work* 2018;61(1):45-60.
432. Czaja SJ, Lee CC, Perdomo D, Loewenstein D, Bravo M, Moxley JH, et al. Community REACH: An implementation of an evidence-based caregiver program. *Gerontologist* 2018;58(2):e130-7.
433. Fauth EB, Jackson MA, Walberg DK, Lee NE, Easom LR, Alston G, et al. External validity of the New York University Caregiver Intervention: Key caregiver outcomes across multiple demonstration projects. *J Appl Gerontol* 2019;38(9):1253-81.
434. Boustani M, Alder CA, Solid CA. Agile implementation: A blueprint for implementing evidence-based healthcare solutions. *J Am Geriatr Soc* 2018;66(7):1372-6.
435. Boots LM, de Vugt ME, van Knippenberg RJ, Kempen GI, Verhey FR. A systematic review of internet-based supportive interventions for caregivers of patients with dementia. *Int J Geriatr Psych* 2015;29(4):331-44.
436. Czaja SJ, Loewenstein D, Schulz R, Nair SN, Perdomo D. A videophone psychosocial intervention for dementia caregivers. *Am J Geriatr Psychiatry* 2013;21(11):1071-81.
437. Griffiths PC, Whitney MK, Kovaleva M, Hepburn K. Development and implementation of tele-savvy for dementia caregivers: A Department of Veterans Affairs Clinical Demonstration Project. *Gerontologist* 2016;56(1):145-54.
438. Brown EL, Ruggiano N, Li J, Clarke PJ, Kay ES, Hristidis V. Smartphone-based health technologies for dementia care: Opportunities, challenges, and current practices. *J Appl Gerontol* 2019;38(1):73-91.
439. Grossman MR, Zak DK, Zelinski EM. Mobile Apps for caregivers of older adults: Quantitative content analysis. *JMIR mHealth and uHealth* 2018;6(7):e162.
440. Gaugler JE, Zmora R, Mitchell LL, Finlay JM, Peterson CM, McCarron H, et al. Six-month effectiveness of remote activity monitoring for persons living with dementia and their family caregivers: An experimental mixed methods study. *Gerontologist* 2019;59(1):78-89.
441. Waller A, Dilworth S, Mansfield E, Sanson-Fisher R. Computer and telephone delivered interventions to support caregivers of people with dementia: A systematic review of research output and quality. *BMC Geriatr* 2017;17(1):265.
442. Hopwood J, Walker N, McDonagh L, Rait G, Walters K, Iliffe S, et al. Internet-based interventions aimed at supporting family caregivers of people with dementia: Systematic review. *J Med Internet Res* 2018;20(6):e216.
443. Gitlin LN, Marx K, Scerpella D, Dabelko-Schoeny H, Anderson KA, Huang J, et al. Embedding caregiver support in community-based services for older adults: A multi-site randomized trial to test the Adult Day Service Plus Program (ADS Plus). *Contemp Clin Trials* 2019;83:97-108.
444. Gaugler JE, Potter T, Pruinelli L. Partnering with caregivers. *Clin Geriatr Med* 2014;30(3):493-515.
445. Gitlin LN, Marx K, Stanley IH, Hodgson N. Translating evidence-based dementia caregiving interventions into practice: State-of-the-science and next steps. *Gerontologist* 2015;55(2):210-26.
446. Wethington E, Burgio LD. Translational research on caregiving: Missing links in the translation process. In: Gaugler JE, Kane RL, eds. *Family caregiving in the new normal*. Philadelphia, Pa.: Elsevier, Inc; 2015: p. 193-210.
447. Zarit SH. Past is prologue: How to advance caregiver interventions. *Aging Ment Health* 2017;16:1-6.
448. Kishita N, Hammond L, Dietrich CM, Mioshi E. Which interventions work for dementia family carers?: an updated systematic review of randomized controlled trials of carer interventions. *Int Psychogeriatr* 2018;30(11):1679-96.
449. Zarit SH. Empirically supported treatment for family caregivers. In: Qualls SH, Zarit SH, eds. *Aging families and caregiving*. Hoboken, N.J.: John Wiley & Sons, Inc.; 2009: p. 131-54.
450. Zarit SH, Lee JE, Barrineau MJ, Whitlatch CJ, Femia EE. Fidelity and acceptability of an adaptive intervention for caregivers: An exploratory study. *Aging Ment Health* 2013;17(2):197-206.
451. Van Mierlo LD, Meiland FJ, Van Hout HP, Dröes RM. Toward an evidence-based implementation model and checklist for personalized dementia care in the community. *Int Psychogeriatr* 2016;28(5):801-13.
452. Gaugler JE, Reese M, Tanler R. Care to Plan: An online tool that offers tailored support to dementia caregivers. *Gerontologist* 2016;56(6):1161-74.
453. Jennings LA, Ramirez KD, Hays RD, Wenger NS, Reuben DB. Personalized goal attainment in dementia care: Measuring what persons with dementia and their caregivers want. *J Am Geriatr Soc* 2018;66(11):2120-7.
454. Whitlatch CJ, Orsulic-Jeras S. Meeting the informational, educational, and psychosocial support needs of persons living with dementia and their family caregivers. *Gerontologist* 2018;18;58(Suppl 1):S58-73.
455. Akarsu NE, Prince MJ, Lawrence VC, Das-Munshi J. Depression in carers of people with dementia from a minority ethnic background: Systematic review and meta-analysis of randomised controlled trials of psychosocial interventions. *Int J Geriatr Psychiatry* 2019;34(6):790-806.
456. Gonyea JG, López LM, Velásquez EH. The effectiveness of a culturally sensitive cognitive behavioral group intervention for Latino Alzheimer's caregivers. *Gerontologist* 2016;56(2):292-302.
457. Llanque SM, Enriquez M. Interventions for Hispanic caregivers of patients with dementia: A review of the literature. *Am J Alzheimers Dis Other Demen* 2012;27(1):23-32.
458. Kally Z, Cote SD, Gonzalez J, Villarruel M, Cherry DL, Howland S, et al. The Savvy Caregiver Program: Impact of an evidence-based intervention on the well-being of ethnically diverse caregivers. *J Gerontol Soc Work* 2014;57(6-7):681-93.
459. Kally Z, Cherry DL, Howland S, Villarruel M. Asian Pacific Islander dementia care network: A model of care for underserved communities. *J Gerontol Soc Work* 2014;57(6-7):710-27.

460. Napoles AM, Chadiha L, Eversley R, Moreno-John G. Reviews: Developing culturally sensitive dementia caregiver interventions: Are we there yet? *Am J Alzheimers Dis Other Dement* 2010;25:389-406.
461. Hicken BL, Daniel C, Luptak M, Grant M, Kilian S, Rupper RW. Supporting caregivers of rural veterans electronically (SCORE). *J Rural Health* 2017;33(3):305-13.
462. Graham-Phillips A, Roth DL, Huang J, Dilworth-Anderson P, Gitlin LN. Racial and ethnic differences in the delivery of the resources for enhancing Alzheimer's Caregiver Health II Intervention. *J Am Geriatr Soc* 2016;64(8):1662-7.
463. Martindale-Adams J, Tah T, Finke B, LaCounte C, Higgins BJ, Nichols LO. Implementation of the REACH model of dementia caregiver support in American Indian and Alaska Native communities. *Transl Behav Med* 2017;7(3):427-34.
464. Meyer OL, Liu XL, Tancredi D, Ramirez AS, Schulz R, Hinton L. Acculturation level and caregiver outcomes from a randomized intervention trial to enhance caregivers' health: Evidence from REACH II. *Aging Ment Health* 2017;24:1-8.
465. Fields NL, Xu L, Richardson VE, Parekh R, Ivey D, Feinhals G. The Senior Companion Program Plus: A culturally tailored psychoeducational training program (innovative practice). *Dementia (London)*. 2016 Jan 1:1471301216685626. doi: 10.1177/1471301216685626. [Epub ahead of print]
466. Luchsinger JA, Burgio L, Mittelman M, Dunner I, Levine JA, Hoyos C, et al. Comparative effectiveness of 2 interventions for Hispanic caregivers of persons with dementia. *J Am Geriatr Soc* 2018;66(9):1708-15.
467. Gilmore-Bykovskiy A, Johnson R, Walljasper L, Block L, Werner N. Underreporting of gender and race/ethnicity differences in NIH-funded dementia caregiver support interventions. *Am J Alzheimers Dis Other Dement* 2018;33(3):145-52.
468. Fredriksen-Goldsen KI, Jen S, Bryan AEB, Goldsen J. Cognitive impairment, Alzheimer's disease, and other dementias in the lives of lesbian, gay, bisexual and transgender (LGBT) older adults and their caregivers: Needs and competencies. *J Appl Gerontol* 2018;37(5):545-69.
469. U.S. Department of Health and Human Services. National Research Summit on Care, Services and Supports for Persons with Dementia and their Caregivers. Available at: <https://aspe.hhs.gov/national-research-summit-care-services-and-supports-persons-dementia-and-their-caregivers>. Accessed December 4, 2019.
470. Khatutsky G, Wiener J, Anderson W, Akhmerova V, Jessup EA, Squillace MR. Understanding direct care workers: A snapshot of two of America's most important jobs: Certified nursing assistants and home health aides. Washington, D.C.: U.S. Department of Health and Human Services; 2011.
471. Stone R. The Long-Term Care Workforce: From Accidental to Valued Profession. In: Wolf D, Folbre N, eds. *Universal Coverage of Long-Term Care in the United States: Can We Get There from Here?* New York, NY: Russell Sage Foundation; 2012: 155-78.
472. Jones AL, Dwyer LL, Bercovitz AR, Strahan GW. The National Nursing Home Survey: 2004 Overview. *Vital Health Stat* 13 2009;(167):1-155.
473. Kramer NA, Smith MC. Training nursing assistants to care for nursing home residents with dementia. In: Molinari V, editor. *Professional psychology in long-term care*. New York, N.Y.: Hatherleigh Press; 2000: p. 227-56.
474. McCabe MP, Davison TE, George K. Effectiveness of staff training programs for behavioral problems among older people with dementia. *Aging Ment Health* 2007;11(5):505-19.
475. Beck C, Ortigara A, Mercer S, Shue V. Enabling and empowering certified nursing assistants for quality dementia care. *Int J Geriatr Psychiatry* 1999;14(3):197-211.
476. Institute of Medicine. *Retooling for an Aging America: Building the Health Care Workforce*. Washington, D.C.: The National Academies Press 2008. Available at: <http://www.nationalacademies.org/hmd/reports/2008/retooling-for-an-aging-america-building-the-health-care-workforce.aspx>. Accessed December 4, 2019.
477. Warshaw GA, Bragg EJ. Preparing the health care workforce to care for adults with Alzheimer's disease and related dementias. *Health Aff* 2014;33(4):633-41.
478. American Health Care Association. (2011). *Staffing Survey Report*.
479. Stone RI. Factors affecting the future of family caregiving in the United States. In: JE Gaugler, RL Kane, eds. *Family Caregiving in the New Normal*. San Diego, CA: Elsevier, Inc; 2015: p. 57-77.
480. Elvish R, Burrow S, Cawley R, Harney K, Pilling M, Gregory J, et al. 'Getting to know me': The second phase roll-out of a staff training programme for supporting people with dementia in general hospitals. *Dementia (London)* 2016;pii:1471301216634926 [epub ahead of print].
481. Spector A, Orrell M, Goyder J. A systematic review of staff training interventions to reduce the behavioural and psychological symptoms of dementia. *Ageing Res Rev* 2013;12(1):354-64.
482. Bray J, Evans S, Bruce M, Carter C, Brooker D, Milosevic S, et al. Enabling hospital staff to care for people with dementia. *Nurs Older People* 2015;27(10):29-32.
483. Palmer JL, Lach HW, McGillick J, Murphy-White M, Carroll MB, Armstrong JL. The Dementia Friendly Hospital Initiative education program for acute care nurses and staff. *J Contin Educ Nurs* 2014;45(9):416-24.
484. Surr CA, Smith SJ, Crossland J, Robins J. Impact of a person-centred dementia care training programme on hospital staff attitudes, role efficacy and perceptions of caring for people with dementia: A repeated measures study. *Int J Nurs Stud* 2016;53:144-51.
485. Eldercare Workforce Alliance. *Geriatrics Workforce Shortage: A Looming Crisis for our Families*. Washington, D.C.: Eldercare Workforce Alliance; 2012.
486. The American Geriatrics Society. *Current Geriatrician Shortfall*. Available at: https://www.americangeriatrics.org/sites/default/files/inline-files/Current-Geriatrician-Shortfall_0.pdf. Accessed December 4, 2019.
487. The American Geriatrics Society. *Projected Future Need for Geriatricians*. Available at: <https://www.americangeriatrics.org/sites/default/files/inline-files/Projected-Future-Need-for-Geriatricians.pdf>. Accessed December 4, 2019.
488. American Association of Nurse Practitioners. *NP Fact Sheet*. Available at: <https://www.aanp.org/all-about-nps/np-fact-sheet>. Accessed December 4, 2019.
489. Hoffman D, Zucker H. A call to preventive action by health care providers and policy makers to support caregivers. *Prev Chronic Dis* 2016;13:E96.
490. Adelman RD, Tmanova LL, Delgado D, Dion S, Lachs MS. Caregiver burden: A clinical review. *JAMA* 2014;311(10):1052-60.
491. Riedel O, Klotsche J, Wittchen HU. Overlooking informal dementia caregivers' burden. *Res Gerontol Nurs* 2016;9(4):167-74.
492. Alzheimer's Association National Plan Care and Support Milestone Workgroup, Borson S, Boustani MA, Buckwalter KC, Burgio LD, Chodosh J, et al. Report on milestones for care and support under the U.S. National Plan to Address Alzheimer's Disease. *Alzheimer's & Dementia* 2016;12(3):334-69.
493. Cross AJ, Garip G, Sheffield D. The psychosocial impact of caregiving in dementia and quality of life: A systematic review and meta-synthesis of qualitative research. *Psychol Health* 2018;27:1-22.
494. Gaugler JE, Westra BL, Kane RL. Professional discipline and support recommendations for family caregivers of persons with dementia. *Int Psychogeriatr* 2016;28(6):1029-40.
495. Austrom MG, Carvell CA, Alder CA, Gao S, Boustani M, LaMantia M. Workforce development to provide person-centered care. *Aging Ment Health* 2016;20(8):781-92.
496. Werner P. Reflections on quality of care for persons with dementia: moving toward an integrated, comprehensive approach. *Int Psychogeriatr*. 2019 Mar;31(3):307-8.
497. Leggett A, Connell C, Dubin L, Dunkle R, Langa KM, Maust DT, et al. Dementia care across a tertiary care health system: What exists now and what needs to change. *J Am Med Dir Assoc* 2019;20(10):1307-12.e1.

498. Noel MA, Kaluzynski TS, Templeton VH. Quality dementia care. *J Appl Gerontol* 2017;36(2):195-212.
499. Bott NT, Shekter CC, Yang D, Peters S, Brady B, Plowman S, et al. Systems Delivery Innovation for Alzheimer Disease. *Am J Geriatr Psychiatry* 2019;27(2):149-61.
500. Tan ZS, Jennings L, Reuben D. Coordinated care management for dementia in a large academic health system. *Health Aff* 2014;33(4):619-25.
501. Callahan CM, Sachs GA, Lamantia MA, Unroe KT, Arling G, Boustani MA. Redesigning systems of care for older adults with Alzheimer's disease. *Health Aff* 2014;33(4):626-32.
502. French DD, LaMantia MA, Livin LR, Herceg D, Alder CA, Boustani MA. Healthy Aging Brain Center improved care coordination and produced net savings. *Health Aff* 2014;33(4):613-8.
503. Borson S, Chodosh J. Developing dementia-capable health care systems: A 12-step program. *Clin Geriatr Med* 2014;30(3):395-420.
504. Reuben DB, Evertson LC, Wenger NS, Serrano K, Chodosh J, Ercoli L, et al. The University of California at Los Angeles Alzheimer's and Dementia Care Program for comprehensive, coordinated, patient-centered care: Preliminary data. *J Am Geriatr Soc* 2013;61(12):2214-8.
505. Thyrian JR, Hertel J, Wucherer D, Eichler T, Michalowsky B, Dreier-Wolfgramm A. Effectiveness and safety of dementia care management in primary care: A randomized clinical trial. *JAMA Psychiatry* 2017;74(10):996-1004.
506. Callahan CM. Alzheimer's Disease: Individuals, dyads, communities, and costs. *J Am Geriatr Soc* 2017;65(5):892-5.
507. Dreier-Wolfgramm A, Michalowsky B, Austrom MG, van der Marck MA, Illiffe S, Alder C. Dementia care management in primary care: Current collaborative care models and the case for interprofessional education. *Z Gerontol Geriatr* 2017;50(Suppl 2):68-77.
508. Reuben DB, Tan ZS, Romero T, Wenger NS, Keeler E, Jennings LA. Patient and caregiver benefit from a comprehensive dementia care program: 1-year results from the UCLA Alzheimer's and Dementia Care Program. *J Am Geriatr Soc* 2019;67:2267-73.
509. Boustani M, Alder CA, Solid CA, Reuben D. An alternative payment model to support widespread use of collaborative dementia care models. *Health Aff (Millwood)* 2019;38(1):54-9.
510. Clevenger CK, Cellar J, Kovaleva M, Medders L, Hepburn K. Integrated memory care clinic: Design, implementation, and initial results. *J Am Geriatr Soc* 2018;66(12):2401-7.
511. Odenheimer G, Borson S, Sanders AE, Swain-Eng RJ, Kyomen HH, Tierney S, et al. Quality improvement in neurology: Dementia management quality measures (executive summary). *Am J Occup Ther* 2013;67(6):704-10.
512. LaMantia MA, Alder CA, Callahan CM, Gao S, French DD, Austrom MG, et al. The Aging Brain Care Medical Home: Preliminary data. *J Am Geriatr Soc* 2015;63(6):1209-13.
513. Gaugler JE, Kane RL, eds. *Family Caregiving in the New Normal*. Philadelphia, Pa.: Elsevier, Inc.; 2015.
514. Alzheimer's Association. Alzheimer's Impact Movement: Use of Medicare Planning Benefit. Available at: <https://alzimpact.org/media/serve/id/5d2c9620e4f5d>. Accessed September 27, 2019.
515. The Lewin Group. Process Evaluation of the Older Americans Act Title III-E-National Family Caregiver Support Program: Final Report, 2016. Available at: https://acl.gov/sites/default/files/programs/2017-02/NFCSF_Final_Report-update.pdf. Accessed December 4, 2019.
516. Alzheimer's Association. Alzheimer's Association Dementia Care Practice Recommendations. Available at: <https://www.alz.org/media/Documents/alzheimers-dementia-care-practice-recommendations.pdf>. Accessed November 5, 2019.
517. Camp CJ. Denial of human rights: We must change the paradigm of dementia care. *Clin Gerontol* 2019;42(3):221-3.
518. Gaugler JE, Bain LJ, Mitchell L, Finlay J, Fazio S, Jutkowitz E, et al. Reconsidering frameworks of Alzheimer's dementia when assessing psychosocial outcomes. *Alzheimers Dement (NY)* 2019;5:388-97.
519. Burton A, Ogden M, Cooper C. Planning and enabling meaningful patient and public involvement in dementia research. *Curr Opin Psychiatry* 2019;32(6):557-62.
520. Hurd MD, Martorell P, Delavande A, Mullen KJ, Langa KM. Monetary costs of dementia in the United States. *N Engl J Med* 2013;368:1326-34.
521. Yang Z, Zhang K, Lin PJ, Clevenger C, Atherly A. A longitudinal analysis of the lifetime cost of dementia. *Health Serv Res* 2012;47(4):1660-78.
522. Murman DL, Chen Q, Powell MC, Kuo SB, Bradley CJ, Colenda CC. The incremental direct costs associated with behavioral symptoms in AD. *Neurology* 2002;59:1721-9.
523. Fishman P, Coe NB, White L, Crane PK, Park S, Ingraham B, et al. Cost of dementia in Medicare Managed Care: A systematic literature review. *Am J Manag Care* 2019;25:e247-53.
524. Yang Z, Levey A. Gender differences: A lifetime analysis of the economic burden of Alzheimer's disease. *Women Health Iss* 2015;25(5):436-40.
525. Hudomiet P, Hurd MD, Rohwedder S. The relationship between lifetime out-of-pocket medical expenditures, dementia and socioeconomic status in the U.S. *J Econ Ageing* 2019;14:100181.
526. Dwibedi N, Findley AP, Wiener C, Shen C, Sambamoorthi U. Alzheimer disease and related disorders and out-of-pocket health care spending and burden among elderly Medicare beneficiaries. *Medical Care* 2018;56:240-6.
527. White L, Fishman P, Basu A, Crane PK, Larson EB, Coe NB. Medicare expenditures attributable to dementia. *Health Services Res* 2019;54(4):773-81.
528. Kelley AS, McGarry K, Gorges R, Skinner JS. The burden of health care costs for patients with dementia in the last 5 years of life. *Ann Intern Med* 2015;163:729-36.
529. Bynum JPW, Meara E, Chang C-H, Rhoads JM. *Our Parents, Ourselves: Health Care for an Aging Population. A Report of the Dartmouth Atlas Project*. The Dartmouth Institute for Health Policy & Clinical Practice; 2016.
530. Rudolph JL, Zanin NM, Jones RN, Marcantonio ER, Fong TG, Yang FM, et al. Hospitalization in community-dwelling persons with Alzheimer's disease: Frequency and causes. *J Am Geriatr Soc* 2010;58(8):1542-8.
531. Beydoun MA, Beydoun HA, Gamaldo AA, Rostant O, Dore GA, Zonderman AB, et al. Nationwide inpatient prevalence, predictors and outcomes of Alzheimer's disease among older adults in the United States, 2002-2012. *J Alzheimers Dis* 2015;48(2):361-75.
532. U.S. Centers for Medicare & Medicaid Services. State Level Chronic Conditions Table: Prevalence, Medicare Utilization and Spending, 2007-2017. Available at: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Chronic-Conditions/CC_Main.html. Accessed September 13, 2019.
533. Landon BE, Keating NL, Onnela JP, Zaslavsky AM, Christakis NA, O'Malley AJ. Patient-sharing networks of physicians and health care utilization and spending among Medicare beneficiaries. *JAMA Intern Med* 2018;178:66-73.
534. Medicare. Glossary. Medicare: The Official U.S. Government Site for Medicare. Available at: <https://www.medicare.gov/glossary/a>. Accessed December 4, 2019.
535. Reschovsky JD, Hadley J, O'Malley J, Landon BE. Geographic variations in the cost of treating condition-specific episodes of care among Medicare patients. *Health Services Res* 2014;49(Part 1):32-51.
536. Leibson CL, Hall Lon K, Ransom JE, Roberts RO, Hass SL, Duhig AM, et al. Direct medical costs and source of cost differences across the spectrum of cognitive decline: A population-based study. *Alzheimers Dement* 2015;11(8):917-32.
537. Suehs BT, Davis CD, Alvir J, van Amerongen D, Patel NC, Joshi AV, et al. The clinical and economic burden of newly diagnosed Alzheimer's disease in a Medicare Advantage population. *Am J Alzheimers Dis Other Dement* 2013;28(4):384-92.

538. Lin P-J, Zhong Y, Fillit HM, Chen E, Neumann PJ. Medicare expenditures of individuals with Alzheimer's disease and related dementias or mild cognitive impairment before and after diagnosis. *J Am Geriatr Soc* 2016;64:1549-57.
539. Geldmacher DS, Kirson NY, Birnbaum HG, Eapen S, Kantor E, Cummings AK, et al. Pre-diagnosis excess acute care costs in Alzheimer's patients among a U.S. Medicaid population. *Appl Health Econ Health Policy* 2013;11(4):407-13.
540. Zhu CW, Cosentino S, Ornstein K, Gu Y, Scarmeas N, Andrews H, et al. Medicare utilization and expenditures around incident dementia in a multiethnic cohort. *J Gerontol A Biol Sci Med Sci* 2015;70(11):1448-53.
541. Kirson NY, Desai U, Ristovska L, Cummings AKG, Birnbaum HG, Ye W, et al. Assessing the economic burden of Alzheimer's disease patients first diagnosed by specialists. *BMC Geriatrics* 2016;16:138.
542. Aigbogun MS, Stellhorn R, Hartry A, Baker RA, Fillit H. Treatment patterns and burden of behavioral disturbances in patients with dementia in the United States: A claims database analysis. *BMC Neurology* 2019;19:33.
543. Harris-Kojetin L, Sengupta M, Lendon JP, Rome V, Valverde R, Caffrey C. Long-term care providers and services users in the United States, 2015-2016. *Vital Health Stat* 2019;3(43).
544. Rome V, Harris-Kojetin L, Park-Lee E. Variation in operating characteristics of adult day services centers by center ownership: United States, 2014. *NCHS Data Brief*, No. 224. December 2015.
545. Caffrey C, Harris-Kojetin L, Rome V, Sengupta M. Variation in operating characteristics of residential care communities by size of community: United States, 2014. *NCHS Data Brief*, No. 222. November 2015.
546. U.S. Centers for Medicare & Medicaid Services. Nursing Home Data Compendium 2015 Edition. Available at: https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandCompliance/Downloads/nursinghomedatacompendium_508-2015.pdf. Accessed December 4, 2019.
547. Teno JM, Gozalo PL, Bynum JP, Leland NE, Miller SC, Morden NE, et al. Change in end-of-life care for Medicare beneficiaries: Site of death, place of care, and health care transitions in 2000, 2005, and 2009. *JAMA* 2013;309(5):470-7.
548. Eiken S, Sredl K, Burwell B, Amos A. Medicaid Expenditures for Long-Term Services and Supports in FY 2016. IAP Medicaid Innovation Accelerator Program. IBM Watson. May 2018. Available at: <https://www.medicaid.gov/sites/default/files/2019-12/Itssexpenditures2016.pdf>. Accessed February 3, 2020.
549. Bynum J. Characteristics, Costs, and Health Service Use for Medicare Beneficiaries with a Dementia Diagnosis: Report 1: Medicare Current Beneficiary Survey. Unpublished; provided under contract with the Alzheimer's Association. Lebanon, N.H.: Dartmouth Institute for Health Policy and Clinical Care, Center for Health Policy Research, January 2009.
550. Clarkson P, Davies L, Jasper R, Loynes N, Challis D. Home Support in Dementia (HoSt-D) Programme Management Group. A systematic review of the economic evidence for home support interventions in dementia. *Value in Health* 2017;20:1198-209.
551. Nickel F, Barth J, Kolominsky-Rabas PL. Health economic evaluations of non-pharmacological interventions for persons with dementia and their informal caregivers: A systematic review. *BMC Geriatrics* 2018;18:69.
552. Callahan CM, Arling G, Tu W, Rosenman MB, Counsell SR, Stump TE, et al. Transitions in care among older adults with and without dementia. *J Am Geriatr Soc* 2012;60(5):813-20.
553. Gozalo P, Teno JM, Mitchell SL, Skinner J, Bynum J, Tyler D, et al. End-of-life transitions among nursing home residents with cognitive issues. *N Engl J Med* 2011;365(13):1212-21.
554. Teno JM, Mitchell SL, Skinner J, Kuo S, Fisher E, Intrator O, et al. Churning: The association between health care transitions and feeding tube insertion for nursing home residents with advanced cognitive impairment. *J Palliat Med* 2009;12(4):359-62.
555. Genworth. Genworth Cost of Care Survey 2019, Summary and Methodology. <https://pro.genworth.com/rriiproweb/productinfo/pdf/131168.pdf>. Accessed November 3, 2019.
556. Jacobson G, Griffin S, Neuman T, Smith K. Income and Assets of Medicare Beneficiaries, 2016-2035. The Henry J. Kaiser Family Foundation Issue Brief. April 2017.
557. U.S. Department of Health and Human Services. What is Long-Term Care Insurance? Available at: <http://longtermcare.gov/costs-how-to-pay/what-is-long-term-care-insurance/>. Accessed December 4, 2019.
558. U.S. Centers for Medicare & Medicaid Services. Your Medicare Coverage. Long-Term Care. Available at: <https://www.medicare.gov/coverage/long-term-care.html>. Accessed December 4, 2019.
559. National Association of Insurance Commissioners and the Center for Insurance Policy and Research. The State of Long-Term Care Insurance: The Market, Challenges and Future Innovations. CIPR Study Series 2016-1. May 2016.
560. Reaves EL, Musumeci M. Medicaid and Long-Term Services and Supports: A Primer. Menlo Park, Calif: Kaiser Commission on Medicaid and the Uninsured, Henry J. Kaiser Family Foundation; December 2015. Publication #8617-02.
561. House Bill 1087, 66th Legislature, 2019 Regular Session. Long-Term Services and Supports Trust Program. Available at: <http://lawfilesexet.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session%20Laws/House/1087-S2.SL.pdf#page=1>. Accessed December 4, 2019.
562. De Vleminck A, Morrison RS, Meier DE, Aldridge MD. Hospice care for patients with dementia in the United States: A longitudinal cohort study. *J Am Med Dir Assoc* 2018;19:633-8.
563. Gozalo P, Plotzke M, Mor V, Miller SC, Teno JM. Changes in Medicare costs with the growth of hospice care in nursing homes. *N Engl J Med* 2015;372:1823-31.
564. U.S. Centers for Medicare & Medicaid Services. Post-Acute Care and Hospice Provider Data 2017. Available at: <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Provider-Charge-Data/PAC2017>. Accessed December 3, 2019.
565. Harris-Kojetin L, Sengupta M, Park-Lee E, Valverde R, Caffrey C, Rome V, et al. Long-term care providers and services users in the United States: Data from the National Study of Long-Term Care Providers, 2013-2014. *National Center for Health Statistics. Vital Health Stat* 3 2016;(38):x-xii;1-105.
566. U.S. Centers for Medicare & Medicaid Services. Medicare Program; FY 2020 Hospice Wage Index and Payment Rate Update and Hospice Quality Reporting Requirements. Available at <https://www.federalregister.gov/documents/2019/08/06/2019-16583/medicare-program-fy-2020-hospice-wage-index-and-payment-rate-update-and-hospice-quality-reporting>. Accessed February 4, 2020.
567. Taylor DH, Jr., Bhavsar NA, Bull JH, Kassner CT, Olson A, Boucher NA. Will changes in Medicare payment rates alter hospice's cost-saving ability? *J Palliat Med* 2018;21:645-51.
568. Miller SC, Lima JC, Looze J, Mitchell SL. Dying in U.S. nursing homes with advanced dementia: How does health care use differ for residents with, versus without, end-of-life Medicare skilled nursing facility care? *J Palliat Med* 2012;15:43-50.
569. Miller SC, Gozalo P, Mor V. Hospice enrollment and hospitalization of dying nursing home patients. *Am J Med* 2001;11(1):38-44.
570. Kiely DK, Givens JL, Shaffer ML, Teno JM, Mitchell SL. Hospice use and outcomes in nursing home residents with advanced dementia. *J Am Geriatr Soc* 2010;58(12):2284-91.
571. Miller SC, Mor V, Wu N, Gozalo P, Lapane K. Does receipt of hospice care in nursing homes improve management of pain at the end of life? *J Am Geriatr Soc* 2002;50(3):507-15.

572. Shega JW, Hougham GW, Stocking CB, Cox-Hayley D, Sachs GA. Patients dying with dementia: Experience at the end of life and impact of hospice care. *J Pain Symptom Manage* 2008;35(5):499-507.
573. Teno JM, Meltzer DO, Mitchell SL, Fulton AT, Gozalo P, Mor V. Type of attending physician influenced feeding tube insertions for hospitalized elderly people with severe dementia. *Health Aff* 2014;33(4):675-82.
574. Mitchell SL, Mor V, Gozalo PL, Servadio JL, Teno JM. Tube feeding in U.S. nursing home residents with advanced dementia, 2000-2014. *JAMA* 2016;316(7):769-70.
575. Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2017 on CDC WONDER Online Database, released December, 2018. Data are from the Multiple Cause of Death Files, 1999-2017, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Available at: <http://wonder.cdc.gov/ucd-icd10.html>. Accessed October 14, 2019.
576. Gilligan AM, Malone DC, Warholak TL, Armstrong EP. Health disparities in cost of care in patients with Alzheimer's disease: An analysis across 4 state Medicaid populations. *Am J Alzheimers Dis Other Dement* 2013;28(1):84-92.
577. Lin P-J, Zhong Y, Fillit HM, Cohen JT, Neumann PJ. Hospitalizations for ambulatory care sensitive conditions and unplanned readmissions among Medicare beneficiaries with Alzheimer's disease. *Alzheimers Dement* 2017;13(10):1174-8.
578. Healthy People 2020. Dementias, Including Alzheimer's Disease. Available at: www.healthypeople.gov/2020/topics-objectives/topic/dementias-including-alzheimers-disease/national-snapshot. Accessed December 24, 2019.
579. Davydov DS, Zibin K, Katon WJ, Pontone GM, Chwastiak L, Langa KM, et al. Neuropsychiatric disorders and potentially preventable hospitalizations in a prospective cohort study of older Americans. *J Gen Intern Med* 2014;29(10):1362-71.
580. Guterman EL, Allen IE, Josephson SA, Merrilees JJ, Dulaney S, Chiong W, et al. Association between caregiver depression and emergency department use among patients with dementia. *JAMA Neurol* 2019;76:1166-73.
581. Patel A, Parikh R, Howell EH, Hsieh E, Landers SH, Gorodeski EZ. Mini-Cog performance: Novel marker of post discharge risk among patients hospitalized for heart failure. *Circ Heart Fail* 2015;8(1):8-16.
582. Lin PJ, Fillit HM, Cohen JT, Neumann PJ. Potentially avoidable hospitalizations among Medicare beneficiaries with Alzheimer's disease and related disorders. *Alzheimers Dement* 2013;9(1):30-8.
583. MacNeil-Vroomen JL, Nagurney JM, Allore HG. Comorbid conditions and emergency department treat and release utilization in multimorbid persons with cognitive impairment. *Am J Emerg Med* 2020;38:127-31.
584. Feng Z, Coots LA, Kaganova Y, Wiener JM. Hospital and ED use among Medicare beneficiaries with dementia varies by setting and proximity to death. *Health Aff* 2014;33(4):683-90.
585. Jennings LA, Laffan AM, Schlissel AC, Colligan E, Tan Z, Wenger NS, et al. Health care utilization and cost outcomes of a comprehensive dementia care program for Medicare beneficiaries. *JAMA Int Med* 2019;179:161-6.
586. Godard-Sebillotte C, Le Berre M, Schuster T, Trottier M, Vedel I. Impact of health service interventions on acute hospital use in community-dwelling persons with dementia: A systematic literature review and meta-analysis. *PLoS ONE* 2019;14(6):e0218426.
587. Amjad H, Carmichael D, Austin AM, Chang C-H, Bynum JPW. Continuity of care and health care utilization in older adults. *JAMA Intern Med* 2016;176(9):1371-8.
588. Alzheimer's Association. Changing the Trajectory of Alzheimer's Disease: How a Treatment by 2025 Saves Lives and Dollars. Available at: https://www.alz.org/help-support/resources/publications/trajectory_report. Accessed December 4, 2019.
589. Zissimopoulos J, Crimmins E, St. Clair P. The value of delaying Alzheimer's disease onset. *Forum Health Econ Policy*. 2014;18(1):25-39.
590. Alzheimer's Association. 2018 Alzheimer's Disease Facts and Figures. *Alzheimers Dement* 2018;14(3):408-11.
591. Liu JL, Hlávka JP, Hillestad R, Mattke S. Assessing the preparedness of the U.S. health care system infrastructure for an Alzheimer's treatment. The RAND Corporation: Santa Monica, CA. (2017) Available at: https://www.rand.org/pubs/research_reports/RR2272.html. Accessed December 4, 2019.
592. Hebert LE, Scherr PA, Bienias JL, Bennett DA, Evans DA. Alzheimer's disease in the U.S. population: Prevalence estimates using the 2000 Census. *Arch Neurol* 2003;60:1119-22.
593. Brookmeyer R, Gray S, Kawas C. Projections of Alzheimer's disease in the United States and the public health impact of delaying disease onset. *Am J Public Health* 1998;88:1337-42.
594. National Alliance for Caregiving and AARP, Caregiving in the U.S., November 2009. Available at: <https://www.caregiving.org/pdf/research/FINALRegularExSum50plus.pdf>. Accessed December 22, 2019.
595. Amo PS, Levine C, Memmott MM. The economic value of informal caregiving. *Health Aff* 1999;18:182-8.
596. U.S. Department of Labor, Bureau of Labor Statistics. Employment, Hours, and Earnings from the Current Employment Statistics Survey. Series 10-CEU 6562160008, Home Health Care Services (NAICS code 6216), Average Hourly Earnings, July 2018. Available at: www.bls.gov/ces/data.htm. Accessed December 24, 2019.
597. Drabo EF, Barthold D, Joyce G, Ferido P, Chui HC, Zissimopoulos J. Longitudinal analysis of dementia diagnosis and specialty care among racially diverse Medicare beneficiaries. *Alzheimers Dement* 2019;15:1402-11.
598. U.S. Department of Health and Human Services, Health Resources and Services Administration, National Center for Health Workforce Analysis. National and Regional Projections of Supply and Demand for Geriatricians: 2013-2025. Available at: <https://bhw.hrsa.gov/sites/default/files/bhw/health-workforce-analysis/research/projections/GeriatricsReport51817.pdf>. Accessed February 4, 2020.
599. Petriceks AH, Olivas JC, Srivastava S. Trends in geriatrics graduate medical education programs and positions, 2001 to 2018. *Gerontol Geriatr Med* 2018;4:1-4.
600. Dall TM, Storm MV, Chakrabarti R, Drogan O, Keran CM, Donofri PD, et al. Supply and demand analysis of the current and future U.S. neurology workforce. *Neurology* 2013; 81:470-78.
601. Duffrin C, Diaz S, Cashion M, Watson R, Cummings D, Jackson N. Factors associated with placement of rural primary care physicians in North Carolina. *South Med J* 2014;107(11):728-33.
602. Scheckel CJ, Richards J, Newman JR, Kunz M, Fangman B, Mi L, et al. Role of debt and loan forgiveness/repayment programs in osteopathic medical graduates' plans to enter primary care. *J Am Osteopath Assoc* 2019;119(4):227-35.
603. Auerback DI, Buerhaus PI, Staiger DO. Registered nurse supply grows faster than projected amid surge in new entrants ages 23-26. *Health Aff* 2011;30(12):2286-92.
604. Meyers D, Fryer GE, Krol D, Phillips RL, Green LA, Dovey SM. Title VII funding is associated with more family physicians and more physicians serving the underserved. *Am Fam Physician* 2002;66(4):554.
605. Center for Medicare & Medicaid Services. Center for Medicare & Medicaid Innovation. The Graduate Nurse Education Demonstration Project: Final Evaluation Report. August 2019. Prepared by IMPAQ International, Columbia, Md. Available at <https://innovation.cms.gov/Files/reports/gne-final-eval-rpt.pdf>. Accessed February 7, 2020.
606. Arora S, Thornton K, Murata G, Deming P, Kalishman S, Dion D, et al. Outcomes of treatment for hepatitis C virus infection by primary care providers. *NEJM*. 2011; 364(23):2199-207.

607. Paul M, Saad AD, Billings J, Blecker S, Bouchonville MF, Berry C. Endo ECHO improves patient-reported measures of access to care, health care quality, self-care behaviors, and overall quality of life for patients with complex diabetes in medically underserved areas of New Mexico. *J Endocr Soc* April 15 2019;3(suppl 1):MON-190.
608. Possin KL, Merrilees JJ, Dulaney S, Bonasera SJ, Chiong W, Lee K, et al. Effect of collaborative dementia care via telephone and internet on quality of life, caregiver well-being, and health care use. *JAMA Intern Med* 2019;179(12):1658-67.

The Alzheimer's Association acknowledges the contributions of Joseph Gaugler, Ph.D., Bryan James, Ph.D., Tricia Johnson, Ph.D., Allison Marin, Ph.D., and Jennifer Weuve, M.P.H., Sc.D., in the preparation of *2020 Alzheimer's Disease Facts and Figures*.

The Alzheimer's Association leads the way to end Alzheimer's and all other dementia — by accelerating global research, driving risk reduction and early detection, and maximizing quality care and support.

Our vision is a world without Alzheimer's and all other dementia.®

Alzheimer's Association
225 N. Michigan Ave., Fl. 17
Chicago, IL 60601-7633

Alzheimer's Association
Public Policy Office
1212 New York Ave., N.W., Suite 800
Washington, DC 20005-6105

800.272.3900
alz.org®

©2020 Alzheimer's Association. All rights reserved.
This is an official publication of the Alzheimer's Association but may be distributed freely and without charge by unaffiliated organizations and individuals. Such distribution does not constitute an endorsement of these parties or their activities by the Alzheimer's Association.

alzheimer's  association®