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REPORT TO CONGRESS

The Burden of Cardiovascular Disease in the United States: Patterns and Barriers to Care

U.S. Department of Health and Human Services
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Office of the Assistant Secretary for Planning and Evaluation

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Introduction

Cardiovascular disease (CVD), or disease of the heart or blood vessels, is a category of diseases affecting approximately half of American adults.[1] The risk factors commonly associated with CVD include high blood pressure, high cholesterol, diabetes, age, obesity, and behavioral risk factors such as smoking, diet, and exercise. Rates of CVD have generally fallen over the past 50 or so years due to better treatment and management of the disease and of risk factors through medication and lifestyle changes. However, the increased prevalence of obesity among US adults over the last two decades has significantly impacted care management and risk for CVD.

Despite the progress made, CVD still has a large health, mortality, and economic burden. For instance, heart disease, one type of CVD, is still the leading cause of death in the United States overall and for both men and women.[2] Another type of CVD, stroke, is the fifth leading cause of death overall in the United States.[3] CVD can also cause many other adverse and costly outcomes such as heart attacks, heart failure, cardiac arrest, and brain damage or disability from stroke. In addition, there are significant disparities within the United States in CVD prevalence and mortality and related adverse health outcomes by race/ethnicity, by sex/gender, by socioeconomic status, and by geographic location of residence.

This report to Congress responds to the below request included in the Explanatory Statement for Departments of Labor, Health and Human Services, and Education, and Related Appropriations Bill, 2023.

> *The Committee notes the growing prevalence of cardiovascular disease (CVD) and the economic burden this deadly disease has on the health care system. The Committee further notes that lipid-panel (cholesterol) screenings, diagnosis and appropriate treatment and management of CVD is vital to prevent major cardiac events and hospitalizations. Various disease prevention and progression therapies are widely available, including statins and modern biologic treatments that have demonstrated efficacy against certain types of CVD. However, such therapies often face barriers including prohibitive utilization management practices by health plans, which limit adoption. The Committee requests a report within 180 days of the date of enactment of this Act on challenges facing healthcare providers and patients with a specific focus on healthcare costs incurred related to postponed, delayed, or suboptimal treatments associated with CVD.*[*]

To respond to this request, this report begins with an overview of CVD and its related adverse health outcomes, as well as a description of some of the risk factors and prevention and treatment options. It also discusses disparities in disease burden and possible barriers patients may face accessing

[*] The language quoted above appeared in the House Report 117-403, page 220, here: https://www.congress.gov/117/crpt/hrpt403/CRPT-117hrpt403.pdf. Similar language appeared in the Senate Explanatory Statement, page 215 here: https://www.appropriations.senate.gov/imo/media/doc/LHHSFY23REPT.pdf. The Joint Explanatory Statement says that unless otherwise indicated, the provisions of House Report 117-403 should be complied with, here: https://www.appropriations.senate.gov/imo/media/doc/Division%20H%20-%20LHHS%20Statement%20FY23.pdf.

treatments, as well as evidence from the existing literature on the economic costs of CVD, particularly when untreated or undertreated. Adults aged 65 and over have the highest prevalence of heart disease due to significantly high prevalence of cardiovascular and behavioral risk factors. This report presents results of an original analysis of the prevalence of CVD among fee-for-service Medicare beneficiaries and related health care utilization and costs to illustrate the scope of the issue in the Medicare fee-for-service program. This analysis shows, for instance, that risk factors for CVD and diagnoses of CVD itself are very common in this population (nearly three in four beneficiaries have at least one of the CVD diagnoses analyzed in this paper, for instance). For most health and screening/monitoring outcomes analyzed, there was significant variation by subgroup, particularly by race/ethnicity, and by whether the beneficiary was dually-enrolled in Medicaid, potentially reflecting disparities in risk factors and in access to care.

The treatment of cardiovascular risk factors plays an important role in preventing major adverse outcomes like heart attack and stroke. For Medicare beneficiaries who had one of the selected serious adverse outcomes, such as acute myocardial infarction and stroke, the rates of treatment for risk factors in the previous year were generally low, and their rates of related testing and diagnoses were often lower than in the overall sample. These results suggest of missed opportunities for testing and diagnosis that may have been helpful in averting these more serious outcomes. The analysis of a selection of CVD-related treatments and procedures illustrate the substantial cost to the Medicare program of CVD testing, treatment, and care following adverse outcomes.

While this report provides estimates of spending due to CVD-related complications, it does not attempt to estimate the amount of potentially avoidable costs to the Medicare fee-for-service program if beneficiaries with CVD-related complications had been screened, diagnosed, and prescribed a course of treatment according to guidelines and best practices. Moreover, this report does not include a cost-effectiveness analysis of efforts to try to increase screening, diagnosis, and treatment rates and it should not be assumed based on the findings of this report that if such efforts were implemented, this would necessarily generate savings. As noted elsewhere in this report, some medication treatments are costly, particularly when accumulated over a lifetime of treatment, some patients are unwilling or unable to take such medications due to short- and long-term side effects, and some patients on treatment will still experience CVD-related complications.

The report concludes with a brief overview of some of the many programs and initiatives the Department operates to specifically address CVD. HHS will continue to look for opportunities to improve prevention and treatment of cardiovascular disease to reduce the burden of such diseases for all Americans.

Background

I. Cardiovascular disease and potential adverse outcomes

Types of cardiovascular disease

Cardiovascular diseases (CVDs), defined as diseases of the heart or blood vessels, is a broad category of diseases that according to one estimate affect at least half of all adults in the United States.[*,4] These diseases place a large health and economic burden on patients and on the health care system. The most common type of CVD is coronary heart disease (sometimes referred to as coronary artery disease or ischemic heart disease), which occurs when the flow of oxygen to the heart is blocked or impeded. In 2021, it was estimated that 1 in 20 adults age 20 and older in the United States had coronary artery disease,[5] and over 42 percent of Medicare beneficiaries aged 65 or older had at least one heart condition in 2013.[6,7,8] In 2022, 12 percent of Medicare enrollees (including those under age 65) had diagnosed heart failure.[9] Another common type of CVD is stroke, which occurs either when blood supply to part of the brain is cut off (ischemic) or when there is bleeding in the brain (hemorrhagic). More than 795,000 people in the United States have a stroke every year, and about 87 percent of these are ischemic strokes.[10] A third very common type of CVD is peripheral arterial disease, which occurs when an artery to a limb is blocked. Estimates of the prevalence of peripheral arterial disease range, depending on the source and population used, from 5.8 percent to 10.7 percent of adults in the United States aged 40 years or older.[11] A fourth common type of CVD is aortic disease; a group of diseases affecting the aorta, which is the blood vessel connecting the heart to the rest of the body. There are many types of aortic diseases, including aortic aneurysms (when the walls of the aorta weaken and bulge), and some are asymptomatic until they progress to more serious outcomes, making estimation of prevalence challenging in the absence of community-wide screening.[12] Different types of CVD can share common risk factors, as well as screenings and potential treatment approaches, discussed later in this report.

Consequences of cardiovascular disease

CVD can lead to serious adverse health outcomes and death. According to the CDC, using data from 2018 to 2021, one person died every 33 seconds from CVD in the United States. Heart disease accounts for the majority of these deaths and is the leading cause of death in the United States with 695,000 deaths in 2021, and more than half of these were from coronary heart disease. While the majority of deaths from coronary heart disease occur among older populations, in 2021, approximately 20 percent of deaths from coronary heart disease were among those under 65.[13] Strokes are the other major category of deaths from CVD; stroke is the fifth leading causes of death overall in the United States with one in six deaths from CVD attributable to stroke in 2021.[14] There are many other potential adverse outcomes from CVD which may or may not result in death, include myocardial infarctions (heart attack),

[*] This estimate from the American Heart Association of CVD prevalence includes coronary heart disease, heart failure, stroke, and hypertension.

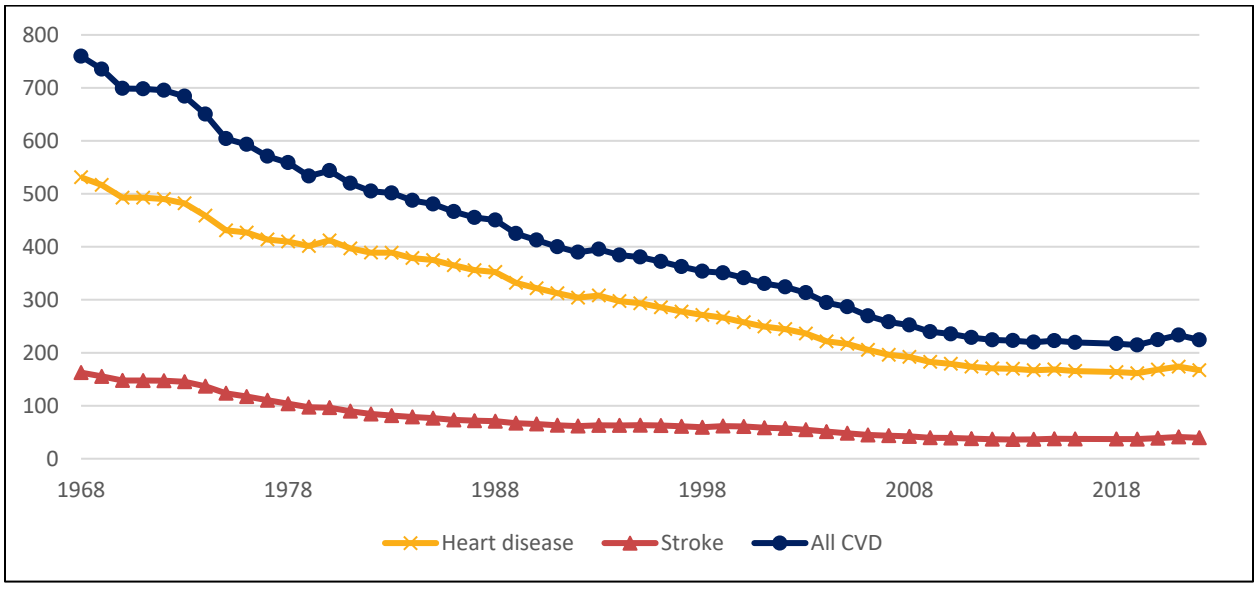
heart failure (when the heart doesn't pump enough blood to the body), cardiac arrest (when the heart stops beating altogether), arrhythmia (a heartbeat that is too fast, too slow, or irregular), myocarditis (inflammation of the heart muscle), and brain damage or disability from stroke.

II. Trends in CVD over time

The prevalence of most, but not all types of CVD, and associated mortality has declined over several decades, and these declines are believed to account for a large portion of the associated increase in life expectancy that occurred between 1960 and 2000.[15] For instance, Figure 1 shows the age-adjusted death rate from all CVD, heart disease, and cerebrovascular disease or stroke for select years for all ages from 1968 to 2022.* There was a general downward trend that was particularly steep between 1968 and the mid 2000s followed by a relative flattening in the trend. The rapid decline in overall CVD between approximately 1960 to 2000 is generally believed to have been caused by a combination in declines in smoking rates as well as advancements and improvements in prevention and treatment.[16,17,18]

In addition, some of the progress that was made over the past few decades was at least partially reversed during the COVID-19 pandemic. There were increases in the death rates from CVD in 2020, 2021, and 2022 compared to 2019. This is likely a combination of the impact of COVID-19 infection itself as well as a result of disruptions in health care access and utilization.[19]

Figure 1: Age-adjusted death rates (all ages) per 100,000 persons, 1968-2022

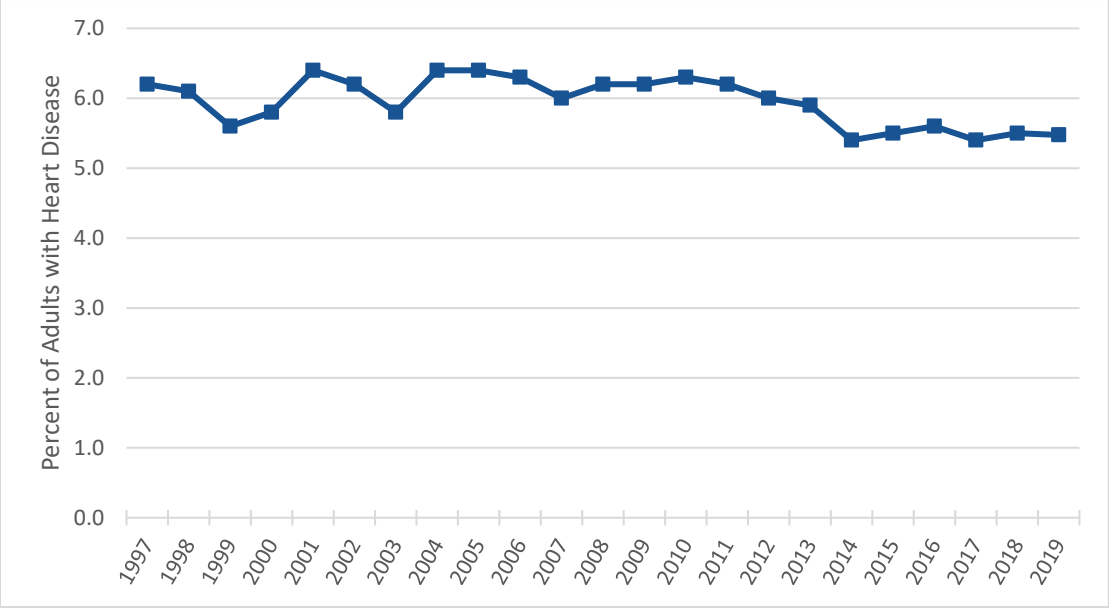


Data source: Centers for Disease Control and Prevention, National Center for Health Statistics. National Vital Statistics System, Compressed Mortality Files 1968-1978, 1979-1998, and 1999-2016 and Mortality 2018-2022. On CDC WONDER Online Database. Accessed at http://wonder.cdc.gov/cmf-icd8.html, http://wonder.cdc.gov/cmf-icd9.html, http://wonder.cdc.gov/cmf-icd10.html, and http://wonder.cdc.gov/mcd-icd10-expanded.html on July 10, 2024.

* Cerebrovascular diseases are those involving blood flow to the brain, such as stroke.

Figure 2 shows the age-adjusted fraction of adults with heart disease over time from 1997 to 2019. There was a slight decline over this period, particularly since around 2010. Over the same time period, the age-adjusted percent of adults reporting that they'd had a stroke remained between 2 and 3 percent.[20]

Figure 2: Percent of adults with heart disease (respondent-reported, age-adjusted) from 1997 to 2019



Data source: National Center for Health Statistics. Health, United States, 2020-2021. Table HDPrv. Hyattsville, MD. 1997-2019. Available from: https://www.cdc.gov/nchs/hus/data-finder.htm.

III. Risk factors

Many factors have contributed to reductions in rates of various CVDs and associated adverse events over the past several decades, including improved treatments and improvements in some risk factors such as a decline in smoking rates.[21] However, some risk factors have been increasing, such as obesity rates, diabetes rates, and the overall aging of the population.[22,23]

While there are some differences in risk factors among the various kinds of CVD, many risk factors are common. For instance, some key risk factors include high blood pressure (hypertension), high blood cholesterol (hyperlipidemia), diabetes, and obesity, as well as a number of behaviors such as smoking, eating an unhealthy diet, physical inactivity, and excessive alcohol use. Evidence suggests obesity may contribute to the development of cardiovascular disease and related mortality independently of other cardiovascular risk factors,[24] and the racial/ethnic differences in obesity may also be contributing to differences in rates of CVD and related mortality (discussed further below).[25] The risk for most kinds of CVD also increases with age and there is an important genetic component of risk as well.[26,27] Many of these risk factors are also common; the CDC reports that approximately 47 percent of people in the United States have hypertension, have hyperlipidemia, or smoke.[28] There is also evidence that worse mental health and behavioral health (for instance, depression, anxiety, and stress) are associated with CVD incidence, prevalence, and mortality.[29,30] For women, there are also risk factors relating to

reproductive health and pregnancy. For instance, early first period (before age 11), early menopause (before age 40), polycystic ovary syndrome, gestational diabetes, preterm delivery, low birth weight or high birth weight, and hypertensive disorders of pregnancy put women at higher risk of developing heart disease.[31] Many social determinants of health (SDOH), such as income and socioeconomic status, education, employment, housing instability and homelessness, transportation, and food security (among others) have been shown to be associated with CVD.[32] SDOH may contribute to many of the aforementioned risk factors causing CVD, as well as have a direct effect on CVD. For instance, challenges related to SDOH may contribute to the incidence of risk factors such as health behaviors like smoking, diet, and development of chronic stress and inflammation, but may have a more direct effect if someone experiences difficulty accessing health care or has limited medical literacy.[33,34]

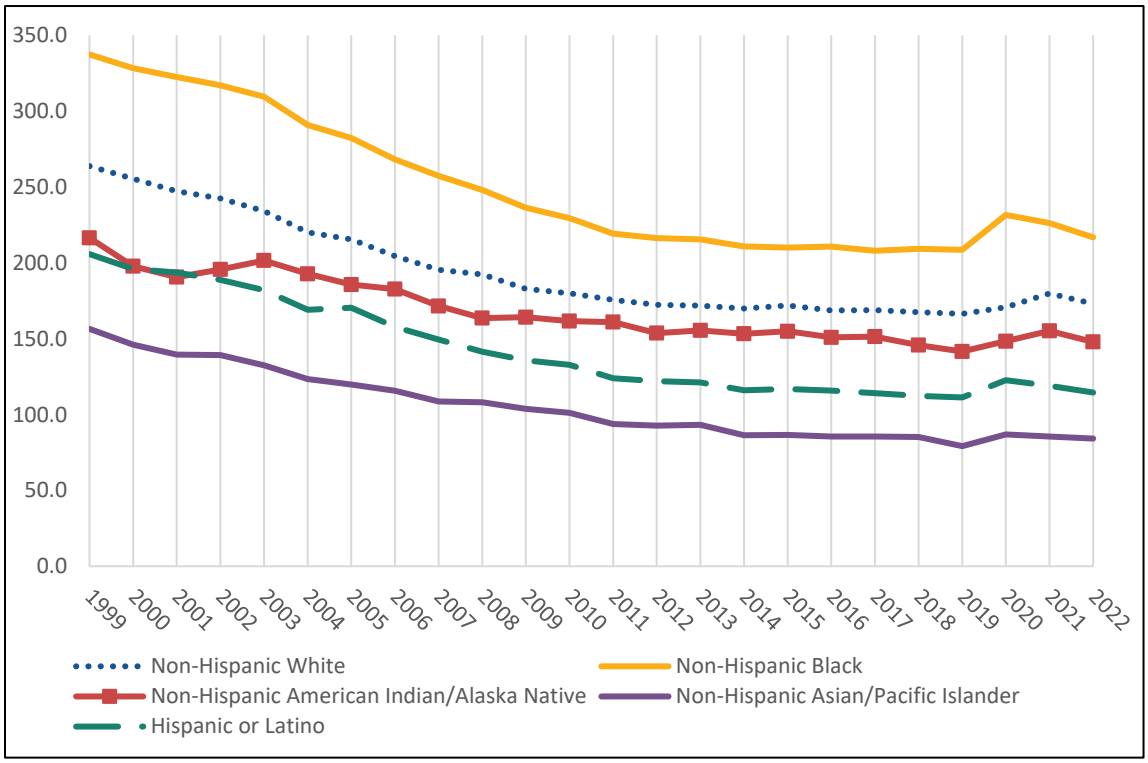
IV. Disparities in disease burden

The burden of CVD, along with its risk factors and its consequences, is not evenly distributed across the population. There are substantial differences in prevalence and mortality of CVD, for instance, by race/ethnicity, rural/urban residence, sex/gender, and socioeconomic status. Differences in prevalence of risk factors compounded by SDOH discussed above and socioeconomic, racial, structural, and barriers to prevention and treatment may be contributing to these disparities in CVD rates and adverse outcomes.[35]

Race/ethnicity

In the United States, rates of CVD and its risk factors are higher among some racial/ethnic groups compared to others. For instance, while the rate of heart disease has been declining across racial/ethnic groups, gaps between racial/ethnic groups have persisted. In all years between 1999 and 2022, non-Hispanic Black adults under age 65 had substantially higher rates of heart disease deaths than all other race and ethnic groups (Figure 3). Non-Hispanic White adults had the second highest rate, followed by American Indian/Alaska Native adults, Hispanic adults, and finally non-Hispanic Asian/Pacific Islanders. These differences in death rates existed despite the fact that non-Hispanic Black, non-Hispanic White, and Hispanic adults had a similar prevalence of heart disease.[36] In 2017, hospital admission for heart failure per 100,000 population was highest for Black individuals than for any other racial/ethnic groups.[37] Non-Hispanic Black adults were 50 percent more likely to have a stroke compared to non-Hispanic White adults, and are 70 percent more likely to die from a stroke.[38] In 2018, the age-adjusted rate of coronary heart disease among American Indian/Alaska Native individuals was 50 percent higher than that of White individuals.[39]

Figure 3: Age-adjusted mortality rates from heart disease per 100,000 population over 1999-2022, all persons

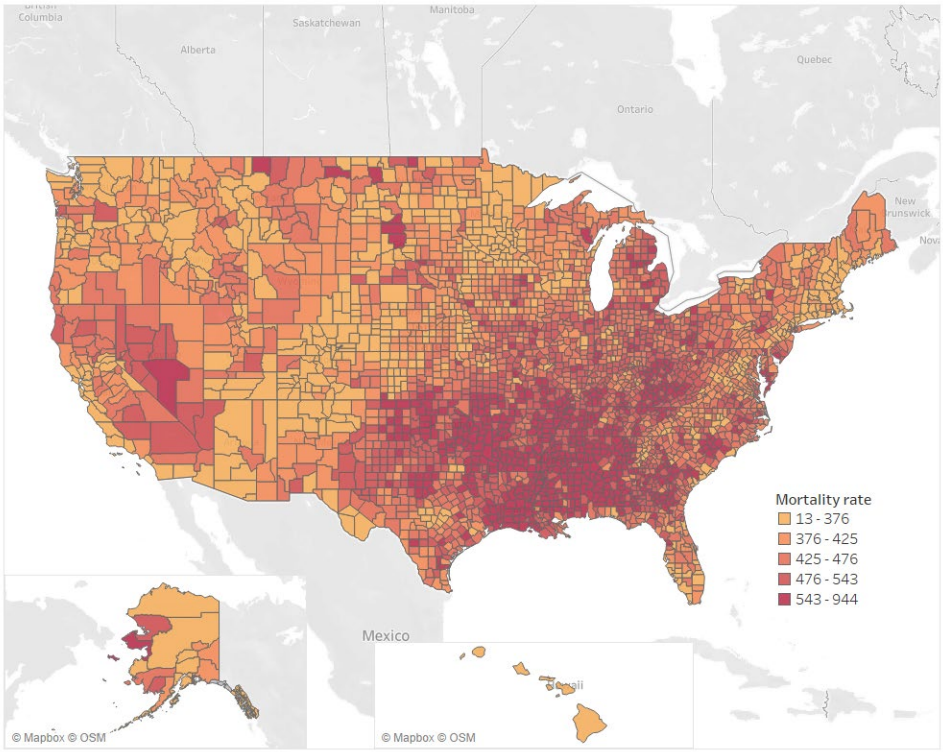


Data source: National Center for Health Statistics. Health, United States, 2020-2021. Table SlctMort. Hyattsville, MD. 1950-2019. Available from: https://www.cdc.gov/nchs/hus/data-finder.htm and https://wonder.cdc.gov/mcd.html.

Geography

A number of studies have analyzed differences in CVD outcomes between geographic areas and between rural and urban areas. Figure 4 shows the age-adjusted mortality rate (per 100,000 individuals) from CVD for adults 35 and older by county in the United States from 2018 to 2020. It shows both the high levels of mortality that exist, as well as the unequal distribution across the United States, with mortality most heavily concentrated in the southeast.

Figure 4: Age-standardized mortality from cardiovascular disease per 100,000 adults (age 35+) by county in 2018-2020



Data source: Centers for Disease Control and Prevention. Interactive Atlas of Heart Disease and Stroke. https://nccd.cdc.gov/DHDSPAtlas/

Differences between rural and urban areas in particular were highlighted in a recent call to action by the American Heart Association (AHA) which highlighted that rural residents have higher prevalence of heart disease and higher mortality rates from CVD and stroke and that gaps between rural and urban areas by many markers have gotten wider in recent years.[40] One study, for instance, showed that rural counties had higher age-adjusted mortality rates from heart failure consistently from 2011 to 2018 even after adjusting for demographic and socioeconomic characteristics, risk factor prevalence, and physician density, and the highest mortality rate was observed for rural Black men.[41] The most recent National Healthcare Quality and Disparities Report finds that in 2017, residents of noncore areas* had the highest rates of hospitalizations and emergency department encounters for heart failure (634 per 100,000), while residents of large fringe metro areas had the lowest rates (402.5 per 100,000). The death rates per 100,000 hospital admissions for heart failure was also highest for noncore areas, although disparities in deaths following hospital admission for acute myocardial infarction (AMI) have narrowed over time as treatment guidelines have been implemented more uniformly.[42] As a final example illustrating these

* This paper used the National Center for Health Statistics Urban-Rural Classification Scheme, which includes six levels of urban-rural classification. The most rural is called noncore because those areas lack an urban area of at least 10,000 people. More details can be found in the paper here: https://www.ahrq.gov/sites/default/files/wysiwyg/research/findings/nhqrdr/chartbooks/2019-qdr-rural-chartbook.pdf

rural-urban disparities, another study found that from 1999 to 2017, age-adjusted CVD mortality rates declined overall and for most subgroups, but from 2011 to 2017 the rate in rural areas increased.[43]

Many aspects of the healthcare delivery system and the communities themselves that affect cardiovascular health may be different in rural areas, including availability of hospital care, distance to the hospital and availability of transportation (time to receiving care can be particularly critical for something like AMI and stroke), quality of hospital care, lack of availability of diagnostic testing and relevant expertise, availability of outpatient and post-acute care, availability of clinicians, and insurance coverage or the ability to pay for care.[44,45] Another factor is that rural populations on average have higher rates of many of the risk factors for CVD, such as being older and having higher rates of diabetes, obesity, hypertension, high cholesterol, tobacco use, poor mental health outcomes, and physical inactivity. They also face more challenges in terms of the SDOH that may impact CVD, such as having lower average incomes, lower average educational attainment, lower employment rates, challenges with accessing housing and transportation, and food insecurity.[46]

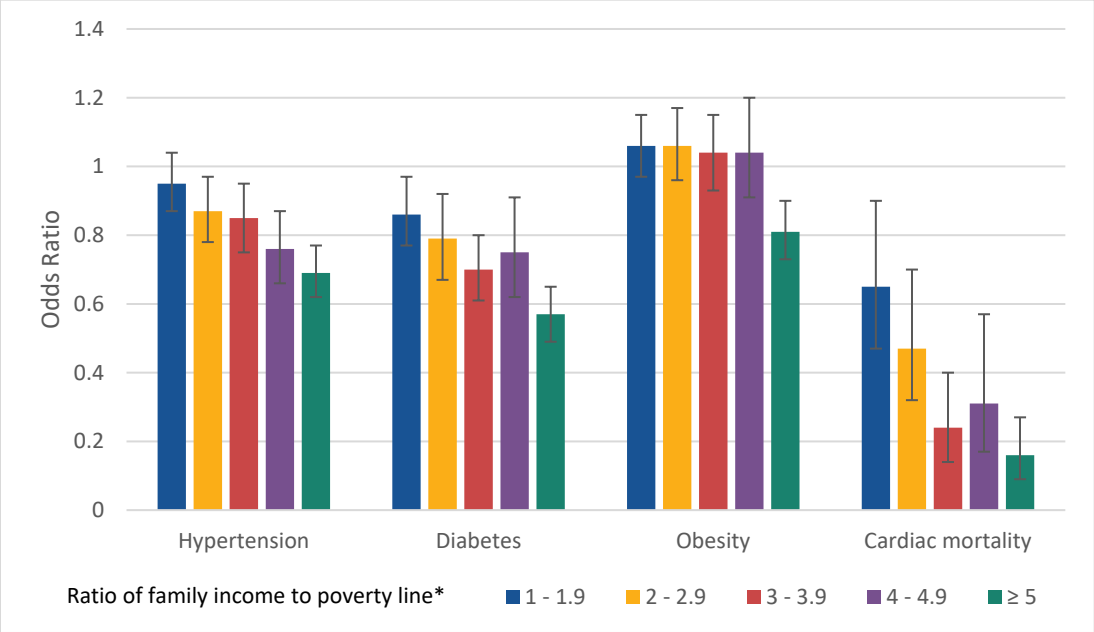
Sex/gender

In recent decades there has been an increased push to raise awareness of the risks for heart disease and CVD among women, where the focus traditionally has often been on men. The prevalence of heart disease and CVD (and associated mortality) is generally higher among men (particularly when adjusted for age). Age-adjusted mortality from CVD, for instance, is about 50 percent higher in men than women.[47] Despite the mortality rate from CVD and heart disease being higher among men, heart disease is also the number one cause of death for women. Because of the number of women living to older ages compared to men, the absolute number of women dying each year from CVD is higher.[48] And, as discussed above, there are many risk factors and types of CVD directly tied to reproductive health and pregnancy. Existing CVD can cause complications during pregnancy and pregnancy itself can lead to the development of CVD and risk factors for CVD (such gestational hypertension and diabetes). As a result, a significant fraction of pregnancy-related deaths and complications during pregnancy are related to CVD. It is estimated that about 1 in 3 pregnancy-related deaths in the United States is related to cardiovascular problems, and high blood pressure, obesity, and older maternal age are risk factors for pregnancy-related death.[49,50] A CDC analysis of pregnancy-related deaths from 2017 to 2019 suggested that 13 percent were from cardiac and coronary conditions, 9 percent were from cardiomyopathy (a disease of the heart muscle), and 7 percent were from hypertensive disorders of pregnancy.[51] It is also estimated that CVD causes complications in 4 of every 100 pregnancies.[52] In 2019, hypertensive disorders in pregnancy affected 15.9 percent of all hospitalization deliveries. Among women who died during delivery hospitalization, 31.6 percent had a diagnosis code for hypertensive disorder documented.[53] Aside from risk factors tied to reproductive health, there are differences in rates of risk factors for women that may be contributing to differences in rates of CVD. For instance, diabetes rates are higher in women and women are more likely to be physically inactive, but less likely to smoke compared to men. Women may also present with CVD differently and CVD treatments may impact women differently (for instance, because of differences in body size), all potentially complicating the story of how best to prevent, diagnose, and treat CVD in women compared to men.[54]

Socioeconomic status

As with many health outcomes, evidence suggests that there is also a strong relationship between lower socioeconomic status and higher prevalence of CVD and higher rates of mortality from CVD. This is true for many indicators of socioeconomic status, such as income, education, and employment status, as well as neighborhood socioeconomic factors.[55] There is also an association between higher income and lower rates of many of the risk factors for CVD such as obesity, high blood pressure, and high blood cholesterol.[56] One study found that after adjusting for demographic characteristics, a lower family income to poverty ratio is associated with higher odds of diabetes, hypertension, coronary heart disease, congestive heart failure, stroke, and all-cause mortality and cardiac mortality (a selection of these results are shown graphically in Figure 5).[57] Another study found that lower educational attainment was associated with a higher hazard of non-fatal myocardial infarction and lower income levels were associated with an increased hazard of cardiac death even after adjusting for smoking and alcohol consumption.[58] Another study of adults over age 50 found that unemployment and job loss are associated with increased risk for acute myocardial infarction (particularly in the first year of unemployment), even after adjusting for a number of risk factors and socioeconomic characteristics.[59] Individuals who live in more socioeconomically disadvantaged neighborhoods have higher hazard ratios for coronary events, even after adjusting for personal income, occupation, and education.[60]

Figure 5: Relationship between family income to poverty line ratio and selected CVD risk factors and cardiac mortality, 2005-2018



Note: This figure represents results from a study by Minhas et al (2023). These are odds ratios from their multivariate regression models controlling for age, sex, and race/ethnicity where the reference category is family income to poverty ratio < 1. The authors use data from the National Health and Nutrition Examination Survey (NHANES) from 2005 to 2018. * Note: smaller values for the family income to poverty line ratio represent lower income levels.

The relationship between socioeconomic status and CVD likely works through a number of both individual and community characteristics that are associated with differences in risk factors. Socioeconomic status, whether measured at the individual or community level, is correlated with access health care, ability to exercise and access to a healthy diet. Having a lower income may also be associated with a greater risk for stress and other mental health conditions, which are related to CVD. Socioeconomic status is also associated with many SDOH.[61] However, some research suggests that differences in prevalence of traditional risk factors (defined by the authors as smoking, high blood pressure, high cholesterol, diabetes, and obesity) may not account for the full disparity in CVD outcomes between those with lower versus higher socioeconomic status, and points to other broader factors associated with low socioeconomic status such as education, racism/bias, and chronic stress that need to also be addressed.[62,63]

These differences in rates of CVD and CVD-related outcomes and mortality for different groups, and many others that could be highlighted, point to the role that differences in risk factors as well as in screening, diagnosis, and treatment may be playing.

Prevention, diagnosis, and treatment

I. Testing and treatment

Ideally, primary prevention of CVD begins with screening for risk factors before the onset of disease and recommending lifestyle changes that can potentially avoid the need for medical treatment.

Testing

Testing for hypertension, high cholesterol, and high blood sugar or diabetes are some early tests to recognize risk for the development of CVD.

Recommendations for frequency of screening tests vary, depending on the type of test and patient characteristics (such as age) and other risk factors. The AHA, for instance, suggests that for normal adults, measurements of blood pressure and weight or body mass and review of behavioral risk factors such as smoking, diet, and physical activity, should take place at each regular health care appointment or at least once per year. They recommend cholesterol be tested every four to six years for adults without elevated risk for heart disease or stroke and they recommend after age 45 blood glucose be tested at least every three years as long as results remain normal.[64]

Medicare Part B, relevant for the population included in the analyses in this report, covers cardiovascular screening blood tests (which may include testing for cholesterol, lipid, and triglyceride levels) once every five years.[65] Medicare Part B also covers up to two blood glucose screenings each year, if a beneficiary's doctor determines that they are at risk for developing diabetes (for instance, if they have a history of high blood sugar or obesity).[66] Blood tests may be covered with greater frequency for monitoring purposes for those who are undergoing treatment. Finally, annual wellness visits (as covered by Medicare Part B) typically should include routine measurements such as height, weight, and blood pressure as well as review of the beneficiary's medical history but do not include a physical exam.[67]

Beyond basic blood work and screenings for risk factors such as hypertension, there are a number of tests for suspected CVD, depending on the patient and the type of CVD. Some examples include electrocardiograms, echocardiograms, ultrasounds, cardiac MRIs, stress tests, and cardiac catheterization.[68]

Lifestyle modifications as a first-line treatment

Lifestyle changes, such as changes to exercise or diet and quitting smoking and drinking, are commonly recommended actions, particularly when recognized early, to try and prevent the progression to more serious risk of developing CVD.

Medication management

If lifestyle changes are not sufficient to manage risk factors or patients are not able to follow through with them, particularly for high blood pressure and high cholesterol, medication may be recommended. The decision about when to prescribe medication, and which medication to use, depends on the patient and on consideration of potential risk for developing serious CVD and having adverse outcomes versus any potential downsides, such as costs and side effects. Some examples of medications that are used to treat hypertension are diuretics, angiotensin-converting enzyme (ACE) inhibitors, angiotensin II receptor blockers (ARBs), calcium channel blockers, alpha blockers, beta blockers, alpha-beta blockers, vasodilators, and aldosterone antagonists. These treatments are often used in combination.[69] Similarly, there are a number of possible medications for high cholesterol, which include statins, cholesterol absorption inhibitors, bempedoic acid, bile-acid-binding resins, and PCSK9 inhibitors.[70]

More intensive treatments

Even medication management and lifestyle changes may not fully prevent a patient from having a cardiovascular event like a heart attack or stroke. Moreover, if a patient is not diagnosed and treated at an early stage or struggles to stay on a treatment plan or it does not fully prevent disease progression, they may have to undergo more significant procedures or surgeries such as insertion of stents (mesh tubes inserted into arteries to help hold them open) or heart surgery (such as bypass surgery, where a new path for blood flow is created around a blocked artery in the heart). They may also be prescribed cardiac rehabilitation* (a monitored exercise program) and otherwise undergo active surveillance.[71,72] These more intensive treatments range from minimally invasive with relatively short recovery times to much more intensive treatments requiring longer recovery, depending on the type of treatment and the severity of the CVD. These more involved treatments tend to be much more expensive than medication treatment alone and can involve a significant amount of pain or discomfort for the patient, as well as a potential for complications (particularly for surgical procedures).

Treatment receipt and adherence

Although available medications and treatments can be very beneficial, there are many people in the United States who have risk factors that are suboptimally managed. For instance, although lifestyle and medication management can be highly effective for many people at managing blood pressure, the Centers for Disease Control and Prevention (CDC) reports that about 75 percent of adults in the United States with high blood pressure have uncontrolled hypertension.[73] Similarly, despite the benefits of statins for cholesterol control being well-documented when prescribed appropriately, adherence can be challenging. It has been estimated that approximately 50 percent of people prescribed statins stop taking them within a year, and adherence generally continues to decline over time.[74] There have been a number of studies looking at predictors of lack of adherence to statin treatment.[75] A major cause of non-adherence reported by patients is adverse side effects of taking statins, which can include headaches, dizziness, weakness, digestive problems, muscle pain, sleep problems, memory problems, and skin problems, among others. Patients with low health literacy and patients with lower incomes also had lower adherence, while patients with follow-up monitoring and cardiologist care had better

* Information on cardiac rehabilitation, including its potential benefits as well as potential barriers to referral, are available here: https://millionhearts.hhs.gov/data-reports/factsheets/cardiac.html

adherence. There have also been several studies which suggest higher copays or other costs are associated with lower adherence to statins, suggesting financial barriers may be playing a role, although the median cost for patients has decreased with the increased use of generics.[76,77]

In addition, there are many individuals in the United States who have been diagnosed with CVD that is suboptimally managed and there may be barriers to appropriate management and treatment, which may be different for different groups of people, contributing to the previously discussed disparities in health and mortality outcomes. For example, affordability of the prescribed medication and treatment may be one factor (not just for statins, as discussed above). Previous research has shown a correlation between adherence to treatment and being uninsured or underinsured, facing higher out-of-pocket costs, or having lower socioeconomic status.[78,79,80]

Another potential barrier is that patients may not be prescribed the appropriate medication or treatment. There is evidence, for instance, that certain groups of people are less likely to get the appropriate or guideline-based treatment for their CVD even after significant adverse events like acute myocardial infarctions, including women,[81,82] Medicaid beneficiaries or uninsured patients (compared to individuals with private insurance),[83,84] rural patients,[85,86] individuals with lower incomes,[87] and patients from some racial/ethnic groups (some literature shows delays to treatment for black and Hispanic patients, for instance).[88,89]

There are likely many reasons different groups may not receive the same quality or quantity of evidence-based treatment for CVD. Interpersonal and/or structural racism and bias is one. Another is a systematic difference in the quality of care or experience of providers that individuals can access. For instance, some research shows that some of the differences in whether certain patients are given appropriate treatment after a cardiovascular event are driven by treatment quality varying by location, rather than at the individual level.[90] This may be due to lack of training in or adherence to care guidelines or to a shortage of cardiovascular specialists or providers with the appropriate training. Some research has found, for instance, that quality improvement programs for hospitals relating to cardiovascular care reduced racial/ethnic differences in outcomes.[91] Other research shows evidence for maldistribution of specialists across geographic areas, with rural patients being more likely to have less access or needing to travel further distances to access cardiovascular care including from cardiovascular specialists.[92]

Economic costs of insufficient prevention and treatment

I. Medical costs

In addition to the health and mortality consequences of CVD for patients and their families, there are also economic consequences of the high prevalence of CVD, particularly when left untreated. The cost of treatment for CVD is substantial. The AHA estimated the direct economic costs of CVD in the United States (estimated using Medical Expenditure Panel Survey, or MEPS, data) for 2018 to 2019, was $251.4 billion annually or around 7% of total national health expenditures.[93] The highest cost subcategory, according to the AHA estimates, was heart disease, which they estimated to account for $117 billion in direct costs and $122.9 billion in indirect costs.[94] A more recent estimate from the AHA suggested that health care costs of risk factors for CVD (hypertension, diabetes, and hypercholesterolemia) will triple in the United States between 2020 and 2050, growing from $400 billion to $1,344 billion (in 2022 US dollars). Health care costs of CVD itself (defined here as coronary heart disease, stroke, heart failure, and atrial fibrillation) will, according to this estimate from the AHA, nearly quadruple, growing from $393 billion to $1,490 billion. Of the categories of CVD included in the AHA analysis, stroke is predicted to cause the largest absolute increase in health care costs.[95] There have been a number of similar estimates using various data sources and covering different years, as well as studies demonstrating the high costs of heart failure and other adverse outcomes.[96,97,98,99]

There have also been other estimates of costs of CVD to the Medicare program and in terms of Medicare beneficiary out-of-pocket spending. An analysis of the 2013 Medicare Current Beneficiary Survey, for instance, found that the annual total cost of care for Medicare beneficiaries aged 65 and older with at least one heart condition was $18,270, compared to $9,203 among beneficiaries with no heart condition.[100] Another study of Medicare beneficiaries aged 65 and older in 2014 found that those with CVD spent $317 more per month out-of-pocket on health care than those without CVD. Similarly, those with hypertension spent $150 more and those with diabetes spent $237 more.[101] On the other hand, a study on why spending growth in Medicare slowed between 1999 and 2012 found about half of that slowdown was likely attributable to a decline in the growth of spending on CVD, and much of this change was likely caused by a reduction in major adverse events due to better treatment and control.[102]

II. Labor-related costs

Most of estimates of the costs of CVD are for direct healthcare costs of treatment for CVD, its adverse outcomes, or treatment of such outcomes. There are relatively fewer estimates that take into account more indirect costs of CVD. In the AHA analysis, for instance, they estimate indirect costs from lost productivity due to premature mortality for CVD to be $155.9 billion annually between 2018 and 2019.[103] Their more recent analysis estimated that productivity losses from CVD would increase 54% between 2020 and 2050, from $234 billion to $362 billion.[104] In addition, although it can be more difficult to estimate, there are a number of avenues through which CVD could impact employment and labor market productivity beyond the costs from premature mortality. For instance, the physical decline and side effects from untreated or suboptimally managed CVD could potentially lead to missed work, declines in working hours, decreased productivity at work, and a higher likelihood of being out of the

labor force. One estimate of the income losses due to morbidity from heart disease and stroke using the 2019 Panel Study of Income Dynamics estimated that for adults under 65, having heart disease was associated with $13,463 less annual labor income and a stroke was associated with $18,716 less annual labor income.[105] One analysis estimated that among individuals who are working, hypertension was associated with an excess of approximately one missed day of work a year, which in aggregate costs U.S. employers approximately $10.3 billion per year, although this does not account for any decreased productivity at work or changes in labor market participation.[106]

III. Association between statin use and health care spending

Although the particular course of treatment, management, and prevention of further adverse health outcomes varies based on the type of CVD, a particular focus of the above Congressional request was on statin use. There is evidence that statins are effective and that higher adherence is related to lower risk of major cardiac events and mortality. However, these benefits are not equal for all groups (for instance, they may be lower for some adults over 74 years of age and depend on what other risk factors exist), and there is some debate as to the correct risk threshold where benefits of statin use outweigh potential costs and side effects.[107,108,109,110,111,112] There is also some evidence that higher adherence to statins among those prescribed statins leads to lower health care costs. A study of Medicare beneficiaries from 2009-2015, for instance, found that adherence to statins was associated with a higher likelihood of cholesterol control and a reduction in total costs of $157.32 per beneficiary per month.[113] Another study of Medicare beneficiaries in the same time period looked at adherence with statins for hyperlipidemia (among other conditions) and found adherence of over 80 percent of days covered by a prescription led to lower outpatient, inpatient, and total costs.[114] A study of individuals with commercial insurance and a statin prescription between 2009 and 2015 found that those who were retained on statins had more outpatient visits but fewer inpatient visits and $18.91 less in total monthly healthcare expenditures.[115] However, as noted above, patients may choose not to take a medication or may decide to stop taking a medication for several reasons, including lack of tolerability of side effects or out-of-pocket costs, and these concerns may be challenging to overcome in terms of retaining such patients on treatment or represent clinical reasons for not keeping a patient on such medication.*

* Information on statins, such as what a statin is, how it works, and potential risks and benefits is available here: https://millionhearts.hhs.gov/learn-prevent/scoop-on-statins.html

Analysis of prevalence of cardiovascular disease, risk factors, complications, and related healthcare utilization and spending among Medicare fee-for-service beneficiaries

I. Description of data and population

This analysis used claims data covering Medicare fee-for-service (FFS) beneficiaries enrolled in 2019 to avoid generating findings related to atypical care patterns or outcomes reflective of the COVID-19 pandemic. Any Medicare beneficiary aged 65 and older who had at least one month of FFS enrollment in 2019 was included in the analysis. Beneficiaries younger than 65 were excluded because they are not the focus of this study, which is on older adults, and also because they qualify for Medicare based on having a disability or end-stage renal disease, and therefore differ in their medical comorbidities and complexity from most other individuals under 65 who do not qualify for Medicare. This analysis focuses on the FFS population and therefore does not include the experiences of beneficiaries enrolled in Medicare Advantage for the full year. This was done because there is no robust way to estimate utilization and spending without claims data because encounter data (the data produced in Medicare Advantage) does not include some of the data elements needed (particularly for spending) and there are issues with completeness and data quality in encounter data generally. Estimates are generally provided for the overall FFS Medicare population as well as by age, sex, race/ethnicity, whether the beneficiary lives in an urban or rural area,[*] and by whether they are dually-enrolled in Medicaid or not. This report provides the prevalence of a selection of risk factors and screening/monitoring services, CVD-related diagnoses, potential outcomes and complications of CVD, as well utilization and costs associated with some CVD-related treatments and outcomes. Given the number and scope of types of CVD and related outcomes and treatments, this is not meant to be an exhaustive list but rather a selection chosen to demonstrate the scope of the issue among the Medicare FFS population.

Table 1 shows some demographic and other characteristics of the beneficiaries included in our analysis. There were over 28 million beneficiaries aged 65 or older with some FFS enrollment in 2019. Of these, 55.7 percent were female, and 44.2 percent were male. The largest age group was ages 65-74 (57.0 percent), followed by ages 75-84 (30.0 percent), and then those ages 85 and over (13.0 percent). The majority of beneficiaries were non-Hispanic White (80.7 percent), followed by non-Hispanic Black (7.4 percent), Hispanic (5.7 percent), non-Hispanic Asian and Pacific Islander (3.0 percent), and American

[*] For this analysis, a beneficiary is considered to be in an urban area if they reside in a Metropolitan Statistical Area, as defined by the Office of Management and Budget. Otherwise, they are categorized as living in a rural area. More information is available here: https://www.cdc.gov/nchs/hus/sources-definitions/msa.htm

Indian/Alaska Native (0.5 percent).[*] Most enrollees were not dually enrolled in Medicaid (86.5 percent) and a large share lived in urban areas (73.3 percent).

Table 1: Description of 2019 Medicare fee-for-service analytic population

	Number of beneficiaries in this category	Percent of beneficiaries in this category
Total	28,366,999	100.0%
Sex		
Male	12,549,344	44.2%
Female	15,812,908	55.7%
Age		
65-74	16,159,766	57.0%
75-84	8,520,394	30.0%
85+	3,686,839	13.0%
Race/ethnicity		
American Indian/Alaska Native	132,945	0.5%
Asian/Pacific Islander	853,323	3.0%
Black	2,088,595	7.4%
Hispanic	1,612,090	5.7%
White	22,895,837	80.7%
Medicaid enrollment		
Not dually enrolled	24,542,952	86.5%
Dually enrolled	3,824,047	13.5%
Rural/urban residence		
Urban	20,796,936	73.3%
Rural	7,516,090	26.5%
Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).		

II. Results

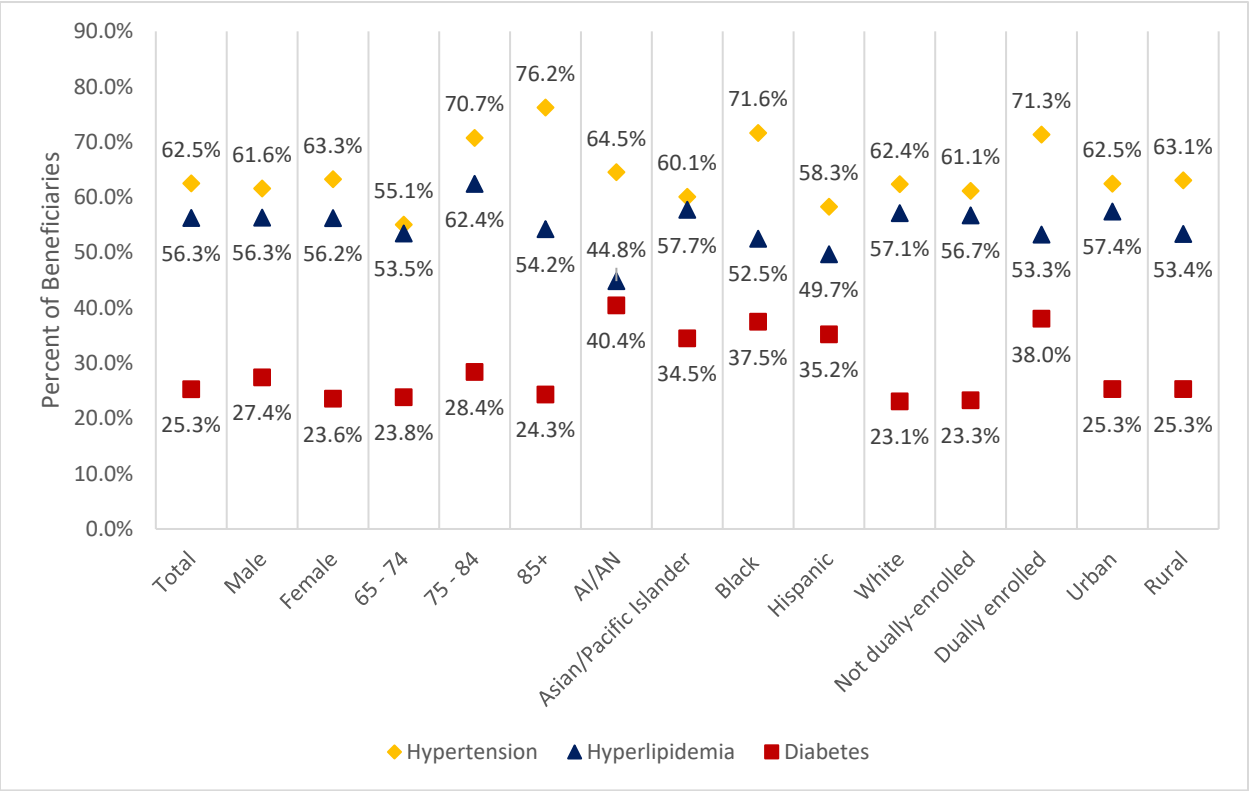
Prevalence of risk factors

The first set of results, shown in Figure 6 below, describe the prevalence of three important risk factors for CVD among this population. In general, tables of diagnoses and conditions report the percent of beneficiaries with that diagnosis or condition. However, while a percent may be easier to understand, a rate per beneficiary life-year accounts for the fact that some beneficiaries were not enrolled for the full year (for instance, if they died or switched to Medicare Advantage) and the purpose of this analysis was to represent all beneficiaries with any enrollment in FFS in 2019, so rates were also calculated for every outcome. However, the results were very similar regardless of whether a rate or percent was used,

[*] In general, race/ethnicity groups other than Hispanic are non-Hispanic, but for succinctness the "non-Hispanic" portion of the description will be dropped for the remainder of the report.

(results not shown) so for ease of understanding only the percent is shown. Figure 6 shows that 62.5 percent of beneficiaries had diagnosed hypertension, 56.3 percent had diagnosed hyperlipidemia, and 25.3 percent had diagnosed diabetes. There were different patterns for the subgroups analyzed and for the three risk factors, although these differences should be interpreted as suggestive as some groups were relatively small (for instance, American Indian/Alaska Native and Asian/Pacific Islander). The largest difference by sex was for diabetes (27.4 percent of male beneficiaries compared to 23.6 percent of female beneficiaries). The percent of beneficiaries with diagnosed hypertension increased with age (from 55.1 percent to 76.2 percent), although the percent of beneficiaries with diagnosed hyperlipidemia and diabetes was highest for ages 75-84. Each of the three diagnoses had a different pattern by race/ethnicity. For instance, Black beneficiaries had the highest prevalence of diagnosed hypertension (71.6 percent), followed by American Indian/Alaska Native beneficiaries (64.5 percent), White beneficiaries (62.4 percent), Asian/Pacific Islander beneficiaries (60.1 percent), and Hispanic beneficiaries (58.3 percent). For hyperlipidemia, the percent of beneficiaries with a diagnosis was highest for Asian/Pacific Islander beneficiaries (57.7 percent), followed by White beneficiaries (57.1 percent), Black beneficiaries (52.5 percent), Hispanic beneficiaries (49.7 percent), and lowest for American Indian/Alaska Native beneficiaries (44.8 percent). For diabetes, the percent of beneficiaries with a diagnosis was highest for American Indian/Alaska Native beneficiaries (40.4 percent), followed by Black beneficiaries (37.5 percent), Hispanic beneficiaries (35.2 percent), Asian/Pacific Islander beneficiaries (34.5 percent), and lowest for White beneficiaries (23.1 percent). Dually-enrolled beneficiaries were over 10 percentage points more likely to have diagnosed diabetes or hypertension compared to non-dually-enrolled beneficiaries, while a smaller percent of dually-enrolled beneficiaries had diagnosed hyperlipidemia compared to non-dually-enrolled beneficiaries. Finally, a similar percent of beneficiaries in urban versus rural areas had hypertension and diabetes diagnoses, although slightly more urban beneficiaries had diagnosed hyperlipidemia (57.4 percent) compared to rural beneficiaries (53.4 percent).

Figure 6: Diagnosis of select risk factors for CVD, percent of Medicare fee-for-service beneficiaries in 2019



Note: This figure is based on internal analysis of Medicare fee-for-service claims data.

Screening/monitoring rates

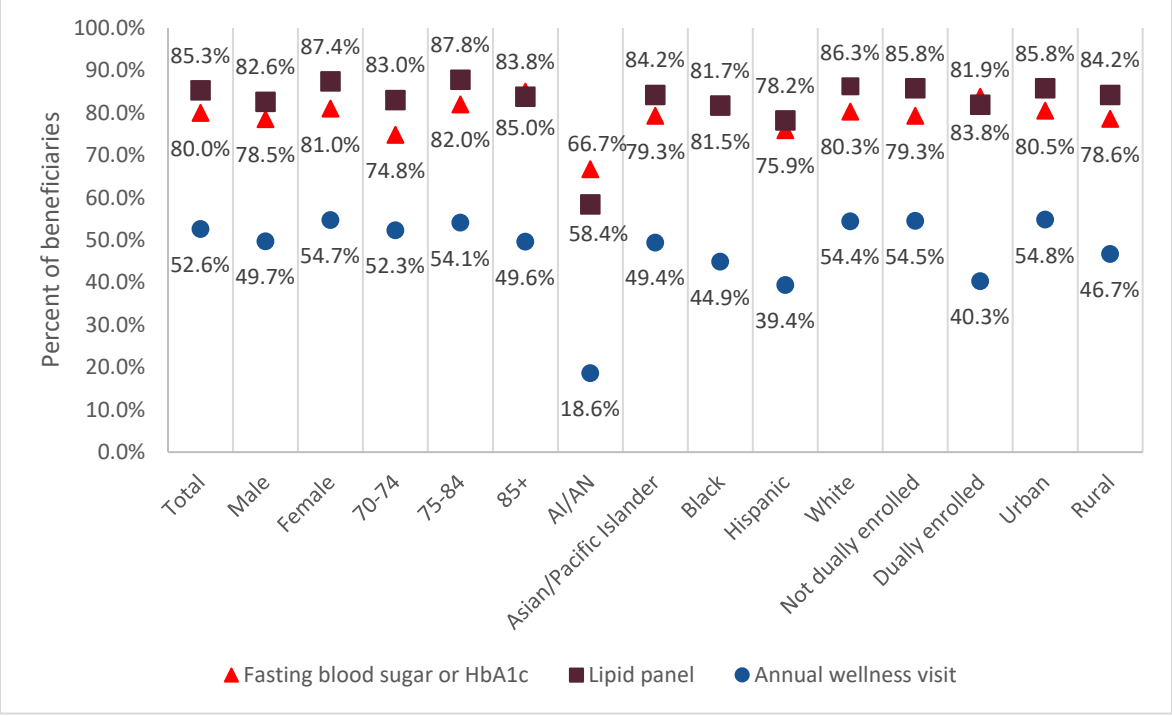
Figure 7 shows screening/monitoring rates for common tests and services related to CVD risk factors. Fasting blood sugar and HbA1c both test for blood sugar levels. The lipid panel tests for lipids in the blood, including cholesterol. Finally, the annual wellness visits (as covered by Medicare) typically should include routine measurements such as height, weight, and blood pressure as well as review of the beneficiary's medical history but does not include a physical exam.[*] Figure 7 focuses on beneficiaries aged 70 and older, to allow a retrospective analysis of whether they had these screening/monitoring tests or visits in the last five years. We include the five-year lookback because not all of these screening/monitoring tools are recommended to be done every year for every beneficiary. The American Diabetes Association, for instance, recommends screening for diabetes should begin at age 35 and be repeated at least once every three years if tests continue to be normal.[116] The American Heart Association recommends a lipid panel beginning at age 20 and continuing every four to six years if the individual does not have other risk factors.[117] These tests are also routinely ordered in people with

[*] More information about Medicare's annual wellness visits is here: https://www.medicare.gov/coverage/yearly-wellness-visits#:~:text=The%20yearly%20%E2%80%9CWellness%E2%80%9D%20visit%20isn,a%20yearly%20%E2%80%9CWellness%E2%80%9D%20visit.

established diagnoses to monitor their progress and response to therapy. These results, as well as similar results using a one-year lookback for all beneficiaries aged 65 and older, are available in the Appendix.

Over 80 percent of beneficiaries have had a test for diabetes or cholesterol in the past five years. The percent with a wellness exam was lower, with only slightly more than half of older beneficiaries having had one in the past five years. Men were more likely to have gotten a screening test for diabetes and elevated cholesterol. Beneficiaries aged 75-84 were the most likely to have had a lipid panel or an annual wellness exam (with both the one and five-year lookback. Beneficiaries aged 85 and older had the highest five-year lookback for testing of fasting blood sugar/HbA1c. For every test or screening visit, American Indian/Alaska Native beneficiaries had the lowest rates, particularly for annual wellness exams. Among beneficiaries aged 70 and older, only 66.7 percent of American Indian/Alaska Native beneficiaries have had a fasting blood sugar or HbA1c test in the past five years, compared to 81.5 percent of Black beneficiaries (who had the highest rate). Similarly, only 58.4 percent of American Indian/Alaska Native beneficiaries aged 70 and older had a lipid panel in the past five years, compared to 86.3 percent of White beneficiaries (who had the highest rate). Dually-enrolled beneficiaries were more likely to have had a fasting blood sugar or HbA1c test (for both lookback periods) compared to non-dually enrolled beneficiaries, while urban beneficiaries were more likely to have had a lipid panel or wellness exam compared to rural beneficiaries. Urban beneficiaries were more likely to have had every screening/monitoring event, for both lookback periods, compared to rural beneficiaries.

Figure 7: Five-year screening/monitoring rates, Medicare fee-for-service beneficiaries aged 70 and older in 2019



Note: This figure is based on internal analysis of Medicare fee-for-service claims data.

Prevalence of CVD diagnoses

Table 2 shows the percent of beneficiaries diagnosed with a select set of CVD diagnoses, as well as a combined category for all CVD diagnoses in the first column. In 2019, nearly three in four beneficiaries in our study population had a CVD diagnosis. This includes, for instance, 19.8 percent of beneficiaries with diagnosed ischemic heart disease, 13.4 percent of beneficiaries with diagnosed heart failure, 23.1 percent of beneficiaries with diagnosed arrhythmia, 9.8 percent of beneficiaries with diagnosed peripheral arterial heart disease, 7.0 percent of beneficiaries with diagnosed atherosclerosis, and 4.8 percent of beneficiaries with diagnosed heart valve disease. For most of these categories, the rates among men and women were similar (or men had slightly higher rates). The largest difference among the categories analyzed was for ischemic heart disease, where 26.0 percent of men had diagnosed ischemic heart disease compared to 14.9 percent of women. For every outcome analyzed, the percent of beneficiaries with the diagnosis increased with age. This increase was particularly large for atherosclerosis and heart failure. The pattern by race/ethnicity differed once again by outcome. Overall, Black beneficiaries had the highest rates of CVD diagnoses (76.8 percent), followed by American Indian/Alaska Native beneficiaries (73.8 percent), White beneficiaries (73.4 percent), Asian/Pacific Islander beneficiaries (67.9 percent), and with the lowest rate among Hispanic beneficiaries (65.5 percent). Among the specific types of CVD analyzed here, Black beneficiaries had the highest rates of diagnoses of heart failure and peripheral arterial disease, while White beneficiaries had the highest rates of diagnosed ischemic heart disease, arrhythmia, and atherosclerosis. Compared to beneficiaries enrolled only in FFS Medicare, dually-enrolled beneficiaries had higher rates of diagnosis for every category except heart valve disease, and this difference was particularly large for heart failure and peripheral arterial disease, where their rates were approximately twice as high. The rates for urban and rural beneficiaries were fairly similar, although slightly higher for rural beneficiaries for arrhythmia, peripheral arterial disease, and atherosclerosis.

Table 2: Diagnosis of select types of CVD, percent of Medicare fee-for-service beneficiaries in 2019

	CVD (all)	Ischemic heart disease	Heart failure	Arrhythmia	Peripheral arterial disease	Atherosclerosis	Heart valve disease
Total	72.8%	19.8%	13.4%	23.1%	9.8%	7.0%	4.8%
Sex							
Male	72.1%	26.0%	14.3%	25.4%	10.5%	7.4%	4.6%
Female	73.4%	14.9%	12.6%	21.3%	9.3%	6.6%	4.9%
Age							
65-74	65.3%	15.0%	8.4%	16.2%	6.3%	4.2%	3.3%
75-84	80.9%	24.9%	16.6%	29.1%	12.2%	9.1%	6.3%
85+	86.9%	29.1%	27.6%	39.6%	19.6%	14.1%	7.8%
Race/ethnicity							
American Indian/Alaska Native	73.8%	20.1%	14.0%	20.3%	8.2%	5.9%	3.5%
Asian/Pacific Islander	67.9%	15.1%	11.0%	15.9%	6.9%	6.1%	3.4%
Black	76.8%	17.5%	17.3%	19.4%	11.8%	6.0%	4.0%
Hispanic	65.5%	16.6%	13.8%	16.3%	9.3%	6.2%	3.5%
White	73.4%	20.6%	13.2%	24.4%	9.9%	7.3%	5.0%
Medicaid enrollment							
Not dually enrolled	71.7%	19.1%	11.9%	22.7%	8.6%	6.6%	4.8%
Dually enrolled	80.0%	24.4%	22.6%	26.0%	17.4%	9.3%	4.3%
Rural/urban residence							
Urban	73.0%	19.8%	13.5%	23.3%	10.3%	7.3%	5.0%
Rural	72.8%	20.0%	13.2%	22.7%	8.6%	6.2%	4.2%

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).

Prevalence of adverse outcomes of CVD

The prevalence of a select set of adverse outcomes from CVD are shown in Table 3 in columns one through four (these are stroke, acute myocardial infarction, aortic aneurysm, and unstable angina). The final column shows the rate of mortality among those beneficiaries with a recent history of CVD (while ideally CVD-related mortality would be reported on, or mortality with CVD as a cause, that is not possible to determine with the information available in claims). These are significant adverse outcomes and conditions, and the overall prevalence is low, although nearly 5 percent of beneficiaries had a stroke. Male beneficiaries were more likely to experience these outcomes compared to women, particularly aortic aneurysm and acute myocardial infarction. The percent of beneficiaries that had each diagnosed outcome increased with age for all the outcomes except unstable angina, and this was particularly true for mortality. There were relatively similar rates of these outcomes across race/ethnicity, with a few exceptions. For instance, Black beneficiaries had the highest rates of having a stroke, American Indian/Alaska Native beneficiaries had the highest rates of having an acute myocardial infarction, and White beneficiaries had the highest rates of having an aortic aneurysm. Mortality among beneficiaries with CVD diagnoses ranged from 2.6 percent of Asian/Pacific Islander beneficiaries to 4 percent of American Indian/Alaska Native and Black beneficiaries. Compared to beneficiaries enrolled only in FFS Medicare, dually-enrolled beneficiaries were more likely to have every outcome, and the percent of beneficiaries was approximately double for stroke, acute myocardial infarction, and greater

than double for mortality. Finally, the percent of urban and rural beneficiaries with each outcome were relatively similar.

Table 3: Select adverse outcomes and mortality, percent of Medicare fee-for-service beneficiaries in 2019

	Stroke	Acute myocardial infarction	Aortic aneurysm	Unstable angina	Mortality and CVD diagnosis
Total	4.7%	1.8%	2.4%	0.3%	4.0%
Sex					
Male	4.8%	2.2%	3.6%	0.4%	4.2%
Female	4.6%	1.5%	1.4%	0.3%	3.8%
Age					
65-74	3.1%	1.3%	1.8%	0.3%	1.7%
75-84	6.0%	2.2%	3.1%	0.4%	4.3%
85+	8.7%	3.3%	3.3%	0.3%	13.0%
Race/ethnicity					
American Indian/Alaska Native	4.8%	2.7%	1.9%	0.4%	4.6%
Asian/Pacific Islander	4.1%	1.4%	1.6%	0.2%	2.6%
Black	6.6%	2.1%	1.7%	0.3%	4.6%
Hispanic	4.5%	1.8%	1.4%	0.3%	3.3%
White	4.6%	1.8%	2.5%	0.3%	4.1%
Medicaid enrollment					
Not dually enrolled	4.2%	1.6%	2.4%	0.3%	3.3%
Dually enrolled	8.0%	3.0%	2.4%	0.4%	8.3%
Rural/urban residence					
Urban	4.8%	1.8%	2.4%	0.3%	3.9%
Rural	4.3%	2.0%	2.3%	0.3%	4.1%

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White). For the final column, this is mortality in 2019 among Medicare beneficiaries with diagnosed CVD and two claims related to CVD. This measure of mortality is reported because of the challenges of determining cause of death from claims.

Rates of risk factors, risk factor treatment, and screening/monitoring tests and visits for beneficiaries in the year prior to an adverse CVD event

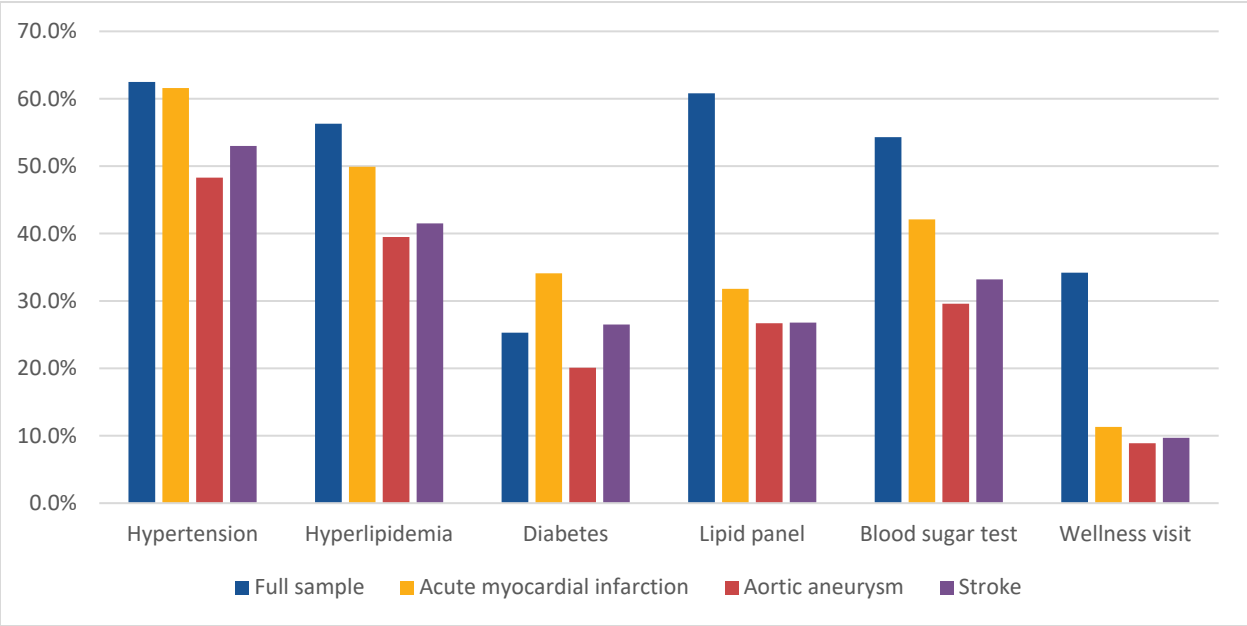
The next three tables present information on serious adverse outcomes related to CVD and, among beneficiaries who had that adverse outcome, the prevalence of CVD-related diagnoses, treatments, and tests/services in the year prior. In particular, among beneficiaries with a particular adverse outcome, we examined whether, in the previous year, they had a claim containing a diagnosis for hypertension, hyperlipidemia, or diabetes; a claim for blood pressure medication, cholesterol medication (including

statins), or diabetes control medication;[*] or a claim with a record of a lipid panel, either a fasting blood sugar test or a HbA1c test, or a wellness exam at least 7 days prior to the adverse outcome.

Figure 8 presents a high-level look at the results for beneficiaries who had an adverse outcome in comparison to our full population of beneficiaries with CVD. Rates of diagnoses of hypertension and hyperlipidemia were somewhat higher in our full population (all beneficiaries) compared to those beneficiaries who had one of the three adverse outcomes, although the pattern for diagnosis of diabetes was more mixed. In addition, the rate of receiving a lipid panel, receiving either a fasting blood sugar test or HbA1c test, and the rates of receiving an annual wellness exam were substantially higher for the overall population of beneficiaries compared to those with one of the adverse outcomes. For instance, beneficiaries with an acute myocardial infarction were substantially less likely to have each of the above tests in the prior year. Only 31.8 percent of beneficiaries who had an acute myocardial infarction had a lipid panel in the prior year, compared to 60.8 percent of our full population. The same comparison was 42.1 percent versus 54.3 percent for either a fasting blood sugar test or HbA1c test, and 11.3 percent versus 34.2 percent for an annual wellness visit. Among beneficiaries with an aortic aneurysm, the rate of diagnosed hypertension, hyperlipidemia, and diabetes was lower than among our full population of beneficiaries. This is perhaps unsurprising for diabetes, which the current literature suggests has an inverse relationship with major forms of aortic aneurysm, but more surprising for hypertension and hyperlipidemia, which are risk factors for aortic aneurysms.[118] There were also substantially lower rates of all three testing/service types overall for the beneficiaries who have had a stroke compared to our full population (26.8 percent versus 60.8 percent for lipid panels, 33.2 percent versus 54.3 percent for fasting blood sugar or HbA1c tests, and 9.7 percent versus 34.2 percent for annual wellness visits). These results are suggestive of missed opportunities for testing and diagnosis that may have been helpful in averting these more serious outcomes, although some caution must be taken when interpreting these results as not every test is recommended as part of annual screening for people who do not have established diagnoses.

[*] Claims for blood pressure medication and diabetes control medication include antiplatelets, ezetimibe, bempedoic acid, ACEI/ARB, PCSK-9 inhibitors, beta blockers, alpha-beta blockers, calcium channel blockers, ACE inhibitors, angiotensin II receptor antagonists, direct renin inhibitors, antiadrenergic antihypertensives, selective aldosterone receptor antagonists, vasodilators, antihypertensive combinations, potassium sparing diuretics, thiazides, and thiazide-like diuretics.

Figure 8: Comparison of CVD-related testing in 2018 for all Medicare fee-for-service beneficiaries vs. those with a CVD-related adverse outcome in 2019



Note: This figure is based on internal analysis of Medicare fee-for-service claims data.

Further details on these results, including results for the subgroups of interest, are provided in the next three tables. Table 4 displays the above percentages for beneficiaries who had an acute myocardial infarction for both the overall sample and for each of the subgroups of interest. Table 5 shows the same for beneficiaries with an aortic aneurysm, and Table 6 presents results for beneficiaries who had a stroke. The same analyses for beneficiaries who were hospitalized with an acute myocardial infarction and for mortality among beneficiaries with CVD are shown in the Appendix.

Although the overall rate of diagnosed hypertension among beneficiaries with an acute myocardial infarction was a few percentage points lower as compared to our full population of all beneficiaries, that relationship does not hold within all demographic categories (for instance, female beneficiaries, Asian/Pacific Islander beneficiaries, and Hispanic beneficiaries with an acute myocardial infarction had higher rates of diagnosed hypertension than those groups among the full population of beneficiaries). The rates of diagnosed hyperlipidemia were substantially lower among beneficiaries with an acute myocardial infarction compared to our full population. The rates of diagnosed diabetes were higher among beneficiaries with an acute myocardial infarction compared to the full sample of all beneficiaries. Among the beneficiaries who had an acute myocardial infarction, only approximately half had a record in the prior year of treatment for one of those three risk factors. All the subgroups had lower rates of the three categories of testing/services compared to our full population of beneficiaries. For these comparisons and those discussed in relation to Table 5 and Table 6, we are comparing subgroups to their equivalent subgroup for the full sample (i.e., females with an acute myocardial infarction in Table 4 compared to all female beneficiaries). Information on diagnoses of hypertension, hyperlipidemia, and diabetes for the full population and all subgroups are found in Figure 6 and screening/monitoring

information for fasting blood sugar/HbA1c, lipid panel, and annual wellness visits for the full population and subgroups is in Appendix Table 1.

Table 4: CVD-related diagnoses, treatment, and testing in 2018 among Medicare fee-for-service beneficiaries with an acute myocardial infarction in 2019

	Hypertension	Hyperlipidemia	Diabetes	Risk factor treatment	Lipid panel	Fasting blood sugar or NbA1c	Annual wellness visit
Total	61.6%	49.9%	34.1%	52.5%	31.8%	42.1%	11.3%
Sex							
Male	59.1%	50.0%	34.6%	49.0%	31.9%	41.4%	11.1%
Female	64.5%	49.8%	33.6%	56.4%	31.8%	42.9%	11.5%
Age							
65-74	57.0%	48.3%	36.0%	51.8%	32.3%	40.9%	10.8%
75-84	64.5%	53.4%	36.5%	54.6%	34.4%	44.6%	12.1%
85+	65.3%	47.3%	27.1%	50.4%	27.2%	40.4%	10.8%
Race/ethnicity							
American Indian/Alaska Native	61.1%	42.2%	47.9%	44.3%	19.3%	34.4%	3.7%
Asian/Pacific Islander	63.2%	53.1%	45.2%	61.1%	36.7%	46.5%	11.6%
Black	67.9%	49.6%	44.9%	53.9%	29.3%	44.9%	9.7%
Hispanic	64.3%	51.9%	48.7%	57.9%	35.0%	46.2%	9.6%
White	60.8%	49.8%	31.6%	51.8%	31.8%	41.5%	11.6%
Medicaid enrollment							
Not dually enrolled	60.4%	50.2%	31.6%	47.8%	32.7%	41.3%	12.1%
Dually enrolled	66.1%	48.8%	42.9%	68.8%	28.8%	44.7%	8.4%
Rural/urban residence							
Urban	61.8%	50.8%	34.3%	52.2%	32.4%	42.4%	11.8%
Rural	61.1%	47.7%	33.6%	53.2%	30.6%	41.3%	10.1%

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).

Table 5 shows that, similar to the results for beneficiaries with an acute myocardial infarction, approximately half of beneficiaries who had an aortic aneurysm had a claim in the previous year for treatment of a risk factor. The results also show that risk factor treatment was lowest for the oldest beneficiaries and for American Indian/Alaska Native beneficiaries. There were even lower rates across groups of having had a lipid panel or wellness visit compared to the previous table of beneficiaries who had an acute myocardial infarction. For both those services, the lowest rates were among the oldest beneficiaries, American Indian/Alaska Native beneficiaries, and among those dually enrolled in Medicaid. For every subgroup, the rates of diagnosed hypertension, hyperlipidemia, and diabetes were lower among the beneficiaries who had an aortic aneurysm compared to our full population, both overall and for every subgroup.

Table 5: CVD-related diagnoses, treatment, and testing in 2018 among Medicare fee-for-service beneficiaries with an aortic aneurysm in 2019

	Hypertension	Hyperlipidemia	Diabetes	Risk factor treatment	Lipid panel	Fasting blood sugar or NbA1c	Annual wellness visit
Total	48.3%	39.5%	20.1%	49.1%	26.7%	29.6%	8.9%
Sex							
Male	47.0%	39.7%	20.7%	47.7%	26.9%	29.6%	8.9%
Female	51.2%	39.3%	19.0%	52.1%	26.2%	29.7%	8.9%
Age							
65-74	46.3%	39.9%	20.8%	50.6%	28.6%	30.0%	9.7%
75-84	49.4%	40.7%	21.0%	49.7%	27.3%	30.2%	8.8%
85+	50.6%	36.2%	16.7%	44.2%	21.1%	27.5%	7.3%
Race/ethnicity							
American Indian/Alaska Native	50.2%	35.2%	28.9%	41.1%	18.0%	27.3%	4.7%
Asian/Pacific Islander	51.0%	42.4%	28.0%	56.3%	32.0%	34.4%	9.9%
Black	59.3%	41.8%	31.6%	50.2%	26.3%	35.7%	8.2%
Hispanic	54.7%	44.1%	33.9%	54.0%	30.9%	36.2%	8.1%
White	47.4%	39.2%	18.7%	48.7%	26.4%	28.9%	8.9%
Medicaid enrollment							
Not dually enrolled	47.1%	39.5%	18.8%	46.4%	27.0%	29.0%	9.2%
Dually enrolled	55.9%	40.0%	28.4%	65.8%	24.8%	33.8%	7.1%
Rural/urban residence							
Urban	48.3%	40.0%	20.2%	48.7%	27.0%	29.8%	9.1%
Rural	48.4%	38.4%	19.8%	50.4%	25.9%	29.3%	8.2%
Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).							

Table 6 shows the same analysis for beneficiaries who had a stroke. The rates of diagnosed hypertension and hyperlipidemia were lower for these beneficiaries than among our full population (overall and for every subgroup). The rates of diagnosed diabetes were slightly higher for beneficiaries who had a stroke than for our full population overall and for most subgroups, and this difference was largest for non-Hispanic White beneficiaries (38.1 percent of non-Hispanic White beneficiaries who had a stroke had a previous diagnosis of diabetes, compared to 23.1 percent of all non-Hispanic White beneficiaries). The only subgroups of beneficiaries who had a stroke with lower rates of diagnosed diabetes than our full population were beneficiaries aged 75 and older, American Indian/Alaska Native beneficiaries, Asian/Pacific Islander beneficiaries, Black beneficiaries, and dually-enrolled beneficiaries. Similar to the previous two tables, slightly under half of these beneficiaries had treatment of a risk factor claims in the prior year, and there are similar patterns for the subgroups.

Table 6: CVD-related diagnoses, treatment, and testing in 2018 among Medicare fee-for-service beneficiaries who had a stroke in 2019

	Hypertension	Hyperlipidemia	Diabetes	Risk factor treatment	Lipid panel	Fasting blood sugar or NbA1c	Annual wellness visit
Total	53.0%	41.5%	26.5%	48.8%	26.8%	33.2%	9.7%
Sex							
Male	51.4%	41.8%	28.0%	46.0%	26.9%	33.2%	9.4%
Female	54.3%	41.2%	25.3%	51.1%	26.8%	33.2%	9.9%
Age							
65-74	49.6%	40.8%	28.8%	48.9%	28.0%	33.3%	9.6%
75-84	54.6%	43.8%	27.7%	50.1%	28.5%	34.4%	10.2%
85+	55.8%	38.8%	21.0%	46.6%	22.4%	31.1%	8.9%
Race/ethnicity							
American Indian/Alaska Native	53.6%	35.3%	38.1%	42.7%	16.6%	26.5%	3.5%
Asian/Pacific Islander	52.9%	43.3%	34.6%	55.0%	30.6%	35.5%	9.8%
Black	57.1%	39.0%	36.7%	49.2%	23.5%	34.6%	7.8%
Hispanic	55.6%	43.3%	39.1%	52.8%	29.7%	36.7%	8.2%
White	52.4%	41.6%	38.1%	48.3%	26.9%	32.7%	10.0%
Medicaid enrollment							
Not dually enrolled	52.2%	42.3%	24.2%	44.8%	28.0%	32.9%	10.6%
Dually enrolled	55.5%	38.6%	34.2%	61.9%	22.8%	34.0%	6.5%
Rural/urban residence							
Urban	53.1%	42.1%	26.6%	48.4%	27.2%	33.4%	10.0%
Rural	52.7%	39.5%	26.1%	50.0%	25.7%	32.5%	8.5%
Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).							

Treatment costs

Table 7 compares overall Medicare median standardized allowed amounts* for all beneficiaries, those with and without CVD, and those with and without ischemic heart disease. These allowed amounts are inclusive of all health care spending for these populations and are not limited to spending related to CVD. The allowed amounts in the table are median monthly standardized allowed amounts per beneficiary. Allowed amounts for the same service can vary across geographic areas because of adjustments for things such as local wage rates. Standardized allowed amounts adjust the allowed charge for these factors to allow comparison of spending amounts across geographic areas. Among all beneficiaries, the median monthly amount was around $333. However, the median monthly amount was higher among beneficiaries with CVD ($450.77) and particularly among beneficiaries with ischemic heart disease ($985.73). For every condition state, males had a higher median amount than females, as

* An allowed amount is the amount of a charge that an insurer (or in this case, Medicare) will pay for a particular service. It does not include beneficiary out-of-pocket spending. More information about the process of calculating standardized amounts is available here: https://resdac.org/sites/datadocumentation.resdac.org/files/CMS%20Part%20A%20and%20Part%20B%20Price%20%28Payment%29%20Standardization%20-%20Basics%20%28June%202021%29.pdf

did older beneficiaries (compared to younger beneficiaries). American Indian/Alaska Native beneficiaries had the highest median monthly allowed amount overall and for most subcategories compared to the other racial/ethnic groups. The only exception was that Black beneficiaries had the highest allowed amount among those with ischemic heart disease ($1,418.31) compared to other racial/ethnic groups. Dually-enrolled beneficiaries generally also had higher allowed amounts compared to non-dually enrolled beneficiaries, with the exception of those without CVD, where the median allowed amount was very similar to that among beneficiaries who were not dually-enrolled. The allowed amounts among urban beneficiaries are generally slightly higher than among rural beneficiaries.

Table 7: Median monthly allowed amounts per beneficiary, Medicare fee-for-service beneficiaries in 2019

	All beneficiaries	With cardiovascular disease	Without cardiovascular disease	With ischemic heart disease	Without ischemic heart disease
Total	$333.08	$450.77	$115.77	$985.73	$259.40
Sex					
Male	$321.80	$441.40	$94.17	$847.91	$226.84
Female	$341.10	$457.66	$131.51	$1,186.71	$281.16
Age					
65-74	$259.91	$365.71	$111.70	$769.19	$216.76
75-84	$408.32	$503.44	$127.53	$1,012.73	$309.93
85+	$690.62	$815.38	$130.55	$1,622.73	$468.94
Race/ethnicity					
American Indian/Alaska Native	$421.43	$576.61	$126.40	$1,280.79	$329.92
Asian/Pacific Islander	$225.53	$301.87	$84.51	$711.59	$183.17
Black	$345.13	$440.58	$76.48	$1,418.31	$258.01
Hispanic	$304.86	$430.14	$84.69	$1,146.62	$228.61
White	$341.76	$462.87	$121.85	$966.74	$266.87
Medicaid enrollment					
Not dually enrolled	$310.16	$417.25	$116.10	$864.78	$246.88
Dually enrolled	$597.47	$785.19	$111.81	$1,850.79	$397.46
Rural/urban residence					
Urban	$339.41	$456.61	$118.97	$988.28	$265.25
Rural	$316.02	$434.58	$107.85	$979.23	$244.02

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).

Table 8 below shows utilization and spending for a selection of treatments, tests, and procedures related to CVD (detailed breakdown for subgroups are shown in Appendix Table 4, Appendix Table 5, and Appendix Table 6). The purpose of these tables is to give a sense of scale in terms of the utilization of these services and how much they cost the Medicare program. Some services, like electrocardiograms, were relatively commonly used but the allowed amount was fairly low (with $355.23 million in total spending on electrocardiograms), while others, like stress tests and cardiac

catheterization, were much less commonly used but accounted for over a billion dollars in spending in 2019. Table 8 shows some of the much less common but more intensive and relatively expensive interventions, with the most expensive (in terms of the total Medicare allowed amount) intervention being subacute rehabilitation and CVD-related hospitalizations. Given that interventions like hospitalization and subacute rehabilitation are both very expensive and indicative of greater morbidity experienced by patients, finding upstream approaches to prevent the need for these more intensive interventions is beneficial overall.

Table 8: Percent of beneficiaries utilizing and median allowed amount (per service) for select CVD-related procedures, services, and treatments, Medicare fee-for-service beneficiaries in 2019

	% of beneficiaries	Median standardized allowed amount per service	Sum allowed amount (millions)
Heart MRI scan	0.1%	$125.18	$13.55
Bypass surgery	0.3%	$959.08	$3,202.84
Heart CT scan	0.6%	$115.96	$31.31
Cardiac rehab	0.7%	$116.26	$442.44
AMI-related hospitalization	0.7%	$11,783.28	$3,199.91
Revascularization	0.9%	$750.74	$3,177.58
Stenting	1.5%	$611.37	$5,502.47
Cardiac catheterization	2.6%	$306.75	$1,185.64
Holter monitoring	3.8%	$27.39	$329.61
Subacute rehab	4.4%	$6,300.50	$23,426.12
CVD-related hospitalization	4.4%	$8,077.32	$21,223.82
Exercise tests	7.0%	$15.10	$110.36
Stress tests	7.2%	$62.06	$1,487.33
Echocardiogram	20.5%	$72.70	$1,870.44
Electrocardiogram	43.4%	$8.51	$355.23

Note: Most categories in the table are mutually exclusive, with some exceptions. The following pairs share some ICD codes: Stenting and revascularization, exercise tests and stress tests, heart CT scan and stress tests, and AMI-related hospitalization and CVD-related hospitalization.

Similar to the previous table, Table 9 shows the utilization and median monthly gross cost for CVD-related drugs (detailed breakdown for subgroups are shown in Appendix Table 7, Appendix Table 8, and Appendix Table 9).* These tables are only applicable to beneficiaries who are enrolled in Medicare Part D, so the sample of beneficiaries included in this table is a subset of those included in the previous tables (approximately 70 percent of the population included in the full tables). The most common treatment shown in this table is statins, which nearly 55 percent of the beneficiaries with Part D had a claim for. There were some differences in statin prescription among the subgroups although they were not as large as some of the differences seen in previous tables. Overall, the total gross drug cost for

* Gross drug cost is the spending metric used for Medicare Part D drugs. It includes spending by Medicare, the plan, and the beneficiary. It does not account for other price adjustments such as rebates. More information is available here: https://data.cms.gov/summary-statistics-on-use-and-payments/medicare-medicaid-spending-by-drug/medicare-part-d-spending-by-drug

statins alone was over $1 billion. This was by far the largest cost of the drugs analyzed for these two tables, although taken cumulatively the gross drug costs for the other types of drugs analyzed is still sizeable.

Table 9: Median monthly gross cost for and percent of beneficiaries utilizing select CVD-related drugs, Medicare fee-for-service beneficiaries enrolled in Part D in 2019

	% of beneficiaries	Median monthly per beneficiary gross drug cost	Total gross drug costs (millions)
Direct renin inhibitors	0.0%	$183.77	$13.11
Selective aldosterone receptor antagonists	0.1%	$50.49	$16.13
PCSK9 inhibitors	0.2%	$443.05	$283.47
Beta blockers (non-selective)	2.3%	$11.93	$112.96
Ezetimibe	2.5%	$15.82	$143.34
Vasodilators	2.6%	$5.35	$44.16
Potassium sparing diuretics	3.5%	$3.20	$37.09
Antiadrenergic antihypertensives	4.1%	$5.48	$111.50
Alpha-beta blockers	7.6%	$4.04	$123.96
Antiplatelets	8.0%	$4.33	$416.12
Antihypertensive combinations	10.6%	$4.89	$286.82
Thiazides	12.6%	$1.67	$106.19
Angiotensin II receptor antagonists	18.6%	$4.04	$375.70
ACE inhibitors	22.2%	$2.76	$219.18
ACEI/ARB	22.9%	$4.99	$939.89
Calcium channel blockers	26.7%	$3.03	$447.74
Beta blockers (cardio-selective)	26.9%	$5.37	$709.19
Statins	54.9%	$5.30	$1,175.33

Discussion and conclusion

This report responds to a request from Congress to provide information on challenges relating to postponing or receiving suboptimal treatment for CVD and associated healthcare costs. This report includes information on existing literature related to the request as well as original research focusing on the Medicare FFS population.

The analysis of healthcare utilization among older Medicare FFS beneficiaries in this report provides information on the prevalence of risk factors and potential adverse outcomes, the resulting costs to the Medicare program, across all individuals with CVD and for various population subgroups. The results of the analysis of Medicare beneficiaries illustrate both the scope of the burden of risk and disease among older people including the disproportionate impact for certain groups depending on the specific type of CVD. The report finds that risk factors, including hypertension, hyperlipidemia, and diabetes, are common among this population as are diagnoses of CVD itself (73.6 percent of beneficiaries in the sample, for instance). The majority of beneficiaries aged 70 and older have had blood sugar and blood cholesterol tested in the past 5 years (over 80 percent) although screening/monitoring rates vary substantially by race/ethnicity. The rates of receiving annual wellness visits are substantially lower. For those beneficiaries who had one of the selected serious adverse outcomes, such as acute myocardial infarction and stroke, the rates of treatment for risk factors in the previous year were generally low, and their rates of related testing and diagnoses were often lower than in the overall sample. Although the analysis does not untangle the reasons for these lower diagnosis and screening/monitoring rates, they are potentially suggestive of some missed opportunities for prevention.

For most health and screening/monitoring outcomes analyzed, there was significant variation by subgroup, particularly by race/ethnicity and dually-enrolled status, potentially reflecting disparities in risk factors and in access to care. For instance, Black beneficiaries were the most likely to have at least one CVD diagnosis, followed by AI/AN beneficiaries, White beneficiaries, Asian/Pacific Islander beneficiaries, and Hispanic beneficiaries. Among the types of CVD analyzed in this report, Black beneficiaries had the highest rates of heart failure and peripheral arterial disease, while White beneficiaries had the highest rates of ischemic heart disease, arrhythmia, and atherosclerosis. Dually-enrolled beneficiaries had higher rates of diagnosis for every category except heart valve disease, and this difference was particularly large for heart failure and peripheral arterial disease, where their rates were approximately twice as high. Of the categories of CVD-related treatments and procedures analyzed for this report, the categories with the largest total sum of the standardized payment amount were subacute rehabilitation (4% of all Medicare FFS beneficiaries accounting for $23.43 billion in spending) and CVD-related hospitalization (4% of all Medicare FFS beneficiaries accounting for $21.22 billion in spending). Other services such as electrocardiograms (43% of all Medicare FFS beneficiaries accounting for $355.23 million in spending) and echocardiograms (21% of Medicare FFS beneficiaries accounting for $1.87 billion in spending) had higher amounts of utilization but were substantially less costly. The overall monthly median allowed amount was particularly high for beneficiaries with ischemic heart disease ($985.73) compared to beneficiaries without ischemic heart disease ($259.40). In addition

to these direct medical costs, studies in the literature estimate billions of dollars in indirect costs attributable to lost productivity from CVD.

Despite significant improvements in the effectiveness of medication to treat for CVD in recent decades, CVD (particularly heart disease and stroke) remains a leading cause of mortality in the United States. One challenge is that the atherosclerosis develops over long periods of time and often without symptoms until it is advanced. Even when risk factors such as hypertension, hyperlipidemia, diabetes, and lifestyle factors are identified and managed, elevated risk can remain. The extent to which individuals are able to prevent the progression from risk factors to the development of CVD and more serious outcomes may be influenced by many factors including, for instance, genetics, access to health education and knowledge, access to regular care and recommended screenings and testing, ability to access and tolerate medication when necessary (particularly statins), and ability to make and sustain recommended lifestyle changes (for instance, ability to access healthier food or smoking cessation programs).[119,120,121] In addition, a substantial fraction of people with an adverse event related to CVD have no identified or diagnosed risk factors.[122] For these reasons, some fraction of CVD and its related outcomes is challenging to prevent. The current study does not analyze the reasons why individuals might not be screened or retained on medical management after a related diagnosis. Additional research to better understand the causal pathways leading to CVD, including how genetics, behavior, environment, and SDOH interact, could help inform policies to improve screening and treatment rates.

Limitations of this analysis include what can be observed in Medicare claims-based data specifically, as well as broader analytic challenges related to this topic that are common across different data sources. One is that it is not always possible, no matter the data source used, to observe or infer delayed or deferred care or missed screenings, and relatedly it is not possible to know if an individual has CVD or a risk factor if they have not been diagnosed. It is also, generally, difficult to estimate what portion of adverse health outcomes or diagnoses could have been avoided because not all adverse outcomes are avoidable, and CVD is a complex group of illnesses. The causes of CVD, as discussed before, are related to individual behavior as well as to SDOH, the quality and quantity of healthcare that is accessible, insurance coverage, and genetics, just to name a few factors. In addition, as more treatments become available, as the costs of different treatments change, and as additional evidence is generated on their effectiveness, the recommendations and consensus on when a particular treatment is cost-effective for a particular patient will continue to change. This adds to the complexity of evaluating when the cost of treatment is a barrier to effective treatment, and potential implications of these barriers to patients, Medicare, and the broader economy. This report also focuses on a particular population (Medicare FFS beneficiaries aged 65 and older in 2019), one that is of significant concern and interest due to their age and the cost of their care, but any patterns and results may not be representative of other groups. For the purposes of this report, the analysis does not include any statements about the statistical significance of differences between groups or make any inferences about any causes of differences observed between groups. Finally, when looking at the literature, some types of CVD and some populations are covered more thoroughly in the literature than others, and what literature exists often focuses on slightly younger ages than was included in the analysis for this report, so the results of those studies may not always apply to older Medicare beneficiaries.

HHS initiatives to address CVD

HHS operates a number of programs and initiatives to specifically address CVD including those briefly described here. For instance, the Million Hearts® Initiative, which began in 2012, is a national initiative co-led by the CDC and CMS. It serves to convene those working in health care and public health to facilitate collaboration and promote implementation of evidence-based strategies, and address health inequity. The Million Hearts® Initiative 2027 goal is to avert one million preventable CVD events between January 2022 and December 2026.[*] For example, CDC's Million Hearts in the Division for Heart Disease and Stroke Prevention and coauthoring partners released both the Cholesterol Management Change Package and the Hypertension in Pregnancy Change Package in 2024.[†] The Cholesterol Management Change Package presents a list of evidence-based process improvements for outpatient clinical settings trying to optimize cholesterol management.[‡] The Hypertension in Pregnancy Change Package provides guidance to improve outpatient care on pregnant and postpartum patients, focusing on early identification, management, and prevention of complications of hypertension during pregnancy.[§] CDC and the Million Hearts® Initiative also support the Live to the Beat Campaign. Live to the Beat is a national consumer-focused communication campaign launched in partnership with the CDC Foundation to educate, equip, and empower Black adults ages 35-54 with heart-healthy information, tools, resources, and messages.[**] In support of the initiative, there was a Million Hearts CVD Risk Reduction Model run by CMMI which ran from 2017 to 2021. The model was a randomized controlled trial that provided incentives for health care providers to engage in beneficiary CVD risk calculation and management. The evaluation of the model found that there were improvements in risk scores, increases in CVD risk assessment and use of medication for hypertension, and reductions in first time heart attacks and strokes and a reduction in all-cause mortality, but there were also negative unintended effects on some types of service use such as increased hospitalizations for all causes.[††]

There are also several objectives in Healthy People 2030 related to cardiovascular health and treatment.[‡‡] The Healthy People initiative began in 1979 and is currently in its fifth iteration. It includes a set of data-driven goals to improve health and well-being over the next ten years. The CDC supports

[*] More information on the Million Hearts® initiative is available here: https://millionhearts.hhs.gov/about-million-hearts/index.html and https://www.cms.gov/priorities/innovation/innovation-models/million-hearts#:~:text=Initiative%20Details,Cholesterol%20management%3B%20and%20Smoking%20cessation.

[†] Coauthors for the Cholesterol Management Change Package are: National Association of Community Health Centers and the American Medical Association. Coauthors for the Hypertension in Pregnancy Change Package are: American Academy of Family Physicians, American College of Nurse-Midwives, American College of Obstetricians and Gynecologists, American College of Osteopathic Obstetricians and Gynecologists, American Medical Association, National Association of Nurse Practitioner's in Women's Health, and Society for Maternal-Fetal Medicine.

[‡] More information on the Cholesterol Management Change Package is available here: https://millionhearts.hhs.gov/tools-protocols/action-guides/cholesterol-management-change-package/index.html

[§] More information on the Hypertension in Pregnancy Change Package is available here: https://millionhearts.hhs.gov/tools-protocols/action-guides/hypertension-pregnancy-change-package/index.html?CDC_AA_refVal=https%3A%2F%2Fmillionhearts.hhs.gov%2Fhpcp%2Findex.html

[**] More information on the Live to the Beat Campaign is available here: https://www.livetothebeat.org/

[††] More information on this model and its results are available here: https://www.cms.gov/priorities/innovation/innovation-models/million-hearts-cvdrrm

[‡‡] More information about Healthy People 2030 and related goals and objectives is available here: https://health.gov/healthypeople/objectives-and-data/browse-objectives/heart-disease-and-stroke.

several heart disease and stroke prevention programs, particularly through its Division for Heart Disease and Stroke Prevention.[*] In addition, the Division of Cardiovascular Sciences at the National Heart, Lung, and Blood Institute of the National Institute of Health supports research on promoting heart and vascular health and relevant intervention across the lifespan.[†] The National Heart, Lung, and Blood Institute also created and supports The Heart Truth® national health education program designed to raise awareness about heart disease as the leading cause of death in women.[‡] The National Institutes of Health also runs the Mind Your Risks® public health campaign, which has the goal of educating Black men about the risks of high blood pressure and how they can take charge of their health.[§] In 2020, the Federal Hypertension Control Leadership Council (composed of 12 HHS agencies and offices) convened in response to a call to action by the Surgeon General to make equitable hypertension control a national priority.[**] In 2022, HHS began a pilot program of self-monitored blood pressure management equipment at six Indian Health Service sites. The goal of the program will be to eventually expand the use of self-monitored blood pressure management equipment across the agency in order to decrease morbidity from uncontrolled and unmonitored hypertension. As of this report, IHS has distributed 950 blood pressure cuffs, including most recently 125 blood pressure cuffs to the Navajo Area. Several sites are developing care coordinator programs to improve patient education and outcomes. IHS is also pursuing additional partnerships, including with the CDC, the Million Hearts Foundation, and the Pre-Eclampsia Foundation.

The Agency for Healthcare Research and Quality (AHRQ) publishes the annual National Healthcare Quality and Disparities Report which provides information on healthcare quality and disparities throughout the United States. Among its measures are several relating to cardiovascular disease, such as rates of screening for high cholesterol, rates of hypertension control, and mortality per 1,000 hospital admissions for various cardiovascular diseases, among others.[††] AHRQ also maintains the Quality Indicators program, which provides standardized, evidence-based measures of health care quality and associated free software that can be used with readily available hospital inpatient administrative data to measure and track clinical performance and outcomes, including indicators relevant to CVD such as preventable hospitalizations due to hypertension, congestive heart failure, or angina, and hospital mortality among patients with congestive heart failure, acute myocardial infarction, percutaneous coronary angioplasty, or coronary artery bypass surgery.[‡‡] In 2015, AHRQ launched EvidenceNOW: Advancing Heart Health to provide support to 1,500 small- and medium-sized primary care practices to adopt evidence-based services for heart health and support quality improvement. In 2021, AHRQ built on the results of the first round of EvidenceNOW and began the second generation of EvidenceNOW

[*] More information on the programs CDC supports working to prevent heart disease and stroke is available here: https://www.cdc.gov/dhdsp/programs/index.htm

[†] More information on this NIH research is available here: https://www.nhlbi.nih.gov/about/divisions/division-cardiovascular-sciences

[‡‡] More information on The Heart Truth® national health education program is available here: https://www.nhlbi.nih.gov/health-topics/education-and-awareness/heart-truth

[§] More information on the Mind Your Risks® public health campaign can be found here: https://www.mindyourrisks.nih.gov/

[**] More information about the council, including its goals, priorities, and initial strategies, is available here: https://www.cdc.gov/dhdsp/fhclc.htm

[††] More information on this report, as well as access to data, is available here: https://www.ahrq.gov/research/findings/nhqrdr/index.html

[‡‡] More information on the Quality Indicators program is available here: https://qualityindicators.ahrq.gov/

with EvidenceNow: Building State Capacity. This stage invests in state-based quality improvement and infrastructure so states can help primary care practices deliver evidence-based care and address equity for heart disease. Results from this model are anticipated in 2024.[*]

The Assistant Secretary for Technology Policy/Office of the National Coordinator for Health Information Technology oversees the United States Core Data for Interoperability (USCDI), which includes a core set of data needed for supporting patient care, including those with CVD and other chronic conditions. The USCDI establishes a baseline of data important for cardiovascular disease and other use cases.[†] In addition, through the Health IT Certification Program, health IT products can include a standardized set of functionalities to support practices and patients, including those with CVD.[‡]

HHS efforts to improve prevention and treatment of cardiovascular disease aim to reduce the burden of such diseases for all Americans.

[*] More information on the second generation of EvidenceNOW is available here: https://www.ahrq.gov/evidencenow/projects/state/index.html; toolkits based on results from EvidenceNOW aimed at practices and providers are available here: https://www.ahrq.gov/evidencenow/tools/index.html

[†] More information on the USCDI is available here: https://www.healthit.gov/isp/united-states-core-data-interoperability-uscdi

[‡] More information on the Certification of Health IT is available here: https://www.healthit.gov/topic/certification-ehrs/certification-health-it

Endnotes

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Appendix

Appendix Table 1: One and five-year screening/monitoring rates, Medicare fee-for-service beneficiaries in 2019

	% beneficiaries screened in past year (among ages 65+)			% beneficiaries screened in past 5 years (among ages 70+)		
	Fasting blood sugar or HbA1c	Lipid panel	Annual wellness visit	Fasting blood sugar or HbA1c	Lipid panel	Annual wellness visit
Total	54.3%	60.8%	34.2%	80.0%	85.3%	52.6%
Sex						
Male	54.0%	59.3%	32.2%	78.5%	82.6%	49.7%
Female	54.5%	62.0%	35.7%	81.0%	87.4%	54.7%
Age						
65-74	51.1%	61.4%	34.7%			
70-74				74.8%	83.0%	52.3%
75-84	59.2%	64.8%	36.0%	82.0%	87.8%	54.1%
85+	56.7%	48.9%	27.9%	85.0%	83.8%	49.6%
Race/ethnicity						
American Indian/Alaska Native	42.1%	34.4%	11.2%	66.7%	58.4%	18.6%
Asian/Pacific Islander	58.9%	63.3%	31.6%	79.3%	84.2%	49.4%
Black	58.9%	55.7%	27.4%	81.5%	81.7%	44.9%
Hispanic	54.3%	54.6%	22.7%	75.9%	78.2%	39.4%
White	53.8%	61.7%	35.7%	80.3%	86.3%	54.4%
Medicaid enrollment						
Not dually enrolled	53.2%	62.0%	36.1%	79.3%	85.8%	54.5%
Dually enrolled	61.0%	53.3%	22.1%	83.8%	81.9%	40.3%
Rural/urban residence						
Urban	55.3%	61.8%	35.8%	80.5%	85.84%	54.8%
Rural	51.8%	58.4%	30.0%	78.6%	84.21%	46.7%

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White). The "annual wellness visit" includes the "Welcome to Medicare" visit (available in the first 12 months of enrollment, as well as subsequent annual wellness visits (which are covered after the initial 12 months of enrollment).

Appendix Table 2: CVD-related diagnoses, treatment, and testing in 2018 among Medicare fee-for-service beneficiaries hospitalized for a myocardial infarction in 2019

	Hypertension	Hyperlipidemia	Diabetes	Risk factor treatment	Lipid panel	Fasting blood sugar or NbA1c	Annual wellness visit
Total	63.3%	52.6%	36.2%	52.8%	35.9%	44.3%	13.2%
Sex							
Male	60.2%	52.1%	35.9%	48.8%	35.7%	43.2%	13.1%
Female	67.1%	53.2%	36.6%	57.8%	36.2%	45.7%	13.3%
Age							
65-74	57.6%	50.0%	37.0%	50.8%	35.8%	42.3%	12.7%
75-84	67.0%	56.5%	39.0%	55.5%	38.8%	47.4%	14.4%
85+	69.3%	51.4%	29.7%	52.6%	31.2%	43.5%	12.5%
Race/ethnicity							
American Indian/Alaska Native	61.9%	43.8%	49.2%	44.2%	22.5%	36.8%	4.3%
Asian/Pacific Islander	65.8%	56.2%	47.8%	62.3%	40.9%	49.7%	13.5%
Black	70.3%	53.6%	47.6%	56.1%	33.9%	48.6%	11.5%
Hispanic	64.8%	53.7%	50.6%	58.0%	38.5%	48.3%	10.9%
White	62.6%	52.4%	33.7%	52.0%	35.9%	43.6%	13.6%
Medicaid enrollment							
Not dually enrolled	62.0%	52.6%	33.8%	48.2%	36.6%	43.5%	14.1%
Dually enrolled	68.6%	52.5%	46.2%	71.7%	33.1%	47.7%	9.8%
Rural/urban residence							
Urban	63.5%	53.8%	36.5%	52.5%	36.7%	44.8%	14.0%
Rural	62.8%	49.9%	35.6%	53.6%	34.1%	43.2%	11.6%

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).

Appendix Table 3: CVD-related diagnoses, treatment, and testing in 2018 among Medicare fee-for-service beneficiaries who died and had CVD in 2019

	Hypertension	Hyperlipidemia	Diabetes	Risk factor treatment	Lipid panel	Fasting blood sugar or NbA1c	Annual wellness visit
Total	86.1%	60.6%	40.0%	55.8%	26.4%	50.6%	9.7%
Sex							
Male	85.1%	63.8%	43.3%	51.5%	28.0%	51.6%	9.9%
Female	87.0%	57.9%	37.0%	59.5%	24.9%	49.8%	9.5%
Age							
65-74	83.0%	61.5%	47.8%	56.6%	29.2%	52.9%	9.7%
75-84	87.3%	65.9%	44.7%	58.0%	29.7%	53.3%	10.5%
85+	87.0%	56.1%	31.8%	53.6%	22.2%	47.3%	9.0%
Race/ethnicity							
American Indian/Alaska Native	84.0%	53.6%	53.7%	51.3%	19.2%	44.4%	4.0%
Asian/Pacific Islander	86.6%	63.0%	51.9%	63.8%	31.1%	51.8%	10.3%
Black	91.0%	61.9%	54.6%	59.4%	26.9%	53.0%	9.0%
Hispanic	88.1%	62.8%	58.1%	62.5%	32.4%	53.3%	9.2%
White	85.6%	60.3%	36.9%	54.9%	25.8%	50.2%	9.8%
Medicaid enrollment							
Not dually enrolled	85.3%	61.6%	36.9%	48.4%	26.7%	49.3%	10.7%
Dually enrolled	88.3%	58.1%	47.6%	74.6%	25.6%	54.0%	7.1%
Rural/urban residence							
Urban	86.5%	61.5%	40.2%	55.0%	26.6%	50.6%	10.2%
Rural	85.3%	58.2%	39.4%	57.8%	25.6%	50.9%	8.3%

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).

Appendix Table 4: Percent of beneficiaries utilizing and median allowed amount for select CVD-related procedures, services, and treatments, Medicare fee-for-service beneficiaries in 2019 (Part I)

	Electrocardiogram	Holter monitoring	Echocardiogram	Exercise tests	Stress tests
Total	43.41%	3.76%	20.54%	7.0%	7.22%
Sex					
Male	44.45%	3.81%	21.98%	8.04%	8.32%
Female	42.60%	3.72%	19.39%	6.13%	6.35%
Age					
65-74	37.91%	3.23%	16.54%	6.89%	7.13%
75-84	49.80%	4.76%	25.36%	8.38%	8.67%
85+	52.74%	3.81%	26.90%	4.10%	4.28%
Race/ethnicity					
American Indian/Alaska Native	36.74%	2.77%	19.34%	6.08%	6.39%
Asian/Pacific Islander	43.33%	2.89%	18.15%	6.37%	6.59%
Black	38.19%	2.83%	21.35%	6.71%	7.07%
Hispanic	44.25%	2.84%	18.55%	6.49%	6.82%
White	40.47%	3.97%	20.82%	7.08%	7.30%
Medicaid enrollment					
Not dually enrolled	43.02%	3.89%	20.15%	7.14%	7.37%
Dually enrolled	45.90%	2.94%	23.03%	5.92%	6.23%
Rural/urban residence					
Urban	39.72%	3.78%	21.18%	7.20%	7.45%
Rural	39.72%	3.74%	18.88%	6.41%	6.62%
Median standardized allowed amount per service	$8.51	$27.39	$72.70	$15.10	$62.06
Sum allowed amount (millions)	$355.23	$329.61	$1,870.44	$110.36	$1,487.33

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).

Appendix Table 5: Percent of beneficiaries utilizing and median allowed amount for select CVD-related procedures, services, and treatments, Medicare fee-for-service beneficiaries in 2019 (Part II)

	Cardiac catheterization	Heart CT scan	Heart MRI scan	Bypass surgery	Stenting
Total	2.62%	0.57%	0.11%	0.33%	1.54%
Sex					
Male	3.44%	0.61%	0.14%	0.52%	2.10%
Female	1.96%	0.55%	0.08%	0.18%	1.09%
Age					
65-74	2.50%	0.64%	0.12%	0.36%	1.45%
75-84	3.19%	0.57%	0.11%	0.37%	1.83%
85+	1.78%	0.31%	0.03%	0.10%	1.23%
Race/ethnicity					
American Indian/Alaska Native	2.98%	0.46%	0.07%	0.39%	1.76%
Asian/Pacific Islander	1.58%	0.52%	0.08%	0.23%	1.02%
Black	2.31%	0.34%	0.11%	0.32%	1.42%
Hispanic	2.10%	0.43%	0.05%	0.31%	1.31%
White	2.73%	0.60%	0.11%	0.33%	1.59%
Medicaid enrollment					
Not dually enrolled	2.64%	0.61%	0.12%	0.32%	1.51%
Dually enrolled	2.45%	0.33%	0.06%	0.36%	1.67%
Rural/urban residence					
Urban	2.51%	0.63%	0.12%	0.32%	1.49%
Rural	2.91%	0.41%	0.08%	0.37%	1.67%
Median standardized allowed amount per service	$306.75	$115.96	$125.18	$959.08	$611.37
Sum allowed amount (millions)	$1,185.64	$31.31	$13.55	$3,202.84	$5,502.47

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).

Appendix Table 6: Percent of beneficiaries utilizing and median allowed amount for select CVD-related procedures, services, and treatments, Medicare fee-for-service beneficiaries in 2019 (Part III)

	Revascularization	Cardiac rehab	Subacute rehab	CVD-related hospitalization	AMI-related hospitalization
Total	0.94%	0.65%	4.36%	4.44%	0.66%
Sex					
Male	1.18%	0.98%	3.87%	5.04%	0.82%
Female	0.75%	0.39%	4.74%	3.97%	0.52%
Age					
65-74	0.84%	0.64%	2.02%	3.03%	0.51%
75-84	1.15%	0.80%	5.43%	5.50%	0.77%
85+	0.86%	0.37%	12.11%	8.17%	1.03%
Race/ethnicity					
American Indian/Alaska Native	1.60%	0.46%	4.48%	5.20%	0.93%
Asian/Pacific Islander	0.81%	0.29%	2.75%	2.93%	0.48%
Black	2.08%	0.35%	5.70%	5.78%	0.69%
Hispanic	1.42%	0.28%	3.53%	4.23%	0.67%
White	0.81%	0.72%	4.44%	4.44%	0.66%
Medicaid enrollment					
Not dually enrolled	0.81%	0.72%	3.39%	4.07%	0.61%
Dually enrolled	1.78%	0.24%	10.56%	6.82%	0.96%
Rural/urban residence					
Urban	0.96%	0.63%	4.40%	4.47%	0.62%
Rural	0.90%	0.74%	4.26%	4.40%	0.76%
Median standardized allowed amount per service	$750.74	$116.26	$6,300.50	$8,077.32	$11,783.28
Sum allowed amount (millions)	$3,177.58	$442.44	$23,426.12	$21,223.82	$3,199.91

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White).

Appendix Table 7: Median monthly gross cost for and percent of beneficiaries utilizing select CVD-related drugs, Medicare fee-for-service beneficiaries in 2019 (Part I)

	Statins	Ezetimibe	PCSK9 inhibitors	Antiplatelets	Beta blockers (non-selective)	Beta blockers (cardio-selective)
Total	54.93%	2.47%	0.24%	8.04%	2.30%	26.91%
Sex						
Male	59.36%	2.76%	0.29%	10.55%	2.15%	27.64%
Female	51.81%	2.26%	0.21%	6.28%	2.41%	26.39%
Age						
65-74	53.43%	2.51%	0.27%	6.57%	2.14%	22.78%
75-84	59.65%	2.78%	0.25%	9.85%	2.63%	31.37%
85+	50.34%	1.54%	0.07%	10.32%	2.27%	34.69%
Race/ethnicity						
American Indian/Alaska Native	50.44%	1.62%	0.13%	8.75%	1.73%	22.49%
Asian/Pacific Islander	59.30%	2.16%	0.28%	8.24%	1.30%	24.36%
Black	55.64%	2.05%	0.15%	9.45%	1.13%	26.21%
Hispanic	56.82%	1.91%	0.19%	8.94%	1.46%	23.63%
White	54.59%	2.55%	0.25%	7.91%	2.52%	27.46%
Medicaid enrollment						
Not dually enrolled	54.76%	2.57%	0.24%	7.39%	2.38%	26.53%
Dually enrolled	55.67%	2.04%	0.27%	10.86%	1.97%	28.52%
Rural/urban residence						
Urban	55.60%	2.58%	0.26%	7.81%	2.25%	26.58%
Rural	53.14%	2.16%	0.19%	8.70%	2.25%	27.81%
Median monthly per beneficiary gross drug costs	$5.30	$15.82	$443.05	$4.33	$11.93	$5.37
Total gross drug costs (millions)	$1,175.33	$143.34	$283.47	$416.12	$112.96	$709.19

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White). The % of beneficiaries column has as a denominator the number of beneficiaries with Part A, Part B, and Part D.

Appendix Table 8: Median monthly gross cost for and percent of beneficiaries utilizing select CVD-related drugs, Medicare fee-for-service beneficiaries in 2019 (Part II)

	Alpha-beta blockers	Calcium channel blockers	ACEI/ARB	ACE inhibitors	Angiotensin II receptor antagonists	Direct renin inhibitors
Total	7.63%	26.71%	22.94%	22.22%	18.62%	0.03%
Sex						
Male	8.92%	26.07%	21.92%	25.76%	17.60%	0.03%
Female	6.72%	27.16%	23.67%	19.72%	19.33%	0.04%
Age						
65-74	6.45%	22.67%	21.44%	21.65%	17.02%	0.02%
75-84	9.05%	30.98%	25.70%	23.71%	21.07%	0.04%
85+	9.52%	34.58%	23.02%	21.21%	19.87%	0.05%
Race/ethnicity						
American Indian/Alaska Native	8.93%	26.14%	20.43%	32.11%	18.47%	0.02%
Asian/Pacific Islander	6.72%	32.58%	34.43%	15.69%	28.86%	0.03%
Black	13.21%	45.62%	27.54%	22.05%	20.68%	0.03%
Hispanic	8.76%	28.63%	26.79%	26.00%	21.79%	0.02%
White	7.17%	24.89%	21.83%	22.26%	17.81%	0.03%
Medicaid enrollment						
Not dually enrolled	7.03%	25.42%	23.12%	21.70%	18.64%	0.03%
Dually enrolled	10.20%	32.25%	22.16%	24.43%	18.51%	0.02%
Rural/urban residence						
Urban	8.09%	26.94%	23.53%	21.44%	19.05%	0.03%
Rural	8.09%	26.10%	21.35%	24.37%	17.44%	0.03%
Median monthly per beneficiary gross drug costs	$4.04	$3.03	$4.99	$2.76	$4.04	$183.77
Total gross drug costs (millions)	$123.96	$447.74	$939.89	$219.18	$375.70	$13.11

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White). The % of beneficiaries column has as a denominator the number of beneficiaries with Part A, Part B, and Part D.

Appendix Table 9: Median monthly gross cost for and percent of beneficiaries utilizing select CVD-related drugs, Medicare fee-for-service beneficiaries in 2019 (Part III)

	Antiadrenergic antihypertensives	Selective aldosterone receptor antagonists	Vasodilators	Antihypertensive combinations	Potassium sparing diuretics	Thiazides
Total	4.08%	0.12%	2.59%	10.59%	3.50%	12.60%
Sex						
Male	5.60%	0.22%	2.57%	10.39%	3.33%	11.42%
Female	3.00%	0.04%	2.61%	10.74%	3.62%	13.42%
Age						
65-74	3.40%	0.11%	1.94%	11.31%	2.98%	12.36%
75-84	4.93%	0.14%	3.20%	10.74%	4.05%	13.59%
85+	5.05%	0.11%	4.02%	7.03%	4.52%	11.25%
Race/ethnicity						
American Indian/Alaska Native	5.10%	0.04%	2.53%	4.53%	4.28%	12.86%
Asian/Pacific Islander	4.20%	0.07%	2.81%	10.75%	1.81%	9.36%
Black	7.34%	0.13%	7.94%	15.92%	4.73%	18.53%
Hispanic	4.57%	0.07%	3.60%	11.51%	2.87%	12.75%
White	3.78%	0.12%	2.09%	10.11%	3.55%	12.27%
Medicaid enrollment						
Not dually enrolled	3.72%	0.13%	2.10%	11.03%	3.36%	12.69%
Dually enrolled	5.60%	0.07%	4.68%	8.74%	4.09%	12.17%
Rural/urban residence						
Urban	3.99%	0.13%	2.68%	10.47%	3.31%	12.23%
Rural	4.32%	0.09%	2.36%	10.95%	4.04%	13.61%
Median monthly per beneficiary gross drug costs	$5.48	$50.49	$5.35	$4.89	$3.20	$1.67
Total gross drug costs (millions)	$111.50	$16.13	$44.16	$286.82	$37.09	$106.19

Note: All race/ethnicity categories other than Hispanic are non-Hispanic (i.e., non-Hispanic Black or non-Hispanic White). The % of beneficiaries column has as a denominator the number of beneficiaries with Part A, Part B, and Part D.