Global Coalition on Aging

Global Alliance on Heart Failure & Healthy Aging
A GCOA INITIATIVE

Undiagnosed Heart Failure:
A Growing Public Health Risk (And Looming Financial Iceberg) for Aging Societies

Some Illustrative Introductory Calculations

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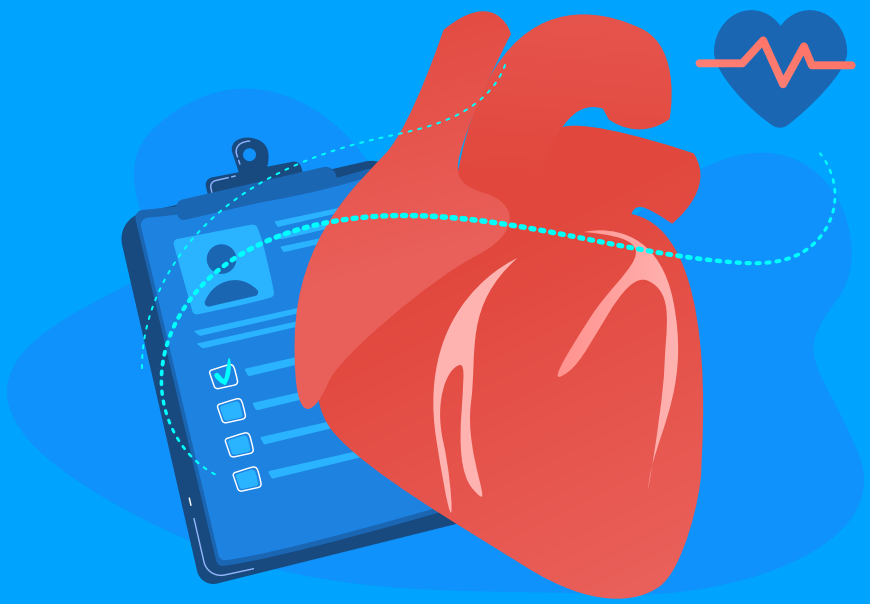

Contents

About This Report

As heart failure affects at least 26 million people around the world, it is notably one of the few cardiovascular conditions that is increasing in prevalence—the total cost of heart failure is predicted to increase 127% by 2030. Lending urgency to the challenge, the World Heart Federation's heart failure roadmap estimates that there are 11.7 million cases of undiagnosed heart failure globally.

Heart failure is not given adequate attention as a health priority because it is not well understood by those most affected or at risk, especially those in the 50+ age demographic. For instance, early symptoms of heart failure, such as shortness of breath, swelling, rapid weight gain, and fatigue are often wrongly dismissed as normal parts of the aging process or misdiagnosed as other co-morbidities associated with aging. This represents a costly mistake—for those who suffer from the condition, their caregivers, and healthcare budgets—that comes as a result of ageism in the healthcare system and across society.

As the global population over 60 is predicted to double by mid-century, reaching 2 billion, it is more urgent than ever for health systems to rethink their response to heart failure.

The calculations in this study are intended to showcase the oncoming surge of heart failure mortality and morbidity as the trends of aging and ageism continue in parallel. In doing so, we aim to bring attention to the missed opportunity around heart failure and call for ongoing studies to investigate these issues in far greater depth.

About the Author

Nicholas Eberstadt holds the Wendt Chair in Political Economy at the American Enterprise Institute. For over 20 years he was a member of the Harvard Center for Population and Development Studies. Dr. Eberstadt has served inter alia on the Board of Scientific Counselors for the CDC's Center for National Health Statistics, the Visiting Council for the Harvard School of Public Health, and the President's Council for Bioethics. He is also a member of the GCOA Advisory Board. His work on demographics, economic development and international security has been widely published in both professional and popular journals. He earned his AB, MPA and Ph.D and Harvard and his M.Sc. at the London School of Economics.[1]

Background

The Global Coalition on Aging's (GCOA) preparatory work, background research, and collaborative findings through the Global Alliance on Heart Failure and Healthy Aging make a persuasive case that heart failure (HF) stands to be an increasing health problem for societies in the decades ahead since the at-risk cohort (persons ages 50 and up) stands to grow substantially in OECD countries over the coming generation, with the highest risk age groups (persons say 70 and up) growing the fastest. Of particular concern here is the large population of older men and women with undiagnosed heart failure—likely the large majority of all persons today afflicted by this condition. Undiagnosed heart failure means higher risk of mortality, lower quality of life, and much higher costs of medical care, as these patients are far more likely to end up unexpectedly and perhaps recurrently in emergency departments (EDs) and intensive care units (ICUs).

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It should be apparent conceptually—i.e., just using words, without supporting statistical calculations or quantitative backup—that the burden of illness, both in terms of morbidity or mortality and health care resources, will tend to increase for aging societies if its age-specific prevalence rises sharply for older men and women. This is true of any NCD or communicable disease with such a profile. But we can attempt to clarify these public health costs and risks through quantitative methods of varying degrees of sophistication.

The simplest and easiest method of conveying the prospective risks of heart failure for societies in the decades ahead is illustrative projections—stylized calculations that present "what-if" scenarios for future years based upon: (a) reasonable "headcount" projections for the populations of countries under consideration by age and sex (we chose to look out to the year 2040); (b) extrapolated age- and sex-specific risks of heart failure for persons at older ages, along with a stylized scaling factor for the proportion of cases that go undiagnosed; and (c) assumption that interventions, social progress, or other factors do nothing to alter the stylized risk coefficients from (b) in the coming decades.

In this report, we take a first step in this process by offering stylized calculations to help show the rough scale of the prospective heart failure problem aging societies face in the coming decades.

More specifically, our calculations show:

1. what the mortality totals for HF in the United States would look like from 2020 through 2040 if 2015 HF death rates by age and sex remained constant through 2040, but were imposed upon America's growing, and aging, population over the next two decades, using US Census Bureau projections to detail those prospective demographic changes;

2. how the HF mortality totals in other important economic and demographic centers—the other G7 member countries, the EU, China, and India—would change between 2020 and 2040, given their prospective projected trends of population change, if unchanging US 2015 HF mortality schedules by age and sex were superimposed on those other national populations; and

3. what an arbitrary but not unreasonable range of possibilities for HF mortality trends and totals generated purely by demographic change and population aging over the coming two decades might look like for the non-US populations under consideration, using information we have gleaned about HF mortality differences between racial/ethnic groups in the US to illuminate this range.

These illustrative projections offer hypothetical results not only for the US—the country for which we do have detailed HF mortality data—but also for large populations around the world for which we currently lack such data.

Our approach cannot generate accurate and precise information about the scale of the prospective HF mortality problem in countries for which such data are currently unavailable to us. But, our method does help us think about the prospective scale of that problem more carefully. For our approach, while unavoidably arbitrary, is also rigorous, straightforward, and entirely transparent. Every step in these calculations

can be clearly explained and easily understood. If the reader accepts our steps and assumption, he or she can accept our results. Alternatively, the reader can replace our steps or assumptions with ones more to their satisfaction—and then consider how those adjustments affect the calculated results presented in this research.

We wish to emphasize explicitly that our calculations only speak to the prospective scale of the mortality toll (levels and trends) from HF. It does not directly address other important aspects of the HF "burden": the prevalence or severity of HF morbidity for those living with that health risk; the scope of undiagnosed HF morbidity in national populations; and the economic costs that HF mortality and morbidity exact from the countries under consideration in this research. Readers may however draw some indirect inferences about these important matters, and their policy implications, from the illustrative statistical displays we offer the reader.

Establishing the US HF Mortality "Baseline"

This report dispenses with extensive literature review. It will suffice to observe that peer-reviewed research on mortality trends from HF based on comprehensive and reliable nationwide mortality databases are exceedingly rare at present. Indeed, for our purposes a single such medical study stands out at present: a 2019 contribution to JAMA Cardiology from a team led by Dr. Stephen Sidney of Kaiser Permanente.[2]

Sidney et al. relied upon the US cause-of-death database maintained by the CDC, WONDER, to reconstruct the 2011-17 period US HF mortality totals, and HF mortality rates for both those under 65 and 65 and over, breaking these down by sex and race/ethnicity.[3] Finally, the Sidney et al. study projects forward to 2030 the mortality toll HF would exact in the USA in upcoming years if America's age-specific risk of death from HF remained fixed at its 2017 levels but population totals in the future varied in accordance with the US Census Bureau's projections from its International Data Base (IDB).[4]

This JAMA Cardiology study did not publish enough detailed information on HF death rates by age and sex in the US for us to easily replicate their findings. Consequently, we did a "deep dive" into the CDC WONDER database ourselves to make sure we could replicate all the results published in the 2019 Sidney et al. paper, and after that, to estimate the illustrative mortality toll for the US from holding HF mortality patterns constant but varying US population according to Census Bureau IDB projections. In our analysis, we opt to use 2015 HF mortality patterns rather than 2017 for the sake of maintaining consistency.

Using the JAMA Cardiology study as our template, we are able to replicate all its reported findings on CVD deaths by age, sex, and race/ethnicity for the years 2011-17. Taking the paper's cause-of-death diagnoses for defining "heart failure"—many separate specific diagnoses fall into this more general category—we were also able to replicate the paper's findings for HF mortality by age, sex, and race/ethnicity for 2011-17: both as an "underlying cause" and a "contributing cause."

Having determined that our analyses of the CDC WONDER data matched the 2019 Sidney et al. study's, we then proceeded to calculate the annual 2011-17 age- and sex- specific death rates for HF as an underlying cause for the US, both nationwide and by race/ethnicity, for the population 50 years of age and older. We used age 50 as an arbitrary but not unreasonable cutoff because the overwhelming majority of HF deaths befall people older than 50, as we shall see.

Unfortunately, CDC WONDER groups death rates for Americans 85 and older into a single catch-all category—a legacy perhaps of the era in which there were exceedingly few oldest-old Americans in the population.

As we reconstructed HF mortality schedules for the US from the CDC WONDER data, we detected a problem that was not highlighted in the Sidney et al. study. For reliable mortality projections, we need a relatively detailed breakdown of death rates by age group—five-year cohorts, such as 50-54, 55-59, and so on, are appropriate for our purposes. Unfortunately, CDC WONDER groups death rates for Americans 85 and older into a single catch-all category—a legacy perhaps of the era in which there were exceedingly few oldest-old Americans in the population. CDC WONDER provides a more detailed breakdown for cause of death by age (85-89, 90-94; 95-99, and 100+)—the numerator for age specific death rates—but only a single figure for the total 85+ population as a denominator. The trouble here is that US Census Bureau and CDC demographic statistics currently lump all persons 85 and older into a single category in their conventional presentations of US demographic data.

As we shall see, this is a trap when dealing with projections for a cause of death afflicting mainly persons 85 and older—a source of potentially serious error.

To cope with this shortcoming, we relied upon a sort of synthetic "patch fix." Regular Census Bureau data do not break down the 85+ population into subsidiary 5 year age groups, but the projections in the Census Bureau's IDB do so. We compared CDC WONDER estimates of the US 2015 population by five-year age groups for the under-85 population to those for the US 2015 in IDB, and while not identical, they were very close: the cumulative difference was less than 0.2%.

Further, CDC and IDB differed by just over 17,000 persons in their 85+ estimates for that same year—and since nearly 6.5 million Americans in 2015 were 85 or older, the discrepancy was trivial, just three-tenths of a percent. Given these very small differences between IDB and CDC WONDER, we felt confident utilizing IDB denominators and CDC WONDER numerators for calculating the missing age-specific, US nationwide death rates for America's oldest-old by cause of death.

We set 2015 as the year for "constant" CVD and HF mortality schedules, while calculating the illustrative impact against these fixed schedules from future population changes according to IDB projections.

CVD and HF Mortality Patterns in the US:
What CDC WONDER Data Reveal

Drawing directly upon the CDC WONDER database for cause of death mortality in the US—without our own additional "patch fix" adjustments to parse mortality schedules for the oldest-old—we can make four important initial points about reported HF mortality.

First: from a nationwide standpoint, HF mortality in America is a cause of death for the very oldest of the old. Nationwide, nearly three-fifths of the deaths attributed to HF in the US in 2015 were to people 85 or older, and less than 10 percent were to people under 65. By way of comparison, about two-fifths of US 2015 deaths from all forms of CVD fell in the 85+ group, with over a fifth in people under 65. Overall, less than a third of all deaths that occurred in 2015 were for people 85 or older and over a quarter of all deaths that year were of people under the age of 65.[5]

Second: we see an almost steady exponential increase in the risk of death from HF mortality for middle and older age groups. CDC WONDER's mortality database provides such information for the 50-54 age group through the 80-84 age group. Such exponential increases in HF mortality by age are seen for the US population as a whole; for men and women alike; and also for the four main racial/ethnic groups in the US population that we study: non-Hispanic whites (a group we might call "Anglos"), non-Hispanic blacks (or African-Americans), Hispanics (or Latinos), and Asian or Pacific Islanders (or Asian-Americans).

Third: notwithstanding the stable nationwide patterns of HF death by age, racial/ethnic groups within the US exhibit marked differences in HF mortality levels and patterns. Between ages 50-54 and 80-84, for example, reported age-specific mortality for Asian-Americans were far below the national average: always well below half the corresponding national age-specific rate and fully two-thirds lower for some of them; only 4 percent of HF deaths among Asian-American women were to women under 65. Hispanics also reported age-specific mortality rates for HF well below the corresponding nationwide averages in the CDC WONDER mortality database: always at least 30 percent lower, and over 40 percent lower for some middle-aged groups. On the other hand, reported HF mortality is dismally high for African-Americans of all age groups covered, and shockingly high for some of these particular cohorts. In 2015, HF mortality was over two and a half times the national average for African-Americans in their late 50s—and nearly three times the national average for those in their early 50s.

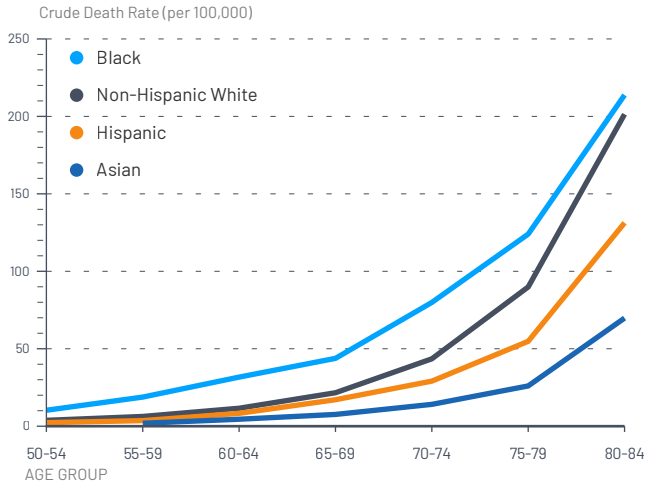
Consequently, the overwhelming majority of deaths from HF for black Americans occur for people under the age of 85. For black men, the picture is particularly dire: barely one HF death in five among the black male population fell to the 85+ group, and nearly a third occurred among those under 65 (about three times the corresponding national average). These major domestic differences in HF mortality levels and concentrations should caution us that there is no single "standard" pattern to HF mortality. Even as these findings should encourage much broader attention to the US HF problem among African-Americans, for the purposes of our illustrative projections, they should also remind that we cannot automatically apply nationwide US patterns abroad in a "one-size-fits-all" manner to obtain reliable HF mortality projections for countries in Asia or Europe.

Finally, CDC WONDER data underscore one noteworthy aspect of the HF mortality problem in the US: it appears to be accountable for a rising share of US deaths. Between 2011 and 2017, the years covered in the 2019 JAMA Cardiology study, the total number of deaths attributed to HF (as an underlying cause) jumped by 45 percent: from 58,000 to over 83,000. The share of total CVD deaths reportedly due to HF (as an underlying cause) likewise jumped from 10 percent to 13 percent, and from about 2.3 percent of total deaths to about 2.9 percent. Further, and in sharp contrast to overall CVD trends, which have been in long term decline in the US for decades, age-standardized HF mortality in the US has reportedly risen between 2011 and 2017, the period covered by the JAMA Cardiology study. (Age adjusted HF has continued to rise since 2017 too: through at least 2019, the most recent year for which such data are currently available.) Our disaggregation indicates consistent and, in many case, sharp increases in age specific HF mortality for Americans of middle and older ages between 2011 and 2017: in contradistinction to the consistent and often sharp decreases in overall CVD for those same age groups over that same period.

We cannot tell how much of this tendency is due to changing awareness of HF diagnoses by medical professionals responsible for death certificates. We would simply observe that the reported increase in total HF mortality in the US in recent years looks like a sharp increase for deaths from a chronic disease—and thus a condition that would seem to deserve greater attention in its own right.

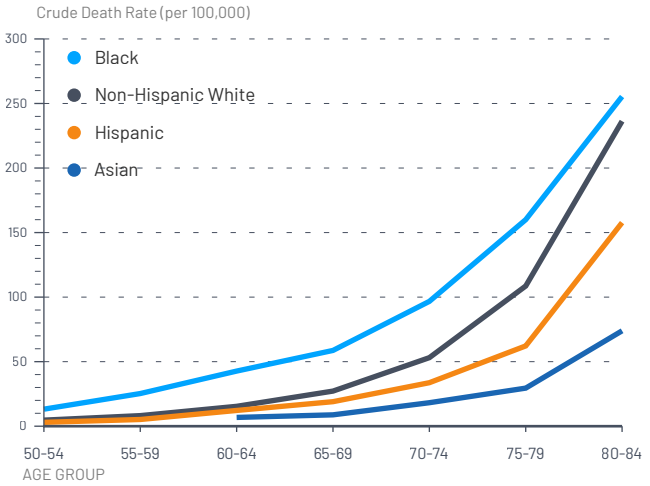
CRUDE DEATH RATE FROM HEART FAILURE, BY FIVE-YEAR AGE GROUP AND RACE/ETHNICITY

Both Sexes USA: 2017



Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html.

Male, USA: 2017



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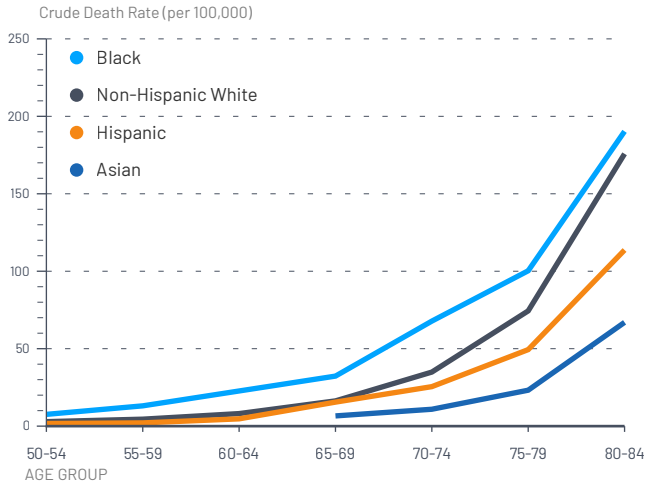
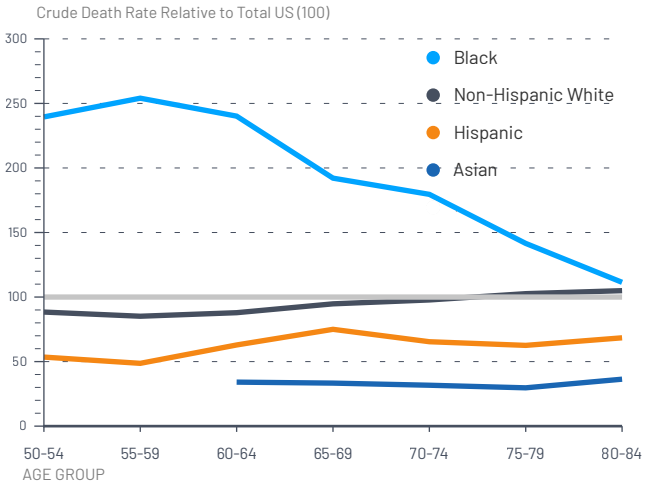
Female, USA: 2017



Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html.

CRUDE DEATH RATES RELATIVE TO TOTAL US BY FIVE-YEAR AGE GROUP AND RACE/ETHNICITY

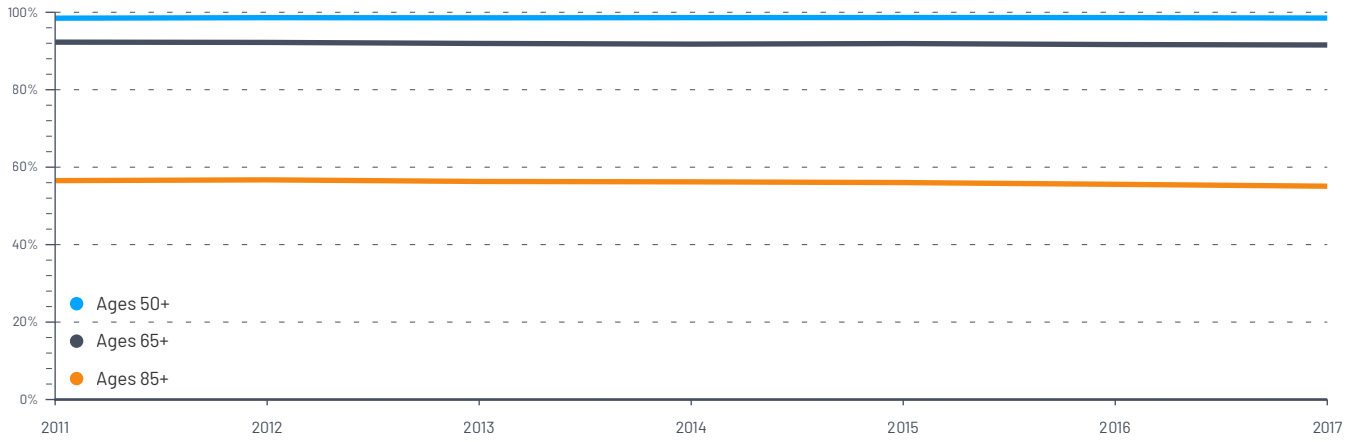
Both Sexes, USA: 2017



Note: The grey horizontal line represents the baseline US total crude death rate from heart failure across each five-year age group.
Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html.

PERCENTAGE OF TOTAL HF DEATHS BY AGE GROUP

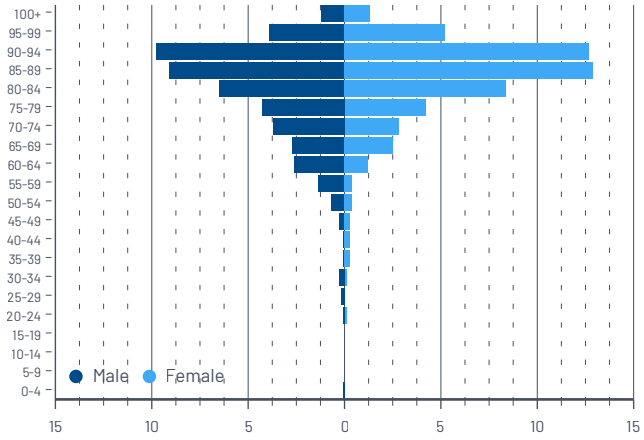
Both Sexes: USA, 2011-2017



Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html.

SHARE OF ALL US HEART DISEASE DEATHS BY FIVE-YEAR AGE GROUP AND SEX

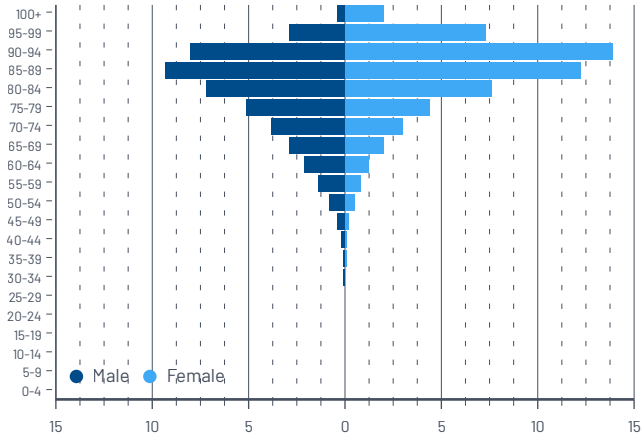
All Races/Ethnicities
(CDC, 2015)



Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html.

SHARE OF US HEART FAILURE DEATHS BY FIVE-YEAR AGE GROUP AND SEX

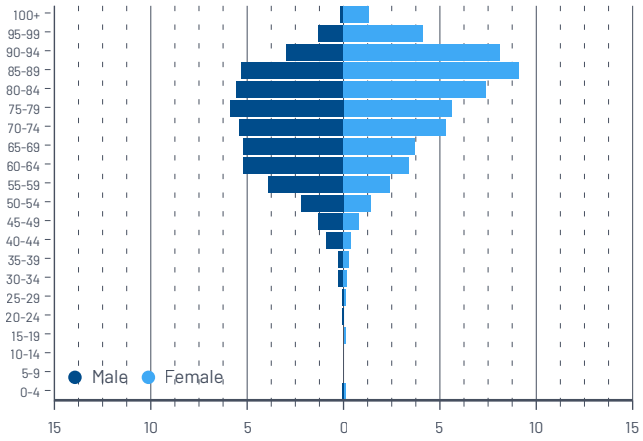
All Races/Ethnicities
(CDC, 2015)



Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html.

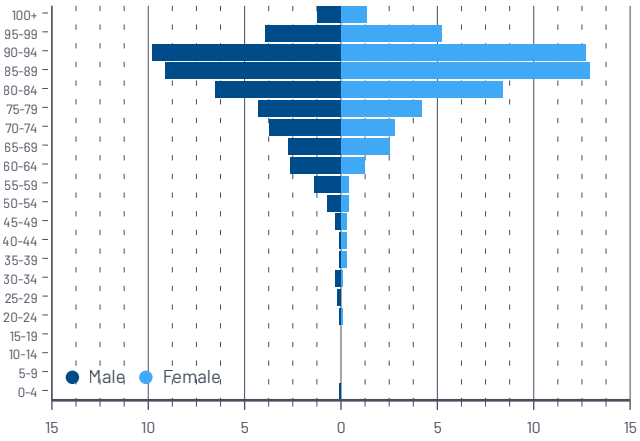
SHARE OF US HEART FAILURE DEATHS BY FIVE-YEAR AGE GROUP AND SEX

African-Americans
(CDC, 2015)



Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html.

Asian-Americans
(CDC, 2015)



Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html.

Estimating HF for America's Oldest-Old:
Our "Synthetic" Method

Given that nearly three-fifths of all HF deaths in America today occur among people 85 years of age or older, it is highly problematic for our exercise that a breakdown by smaller age groups is not available from CDC WONDER for HF mortality for America's 85+ population.

Our work-around for this problem is a synthetic method, inserting the Census Bureau's IDB estimates of US nationwide male and female cohorts 85-89, 90-94, 95-99, and 100+ years of age as denominators and using CDC WONDER HF death totals for those same cohorts as numerators to obtain proxied age-specific HF death rates for America's oldest-old population nationwide.

We are mixing "apples and oranges"—distinct data sources with non-identical readings for the years we can compare. This is a methodological yellow flag. But in practice the differences between the IDB and CDC WONDER estimates of US population by age and sex are very small for those data we can compare (i.e., the 85+ group in toto and the under-85 population disaggregated by age and sex into five-year cohorts)—less than a rounding error after the decimal place. We can therefore be quite confident that our synthetic method is not distorting or biasing our own estimates of age-specific 85+ HF mortality in the US to any appreciable degree.

Our synthetic method indicates a continuation of the exponential increase in age-specific HF mortality already observed for middle-aged and US men and women nationwide on into the oldest-old age groups. For men, women, and the total population, HF mortality rises by about 13-14 percent for each calendar year of age from 50-54 through 90-94—and then by 8-10 percent after ages 90-94. We regard this as a reassuring "reality check" for our "patch fix" method.

The importance of disaggregating HF mortality for the 85+ group is highlighted by the anomalous crude death rates CDC WONDER reports for various US 85+ sub-populations when all persons in their oldest-old group are lumped summarily together. As we have seen, African-Americans suffer by far the highest levels of age-specific HF mortality for Americans 50-84 years of age. Yet CDC WONDER reports black American 85+ crude death rates for HF are consistently, and significantly, lower than the US national average—roughly 19 percent lower in 2015, for example. At play is an ecological fallacy—the confounding impact of big differences in the age composition of the oldest old. Less obvious but equally confounding effects would taint our projections if we did not decompose age specific mortality for the 85+group, as we do with our synthetic method.

Illustrative Projections of HF Mortality for the US 2020-2040:
The "No-Improvements" Scenario

Using our "patch fix," we can now project hypothetical totals for the US for HF mortality for 2020-2040, under a scenario where we assume nationwide HF death rates by age and sex for the 50+ population stay fixed at their 2015 levels—but population continues to grow and age as per the Census Bureau IDB projections.

Our illustrative scenario depicts total nationwide HF mortality soaring from its actual level of 74,000 deaths in 2015 to 112,000 in 2030 and 157,000 by 2040.

Our illustrative scenario depicts total nationwide HF mortality soaring from its actual level of 74,000 deaths in 2015 to 112,000 in 2030 and 157,000 by 2040.

In this "no-HF-mortality-improvement-after-2015" scenario, total nationwide HF deaths in 2030 would be over 50 percent higher in 2030 than they were in 2015—and in 2040 well over twice as high as (112 percent higher than) the 2015 level. The implied tempo of mortality increases for the US for HF between 2015 and 2040 would be 3 percent a year.

We also ran a "no-mortality-improvement-after-2015" scenario for projecting overall CVD mortality for the US to 2040, using our same "patch fix" to estimate CVD mortality for the 85+ population. In that scenario, total CVD deaths also rose exponentially—but while the absolute magnitude of the overall CVD toll was obviously much greater, the implied pace of increase was slightly slower: 2.6 percent per annum. The difference is largely explained by the fact that HF mortality "skews older" than overall CVD mortality, and that the oldest-old groups in the US are projected to be growing especially rapidly over the coming decades.

Applying US Nationwide HF Mortality Schedules for 2015 to Other Countries and Regions:

Illustrative Projections to 2040 for the "No-Improvements" Scenario

If we apply our synthetic US 2015 nationwide schedule for age-specific 50+ CVD and HF mortality to IDB demographic projections for other countries and regions of interest, we can calculate illustrative CVD and HF mortality totals from 2015 to 2040 for the rest of the G7 countries, the EU, China, and India. The totals we calculate may be seen in the accompanying figures.

As with the US, the hypothetical totals for CVD and HF rise exponentially in all these countries and regions. This result should not surprise, given that all the places in question are expected to experience population aging over the coming decades, and some of them are expected to undergo population growth as well. And in all these other countries and regions, the hypothetical increase in HF mortality is faster than for CVD mortality—no surprise here either, given that we are modeling with US schedules that bring this "built-in" result.

Notwithstanding: the illustrative variations in hypothetical HF totals are important to bear in mind.

The least dramatic illustrative increases in HF deaths between 2015 and 2040 is for Italy (a 66 percent increase, averaging 2 percent a year).

The EU's illustrative increase in total HF mortality would be about 83 percent, averaging 2.4 percent a year—close to the illustrative projections for France, Germany, and Britain.

Canada's illustrative increase in projected HF deaths would be almost the same as that of the US: a 114 percent rise between 2015 and 2040, or a tempo of 3 percent a year.

Despite its ongoing population decline, we model an illustrative increase in HF death totals for Japan of 132 percent—with HF deaths rising by 3.4 percent a year between 2015 and 2040.

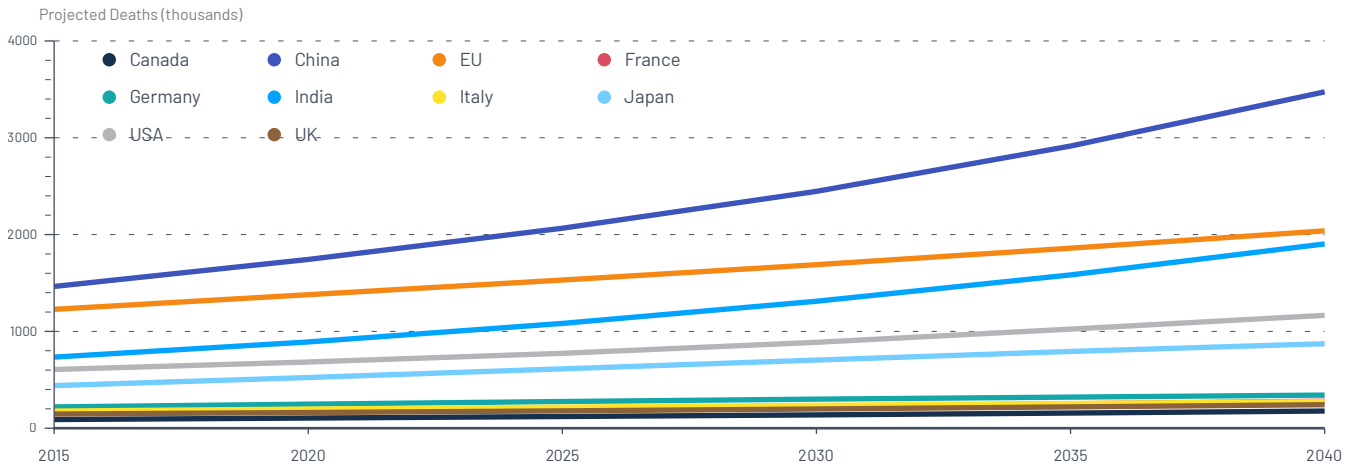
China's illustrative increase in HF deaths would be on the order of 175 percent—with HF deaths increasing at the tempo of 4 percent a year during the quarter century.

The most radical illustrative increase in total HF deaths, however, would be for India, where modeled HF death totals would nearly triple (up 196 percent), rising by a hypothetical 4.3 percent a year between 2015 and 2040.

India is the most youthful of the countries/regions under consideration in this note—but it is also a place with the most rapidly surging hypothetical HF death total. The India example should remind us that, absent improvement in HF mortality schedules, the toll of HF death can rise very rapidly in developing societies too: countries with youthful and growing populations and lower income levels.

PROJECTED DEATHS FROM ALL HEART DISEASE Ages 50+

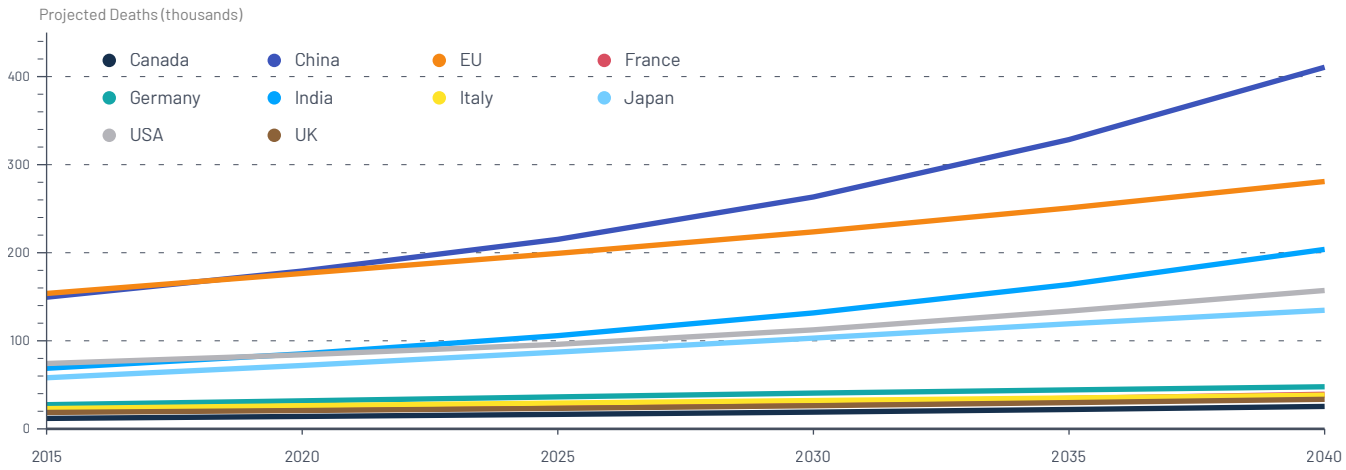
(CDC, 2015, and Census IDB, 2015-2040)



Note: Deaths from all heart disease and heart failure are projected using 2015 crude death rates for 5-year age groups over the age of 50 in the US. The crude death rates are combined with five-year age group population projections from the US Census Bureau's International Data Base.
Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html; and US Census Bureau, International Programs, International Data Base, accessed December 10, 2020, https://www.census.gov/data-tools/demo/idb/informationGateway.php.

PROJECTED DEATHS FROM HEART FAILURE Ages 50+

(CDC, 2015, and Census IDB, 2015-2040)



Note: Deaths from all heart disease and heart failure are projected using 2015 crude death rates for 5-year age groups over the age of 50 in the US. The crude death rates are combined with five-year age group population projections from the US Census Bureau's International Data Base.
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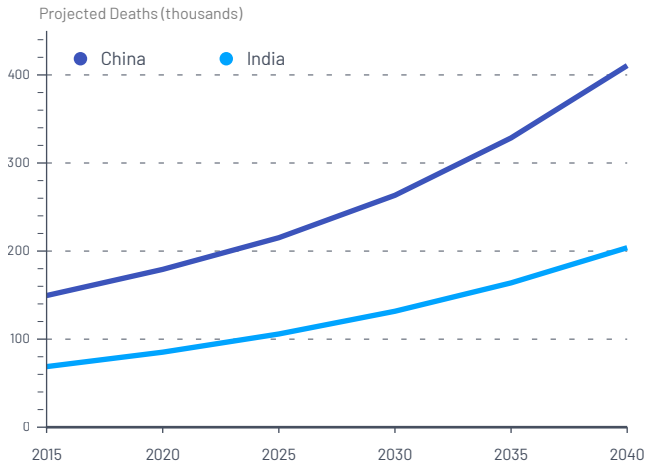
PROJECTED DEATHS FROM HEART FAILURE

Ages 50+: China and India
(CDC, 2015, and Census IDB, 2015-2040)



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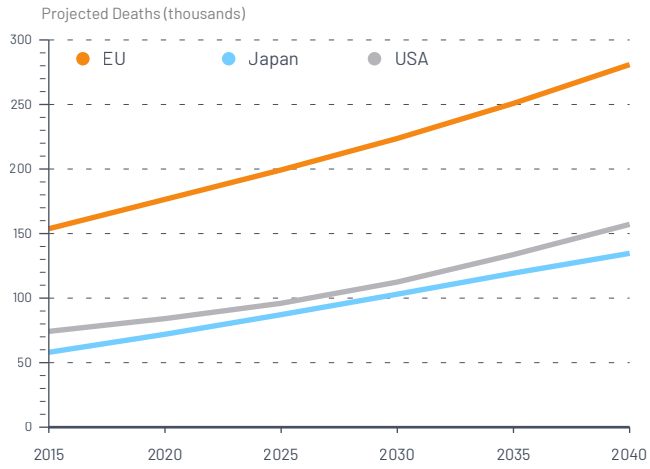
Ages 50+ EU, USA, Japan
(CDC, 2015, and Census IDB, 2015-2040)



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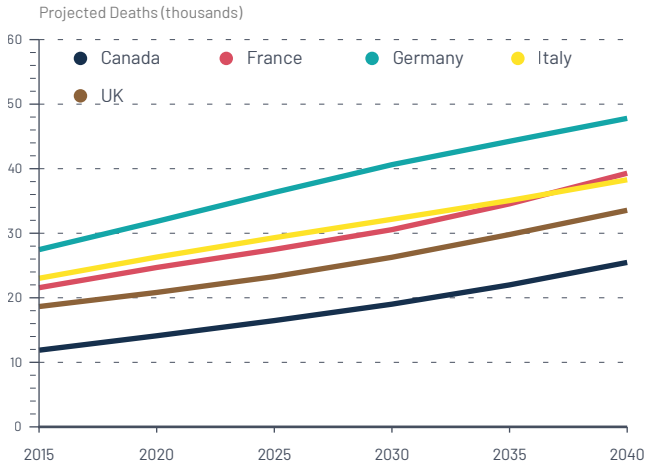
Ages 50+: G7 minus USA and Japan
(CDC, 2015, and Census IDB, 2015-2040)



Note: Deaths from all heart disease and heart failure are projected using 2015 crude death rates for 5-year age groups over the age of 50 in the US. The crude death rates are combined with five-year age group population projections from the US Census Bureau's International Data Base.
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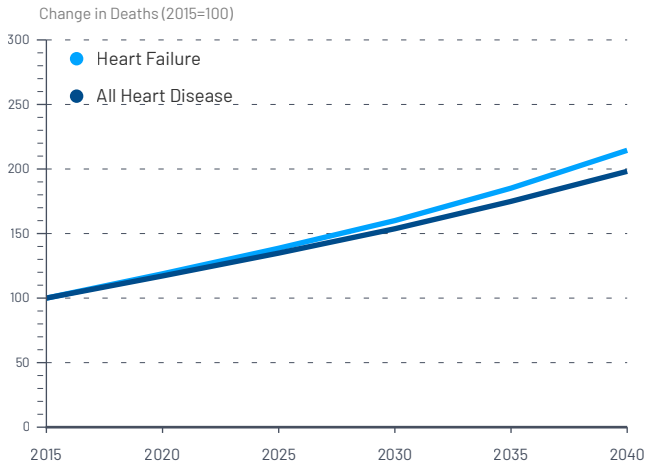
RELATIVE CHANGE IN DEATHS FROM ALL HEART DISEASE AND HEART FAILURE

Canada, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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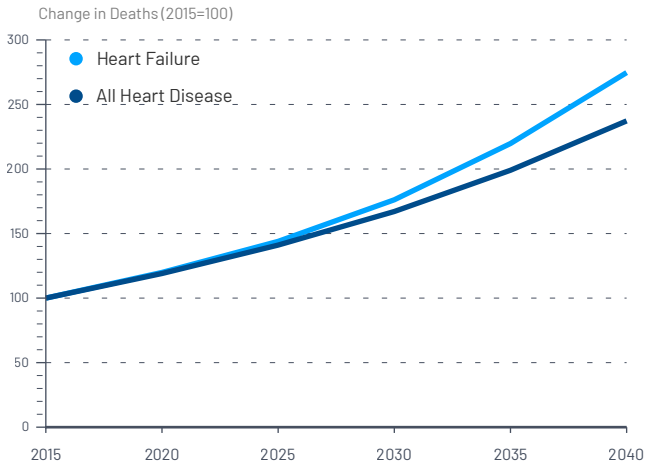
China, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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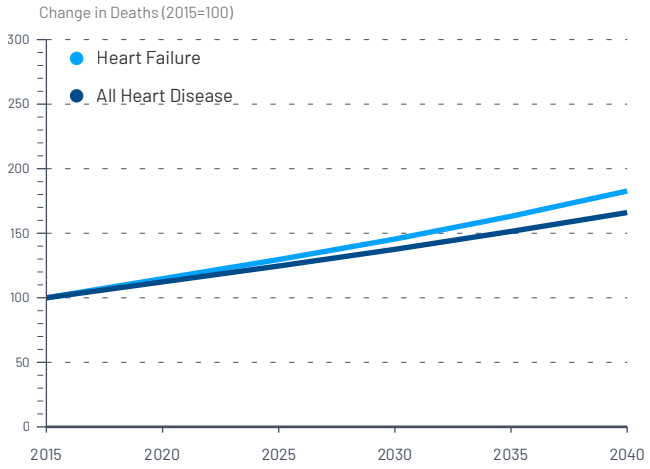
EU, Ages 50+
(CDC, 2015, and Census, 2015-2040)



Note: Deaths from all heart disease and heart failure are projected using 2015 crude death rates for 5-year age groups over the age of 50 in the US. The crude death rates are combined with five-year age group population projections from the US Census Bureau's International Data Base.
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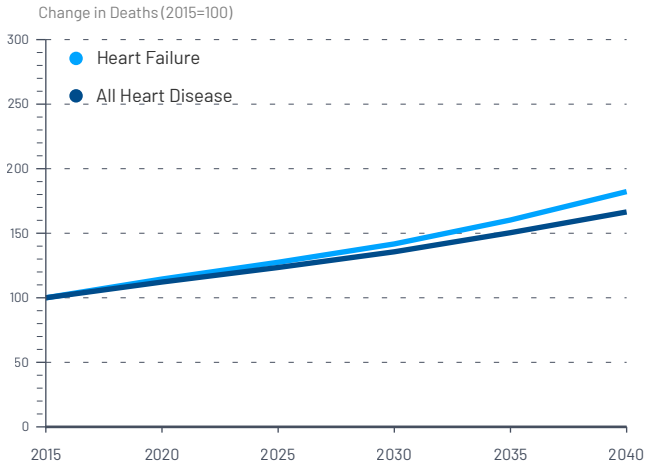
France, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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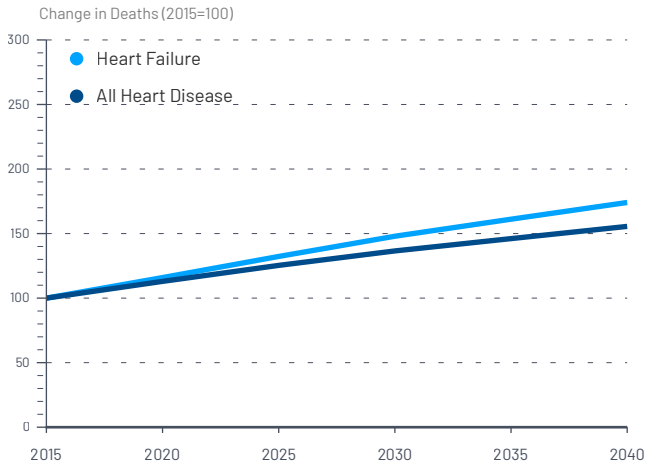
RELATIVE CHANGE IN DEATHS FROM ALL HEART DISEASE AND HEART FAILURE

Germany, Ages 50+
(CDC, 2015, and Census, 2015-2040)



Note: Deaths from all heart disease and heart failure are projected using 2015 crude death rates for 5-year age groups over the age of 50 in the US. The crude death rates are combined with five-year age group population projections from the US Census Bureau's International Data Base.
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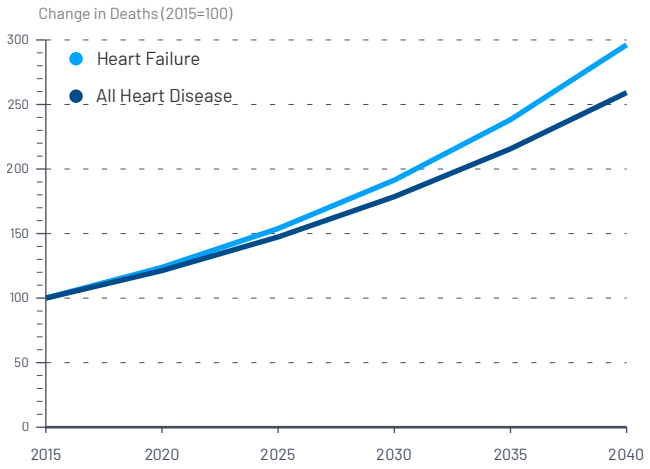
India, Ages 50+
(CDC, 2015, and Census, 2015-2040)



Note: Deaths from all heart disease and heart failure are projected using 2015 crude death rates for 5-year age groups over the age of 50 in the US. The crude death rates are combined with five-year age group population projections from the US Census Bureau's International Data Base.
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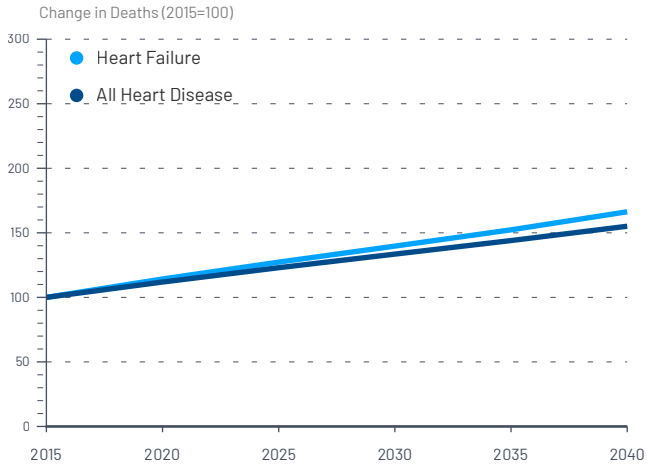
Italy, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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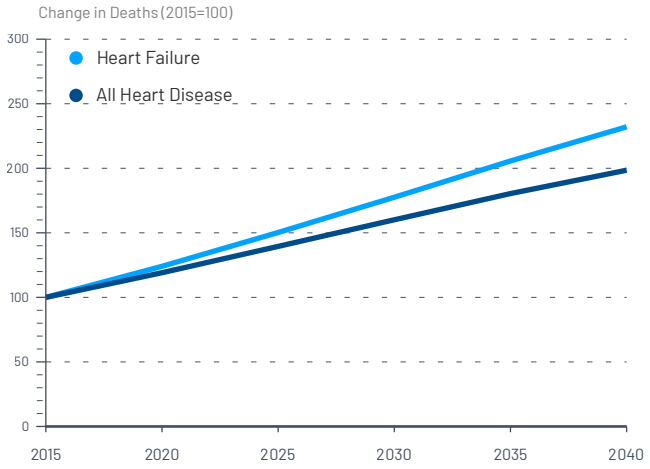
Japan, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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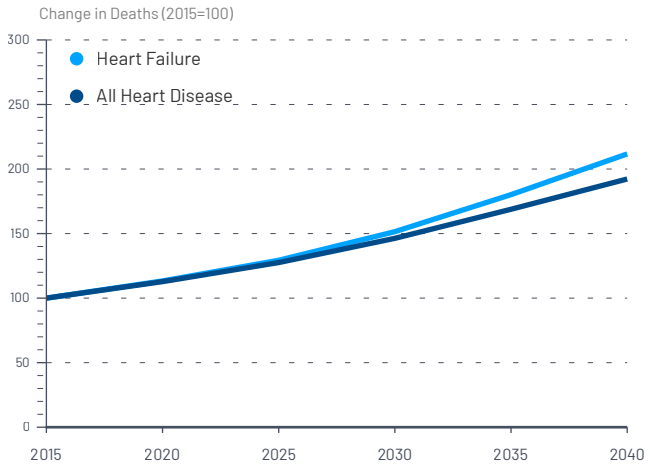
RELATIVE CHANGE IN DEATHS FROM ALL HEART DISEASE AND HEART FAILURE

USA, Ages 50+

(CDC, 2015, and Census, 2015-2040)



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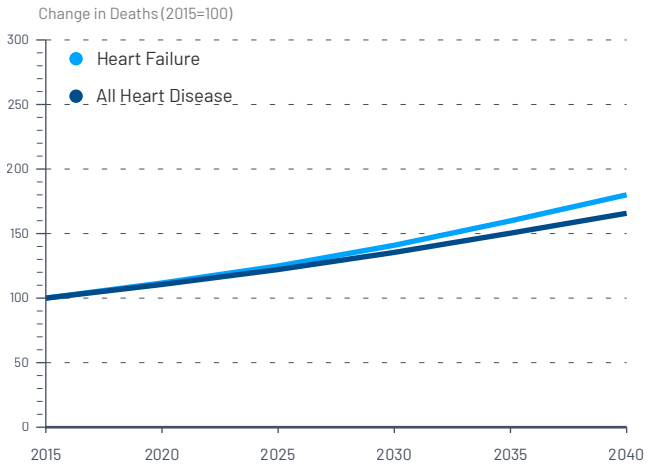
UK, Ages 50+

(CDC, 2015, and Census, 2015-2040)



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A "Sensitivity Analysis" for Illustrative Projections for Other Countries

Based on US Domestic Variations in HF Mortality Patterns

Our simple model offers an illustrative first take on prospective HF mortality trajectories outside the US under a "no-HF-progress" scenario, on the assumption that overseas patterns of age-specific HF mirror America's. But that assumption is questionable, for HF levels and trends in other countries are unlikely to be exactly the same as in the US.

The magnitude of the problem is suggested by "Global Burden of Disease" (GBD project estimates from the Institute of Health Measurement and Evaluation (IHME) at the University of Washington.[6] The GBD project aims to estimate, among other things, age-specific cause of death rates for all countries of the world. There are naturally data gaps and heroic assumptions in such an ambitious undertaking—and the project does not yet generate numbers of HF internationally. (If it did we might not have needed to conduct the current exercise.) But the GBD project does offer its own, presumably standardized and methodologically consistent, summary estimates for crude death rates for both sexes for the 70+ population from all cardiovascular diseases. IMHE indicates dramatic CVD mortality rates for the older populations of the countries we consider in this exercise. For example: 70+ CVD mortality rates are said to be 50 percent higher in China than the US; 40 percent lower in Japan than in the US; and 150 percent higher in China than Japan.

Regardless of the limitations of those GDB calculations, such contrasts in crude death rates from CVD for older groups should impress the importance of adjustments of our "US-normed model" to attempt to take local realities into account.

While we manifestly lack accurate and internationally comparable multi-country HF mortality data at this writing, we can respond to the need for "sensitivity analysis" by scaling illustrative results for other countries against the very different HF patterns we have found within the US for various racial/ethnic groups. We have discovered big differences in HF mortality levels for Asian, Hispanic, "Anglo," and Black Americans—generally tracking with the differences in overall life expectancy at birth separating these subpopulations today. We therefore might want to compare countries/regions abroad to the US ethnicity most closely approximating its level of life expectancy at birth as we look for the best available proxy for HF trends from our limited selection of offerings.

In 2015, according to the CDC, overall life expectancy at birth in the US was about 79 years: African-American life expectancy was 75 years, and Hispanic life expectancy was 82 years.[7] The CDC does not publish estimates of life expectancy for Asian-Americans, but the Social Science Research Council's "Measure of America" project estimates life expectancy for this group was 87 years in 2010—higher than for any national population as this time.[8]

To go by these benchmarks, and IDB estimates of international life expectancy in 2015, Asian-American trends might be the most appropriate comparators for Japan; EU countries might be most comparable to Hispanic-American health trends; China would be most nearly comparable to African-American trends; and India would have a poorer profile than any available US grouping, with African-American mortality levels perhaps closest.

We do not have all the data we would need to estimate current age-sex mortality schedules for HF for Americans by race/ethnicity—in particular, we lack population breakdowns by five-year cohorts for African-American, Asian-American, and Hispanic-American men and women 85 and older. These are the missing denominators for the necessary calculations for HF death rates for Asians, blacks, and Hispanics aged 85-89, 90-94, 95-99, and 100+.

Even though we lack these numbers, we can probably approach the true figures with a quick-and-dirty shortcut technique: namely, scaling the HF death rates for these oldest-old by the US nationwide geometric progression witnessed for 85-89 vs. 80-84; 90-94 vs. 85-89; and so on. Using this approach, we manufacture a complete mortality schedule for HF for two "models," one with lower HF mortality and one with higher HF mortality than the US nationwide average.

Our proffered approach to "sensitivity analysis" is only a stopgap. The academic literature on "model life tables" demonstrates that mortality schedules in countries can differ in important "structural" ways even when two populations share the same level of life expectancy at birth: in the East Asian models, for example, death rates for middle-aged men tend to be higher at any given level of general mortality.[9] Our technique offers no such nuance or elegance. On the other hand, it does provide some illustration of the potential impact of higher and lower HF mortality scenarios—and through empirically-grounded findings rather than entirely imaginary or arbitrary rules of thumb.

Illustrative Results of Our "Sensitivity Analysis" for HF Mortality to 2040 for Other Countries and Regions

We can now experiment with our four illustrative "models" for projected HF death totals for the countries under consideration under the assumption of no progress against HF between now and 2040.

We begin with the US.

On African-American HF mortality schedules, total HF would have been nearly a third higher in 2015 than the total that was actually reported; 2040 projections would be about a quarter above the previous all-US projections. Note that the differential disadvantage diminishes in these projections because the US population ages in IDB projections, lessening the relative impact of those extremely high HF rates among middle-aged African-Americans.

The Hispanic model on the other hand would make for one-third fewer total HF deaths for the US in 2015, and likewise about a third fewer total projected deaths for 2040 than through the all-US model. For its part, the Asian-American model would have implied barely a third the HF death toll in 2015 that the US actually experienced, and just 35 percent of the all-US model's projected total for 2040.

The "no-HF-progress" scenarios based on our all-US, Asian-American, and Hispanic-American models generate almost the same proportional increases in notional HF deaths between 2015 and 2040 (bunched between 112 and 114 percent in this particular case). The African-American model generates a slightly lower increase (98 percent in this case) for reasons already mentioned. The same pattern holds for the other countries and regions to which we apply these models: the African-American variant generates slightly lower increases in HF levels over time, but much higher initial levels, while the other three generate lower levels but higher (and quite similar) tempos of HF illustrative mortality increases.

For Japan, using our Asian-American model, the implied HF toll would have been 20,000 deaths in 2015 and 48,000 in 2040. The per capita 2015 HF death toll from the Asian-American model for Japan is twice as high as for the same model applied to the US—an indication of just how powerful the population aging factor is as a driver of total HF deaths in modern societies. The other three models—Hispanic; all-US; and African-American—are also available for perusal, but for reasons already indicated we believe these are much less relevant for illustrating HF death scenarios for Japan.

For Canada, where life expectancy closely approximates that of the US Latino population, our Hispanic model may be most apposite. By that illustrative model, projected HF deaths under the "no-HF-progress" scenario would rise from 8,000 in 2015 to 17,000 in 2040.

The EU's life expectancy overall falls between the US national average and that of America's Hispanic population. If we use those two models to band projections of EU HF deaths in the "no-HF-progress" scenario, our projections range from 103,000 to 154,000 deaths in 2015 to 190,000 to 281,000 in 2040.

For EU member France, whose life expectancy level approximates that of US Latinos, our Latino model implies 15,000 HF deaths in 2015 and 28,000 in 2040 under that same scenario. Italy, with a life expectancy likewise very close to the US Latino level, might best be matched with the US Hispanic model, in which case the implied "no-HF-progress" scenario would run from 15,000 in 2015 to 26,000 in 2040. Germany, with a life expectancy between the all-US and the US Hispanic levels, might best be matched against those two models, in which case its "no-HF-progress" scenario would be illustrated by a band running from 18,000 to 27,000 in 2015 to 32,000 to 48,000 in 2040. (Note once more the impact here of the population aging factor—implied per capita deaths in our models for Germany in 2015 are nearly half as high as in America, entirely due to differences in population structure.)

For the UK, with a life expectancy between the all-US and the Hispanic levels, the implied bands for modeled projections run from roughly 13,000 to 19,000 in 2015 to 23,000 to 34,000 in 2040.

It will be no surprise that vastly higher HF tolls are implied for both China and India. Readers can choose their own preferred variant for gauging prospects for China—but if we look to the African-American model, with China's current life expectancy almost matching black America's, our modeled results would imply an explosion of HF deaths: from an illustrative 220,000 in 2015 to over 550,000 in 2040.

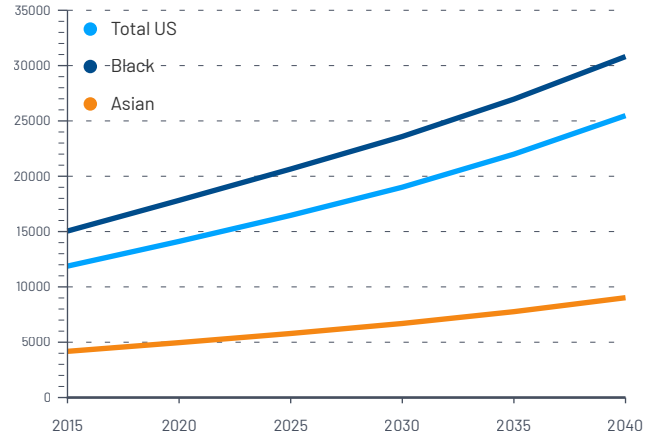
As for India: our African-American model would imply over 100,000 deaths in 2015, leaping to nearly 300,000 projected deaths by 2040. By 2040, under Census IDB projections, India's population would be nearly 200 million larger than China's—yet

our model projects barely half as many total HF deaths for India as China for that year: yet another reminder of the crucial role of population aging as a driver of HF mortality, absent progress in reducing age-specific mortality risks for HF. It is possible that our African-American model might overestimate India's true HF levels—given India vs. African-American differences in nutrition and health in general. But it is also possible that our African-American model could understate India's true levels, insofar as general life expectancy in India today (2015) is still over six years lower than for black America, according to estimates by the US Census Bureau and the CDC.

The "sensitivity analysis" we introduce to this exercise demonstrates that the possible range of prospective HF levels for countries under consideration can vary rather dramatically—and our simple models do not exhaust the variance that might exist between one society and another. This indicates the tremendous importance of understanding the true "starting point" or initial level of HF deaths in any specific country. This empirical reality can only be determined by in-country research. While our exercise cannot determine "starting points" or levels outside the US in advance, our model may provide a more robust insight into trends—the trajectory of increasing HF deaths countries may face absent HF progress simply on the basis of population change in general, and most especially populating aging.

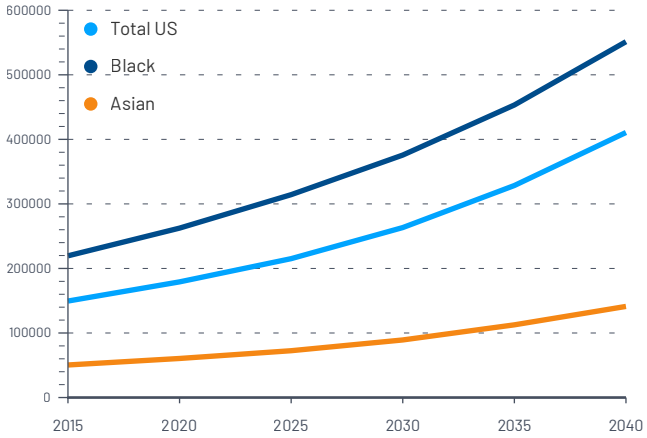
TOTAL DEATHS FROM HEART FAILURE BY DEATH RATE

Canada, Ages 50+
(CDC, 2015, and Census, 2015-2040)



Note: Deaths from heart failure are projected using 2015 crude death rates for 5-year age groups over the age of 50 in the US. For age groups over 80 to 84, the crude death rates for Blacks and Asian are calculated by multiplying the total US crude death rates for those age groups by the ratio of the total US crude death rate to the rates of Blacks or Asians ages 80 to 84. The crude death rates are combined with five-year age group population projections from the US Census Bureau's International Data Base.
Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html; and US Census Bureau, International Programs, International Data Base, accessed December 10, 2020, https://www.census.gov/data-tools/demo/idb/informationGateway.php.

China, Ages 50+
(CDC, 2015, and Census, 2015-2040)



Note: Deaths from heart failure are projected using 2015 crude death rates for 5-year age groups over the age of 50 in the US. For age groups over 80 to 84, the crude death rates for Blacks and Asian are calculated by multiplying the total US crude death rates for those age groups by the ratio of the total US crude death rate to the rates of Blacks or Asians ages 80 to 84. The crude death rates are combined with five-year age group population projections from the US Census Bureau's International Data Base.
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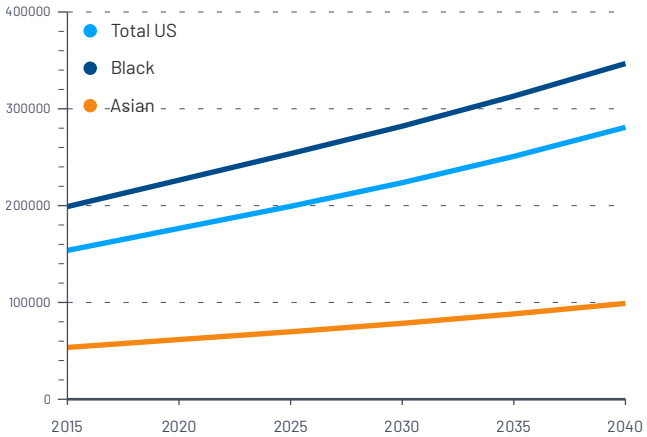
EU, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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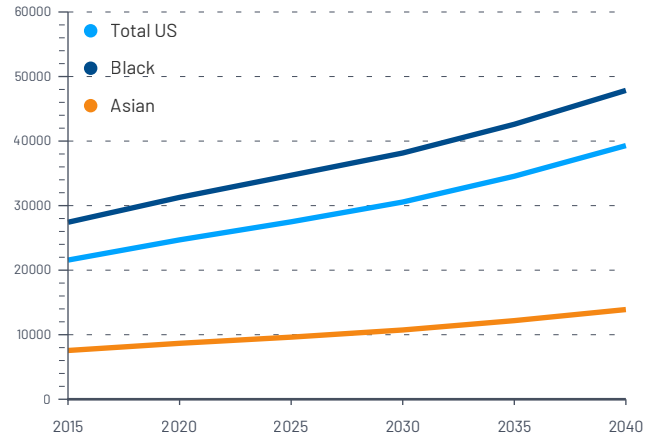
France, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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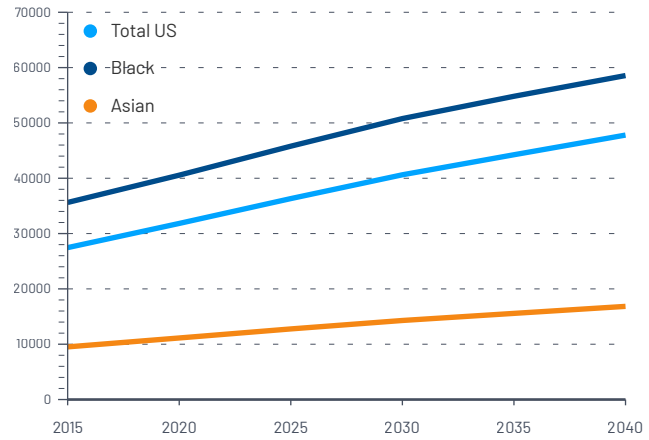
TOTAL DEATHS FROM HEART FAILURE BY DEATH RATE

Germany, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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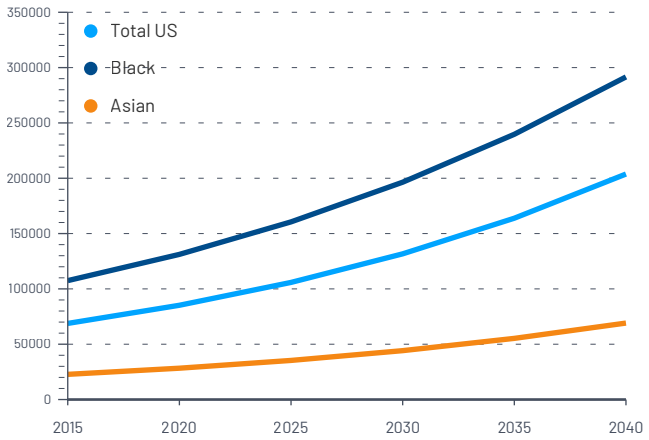
India, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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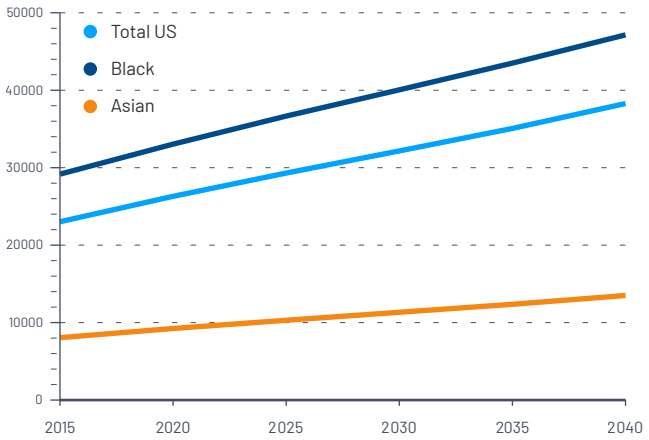
Italy, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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Japan, Ages 50+
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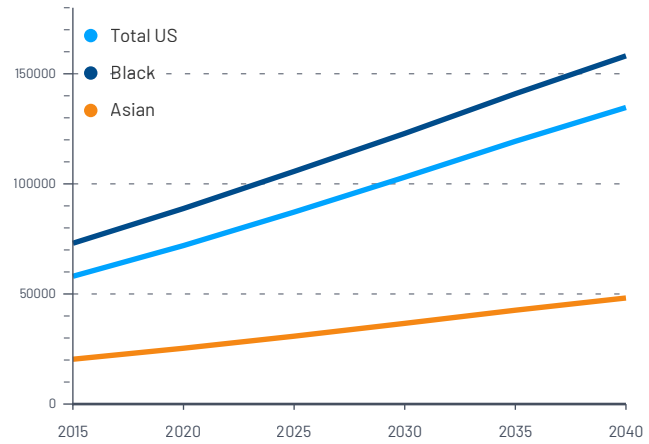

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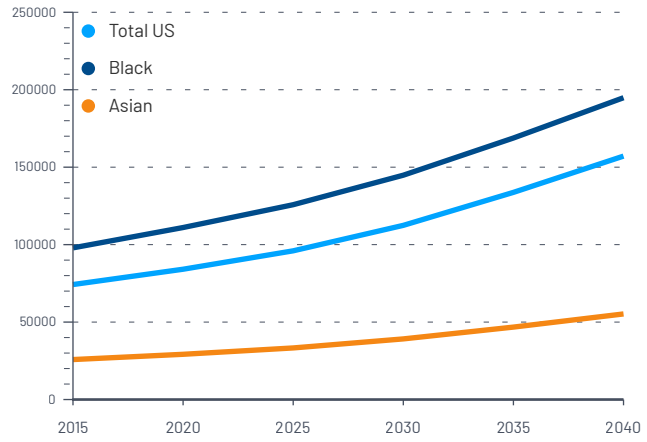
TOTAL DEATHS FROM HEART FAILURE BY DEATH RATE

USA, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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UK, Ages 50+
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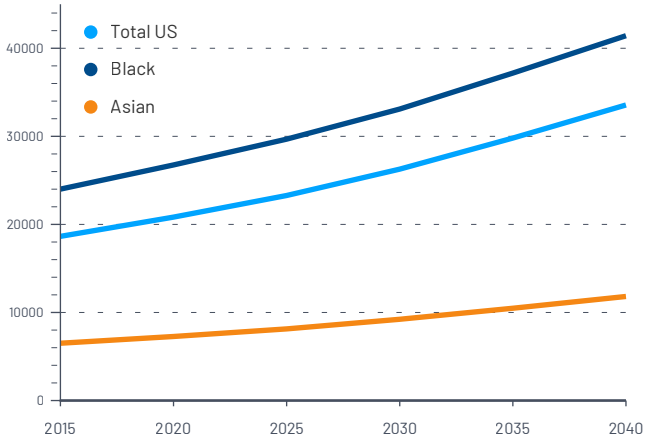

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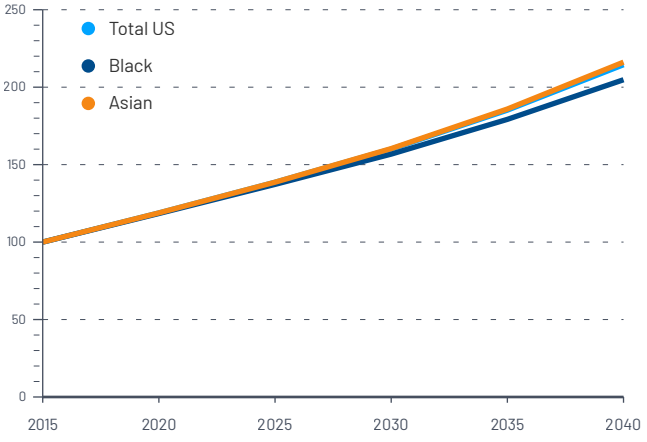
RELATIVE CHANGE IN DEATHS FROM HEART FAILURE BY DEATH RATE

Canada, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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China, Ages 50+
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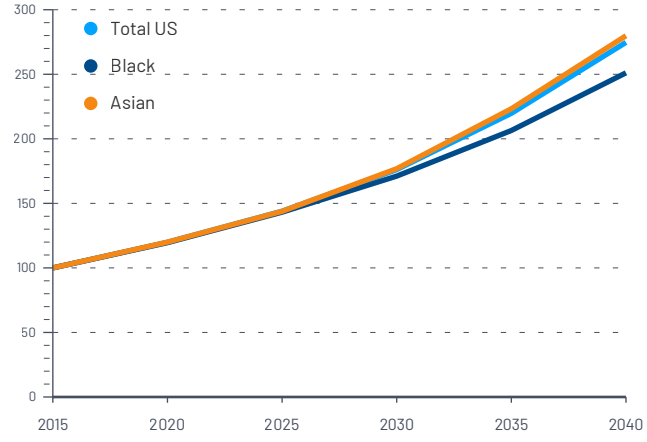

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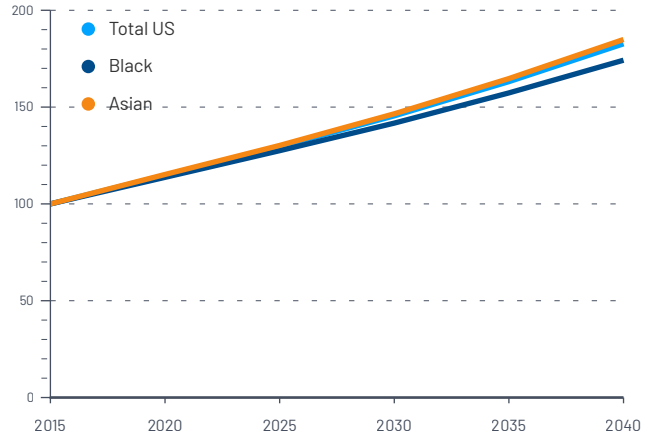
RELATIVE CHANGE IN DEATHS FROM HEART FAILURE BY DEATH RATE

EU, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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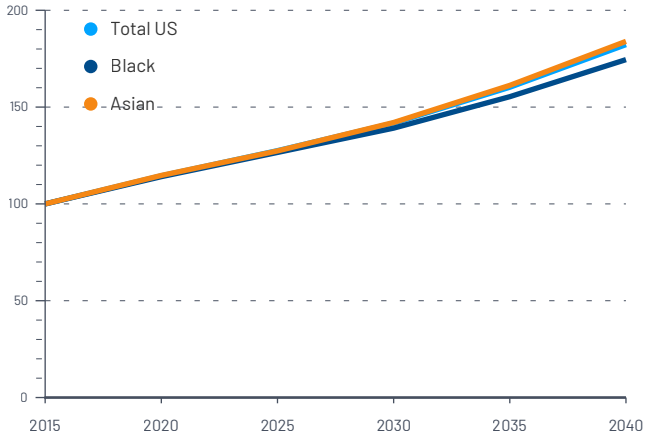

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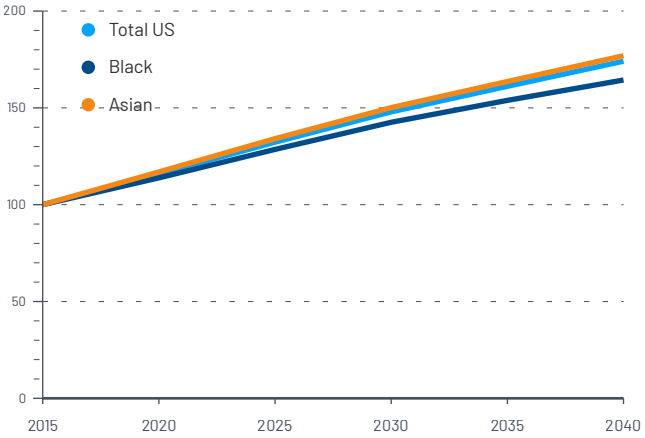

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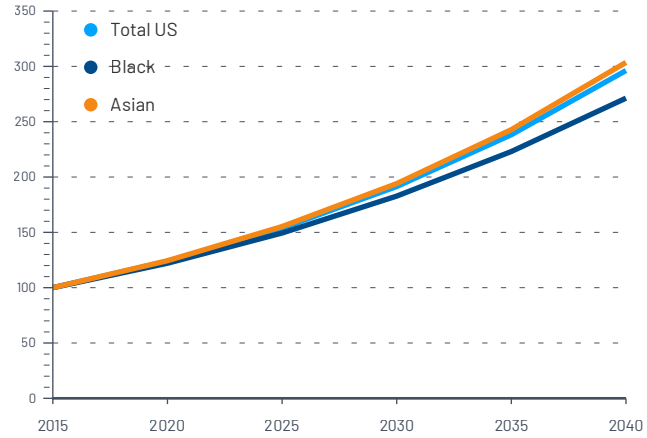
(CDC, 2015, and Census, 2015-2040)



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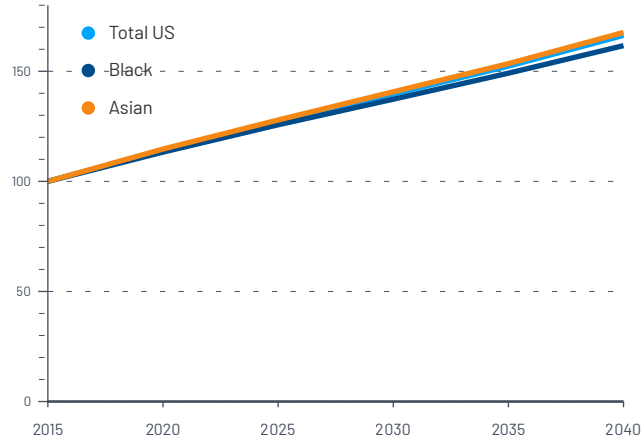
RELATIVE CHANGE IN DEATHS FROM HEART FAILURE BY DEATH RATE

Italy, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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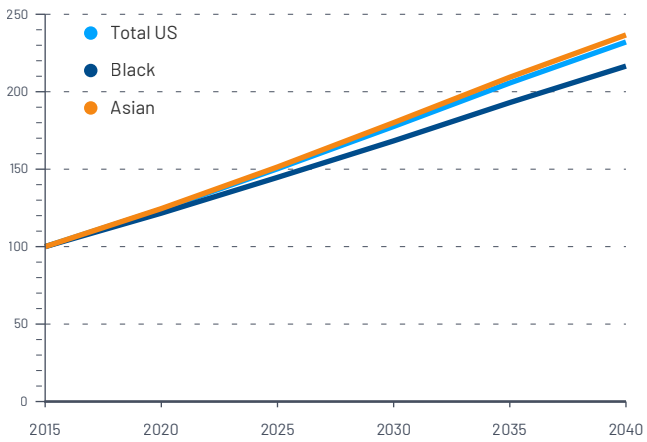

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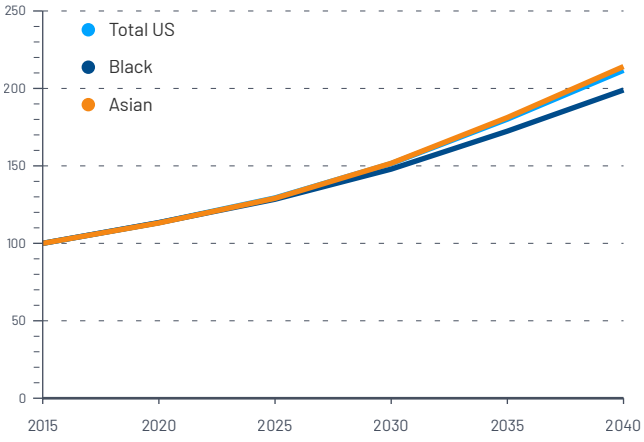

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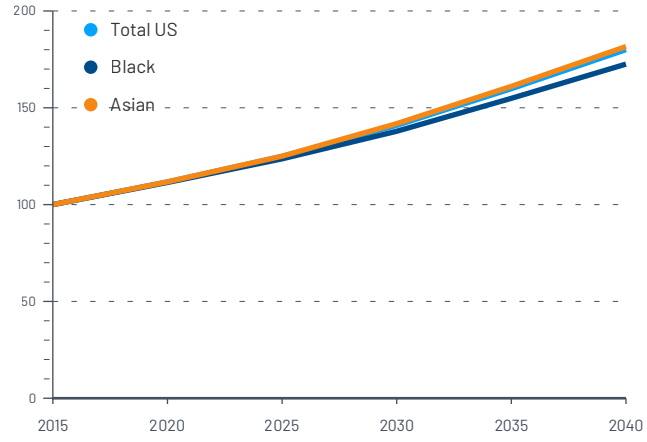
UK, Ages 50+
(CDC, 2015, and Census, 2015-2040)



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Concluding Observations

In this exercise, we use actual reported US cause of death data for heart failure to examine domestic patterns of HF mortality and to model future prospects for total HF deaths under the hypothetical scenario of "no-HF-progress" with respect to improvements in age-specific risk of HF death in the years ahead. The intention was to focus attention on the "demographic momentum," from population growth and especially population aging, that is ceteris paribus pressing for much higher HF death levels in the US and other countries around the world in the decades immediately ahead.

American HF data reveal an exponentially increasing risk of death by HF at every additional year of age, from fifty-somethings up to centenarians—a tendency reflected in death schedules for men and women alike. US data also reveal that HF deaths in America are concentrated among the oldest-old, with the 85+ group accounting for nearly three in five HF deaths nationwide.

(...) the overwhelming majority of the increase in illustrative HF deaths is due to population aging.

Since the oldest-old population is America's most rapidly growing demographic, and since the risk of HF death increases exponentially even at the oldest ages, the simple arithmetic of population aging sets the stage for tremendous increases in total HF deaths for the US between 2015 and 2040 if no progress is made in reducing the risk by age of HF death. Using Census Bureau projections for prospective population change in the decades ahead, we calculated that America's HF death total would increase by 112 percent between 2015 and 2040 under a "no HF progress" scenario that held US age-specific HF death rates constant after 2015. Since the US population in IDB projections is seen as growing by 18 percent between 2015 and 2040, this means the overwhelming majority of the increase in illustrative HF deaths is due to population aging.

We demonstrated that population change, and especially population aging, were likewise poised to drive up HF deaths in the decades ahead in other major population centers and economies around the world, absent HF progress. If risk of HF death by age increases exponentially in places like Japan, Europe, Canada, China, and India—as we have every reason to believe—then coming demographic changes are creating tremendous pressure in all these places for massive increases in HF death totals for the decades immediately ahead. Only major reductions in age-specific death rates in coming years can mitigate this pressure.

Our analysis revealed dramatic differences in age-specific risk of death from HF within the US by race/ethnicity. Reported HF mortality risk by age was markedly below the national average for Hispanic-Americans, and even lower for Asian-Americans. On the other hand, the HF mortality schedule was far above the national average for African-Americans—and especially dire for middle-aged black men. If the US were subject to this African-American model of HF mortality risk, total HF deaths would have been nearly a third higher in 2015 than the actual toll recorded. On the other hand, if the US had enjoyed the Asian-American model of HF risk, total HF deaths in the US would have been almost two-thirds lower in 2015 than the actual level of US HF deaths that year.

These ethnic patterns are important in their own right—they point to alarming health problems that need to be addressed, especially for black American men, and also to heartening "best practices" represented by HF mortality schedules for Asian-Americans, patterns that need to be studied, better understood, and potentially replicated elsewhere.

But these intra-US differences in HF mortality "models" also offer a first step toward illustrating prospective current and future levels of HF deaths outside the US with a bit more flexibility. There is no reason to assume that the nationwide US mortality schedule for HF applies exactly to Japan, Canada, Europe, China, India, or anywhere else. Given the big existing variations in HF mortality levels within the US, we can apply different "models" based on extant patterns exhibited by various American ethnicities to other places in the hope of obtaining more realistic projections, in accordance with the "fit" between overall mortality levels of a non-US population and a given US ethnic group. This approach to "sensitivity analysis" is far from perfect, needless to say—but it is at least a start, and in a context where accurate and comparable HF data are not at present available, offers a base upon which future refinements and improvements can be developed.

Several final observations are in order.

First, our illustrative calculations of prospective HF deaths could prove to be conservative. We say this because reported American HF mortality rates by age are currently rising—unlike overall CVD mortality, which continues to decline on an age-adjusted basis. Holding HF mortality constant at its 2015 level will certainly underestimate total US HF deaths for 2020—possibly for years to come. Rising HF mortality schedules in America beg the question of whether other countries and regions are subject to rising age specific HF mortality risks as well.

Second, our exercise takes no direct account of the problem of undiagnosed HF risk, either in the US or elsewhere. A separate literature indicates that most HF morbidity is undiagnosed. Given the incidence of American HF mortality—which occurs mainly in America's 85+ population—and the chronic nature of the HF problem itself, it seems reasonable to infer that our projections suggest that America and other societies may face an immense increase in the problem of undiagnosed HF, absent HF progress and attendant improvements in prevention and treatment.

Finally, it should go without saying that our illustrative projections are suggestive of ballooning health care costs from HF. We do not attempt to estimate any of the economic costs, direct or indirect, that would be implied by such major increases in HF mortality in the US and elsewhere. But given the current forensics of a typical HF death, it is generally understood the last year of life for a person who succumbs to HF tends to be very costly in terms of medical resources alone, and not only in the US. Without significant changes in the risk of death by age for HF, our illustrative calculations in this exercise are suggestive of the looming economic costs from HF that may lie in store, both in the US and elsewhere.

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Global Coalition on Aging

About the Global Coalition on Aging

The Global Coalition on Aging aims to reshape how global leaders approach and prepare for the 21st century's profound shift in population aging. GCOA uniquely brings together global corporations across industry sectors with common strategic interests in aging populations, a comprehensive and systemic understanding of aging, and an optimistic view of its impact. Through research, public policy analysis, advocacy, and strategic communications, GCOA is advancing innovative solutions and working to ensure global aging is a path to health, productivity and economic growth.

Global Alliance on Heart Failure & Healthy Aging
A GCOA INITIATIVE

About the Global Alliance on Heart Failure and Healthy Aging

The Global Alliance on Heart Failure and Healthy Aging is a multisectoral initiative that aims to reframe heart failure as an urgent priority on the global health agenda in the context of 21st-century aging. While heart failure does increase in prevalence with age, its symptoms, such as fatigue and shortness of breath, must not be mistaken as normal parts of aging or as other co-morbidities associated with older age.

The Alliance consists of experts at the intersection of aging, cardiovascular health, healthcare policy and practice, patient advocacy and communications—all committed to stimulating education, awareness, and policy action that will improve understanding, lead to earlier diagnosis, and mitigate individual, family and economic burdens of this insufficiently recognized and costly disease condition.

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