# Financial Well-Being in Late Life: Understanding the Impact of Adverse Health Shocks and Spousal Deaths

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# ABSTRACT

This paper uses data on the over-65 population drawn from ten waves of the Health and Retirement Study (HRS) to explore the role of health shocks in contributing to the draw-down of retirement wealth. Such shocks are common. For example, the lifetime probability of being diagnosed with arthritis is 55 percent for a 65-year-old arthritis-free woman, and 46 percent for a man. For a stroke, the probabilities are 24 percent and 21 percent, respectively. We focus on eight health conditions. For six, we cannot reject the null hypothesis that net worth is unaffected by a new diagnosis. For the other two, stroke and lung disease, we find substantial net worth declines, about \$25,000 and \$29,000, following diagnosis. The decline in wealth is larger for those with substantial initial wealth than for those with relatively little. We also calculate a 65-yearold's expected reduction in wealth, over his remaining lifespan, for each potential health shock. Taken together, we estimate the average expected "wealth cost" of health shocks to be 3 percent of household net worth at age 65 for single men, 9 percent for married men, 10 percent for married women, and 14 percent for single women. These disparities are more reflective of differences in average wealth by group than of differences in the change in net worth coincident with diagnosis.

Acknowledgements: This research was supported by the U.S. Social Security Administration through grant #RRC08098400-09 to the National Bureau of Economic Research as part of the SSA Retirement Research Consortium. Poterba is a trustee of the College Retirement Equity Fund (CREF) at TIAA, a provider of retirement income services. The findings and conclusions expressed are solely those of the authors and do not represent the views of SSA, TIAA, or the NBER. "How much savings do I need to prepare for late-life health shocks?" is one of the most vexing financial planning questions faced by individuals nearing retirement. The answer to this question depends on the probability of a substantial adverse health event, and the cost of such an event should it occur. While the financial consequences of some health risks are covered by Medicare and Medicaid, DiNardi, French, Jones and McCauley (2015) find that government insurance is far from complete, failing to cover about 35 percent of overall direct medical expenses and much less for elderly households with substantial health-related expenses. In a recent study of hospital admissions among younger individuals, Dobkin, Finkelstein, Kluender and Notowidigdo (2016) find that even individuals with insurance face considerable uninsured financial risk, primarily through lost earnings and unreimbursed out-of-pocket costs.

Late-life health shocks may contribute to observed low levels of financial assets in old age. Poterba, Venti and Wise (2016) find that among married households in the Health and Retirement Study (HRS), who can be studied from age 65 through death, about 36% have net worth of less than \$100,000 (including home equity) and 44% have less than \$10,000 of net financial assets just before the death of the first-to-die partner. While low assets at the end of life are primarily the result of low accumulation prior to retirement, some households appear to have saved enough to finance normal consumption needs in retirement but still deplete their assets before their final years. One explanation for this the realization of costly but low-probability health expenditure shocks. The death of a spouse, which may coincide with extraordinary medical expenses, can also be an important financial shock for other reasons.

In this paper, we analyze health shocks and post-retirement wealth dynamics using detailed longitudinal information on asset holdings and measures of health from the HRS. Respondents are interviewed in "waves" every two years. We examine the financial impact of health events by comparing financial resources in adjacent waves for those who do, and do not, experience a health event or a change in family status. We present estimates for all HRS respondents over the age of 65 in all pairs of adjacent waves between 1998 and 2014. The difference between the between-wave change in financial resources for those who experience a health event, and those who do not, is a crude estimate of the short-term financial impact of the health event. We study changes

in net worth and seven of its subcomponents. We also explore how the financial impact of health events is moderated by private insurance, and assess the extent to which these events are responsible for households depleting their assets prior to death.

Many health-related expenditures in retirement are covered by public insurance. Most Americans over the age of 65 are covered by Medicare, and many supplement it with private (Medigap) plans. Low-wealth households are also eligible for Medicaid. Many elderly nevertheless face substantial out-of-pocket costs, since Medicare deductibles and copays can be substantial and the program does not cover some health-related expenditures, including dental care, vision care, hearing aids, and many costs of long-term care. Even when direct medical expenditures are reimbursed, the elderly may face other non-reimbursable costs, such as home renovation, the cost of hiring service providers for cleaning or transportation or personal care, and in some cases a loss of earnings, that may drain their savings.

Previous studies have used two different strategies to estimate of the financial burden of health care costs among the elderly. The first is to directly tabulate health care costs not reimbursed by either public or private insurance programs. The data required to implement this "bottom-up" approach can be obtained from household surveys or from administrative records. Marshall, McGarry and Skinner (2011) and Kelley et. al. (2012) carefully tabulate reported health-related expenditures from the core (living) and exit (deceased) interviews of the HRS. The former study estimates that out-of-pocket medical costs in the last year of life average \$11,618, with substantial heterogeneity. The 90th percentile spending value is \$29,335; the 95th is \$49,907, and the 99<sup>th</sup>, \$94,310. The latter study considers the five-year period prior to death, and estimates that spending at the 90<sup>th</sup> percentile totals approximately \$90,000.

Other studies employing this approach include Hurd and Rohwedder (2009), Webb and Zhivan (2010), Paschenko and Porapakkarm (2015) and Di Nardi, French, Jones and McCauley (2016). The first study uses the Medicare Current Beneficiary Survey (MCBS), the HRS and the Medical Expenditure Panel Survey (MEPS), the second and third use the HRS, and the fourth uses the MCBS. Fronstin and VanDerhei (2017) use a slightly different approach, simulating how much households need to save to cover insurance premiums, deductibles, copays and other health expenses over the

course of retirement. They do not consider dental, vision or long-term care expenses. They find that a 65-year-old man needs \$72,000, and a woman \$93,000, to have a 50 percent chance of being able to cover all post-retirement health expenses. For those who experience unfavorable health shocks, the amount needed to cover health expenses can exceed \$350,000.

The bottom-up approach does not indicate how health shocks affect wealth, since some health costs may be funded out of current income rather than by drawing down savings. It also suffers from a potential data problem: the reported information on health costs may be incomplete. Survey respondents may not be asked or recall all relevant expenditures, and administrative records may capture only health episodes associated with at least some reimbursed expenses. "Indirect" health expenditures, such as those associated with making a home handicapped accessible, are particularly difficult to measure and may not recognized as resulting from a health shock.

The second strategy used to estimate the burden of health care costs is a "topdown" approach that infers health-related costs from changes in wealth associated with changes in health. Some studies focus on the association between wealth and indicators of general or overall health, while others consider the how wealth changes are associated with the presence or onset of specific health conditions. Wallace, Haveman and Wolfe (2014), who focus on overall health, find that a permanent health decline has an immediate and lasting effect on wealth. For households near the middle of the wealth distribution, non-housing wealth declines by about \$68,000 (approximately 20% of initial non-housing wealth) following a one standard deviation decline in an index of overall health. Poterba, Venti and Wise (2017) construct a similar index and find that in the first 16 years of the HRS, individuals in the lowest third of the health distribution accumulated only half as much wealth as those in the top third.

Many studies of the association between wealth and the presence or onset of specific medical conditions use the original HRS cohort (age 51 to 61 in 1992), so their results pertain to the health-wealth tradeoff in the years preceding and immediately after retirement. Smith (1999, 2004, 2005) finds that wealth is reduced by about \$40,000 for households who first experience a health impairment in their 50's or 60's. Using the same data, Wu (2003) and Lee and Kim (2008) also find that health shocks are

associated with substantial declines in wealth. Cook, Dranove and Sfekas (2016) find that assets decline by 30 to 50% when an uninsured household member under the age of 65 becomes ill. Coile and Milligan (2009) use data for all of the HRS cohorts through 2002 and notably consider the wealth effects of health shocks for individuals over the age of 70. They find significant wealth declines in the three years after the diagnosis of a new chronic illness.

The onset of chronic health conditions is not the only source of wealth depletion faced by the elderly. DiNardi, French and Jones (2015), using the older AHEAD cohort, find that the death of a spouse is associated with a \$30,000 to \$60,000 reduction in wealth (in 2005 dollars). Sevak, Weir and Willis (2003/2004), Johnson <u>et al.</u> (2006) and Coile and Milligan (2009) have also shown that widowhood is associated with large reductions in wealth. Life insurance payouts seem to do little to reduce the burden of premature death. While 55 percent of surviving spouses report a life insurance payout, Harris and Yelowitz (2016) find a similar decline in wealth for those with and without insurance.

We adopt a top-down approach to explore the association between health shocks and wealth drawdown among those over the age of 65. We build on previous studies by examining a range of specific health conditions, and by exploiting the longitudinal structure of the HRS, allow for cross-sectional differences in household net worth levels. We compare wealth changes in time intervals when a household member is diagnosed with a new condition with changes in periods without such health events.

The paper is divided into four sections. The first describes our data and presents summary information on the likelihood of adverse health events after age 65. The second describes the relationship between new health conditions and the change in net worth. Section three combines information on the risk of new health conditions with the evidence on the wealth consequences of these conditions to estimate the expected lifetime "wealth cost" of various health conditions for 65-year-olds. This cost varies across individuals because of differences in both the lifetime probability of experiencing a condition and in the expected wealth cost of the condition if it occurs. The expected cost varies considerably by gender and marital status, ranging from \$17,000 for single

men to \$73,000 for married women; so does the average wealth level for those in different groups. A brief conclusion suggests several directions for future work.

### I. Data

Our analysis is based on the 1996 to 2014 waves of the HRS. There are approximately two years between waves. Our estimation sample includes observations on all HRS respondents age 65 or older in each pair of adjacent waves. For example, for an individual who was 70 in 2000, we would analyze the wave-to wave change in wealth beginning in 1996-1998, when this respondent was between 66 and 68 years old.<sup>1</sup> An individual may appear in the sample as many as nine times, at different ages, between the wave-pairs 1996-1998 and 2012-2014. The unit of observation is the *individual*, but wealth and financial assets are measured as *household* amounts. This reflects the difficulty of assigning ownership of jointly held assets within married couples. Net worth is the sum of financial assets in retirement and other accounts, home equity, other assets including real estate, net business assets, financial assets, less non-housing debt. IRA, 401(k) and Keogh balances are included in financial assets.<sup>2</sup> All asset balances are converted to 2014 dollars using the CPI-U.

Estimates of the level and change in net worth and its components are sensitive to measurement error and data outliers. Many outliers are apparently the result of misreporting or miscoding. We limit the influence of extreme values by excluding from our sample for each year those individuals in the top and bottom one percent of the distribution of changes in net worth for that year; two percent of the sample is therefore trimmed. To assess whether this approach inadvertently removes a substantial fraction of those who experience adverse health shocks, we computed the probability of being excluded for those who do, and who do not, experience a health event. For most shocks, the differences are small. For example, for individuals who experience a stroke in a given two-year window, the probability of being trimmed is 1.8 percent; it is 2.0

<sup>&</sup>lt;sup>1</sup> All estimates reported in this study correct standard errors for multiple observations on the same individual.

<sup>&</sup>lt;sup>2</sup>An exception is that 401(k) balances were not collected for members of the AHEAD cohort. These respondents were unlikely to have participated in 401(k) plans. These plans were first authorized in 1982 and did not become widespread until the late 1980s and early 1990's and thus were unavailable to most members of the AHEAD cohort who were age 70 or older in 1993. Estimates are based on the new HRS-RAND cross-wave wealth imputations described in Hurd, Meijer, Moldoff, and Rohwedder (2016).

percent for those who do not experience a stroke. For heart disease, lung disease, and those who lose a spouse, both probabilities are 2.0 percent. For those newly-diagnosed with cancer, the trimming rate is 2.9 percent; this is higher than the 1.9 percent for those without such a diagnosis. For those who enter a nursing home, the probability of being trimmed is 1.4 percent, compared with 2.1 percent for those who do not. The lower probability of those who enter nursing homes in part reflects the lower average net worth of the members of this group (\$406,478) relative to the members of the group that does not enter a nursing home (\$580,111).

Table 1 reports sample means for key variables in our analysis. It presents information for the entire sample, for individuals in four age intervals (65-70, 70-75, 75-80, and 80 or older), and in four marital status/gender categories. The sample size (78,727) refers to the maximum number of person-year observations we can analyze.

	A II		by age	interval		single	single	married	married
Variable	All	age 65-70	age 70-75	age 75-80	age 80+	women	men	women	men
Total net worth	458,821	515,71	480,631	452,410	372,979	253,701	328,144	588,944	601,225
Change in net worth	-12,211	-1,01	-11,929	-10,150	-27,749	-10,396	-12,938	-15,134	-11,451
Onset of new health condition									
since last wave									
stroke	0.038	0.02	0.034	0.043	0.057	0.029	0.026	0.039	0.037
heart attack	0.048	0.04	0.048	0.049	0.056	0.032	0.043	0.057	0.057
cancer	0.049	0.05	0.053	0.049	0.040	0.023	0.030	0.051	0.053
lung disease	0.030	0.03	0.029	0.033	0.028	0.021	0.021	0.033	0.032
arthritis	0.147	0.13	0.154	0.148	0.151	0.039	0.036	0.074	0.081
diabetes	0.043	0.05	0.049	0.041	0.027	0.022	0.029	0.045	0.046
high blood pressure	0.138	0.14	0.141	0.136	0.133	0.045	0.049	0.077	0.078
psychiatric problems	0.033	0.02	0.030	0.035	0.041	0.026	0.020	0.035	0.033
Since last wave:									
hospitalization	0.431	0.38	0.417	0.460	0.476	0.360	0.370	0.489	0.476
nursing home entry	0.089	0.03	0.058	0.090	0.184	0.118	0.093	0.080	0.066
home health care	0.157	0.10	0.134	0.169	0.235	0.162	0.131	0.167	0.151
death of spouse	0.036	0.02	0.032	0.044	0.050	0.000	0.000	0.095	0.037
Number of observations	78,727	21,91	20,870	16,630	19,308	25,142	6,964	20,956	25,665

nursing home variables indicate whether either partner experienced the event.

The first row reports mean net worth and the second row shows the mean change in net worth for all individual-years in our sample. On average, net worth declined by \$12,211 between the waves.<sup>3</sup> The decline is smaller for younger than for older households and greater for single-person households than for those in two-person households.

<sup>&</sup>lt;sup>3</sup> The decline of \$12,211 is an average over all waves and masks considerable inter-wave variation due, in part, to the Great Recession. Wave-to-wave changes in net worth are:

1998-2000	5,461	2000-2002	-10,558
2002-2004	11,004	2004-2006	11,961

The next eight rows show the incidence of newly-diagnosed health conditions that may affect wealth depletion.<sup>4</sup> For each pair of survey waves and each health condition, we calculate the probability that those who have not previously reported this condition report it in the second wave of the pair. We are thus computing the probability of a "first stroke" or "first arthritis diagnosis." For some common conditions, such as arthritis and hypertension, more than half of the population at older ages reports the condition; we exclude them from the at-risk population in our calculations. A married person is classified as having experienced a health event if either partner reported experiencing the health event between the waves. For stroke, for example, 3.8 percent of all respondents in households without previous stroke diagnoses, 3.3 percent of single women, and 4.5 percent of married women reported a stroke diagnosis. Most of the age profiles for the incidence of new diagnoses are relatively flat. This reflects in part our measuring the onset rather than the prevalence of each medical condition, and in part mortality selection: those who reach older ages were, on average, healthier at younger ages than their shorter-lived contemporaries.

The next two rows show the percentage of households in which at least one member was hospitalized or entered a nursing home between waves. Not surprisingly, nursing home entry increases sharply with age. The final row shows the percentage of married households in which one partner died between the waves.

Figures 1a (women) and 1b (men) plot the age-specific probabilities of experiencing each of the eight health conditions. Unlike the summary information in Table 1, the probabilities plotted in these figures do not include health shocks to a spouse for the case of married individuals. Thus for a married woman, Figure 1 shows the probability that she will experience a particular health event herself. These values are lower than the corresponding values for married women in Table 1. For both men

2006-2008	-39,943	2008-2010
2010-2012	-39,817	2012-2014

<sup>&</sup>lt;sup>4</sup> The first two and last three rows of Table 1 use observations on all respondents. The sample size reported in the table pertains to these rows. The mean probabilities for the onset of new health conditions between adjacent waves exclude persons who have previously experienced the condition and are thus based on smaller samples. We are able to exclude individuals with pre-existing conditions because for most health conditions the HRS inquires whether the respondent ever experienced it. The HRS did not inquire about pre-existing heart attacks until 2008, so we assume an observed heart attack is the first the respondent has experienced.

-56,028 16,906 and women, the profiles for stroke, heart attack and psychiatric problems increase with age, but the onset of the other health conditions appears to be unrelated to age.

Table 1 suggests that health events are fairly common, with two-year probabilities of new health conditions ranging from nearly 3% for a heart attack to over 13% for arthritis and high blood pressure. To assess the cumulative probability that a 65-year-old will experience a health conditions before dying, we estimate the probability of the onset of each condition at each age. We then calculate the probability that a 65year-old individual who does not have a given health condition will experience that condition at some point in their remaining years of life by weighting the probabilities underlying Figures 1a and 1b by the probability that a 65-year-old will survive to each age between 65 and 100. The survival probabilities are obtained from death probabilities by age and gender (in 2010) published by the Office of the Actuary of the Social Security Administration

Table 2 shows the estimated lifetime probabilities of each health diagnosis for a 65-year-old who has not previously reported this diagnosis. For a 65-year-old with no prior health conditions, arthritis is the most common prospective health condition. The chance of developing it is 55% for an arthritis-free woman at age 65, and 46% for men. These statistics accord reasonably well with data from the Center for Disease Control (2017a, 2017b) which show that 49.6% of Americans over the age of 65 have ever reported arthritis.

The estimates in Table 2 should differ from values reported by the CDC for at least two reasons. First, the CDC rate includes individuals who first experienced a health condition before age 65; Table 2 does not. This should result in CDC rates higher than those in Table 2. Second, for conditions with high mortality rates subsequent to onset, the CDC estimate of the fraction of those alive at any moment who have the disease may be lower than the probability of ever being diagnosed with the disease. Those who die from the disease will not be recorded by the CDC as individuals with this condition.





Table 2. Probability of a 65 experiencing the onset of a	5 year-old individ a new health eve	ual nt in their
lifetime		
Variable	women	men
Health condition		
stroke	0.241	0.213
heart attack	0.260	0.360
cancer	0.220	0.299
lung disease	0.175	0.178
arthritis	0.548	0.460
diabetes	0.222	0.242
high blood pressure	0.445	0.387
psychiatric problems	0.238	0.152
Note: Sample excludes persons in worth in the top or bottom 1% in ea who experienced the health condition	households with char ch year. In each row on prior to age 65 are	nge in net v persons excluded.

These considerations notwithstanding, most of the entries in Table 2 coincide relatively closely with 2010 CDC estimates of the fraction of the population reporting various conditions. Table 2 suggests the probability of a heart attack to be 26% for women and 36% for men. The CDC rate for heart disease (a broader classification than heart attack) among those over age of 65 is 30.5%. The probabilities for diabetes (22% and 24%) are close to the CDC rate of 22%. The Table 2 values for cancer, 22% for women and 30% for men, are higher than the CDC rate of 18.5%, as are the rates for stroke (24% and 21% in Table 2, 8.2% at CDC). Because strokes occur late in life and are associated with high rates of mortality, the probability of experiencing a stroke after age 65 may be greater than the fraction of the population over the age of 65 that reports having experienced a stroke. The Table 2 rates for high blood pressure (45% and 39%) are below the CDC rate of 68%, probably because many individuals develop high blood pressure before age 65 and are thus not included in our calculation. The findings in Table 2 underscore the broad conclusion that the probability that an individual experiences one or more health events after age 65 is substantial.<sup>5</sup>

<sup>&</sup>lt;sup>5</sup> The chance of developing multiple conditions is not the sum of the individual condition probabilities because of heterogeneity in individual health status. Someone who develops high blood pressure, for example, may be more likely to experience a heart attack than someone who is not hypertensive.

#### II. Results

We now examine how net worth and its components are related to health events. We use a difference-in-difference (DD) specification to address this issue. We illustrate it by considering the change in net worth associated with an individual's experiencing a first stroke. We define those who experienced a stroke between wave t-1 and wave t as the "treatment group" and those who did not as the control group. For married respondents, "experiencing a stroke" includes a new stroke diagnosis for either member of the couple. We limit ourselves to those who had not experienced a stroke in any prior wave. Let A<sub>it</sub> denote individual i's net worth in wave t. The DD estimate ( $\delta$ ) of the link between a new stroke and net worth is the mean over all individuals of:

(1) 
$$\delta = (A_t^T - A_{t-1}^T) - (A_t^C - A_{t-1}^C).$$

The superscripts T and C denote the treatment and control groups. We estimate  $\delta$  from a regression equation which includes time effects:

(2) 
$$A_{it} = \alpha + \beta T_{it} + \gamma^* Post_{it} + \delta^* (T_{it} * Post_{it}) + v_t + e_{it.}$$

The variable Post<sub>it</sub> takes on a value of zero if the observation for individual i is for wave t-1 and a value of one if the observation is for wave t, and  $T_{it} = 1$  if the individual experienced a stroke between wave t-1 and wave t. For married individuals,  $T_{it} = 1$  if *either* partner experiences a first stroke between the waves.

We use data on all pairs of adjacent waves in the HRS from 1996 through 2014 and restrict the sample to individuals over the age of 64. The estimates of the key coefficients related to stroke are shown below:

(3) 
$$A_{it} = 347,786 - 32,176^{*}T_{it} - 47,599^{*}Post_{it} - 25,393^{*}(T_{it} *Post_{it}) + v_t + e_{it}$$
  
(t=39.6) (t=14.4) (t=3.18) (t=3.01)

The estimate of  $\delta$  suggests that experiencing a stroke between the waves is associated with a \$25,393 reduction in net worth; this amount is nearly 6 percent of the average net worth of individuals experiencing a stroke. The year effects show a substantial upward trend. Mean net worth for the sample in 1996 (the omitted year) was \$333,047, compared with \$508,583 in 2014. Median net worth rises more slowly, from \$175,438

in 1996 to \$220,000 in 2014. Median net worth peaked at \$264,936 in 2008. Mean net worth was also highest in that year, at \$536,446. The year effect for 1998 is \$52,182 (t= 6.91), rising to 209,124 (t=15.18) in 2008 before falling to 182,043 (t=12.4) in 2010 and 162,855 (t=10.94) in 2012, and then rising to 215,435 (t=12.3) in 2014.

## II.A. Difference in Difference (DD) Estimates for Net Worth

Table 3a reports estimates of the parameter  $\delta$  from equation (2) for all of the health-related shocks studied in Table 1. The dependent variable, A<sub>it</sub>, is net worth. The first column of Table 3a presents estimates for all individuals; this is followed by estimates that disaggregate respondents by gender and marital status. Each estimate in the table is obtained from a separate regression that is identical to (2). Year effects are included, but not reported, in all specifications. The sample used for each regression excludes individuals who previously reported experiencing each health shock.<sup>6</sup> An individual who had a stroke between 1994 and 1996 is excluded from the sample of individuals we consider at risk of a first stroke in all subsequent years. Such an individual could, however, be included in the sample at risk of an initial cancer diagnosis in subsequent years. Differences in the number of individuals who report already having various conditions translate into differences in sample sizes. The sample includes 133,647 person-years when we consider individuals at risk of a first stroke, but only 39,137 for a first diagnosis of arthritis and 44,889 for high blood pressure.

The estimates for the full sample indicate a statistically significant decline in net worth for only two of the eight diagnoses – stroke and lung disease. The coefficients for these two diagnoses are negative for most of the gender/marital status groups that we consider, but the standard errors are large. For single women and single men, we cannot reject the null hypothesis that lung disease and stroke have no effect on net worth. For three of the four coefficients for married groups, we can reject the null. For

<sup>&</sup>lt;sup>6</sup> The samples used to produce estimates for each of the eight health conditions exclude individuals who experienced each health shock on or before wave t-1, so the estimates describe the effect of the *first* occurrence of each medical condition. No exclusions are made for the samples used to estimate the hospitalization, entry to nursing home and death of spouse effects. The sample size differs across conditions because the number of individuals who have not had that condition differs.

	all		Single W	omen	Single I	Men	Married W	/omen	Married	Men
Shock	coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat
Onset of:										
stroke	-25,393	-3.01	-7,928	-0.49	-42,024	-1.44	-27,872	-1.78	-33,929	-2.32
heart attack	-4,106	-0.55	-11,198	-1.06	-17,444	-0.60	4,525	0.32	1,388	0.10
cancer	8,808	1.20	-5,695	-0.42	-20,231	-0.98	16,154	1.13	17,173	1.39
lung disease	-29,076	-3.80	-1,304	-0.11	-15,346	-0.93	-39,160	-2.50	-47,431	-3.34
arthritis	-11,242	-1.09	2,063	0.18	99,611	2.89	-61,609	-2.61	-31,914	-1.49
diabetes	4,248	0.52	10,634	0.97	10,250	0.52	7,477	0.46	-3,231	-0.21
high blood pressure	10,349	1.13	5,872	0.58	-6,478	-0.29	23,648	1.06	6,880	0.32
psychiatric problems	-13,180	-1.40	-12,457	-1.10	77,868	1.77	-44,014	-2.16	-11,180	-0.68
Since last wave:										
hospitalization	-7,597	-2.79	-8,408	-2.11	-707	-0.08	-5,727	-1.00	-10,614	-1.97
nursing home entry	-14,999	-3.46	-17,215	-3.31	-8,137	-0.66	-13,804	-1.26	-19,154	-1.89
home health care	-3,282	-0.93	-6,466	-1.27	-9,533	-0.82	-170	-0.02	-2,095	-0.30
death of spouse	-31,317	-3.95	0		0		-30,910	-3.17	-34,329	-2.33

condition, hospitalization and nursing home variables indicate whether either partner experienced the event. All equations include year effects.

stroke and lung disease, the inter-wave decline in net worth is between \$25,000 and \$50,000. For most other conditions the pattern of coefficients is inconsistent across sample sub-groups. It is possible that the other diagnoses do not involve substantial out of pocket cost either because the total cost of care and related patient responses, say of arthritis, are not large, or because insurance coverage is more complete, as it may be for heart attack. It is also possible that for some health conditions that develop gradually, it is difficult to assign a date of onset. The DD analysis therefore has low power. We use the date an individual was informed of the diagnosis by a doctor, but this may be somewhat arbitrary for chronic conditions such as arthritis or hypertension.<sup>7</sup>

The second, third, and fourth third rows from the bottom of Table 3a indicate the effects of a hospital admission, a nursing home stay, and the utilization of home health care on net worth. The first two of these events are associated with a statistically significant decline in net worth: \$7,597 for a hospital stay and \$14,999 for a nursing home stay. The value for hospitalization should be contrasted with Dobkin <u>et al.'s</u> (2016) estimate, using HRS data, of a \$1,323 increase in out-of-pocket spending in the year after a hospitalization. One potential reconciliation of these findings is that a substantial component of the cost of a hospitalization and subsequent recovery involves spending on goods and services that are not traditionally classified as medical

<sup>&</sup>lt;sup>7</sup> For example, we date the onset of arthritis using the following question: Since we last talked to you (in previous wave interview), have you had or has a doctor told you that you have arthritis or rheumatism?

expenses. For example, if some hospitalizations lead to significant needs for home renovation, that could explain how a substantial wealth decline could coincide with only modest out-of-pocket medical expenses. This issue warrants further analysis.

When we focus on stays of more than seven days, the estimated coefficients are larger than those for all stays: about \$23,000 for hospital stays and \$43,000 for nursing home stays. These results suggest that episodes of intensive health care use, such as hospital stays, may be more predictive of wealth decline than medical diagnoses.

The last row in Table 3a reports the wealth changes associated with the loss of a spouse. These shocks are associated with a large and statistically significant wealth drop for both men (\$34,329) and women (\$30,910). The costs of losing a spouse, which is a health-related shock, are likely to extend beyond health outlays.

The estimates in Table 3a, involving separate estimated equations for each health shock, assume that the shocks are independent. They clearly are not. A heart attack increases the likelihood of a hospitalization. To address the importance of this issue, we have estimated our DD model with five independent variables corresponding to indicators for the five health shocks that have statistically significant effects in the independent specifications. We estimate this equation on the sample of individuals with no previous history of lung disease or stroke; we include those with prior hospitalization or nursing home stays. The estimated coefficients in this multivariate regression are very similar to those in the five univariate equations. In the univariate equation, the estimated effect of stroke is -25,393 (t = 3.01); in the multivariate case, the estimate is -227,636 and it remains statistically significant. The coefficient for lung disease drops from -229,076 to -19,603. That for spousal death changes very little, from -224,012 to -224,105. Neither hospitalization nor nursing home stay has a statistically significant negative effect in the multivariate specification; both point estimates, -5,380 and -10,707 respectively, fall by about one third relative to the univariate estimates.

The specification in (2), and in Table 3a, assumes equal effects of health events for individuals at all points of the wealth distribution. The estimates in Table 3b relax this assumption. The first column reproduces the full sample estimates from Table 3a. The next three columns show estimates for three net worth intervals chosen to

	all		NW<\$1	00k	\$100k< NW	< \$500k	NW>\$5	00k
Shock	coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat
Onset of:								
stroke	-25,393	-3.01	-4,682	-1.25	-24,861	-3.81	-59,290	-2.19
heart attack	-4,106	-0.55	-5,347	-1.18	-10,560	-1.55	-23,146	-0.95
cancer	8,808	1.20	4,129	0.75	2,192	0.34	36,743	1.68
lung disease	-29,076	-3.80	-9,986	-2.34	-36,449	-5.34	-84,959	-3.09
arthritis	-11,242	-1.09	-243	-0.05	3,286	0.34	-29,910	-1.03
diabetes	4,248	0.52	-3,361	-0.78	13,206	1.59	-15,227	-0.65
high blood pressure	10,349	1.13	-1,147	-0.27	6,378	0.83	18,701	0.70
psychiatric problems	-13,180	-1.40	1,538	0.28	-22,870	-2.08	-48,292	-1.48
Since last wave:								
hospitalization	-7,597	-2.79	-1,745	-1.08	-13,274	-4.96	-16,149	-1.91
nursing home entry	-14,999	-3.46	-4,109	-1.69	-34,669	-7.01	-68,434	-3.96
home health care	-3,282	-0.93	-2,436	-1.30	-15,216	-3.89	-22,914	-1.83
death of spouse	-31,317	-3.95	6,592	1.50	3,293	0.45	-140,946	-5.64

roughly correspond to terciles of the distribution of net worth. For each health shock, the decline in net worth is larger for individuals with greater wealth. For example, a

Note: Estimation sample excludes persons in households with net worth in the top or bottom 1% in each year. For married persons, the medical condition, hospitalization and nursing home variables indicate whether either partner experienced the event. All equations include year effects.

stroke is associated with a net worth reduction of \$4,632 for low wealth individuals, \$24,861 for middle wealth individuals, and \$59,290 for high wealth individuals. A similar pattern is observed for three of the other health events that are statistically significant in the first column (lung disease, hospitalization and nursing home entry). For nursing home entry, for example, the coincident decline in net worth is \$4,109 for those in the bottom tercile, compared with \$68,434 for those in the top tercile. For the death of a spouse, the reduction in net worth is not statistically significant for the two lower wealth groups, but is large and statistically significant (-\$140,946) for high wealth individuals.

Why does a given health shock, such as a stroke, appear to be costlier for wealthier households? This issue has not been explored in previous research. There are several potential explanations. One is that the fraction of treatment costs covered by public insurance programs is greater for low-wealth than high-wealth households. Those who are eligible for Medicaid, for example, may not face the same out-of-pocket expenses that higher-income and wealth households might face. Existing evidence on this possibility is mixed. DiNardi <u>et al.</u> (2016) fine relatively little income-related variation in out-of-pocket spending on medical care among the elderly: an average of \$2480 for those in the lowest income quintile and \$3000 for those in the highest. Kelly <u>et al.</u> (2015)

find that more educated elderly households report greater out-of-pocket health care spending. Since income and education are positively correlated, these results suggest a positive income-medical spending gradient.

Another possibility is differential reliance on uncompensated care. Those in the lower strata of the wealth distribution may not be able to pay some bills. Although some might incur debt as a result of these charges, this may not occur for all households. The links between various diagnoses, care received, medical debt, and potential bankruptcy for those in the lower tail of the wealth distribution warrants further analysis. A third possibility is that the care received differs between those high and low in the wealth distribution, and that wealthier households choose to purchase more care than their low-wealth counterparts. We cannot distinguish between these various possibilities.

Our data provide some information on the role of private insurance in protecting households against the costs of health shocks. Nearly all individuals age 65 and over are eligible to participate in the Medicare program, which covers about 65% of direct medical expenditures. Part A (hospital insurance) is provided free of charge. Parts B (medical insurance) and D (drug insurance) are subsidized but require monthly premiums. In addition to premiums, beneficiary costs may include copayments, coinsurance, and deductibles. Medicare does not cap out-of-pocket expenditures for most diagnoses, so beneficiaries can be exposed to substantial expenditure risk. Many individuals over age 65 also have private health insurance, either employer-provided or privately purchased, to supplement Medicare. About 32% of the individuals are in our sample are covered by private health insurance; 6% have long term care insurance.

To explore the effect of supplemental insurance coverage on the link between health shocks and net worth, we stratify our sample and estimate different  $\delta$  coefficients for those with and without supplemental coverage. Table 4 shows the results. The primary conclusion is that LTC insurance reduces the financial cost of a nursing home stay. For those without such coverage, net worth declines by \$21,179 in response to a stay; for those with coverage, the estimated effect of a nursing home stay is positive and not statistically significant different from zero. There is virtually no difference

	covered	by supple	mental insu	rance?	covered	covered by long-term care insurance?				
<b>Shock</b> Onset of:	No	Yes	Difference	t-stat for difference	No	Yes	Difference	t-stat for difference		
stroke	-25,674	-25,405	270	0.02	-27,468	-14,896	12,572	0.35		
heart attack	5,273	-13,528	-18,801	-1.14	-1,914	-37,222	-35,308	-1.27		
cancer	-10,034	19,162	29,196	2.04	3,038	39,265	36,227	1.45		
lung disease	-22,007	-33,839	-11,832	-0.77	-25,256	-51,394	-26,138	-0.87		
arthritis	773	-17,986	-18,759	-0.97	16,012	-143,622	-159,634	-4.56		
diabetes	-16,385	16,864	33,248	1.97	9,905	-28,074	-37,979	-1.26		
high blood pressure	6,655	11,777	5,123	0.30	1,836	65,888	64,052	1.87		
psychiatric problems	-37,670	8,044	45,714	2.40	-1,184	-78,251	-77,067	-1.92		
Since last wave:										
hospitalization	-4,759	-9,558	-4,800	-0.88	-8,628	-2,021	6,607	0.69		
nursing home entry	-18,510	-13,159	5,351	0.62	-21,179	23,628	44,807	2.52		
home health care	-534	-4,924	-4,390	-0.63	-1,437	-15,087	-13,650	-1.08		
death of spouse	-21,839	-38,596	-16,757	-1.07	-32,054	-27,309	4,745	0.16		

Table 4: DD estimates of the association between health-related events and net worth ( $\delta$ ), by supplemental health

Note: Estimation sample excludes persons in households with change in net worth in the top or bottom 1% in each year. For married persons, the medical condition, hospitalization and nursing home variables indicate whether either partner experienced the event. All equations include year effects.

between the changes in wealth associated with a stroke, or with lung disease, for those with and without supplemental insurance, perhaps because both of these diseases may generate significant non-medical costs. For cancer, diabetes, and psychiatric problems, however, the difference between the change in net worth for individuals with and individuals without supplemental coverage is statistically significant (marginally so for diabetes). For example, for those who report a new cancer diagnosis, net worth dropped by -\$10,034 for those without coverage. The point estimate suggests an increase of \$19,162 for those with supplemental coverage – a difference of \$29,196.

Changes in net worth associated with hospitalization, nursing home entry, use of home health care and the death of a spouse are unrelated to coverage by supplemental insurance. These results are broadly consistent with Goldman and Zissimopoulos (2003) who find that Medicare beneficiaries with and without Medigap plans have similar out-of-pocket health expenditures.

#### II.B. DD Estimates for Other Components of Wealth

The foregoing analysis considers how health shocks affect net worth. The effects of such shocks may differ across components of net worth. Net financial assets, for example, might change in a different way than home equity. Table 5 reports estimates of the DD specification of in (2) for various components of net worth. Recall that net worth is the sum of retirement and non-retirement financial assets, net housing equity (which can be negative), vehicles, other assets, and non-housing debt.

	Total Net	Worth	Retirer	nent	Non-Reti	rement	Non-Housi	na Debt	Housing	Fauity	Vehic	les	Other a	ssets
			Financial	Assets	Financial	Assets			. Io doinig	- 99.19		.00	o unor u	
Shock	coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat
Onset of:														
stroke	-25,393	-3.01	-3,862	-2.72	-8,676	-2.20	-48	-0.47	-7,025	-3.79	-1,014	-3.79	3,487	1.90
heart attack	-6,262	-0.74	-925	-0.53	-442	-0.14	65	0.42	-5,050	-2.26	-441	-1.35	-4,006	-1.58
cancer	8,808	1.20	-1,785	-1.12	7,005	2.60	-5	-0.05	2,154	1.31	250	0.93	-2,337	-1.46
lung disease	-29,076	-3.80	-3,470	-2.21	-13,609	-4.45	102	0.84	-5,723	-2.70	-139	-0.50	-636	-0.36
arthritis	-11,242	-1.09	-2,144	-1.23	-4,991	-1.35	132	1.37	-2,560	-1.29	-172	-0.65	-3,655	-1.93
diabetes	4,248	0.52	4,467	2.21	1,334	0.44	-75	-0.58	2,325	1.30	-508	-1.91	-1,259	-0.46
high blood pressure	10,349	1.13	1,734	0.98	2,202	0.70	-59	-0.59	1,443	0.66	317	1.09	5,805	2.21
psychiatric problems	-13,180	-1.40	350	0.22	4,009	1.19	146	1.50	-10,272	-4.41	-809	-2.73	1,889	1.30
Since last wave:														
hospitalization	-7,597	-2.79	-1,749	-2.71	-3,736	-2.76	49	1.38	-2,567	-3.97	-424	-4.49	-2,026	-2.56
nursing home entry	-14,999	-3.46	-1,433	-1.89	-3,176	-1.83	16	0.31	-11,633	-11.38	-238	-1.83	-1,163	-1.12
home health care	-3,282	-0.93	-1,476	-1.92	-5,650	-2.59	61	1.24	-1,585	-1.84	-357	-2.95	-1,819	-2.01
death of spouse	-31,317	-3.95	-2,567	-1.84	-584	-0.19	-115	-1.03	-8055	-4.27	-1,749	-7.08	1,114	-0.63
Mean of dependent variable	459,6	46	54,9	67	119,0	000	1,46	i8	130,8	11	11,53	38	36,2	75

nursing home variables indicate whether either partner experienced the event. All equations include year effects.

The results indicate that a stroke is associated with a statistically significant decline fin non-retirement financial assets, housing equity, retirement financial assets, and vehicle wealth. The same is true for lung disease, except the change in vehicle wealth are not statistically significantly different from zero. For the onset of psychiatric problems, although the effect on net worth is not statistically significantly different from zero, there is a substantial negative effect on housing equity, along with the positive but smaller effect (-\$10,272 and +\$4,009, respectively) on non-retirement financial assets. This pattern is consistent with some households reacting to this diagnosis by selling their primary home, or taking out a home mortgage, and holding some of the proceeds in financial assets or other forms.

#### III. The Expected Wealth Draw-Down Associated with Health Shocks

The foregoing analysis suggests that despite widespread coverage by public insurance, some health related-events are associated with a coincident decline in net worth. To assess the importance of potential health events for retirement income security, we calculate the expected wealth decline associated with prospective health shocks for a 65-year-old. This measure will depend on the "wealth cost" of each health-related event and how likely it is that the individual will experience these events. It also depends on the health shocks under consideration; our list is not exhaustive.

To compute this measure, we use the estimates from Table 3a of  $\delta_i$ , the wealth cost of health shock i, along with estimates of the probability that an individual will experience event i at various ages.<sup>8</sup> We denote the probability of a particular health shock i at age a as  $p_{ai}$ , and let  $s_a$  denote the probability that a 65-year-old survives until age a. Under the additional assumptions that the real discount rate is 2.5 percent per year, and that the wealth cost of the health shock ( $\delta_i$ ) is not affected by the individual's age, an assumption that is unlikely to be correct but that we do not have sufficient data to reject in most cases, the expected wealth cost of a group of health shocks is

(5) 
$$C = \sum_{i=1}^{5} \sum_{a=65}^{100} b_a \rho_{ia} s_a \delta_i$$

We limit our analysis to a set of five health shocks. We can calculate the survival probabilities by gender from tables on the historical probability of death provided by the U.S. Social Security Administration Office of the Actuary (2017). We do not distinguish survival probabilities by marital status. We cap the analysis at age 100 because the event probabilities calculated from the HRS become unstable and the survival probabilities are quite low beyond that age. We perform separate calculations for each of the four gender/marital status categories considered above.

Table 6a presents our estimates of the expected draw-down in wealth as a result of prospective health shocks for 65-year-old men and women. We present calculations for both married and single individuals, and use information on the differential magnitude of wealth changes around health shocks for each group. In calculating these wealth changes, as well as the probability of health shocks at various ages, we condition on marital status <u>at the age in question</u> and not at age 65. The longitudinal component of the HRS sample is too short to enable us to condition on attributes at age 65 and to estimate the full set of probabilities and health costs that are necessary to evaluate (5). Thus we in effect assume that marital status at age a > 65 coincides with that at age 65. The key shortcoming of this assumption is that it does not recognize that more than half of the individuals who are married at 65 will be single at some later age,

<sup>&</sup>lt;sup>8</sup> The earlier figures showed probabilities of experiencing each event, by age, for men and women. This calculation uses probabilities that are estimated separately for the four marital status and gender categories used in Table 3a. For married persons the calculation uses the probability that either partner experienced the event.

as a result of both spousal deaths and divorce. Our counterfactual assumption is likely to impart an upward bias to our estimate of the wealth draw-down from health events for married individuals, because the probability of a health event is higher for a married person than a single one.

The calculations in Table 6a suggest that an individual at age 65 could expect between \$15,000 and \$75,000 of health-related wealth declines, depending on gender

events for a 05 year-old		y genuer and r	nantai Status	s at age 05
Event (since last wave)	Single Women	Single Men	Married Women	Married Men
stroke	\$1,504	\$8,321	\$8,375	\$8,002
lung disease	\$222	\$2,793	\$9,633	\$9,789
hospital stays	\$21,936	\$1,802	\$21,110	\$32,848
nursing home stays	\$11,121	\$3,993	\$9,369	\$7,691
death of spouse	\$0	\$0	\$24,446	\$7,701
Total	\$34,783	\$16,909	\$72,933	\$66,031
As % of household net worth at age 65	14.1%	3.0%	9.9%	9.0%
Note: For married individuals. t	he calculations a	are based on the p	robability that eit	ther partner

 Table 6a: Expected lifetime reduction in net worth due to health-related

 events for a 65 year-old individual, by gender and marital status at age 65

Note: For married individuals, the calculations are based on the probability that either partner experienced the event.

and marital status. Hospital stays and spousal deaths are the largest contributors. The expected cost of both stroke and lung disease are under \$10,000 for all groups. But for death of a spouse, a married woman at age 65 faces an expected prospective drop in wealth of \$24,446. The total economic effect of a spousal death is likely to be larger; our measure of net worth excludes potential losses in pension entitlements or other benefits. The expected wealth "cost" of the loss of a spouse, for a married man at age 65, is about one third of that for women. For most health events, the expected decline in net worth is greater for married than for single individuals, in part because for married individuals, we define a "health event" as having occurred for each of them if either one experienced a health shock. The expected wealth decline represents 14.1% of the average net worth at age 65 for single women and 9.9% for married women, but only 3.0% for single men and 9% for married men.

Table 6b presents estimates similar to those in Table 6a, but it now stratifies individuals by household wealth at age 65.<sup>9</sup> Individuals in higher wealth households

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		Net Worth at Age 65	i
Event (since last wave)	<\$100k	100k to \$500k	>500k
stroke	\$1,058	\$5,445	\$14,952
lung disease	\$2,376	\$7,194	\$13,979
hospital stays	\$5,444	\$39,469	\$47,302
nursing home stays	\$2,936	\$16,406	\$27,578
death of spouse	-\$1,508	-\$833	\$26,172
Total	\$10,306	\$67,681	\$129,982
As % of household net worth at age 65	39.8%	26.4%	8.2%

Note: For married individuals, the calculations are based on the probability that either partner experienced the event.

can expect much larger wealth draw-down in connection with future health shocks. All of the five shocks that we consider are associated with a larger future expected wealth decline for those with more than \$500,000 in net worth relative to those with less than \$100,000. The differences are largest for the death of a spouse, nursing home stay, and hospital stay. Although the expected draw-down in wealth is larger for those with reductions are smaller.

The estimates of event-coincident wealth decline in Table 6a do not coincide with total post-retirement out-of-pocket spending on health care. They omit the cost of health insurance premiums and other routine health care costs that may not be covered by insurance. Studies that have estimated average out-of-pocket costs for retired individuals, such as Di Nardi, <u>et al.</u> (2016), Goldman and Zissimopoulos (2003), Hurd and Rohwedder (2009), and Paschenko and Porapakkarm (2016), suggest average

<sup>&</sup>lt;sup>9</sup> The same issue that arose in conditioning on marital status at ages greater than 65 also arises with regard to conditioning on wealth. While we would like to calculate expected wealth changes and probabilities of health-related shocks at older ages, conditional on wealth at age 65, in practice we condition on coincident wealth (at age a) when estimating these parameters.

values between \$1,500 and \$3,000 per year.<sup>10</sup> Some studies have consequently suggested substantially higher values for the resources needed to cover late-life medical expenses. Fronstin and Vanderhei (2017), for example, report that a 65-year-old single person in 2016 would need \$93,000 to have a 50 percent chance of being able to cover all health-related expenses in retirement; a married couple would need \$165,000. Their calculations are prospective, and rely on assumptions about the growth in health care costs. Our analysis is retrospective, and is based on actual wealth changes around health shocks in the past along with history-based estimates of the future probability of such shocks.

Another important distinction between our analysis and some previous studies is our focus on a subset of all health shocks. While we have included the ones for which we found substantial negative effects on wealth, our list of potential health shocks is not exhaustive and is limited by the data collected in the HRS. While we have tried to consider the most important health shocks, others not on our list could have important financial consequences for households.

A final consideration is that because the elapsed time between HRS waves is two years, our analysis may not capture all of the health-related expenditures in the last year of life. Marshall, McGarry and Skinner (2011) estimate that last-year spending equals \$11,618, and that the 90<sup>th</sup> percentile of such spending is \$29,335. The skewness of last-year spending emerges clearly in a number of studies, and could lead our estimates to understate the total wealth cost, particularly if those who die between waves and therefore are omitted from our inter-wave difference analysis have larger costs than those who are (say) hospitalized and survive until the next survey wave.

# **IV. Conclusion**

This paper uses data on the over-65 population drawn from ten waves of the Health and Retirement Study (HRS) to explore the role of health expenditure shocks in contributing to the draw-down of retirement wealth. We investigate eight health conditions including stroke, cancer, and lung disease, as well as health-related events

<sup>&</sup>lt;sup>10</sup> For reference, the expected present discounted value of \$2,000 per year, in constant dollars, from age 65 to 100, discounted at 2.5 percent per year and using the survival rates for women that we employ, is \$27,775.

such as a hospital stay, a nursing home stay, home health care, and, for married individuals, the loss of a spouse. New health events are common in this population. For example, every two years, on average 14.7 percent of the HRS respondents who did not previously report a diagnosis of arthritis indicate that they or, if they are married, their spouse, have been diagnosed with this condition. Arthritis is followed in prevalence of new diagnosis by hypertension (13.8 percent), cancer (4.9 percent), heart attack (4.8), diabetes (4.3), stroke (3.8), psychiatric problems (3.3), and lung disease (3.0 percent). A married individual over the age of 65 has a 3.6 percent chance every two years of a spousal death. The chance of a hospital admission is 43.1 percent, a nursing home stay 8.9 percent, and using home health care, 15.7 percent.

A 65-year-old arthritis-free woman has a 54.8 percent probability of subsequently being diagnosed with arthritis (46 percent for men). For stroke, the probabilities are 24.1 percent for a woman, and 21.3 percent for a man. For lung disease, the probabilities are 17.5 and 17.8 percent respectively. Because our calculations omit respondents who had already been diagnosed with these conditions by age 65, they understate the fraction of those over 65 who experience these conditions.

We find mixed associations between new health diagnoses, heath events, and changes in net worth. For six of the eight conditions we consider, we cannot reject the null hypothesis that net worth is unaffected by a new diagnosis. This may be due to the modest cost of treating these conditions, to the near-universality of Medicare, or to our focus on the costs within the first two years of diagnosis, which may substantially understate the cost of chronic conditions. For two conditions, stroke and lung disease, we find substantial declines in net worth following the diagnosis: just over \$25,000 for a stroke, and \$29,000 for lung disease. A nursing home stay is associated with a \$15,000 wealth decline, and loss of a spouse with a \$31,000 drop. For most health events, the decline in net worth is greater for wealthier individuals than for poorer individuals. For example, a stroke (lung disease) is associated with a decline in net worth of \$4,682 (\$9,986) for low wealth individuals and a much larger decline of \$59,290 (\$84,959) for wealthier individuals. Why a stroke of lung disease should "cost" more for a wealthy individual than for a less wealthy individual is an open question. The difference may be

related to Medicaid coverage or to differences in the cost or intensity of treatment. We plan to address this issue in subsequent work.

To place these results in context, we calculate the expected reduction in wealth a 65-year-old individual would face over his or her remaining lifespan for each potential health shock. This calculation involves the probability that the individual will survive to each advanced age, the probability that a new shock will strike at each age, and the wealth decline associated with each shock. We calculate that the expected "wealth cost" of a stroke for a married (single) man at age 65 is \$8,002 (\$8,321). For women, the analogous values are \$8,375 (married) and \$1,504 (single), where the latter figure represents both a lower likelihood of stroke and a smaller wealth decline conditional on a stroke. Our estimate of the expected wealth decline coincident with a hospital stay is about \$21,000 for both married and single women, but is substantially higher for married men than for single men (\$32,848 versus \$1,802). Married women face larger declines in wealth when a spouse dies (\$24,446) than do men (\$7,701). Adding up the expected cost of the five shocks for which we find substantial declines in net worth – stroke, lung disease, hospital stay, nursing home stay, and death of a spouse – we estimate that the expected wealth decline associated with these shocks is between 3 and 9 percent of household net worth at age 65 for single and married men, but higher – between 10 and 14 percent of net worth – for married and single women at the same age.

A key limitation of our approach is our lack of information on expenditures as well as household net worth. If some health shocks result in changes in consumption outlays or wealth transfers that are not related to health, for example if a cancer diagnosis leads to an acceleration of asset transfer to children for estate planning or other reasons, we will attribute the associated decline in net worth to a health shock. Another shortcoming is our focus on the change in net worth over a period that is no longer than two years, and typically only one year, after the onset of a new condition. This approach may under-state the long-term wealth effect of chronic conditions. A final concern is that our focus on mean outcomes may fail to capture much larger tail events that involve significant health-related financial costs. Previous research on these issues suggests that the upper tail of the outlay distribution involves much higher costs than the mean. These are issues for future study.

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