

## Simulation Methodology and Results

Over the next several decades, the elderly share of the population is projected to move from 12.5 percent in 1999 to 21.3 percent in 2049. Therefore, one of the most valuable applications of age estimates is to be able to isolate the effect on health care spending growth from only the changing age-mix of the population. This last exercise was done by Sally Burner and colleagues in 1992.<sup>1</sup> We can then simulate the impact of this factor in the future by holding constant other cost-increasing factors that drive growth in health care spending such as technological change, price inflation, and age-specific utilization rates, at 1999 levels. Stated another way, these factors are assumed to stay constant at their 1999 levels in future years. The only factor that can change is the percentage of the population in each age group. Another cost-increasing factor is population growth; however, this factor is removed in the simulation because the results are reported on a per capita basis. This exercise does not create a complete health care projection, but instead provides insight into the challenges that society will face to finance health care spending in the future.

Although we could have run the simulation for each individual year, we decided to run the simulation in ten-year intervals (1999, 2009, 2019, 2029, 2039, 2049). We also included an aging effect from 1987 to 1999 by running the simulation using 1999 levels and the observed population distribution in 1987. The selected years give a concise picture of how the projected movement of the population will move into different age groups over the next several decades. Using this methodology, we could go back and run the simulation for other specific years (like 2011, the year that the first part of the baby boom generation becomes eligible for Medicare). This type of exercise will show if the estimate for that specific year is significantly different from the estimate of that year generated by an interpolation of the estimates on the 10-year intervals.

The first item that we used to complete the simulation is population projections. We used the population numbers reported annually in the Social Security Trustees Report and we grouped them into the seven age groups that we used for the age estimates (0-18, 19-44, 45-54, 55-64, 65-74, 75-84, and 85 and over). A person's age was calculated from July 1 of each year. Then, we adjusted these population numbers in the historical period to match the population numbers reported in the national health accounts. The Social Security population numbers are converted to national health accounts population after all people living outside the United States (armed forces overseas or residents of U.S. territories) are removed. Then, we calculated a ratio of the historical population numbers and applied them to the Social Security population projections in order to generate a population projection time series that is consistent with the national health accounts. The table below shows the population estimates that we used for each of the years in the simulation. Refer to our recent *Health Care Financing Review* web exclusive paper, [Age Estimates in the National Health Accounts](#), to see the distribution and average annual growth rate for these population projections.

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<sup>1</sup> Burner, S.T., Waldo, D.R., and McKusick, D.R.: National Health Expenditures Projections Through 2030. *Health Care Financing Review* 14(1):1-29, Fall 1992.

### Population Projections (in millions) by Age Group

	1987	1999	2009	2019	2029	2039	2049
All Ages	242.7	277.8	304.3	328.4	348.5	363.6	375.3
0-18	70.5	79.6	81.4	84.3	85.9	86.7	88.5
19-44	97.5	102.9	104.5	108.4	112.3	113.9	116.7
45-54	23.4	36.6	44.4	41.3	42.5	46.1	45.3
55-64	21.7	23.8	35.4	42.9	40.1	41.5	45.1
65-74	17.2	18.3	20.7	30.9	37.7	35.6	37.2
75-84	9.3	12.1	12.6	14.7	22.5	28.0	26.9
85+	3.1	4.4	5.4	5.8	7.4	11.9	15.7

The second and final item that we used was the per capita estimates for 1999 by the seven age groups, type of service, and source of funding. These levels are shown on the tables page of this website on [Table 1](#).

This document will now walk through how the simulation was completed for 2009. The same methods were applied to get the results of the simulation for 1987, 2019, 2029, 2039, and 2049. The starting point for the 2009 simulation is the population projections for 2009 that are consistent with the historical national health accounts. Then, we set up a matrix for each of the ten types of service under personal health care (hospital care, physician & clinical services, prescription drugs, nursing home care, home health care, other professional services, dental care, nondurables, durables, and other personal health care) in the national health accounts.<sup>2</sup> The top part of the matrix contains the six major source of funding categories (out-of-pocket, private health insurance, other private, Medicare, Medicaid, and other public) while the left side of the matrix contains the seven age groups used for our estimates. Then, for each of the 42 cells in this matrix for each type of service category, the 1999 per capita estimate for that cell is multiplied by the 2009 population projection for that particular age group. The result is a matrix of health care spending for that type of service in 2009 assuming the same per person spending that existed in 1999 with the population of 2009.

This same exercise is then repeated for the other nine types of service in personal health care. Next, the results for the ten types of service are summed to get a simulation of personal health care for 2009 assuming the same per person spending in 1999 with the 2009 population. These estimates assume that the population distribution as well as the actual level of the population is allowed to change. This simulation is intended to pick up only the first of those two factors; therefore, the impact of the second factor must be removed. So the final step for the 2009 simulation is to divide the results by the 2009 population to get per capita estimates.

The simulation for 2009 described above can then be repeated for 1987, 2019, 2029, 2039, and 2049. All of the assumptions and methods will remain the same, specifically using the 1999 per person estimates and the population projections that are consistent with the national health accounts. The results are shown below.

The first table shows levels for personal health care expenditures when run through the simulation; the first half shows simulated spending by type of service while this second half is by

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<sup>2</sup> For a complete description of what goes into each category of personal health care, see the definitions, sources, and methods web site of the national health accounts at [www.cms.hhs.gov/statistics/nhe/dsm.pdf](http://www.cms.hhs.gov/statistics/nhe/dsm.pdf)

source of funding. The levels for 1999 are identical to the estimates in [Table 1](#). However, the estimates for all other years assume that the 1999 per capita levels for each type of service and source of funding remain the same but the population projection used in one consistent with the national health accounts for that year. Note that the 1987 level is above the actual 1987 personal health care number in the national health accounts because a much higher 1999 per capita level was assumed. This exercise was done to see the effect of aging and population growth.

**Simulated expenditures (in billions \$) by type of service & source of funding**

	1987	1999	2009	2019	2029	2039	2049
Personal Health Care	905.2	1065.0	1209.8	1374.6	1559.3	1724.4	1829.2
Hospital Care	337.2	393.5	446.3	511.3	580.5	634.9	668.2
Physician & Clinic	233.5	270.9	306.1	344.9	380.4	404.8	420.8
Prescription Drugs	89.0	104.4	121.3	138.4	152.7	163.1	170.1
Nursing Home Care	70.2	89.6	102.6	118.6	152.4	198.7	228.4
Home Health Care	26.2	32.3	36.7	42.2	51.5	61.8	67.9
Dental	48.6	56.4	62.9	68.4	72.7	75.4	77.3
Other Professional	31.5	36.7	41.4	45.6	49.2	52.5	54.8
Other PHC	28.5	33.7	37.7	41.7	47.2	54.2	58.9
Nondurables	25.9	30.3	34.9	40.8	46.6	50.5	52.9
Durables	14.6	17.2	19.6	22.6	26.0	28.5	29.9
Pvt Hlth Insurance	315.5	366.4	421.4	463.0	489.3	516.4	537.8
Medicare	171.0	206.2	233.0	293.4	378.4	436.6	465.8
Medicaid	147.6	174.2	194.9	216.1	244.8	280.1	304.2
Out-Of-Pocket	155.5	184.5	210.4	237.7	269.5	301.3	321.9
Other Public	67.3	77.5	87.3	95.7	102.5	109.0	114.0
Other Private	48.3	56.2	62.8	68.7	74.8	81.2	85.4

As stated before, the previous table allowed both the distribution and the level of the population to change. These numbers therefore show the effects of population growth and the changing demographic mix of the population. Since it is our goal to show just the effect of a different population age mix, we then divided each column by its population projection to get the simulated per capita estimates in the table below.

**Simulated per capita expenditures (\$) by type of service & source of funding**

	1987	1999	2009	2019	2029	2039	2049
Personal Health Care	3,729	3,834	3,975	4,186	4,475	4,742	4,874
Hospital Care	1,389	1,416	1,467	1,557	1,666	1,746	1,780
Physician & Clinic	962	975	1,006	1,050	1,092	1,113	1,121
Prescription Drugs	367	376	399	421	438	448	453
Nursing Home Care	289	323	337	361	437	547	609
Home Health Care	108	116	121	128	148	170	181
Dental	200	203	207	208	209	207	206
Other Professional	130	132	136	139	141	144	146
Other PHC	117	121	124	127	136	149	157
Nondurables	107	109	115	124	134	139	141
Durables	60	62	64	69	75	78	80
Pvt Hlth Insurance	1,300	1,319	1,384	1,410	1,404	1,420	1,433
Medicare	704	742	766	893	1,086	1,201	1,241
Medicaid	608	627	640	658	703	770	810
Out-Of-Pocket	641	664	691	724	774	828	858
Other Public	277	279	287	292	294	300	304
Other Private	199	202	206	209	215	223	228

The next table shows the average annual percentage change in the simulation due to the changing age mix of the population. The table immediately following this gives index levels (1999=100.0), which give a better perspective of cumulative change.

**Average annual growth rates by type of service & source of funding**

	1987- 1999	1999- 2009	2009- 2019	2019- 2029	2029- 2039	2039- 2049	1999- 2049
Personal Health Care	0.2	0.4	0.5	0.7	0.6	0.3	0.5
Hospital Care	0.2	0.3	0.6	0.7	0.5	0.2	0.5
Physician & Clinic	0.1	0.3	0.4	0.4	0.2	0.1	0.3
Prescription Drugs	0.2	0.6	0.6	0.4	0.2	0.1	0.4
Nursing Home Care	0.9	0.4	0.7	1.9	2.3	1.1	1.3
Home Health Care	0.6	0.4	0.6	1.4	1.4	0.6	0.9
Dental	0.1	0.2	0.1	0.0	-0.1	-0.1	0.0
Other Professional	0.1	0.3	0.2	0.2	0.2	0.1	0.2
Other PHC	0.3	0.2	0.2	0.7	1.0	0.5	0.5
Nondurables	0.2	0.5	0.8	0.7	0.4	0.1	0.5
Durables	0.2	0.4	0.7	0.8	0.5	0.1	0.5
Pvt Hlth Insurance	0.1	0.5	0.2	0.0	0.1	0.1	0.2
Medicare	0.4	0.3	1.6	2.0	1.0	0.3	1.0
Medicaid	0.3	0.2	0.3	0.7	0.9	0.5	0.5
Out-Of-Pocket	0.3	0.4	0.5	0.7	0.7	0.3	0.5
Other Public	0.0	0.3	0.2	0.1	0.2	0.1	0.2
Other Private	0.1	0.2	0.1	0.3	0.4	0.2	0.2

**Index levels by type of service & source of funding**

	1987	1999	2009	2019	2029	2039	2049
Personal Health Care	97.3	100.0	103.7	109.2	116.7	123.7	127.1
Hospital Care	98.1	100.0	103.5	109.9	117.6	123.3	125.7
Physician & Clinic	98.6	100.0	103.2	107.7	111.9	114.2	115.0
Prescription Drugs	97.5	100.0	106.0	112.1	116.6	119.3	120.5
Nursing Home Care	89.6	100.0	104.5	112.0	135.6	169.4	188.7
Home Health Care	92.8	100.0	103.9	110.5	127.0	146.3	155.6
Dental	98.7	100.0	101.8	102.6	102.8	102.1	101.5
Other Professional	98.3	100.0	103.2	105.3	107.1	109.5	110.6
Other PHC	96.7	100.0	102.1	104.6	111.7	122.8	129.4
Nondurables	97.7	100.0	105.1	113.8	122.5	127.1	129.0
Durables	97.1	100.0	103.9	111.0	120.4	126.5	128.3
Pvt Hlth Insurance	98.5	100.0	104.9	106.9	106.4	107.6	108.6
Medicare	94.9	100.0	103.1	120.4	146.3	161.8	167.2
Medicaid	97.0	100.0	102.1	104.9	112.0	122.8	129.2
Out-Of-Pocket	96.5	100.0	104.1	109.0	116.5	124.7	129.2
Other Public	99.4	100.0	102.9	104.5	105.4	107.5	108.9
Other Private	98.4	100.0	102.1	103.4	106.2	110.4	112.6

This analysis shows that the effects of the changing age-mix of the population on personal health care spending growth would average just under 0.5 percent annually (27 percent cumulatively) from 1999 to 2049, double the average annual growth rate due to aging from 1987 to 1999. The growth rate over the 50-year simulation period is also above the 0.3 percent growth rate during the 1965-to-1999 period, which has also been documented in other studies.<sup>3</sup> Even though the changing age-mix of the population is expected to play a larger role in the future, it is still rather limited when compared to the 10.6 percent average annual growth of personal health care spending from 1965 to 1999.

These small age-mix effects on the annual growth of overall health spending mask more significant effects on certain services and payers. The nursing home sector is most affected by this demographic change, which would increase nursing home spending by 1.3 percent annually (89 percent cumulatively) from 1999 to 2049. Growth is projected to peak between 2029 and 2039 when the baby boom generation reaches and surpasses age 85, and is expected to have a considerable impact on Medicaid and out-of-pocket spending that pays for the vast majority of this care. The simulation also shows that growth in home health care will be significantly affected by demographic change, growing 0.9 percent annually (56 percent cumulatively) from 1999 to 2049. In contrast, spending on hospital care, prescription drugs, and physician & clinical services is projected to experience smaller age-mix impacts over the 5-decade period.

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<sup>3</sup> Burner, S.T., et al.: National Health Expenditures Projections Through 2030. *Health Care Financing Review* 14(1):1-29, Fall 1992. Reinhardt, U.E.: Does The Aging of The Population Really Drive The Demand For Health Care? *Health Affairs* 22(6):27-39, November/December 2003. Strunk, B.C., and Ginsburg, P.B.: Aging Plays Limited Role in Health Care Cost Trends, Sept 2002: <http://www.hschange.com/CONTENT/473/473.pdf>.

The program responsible for financing the largest portion of health care spending by the elderly—Medicare—will experience the most significant age-mix effect of any payer, increasing just over 1 percent annually (67 percent cumulatively) from 1999 to 2049. In contrast, both Medicaid and out-of-pocket spending can be expected to increase by 0.5 percent annually due to age-mix effects—only slightly faster than the effect on overall spending. The impact of aging on private health insurance is greatest between 1999 and 2009, as the baby boomers enter the more expensive working-age cohorts and just before they become eligible for Medicare. However, the age-mix effect on private health insurance growth is limited over the 50-year simulation period, averaging just 0.2 percent per year.

If you have any questions or would like more information on the simulation, please e-mail [dnhs@cms.hhs.gov](mailto:dnhs@cms.hhs.gov) and include “Age Estimates Simulation” in the subject line.