

ACCURACY ANALYSIS OF THE SHORT-TERM (11-YEAR) NATIONAL HEALTH EXPENDITURE PROJECTIONS

Many users of the Centers for Medicare & Medicaid Services' (CMS) National Health Expenditures (NHE) projections have requested analyses on the accuracy of the agency's short-term estimates over time. This paper updates and examines the accuracy of the NHE Projections by comparing each set of those projections from 1997 through 2009 (representing a total of 12 distinct projection sets) to the current estimates of historical National Health Expenditures.¹ The report includes analysis of the projection accuracy for growth in total NHE, personal health care (PHC) spending, as well as spending in three of the major health care sectors (hospitals, physicians and clinical services, and prescription drugs).

KEY FINDINGS (Table 1)

Total NHE and Health Share of GDP

- On average, CMS' projections of growth in total NHE have overestimated actual spending growth by 0.4 percentage point in the first projected year (with a range of -1.0 to 1.7 percentage points).
- In the second projected year, the NHE growth rate projections have overestimated actual spending growth by an average of 0.3 percentage point with a range of -1.0 to 1.9 percentage points.
- In the third projected year, the growth rate projections have overestimated actual spending growth by 0.3 percentage point with a range of -1.4 to 2.7 percentage points.
- The mean absolute difference between projected and actual NHE growth in the first, second, and third years has been 1.0 percentage point, 0.8 percentage point, and 1.3 percentage points, respectively.
- In the first projected year, the health share of GDP has underestimated actual estimates by 0.3 percentage point on average, with a range of -0.7 to 0.2 percentage point.

Personal Health Care (PHC)

- In the first projected year, CMS' projections of PHC growth have overestimated historical estimates by 0.1 percentage point on average; on a year-to-year basis, the difference between projected and historical growth in PHC has ranged from -1.1 to 1.3 percentage points.
- The second year of each projection has been, on average, overestimated by 0.1 percentage point since 1997. On a year-to-year basis, the difference between projected and current historical growth rate estimates has ranged from -1.0 to 1.6 percentage points.
- In the third projected year, the growth rate projections have been, on average, overestimated by 0.4 percentage point with a range of -1.8 to 2.1 percentage points.
- In absolute terms, projected PHC growth has varied from actual PHC growth by an average of 0.9 percentage point in the first year, an average of 0.8 percentage point in the second year, and an average of 1.0 percentage point in the third year.

Sector-Specific Projections

- CMS' hospital spending growth estimates have averaged an underestimation of 0.2 percentage point in the first year, 0.4 percentage point in the second year, and 0.6 percentage points in the third year. The mean absolute difference between projected and actual hospital spending growth has been 1.0 percentage point in the first year, 1.3 percentage points in the second year, and 1.8 percentage points in the third year.
- The projection of spending growth for physician and clinical services tends to be overestimated by an average of 0.2 percentage point in the first, 0.3 percentage point in the second, and 0.7 percentage point in the third year. The mean absolute difference is 1.0 percentage point in the first year and 1.2 percentage points in the second and third year.
- Projections of drug spending growth have, on average, overestimated actual spending growth by 0.1 percentage point in the first year, 0.6 percentage point in the second year, and 1.1 percentage points in the third year. The mean absolute difference is 2.5 percentage points in the first year, 3.3 percentage points in the second year, and 4.2 percentage points in the third year.

MEASUREMENT OF PROJECTION ACCURACY

Projection accuracy can be assessed based on a number of simple statistical measures; all measures in this report compare the projected growth rates from each vintage of the NHE Projections since 1997 (12 sets) to the corresponding current historical NHE estimates for 2009. The difference between projected and actual growth rates (in percentage points) is described in two ways. The first is the mean difference between the projected and actual spending growth rates. In this measure, the sign is retained on the difference, so it is possible for years of overestimation or underestimation to partially or completely offset one another. The second measure is the mean absolute difference, which describes the average difference between the projected and actual growth rates, regardless of sign. Also highlighted are the ranges in the differences between the projected and actual values by year, the percentage of the twelve projections sets in which the correct direction of growth was estimated (acceleration/deceleration), and the frequency of over- and under-projections over the twelve sets of projections.

The history of annual NHE Projections is relatively short, which influences the breadth of this analysis. Although some short-term and long-term projections of national health spending were published in the early 1990s, the release of short-term NHE projections on an annual basis did not commence until 1997; the current general econometric model framework and methodology have been in place since the 1999 publication.² Given the limited number of projections, the analysis presented here focuses primarily on accuracy in estimating the growth rate the first, second, and third years of the projection period.

POTENTIAL REASONS WHY PROJECTIONS MAY DIFFER FROM ACTUAL SPENDING ESTIMATES

Projections are inherently subject to uncertainty. This uncertainty stems from a number of factors that can influence the relationship between the projections and the actual spending outcomes.

First, revisions to the historical NHE series and other exogenous data sources are incorporated each year, reflecting the latest data available at the time of estimation. These revisions can include everything from minor updates to source data to significant changes in category definitions and/or methodology. For the most part, revisions are slight and reflect updated source data. The largest revisions to the historical NHE data tend to occur following quinquennial comprehensive revisions, or “benchmarks,” where changes in methodology and definitions are incorporated and the full time series (1960 — forward) is open for revision.³

One substantial change to source data that was incorporated in the 1999 NHE was the adoption of the North American Industrial Classification System (NAICS) in place of the Standard Industrial Classification (SIC) system. This not only resulted in changes in estimates for the National Health Expenditures, both in definitional boundaries and methodology, but also in the exogenous data from many other government data sources that are used in these projections.⁴ The 2009 comprehensive revision (completed in 2010) reflects, among other changes, classification changes in preparation for accounting for changes in national health spending categories related to the Patient Protection and Affordable Care Act of 2010.⁵

Another factor related to source data that can contribute to the accuracy of results concerns the changing projections of exogenous data inputs. Exogenously-projected data include the macroeconomic forecasts such as Gross Domestic Product (GDP) or the unemployment rate. However, the most important exogenous variable is that of disposable personal income. This extremely influential parameter plays a major role in the aggregate model, as well as many sector models.⁶ With the most recent recession, the exogenous projections that we used for the projections released in 2007 and 2008 did not predict this recession. Therefore, since lower economic growth and income lead to lower use of health services such as doctor visits and prescription drugs, this was one reason for our recent overestimation of health spending growth, which was most easily seen in the physician and clinical services and prescription drug sectors. Similarly, our overestimation of NHE growth in 2009 was directly related to a source that estimated large increase in health insurance enrollment (through COBRA plans) that never occurred.

The third major factor influencing projection accuracy is related to the NHE Projections model and the methodology by which the projections are generated. Constant changes in data sources and new developments in the health care sector may reduce the ability of a given equation in the NHE Projections model to fit the historical data over time and thus, lead to less accurate projections of spending. As a result, the specification of each equation in the model is reviewed annually for potential improvements in terms of data sources and specification based on the ability of the given models to fit the historical data and provide a reasonable, technically sound, and more accurate projection.

Similarly, adjustments to the model's solution (also known as add factors) are an important input to these projections; while projections can be improved by taking into account important factors that cannot be modeled directly (including the consensus of industry experts), resulting historical health spending estimates may be different because of new adjustments, unforeseen developments in the health sector, or any other factor that did not affect spending in a manner consistent with prior expectations.

Finally, the current-law framework guiding these projections leads to potential differences between projected and actual health spending, as legislative changes occurring after the projections are produced cannot be taken into account. Several important legislative changes have occurred during the period in which projections have been published, including the Balanced Budget Act of 1997 (BBA), Balanced Budget Refinement Act of 1999 (BBRA), Benefits Improvement and Protection Act (BIPA) of 2000, the Medicare Modernization, Prescription Drug, and Improvement Act (MMA) of 2003, and, most recently, the Patient Protection and Affordable Care Act (ACA) of 2010. Similarly, it has been noted in several projections reports that future legislative interventions intended to prevent cuts to the Medicare Physician Fee Schedule mandated by current law lead to underestimated projections of physician spending.

ANALYSIS AND DISCUSSION OF PROJECTION ACCURACY

NHE, Health Share of GDP, and PHC

NHE growth has averaged 6.6 percent per year since 1997. Projections of growth in overall NHE have, on average, overestimated actual spending growth by 0.4 percentage point in the first projected year, 0.3 percentage point in the second projected year, and overestimated growth by 0.3 percentage point in the third projected year. The mean absolute differences in the first, second, and third years have been 1.0 percentage point, 0.8 percentage point, and 1.3 percentage points, respectively. The direction of growth from the most recent historical year to the first year of the projection period has been correctly projected in 83 percent of projections while the direction of growth for the second year has been correctly estimated 82 percent of the time and the direction of growth in the third year has been correctly estimated 70 percent of the time.

The health share of GDP has increased from 13.5 percent in 1997 to 17.6 percent in 2009. The accuracy of projecting health spending as a share of GDP is dependent not only on the projections of health spending, but also on the exogenously-projected growth of GDP. The CMS projections of the health share of GDP have been projected with an average underestimation of 0.3 percentage point in the first and second years of the projection, and an average underestimation of 0.4 percentage point in the third year of the projection. The direction (increase or decrease in the health share) for the first projected year has been correctly estimated in 11 of the 12 sets of projections.

Growth in personal health care (PHC), a subset of NHE, has averaged 6.5 percent per year since 1997. For the projection sets analyzed, PHC growth has been overestimated with an average difference of 0.1 percentage point in year one and year two of the projection and 0.4 percentage point in year three. In absolute terms, projected PHC growth has varied from actual growth by

an average of 0.9 percentage point in the first year, 0.8 percentage point in the second year, and 1.0 percentage point in the third year. The direction of growth in the first year of the projection period has been correctly estimated in 9 of 12 sets of projections while the second year has been correctly estimated 8 of 11 times and the third year has been correctly estimated 6 of 10 times.

Hospital

Hospital spending growth has averaged 6.1 percent per year since 1997. The hospital spending projections have, on average, tended to be underestimated, with a mean difference of 0.2 percentage point below actual growth (with a range of -1.8 to 2.0 percentage points), 0.4 percentage point below actual spending growth in the second year (with a range of -2.6 to 2.1 percentage points), and 0.6 percentage points below actual growth in the third year (with a range of -2.7 to 2.0 percentage points). The mean absolute difference between projected and actual hospital spending growth has been 1.0 percentage points in the first year, 1.3 percentage points in the second year, and 1.8 percentage points in the third year. The direction of growth has been correct in 6 of 12 sets of projections for the first year, 7 of 11 for the second year, and 7 of 10 for the third year.

A number of possible explanations can account for the differences between projected and historical hospital spending. Legislative changes to current law, such as the BBA, BBRA, BIPA, and annual updates to Medicare and Medicaid payment policy can affect spending growth for those payers and by extension, aggregate hospital spending growth. The projections also may not have fully anticipated the effect of recent industry behavior on spending, such as the effect of the hospital construction boom in the last decade and so-called “medical arms race,” and any changes in private insurance reimbursement to hospitals or in insurance benefit design.⁷ Hospital use patterns may influence spending estimates in unanticipated ways (e.g. higher use due to a strong flu season, reduced use in response to the recent recession, etc.)

Physician and Clinical Services

Spending for physician and clinical services has grown 6.2 percent per year, on average, since 1997. Physician and clinical services spending growth has tended, on average, to be overestimated in the first year of the projection period by 0.2 percentage point, 0.3 percentage point in the second year, and 0.7 percentage point in the third year. The ranges for those projections are -1.8 to 2.3 percentage points in the first year, -1.3 to 2.5 percentage points in the second year, and -1.4 to 2.4 percentage points in the third year. In absolute terms, projected growth has varied from actual growth an average of 1.0 percentage point in the first year and 1.2 percentage point in the second year and third year. The direction of growth in the first year of the projection period has been correct in 9 of 12 sets of projections while the second year has been correct in 9 of 11 sets of projections and the third year has been correct in 6 of 10 sets of projections.

One reason physician spending growth projections have diverged from historical estimates is related to the physician payment updates required under current law. The Sustainable Growth Rate (SGR) system mandates the adjustment of future physician payment updates for any differences between past target and actual physician spending levels.⁸ Since 2003, scheduled negative updates for the coming calendar year have been avoided through legislative changes;

however, CMS' projections have historically been completed prior to that legislation's enactment. Projecting within a current-law framework, the scheduled negative updates must be assumed, which may ultimately result in an underestimate of Medicare physician expenditure growth.

Despite the potential to underestimate Medicare due to SGR changes, overall physician growth has, on average, been slightly overestimated. Other factors, which ultimately differed from expectations, such as lower reimbursements to doctors in PHI or Medicaid plans and lower-than-expected utilization growth, have overwhelmed the SGR effect and caused the slight overestimation in spending growth in this category.

Prescription Drugs

Prescription drug spending growth has averaged an increase of 10.6 percent per year since 1997. The projections of drug spending growth have, on average, overestimated historical spending in the first, second, and third years of the projection period by 0.1, 0.6, and 1.1 percentage points, respectively. The mean absolute difference is 2.5 percentage points in the first year, 3.3 percentage points in the second year, and 4.2 percentage points in the third year. The direction of growth for the first year was correct in 8 of 12 sets of projections, correct for the second year in 7 of 11 sets, and correct for the third year in 8 of 10 sets.

However, the range of differences between the projected and actual growth rates for prescription drug spending is much larger than the other 2 major sectors analyzed. In the first year of the projection period, the prescription drug growth projection ranged from 6.1 percentage points below to 3.3 percentage points above the actual spending growth estimate. For the second year of the projection period, the projection range was larger, from 6.3 percentage points below to 5.4 percentage points above the actual spending growth estimate. And for the third year of the projection period, the projection range was even larger, from 10.2 percentage points below to 6.4 percentage points above. In addition to the fact that drug sector growth is historically much more volatile than that of any other sector, this wide range between the projected and actual growth rates is due largely to the fact there was an all-time high in growth in 1999 and an all-time low in growth in 2008. Although CMS projected double-digit growth of 14.0 percent in 1999, the actual growth rate was 18.4 percent, a rate primarily caused by a large influx of new prescription drugs (like Celebrex and Vioxx) that achieved blockbuster status. Their success was emboldened, in part because these drugs were heavily advertised on television and this advertising proved to be remarkably effective. Because regulations on drug advertising were eased in 1997, there was little experience to draw from on the large effect direct-to-consumer advertising might have on drug spending growth in 1999. On the opposite side, the start of a recession along with a faster-than-predicted increase in the generic dispensing rate caused drug spending to grow at just 3.1 percent in 2008 (versus a prediction of 6.8 percent in the projections released in February 2007).

CONCLUSION

Projecting national health expenditure growth rates that are the results of millions of individual purchases of health care goods and services is far from a perfunctory exercise. Accurate projections rely not only on an understanding of sophisticated modeling techniques and

economic theory, but also on the reliability of the underlying data, the advice of experts in various health care fields, the status of current law at the time the projection is made, and professional judgment.

This report represents a comprehensive and publicly-available analysis on the accuracy of CMS' NHE projections, which has been updated and expanded upon over the last four years. It is intended to quantify the accuracy of the agency's projections, as well as to provide background on the inherent uncertainty that is associated with their construction. The Office of the Actuary will continue to update this review on an annual basis in order to foster a better understanding of the future outlook for national health care spending.

¹ The NHE Projections were not constructed in 1998.

² Early publications (1991-1995) include S. Sonnefeld, J. Lemieux, and D. McKusick, "Health Spending Through 2030: Three Scenarios," *Health Affairs* Winter 1991: 231- 242; S. Sonnefeld, D. Waldo, J. Lemieux, and D. McKusick, "Projections of National Health Expenditures through the year 2000," *Health Care Financing Review* 13, no. 1 (1991): 1-27; S.T. Burner, D.R. Waldo, and D.R. McKusick, "National Health Expenditures Projections Through 2030," *Health Care Financing Review* 14, no.1(1992): 1-29; L.C. Paringer, "Assessing the Definitions and Projections of National Health Expenditures," Unpublished Draft Preliminary Report Submitted to the Office of Technology Assessment. U.S. Congress. U.S. Congress Office of Technology Assessment, Health Program, 1994; S. Burner, and D. Waldo, "National Health Expenditure Projections, 1994-2005," *Health Care Financing Review* 16, no. 4 (1995): 221-242. For more information on the current methodology, see "NHE Projections Methodology", <http://www.cms.hhs.gov/NationalHealthExpendData/downloads/projections-methodology.pdf> (accessed 21 September 2011).

³ "Summary of National Health Expenditure Account 2009 Comprehensive Revisions," <http://www.cms.hhs.gov/NationalHealthExpendData/downloads/benchmark2009.pdf> (accessed 21 September 2011)

⁴ Examples of such sources include data produced by the US Bureau of Labor Statistics and the US Census Bureau. Efforts associated with the SIC-NAICS conversion at these agencies can be found at www.bls.gov and www.census.gov.

⁵ Summary of National Health Expenditure Account 2009 Comprehensive Revisions."

⁶ "NHE Projections Methodology," <<http://www.cms.hhs.gov/NationalHealthExpendData/downloads/projections-methodology.pdf>>.

⁷ G. Bazzoli, A. Gerland, & J. May. "Construction Activity in US Hospitals," *Health Affairs* 25, no.3 (2006), 783-791; G. Taylor, M. Parate, & P. Feeley, *Sixth Annual Non-Profit Hospital Survey: a Robust Capital Cycle Remains the Most Investable Theme* (New York: Banc of America Securities, 2007); R.A. Berenson, P.B. Ginsburg, & J.H. May, "Hospital-Physician Relations: Cooperation, Competition, or Separation?" *Health Affairs* 26, no. 1 (2007): w31-w43 (published online 5 December 2006; 10.1377/hlthaff.26.1.w31).

⁸ M. K. Clemens, "Estimated Sustainable Growth Rate and Conversion Factor, for Medicare Payments to Physicians in 2007," November 2006, <http://www.cms.hhs.gov/SustainableGRatesConFact/Downloads/sgr2009f.pdf> (accessed 21 September 2011).

Table 1 – NHE Projection Accuracy for selected components and years

<i>Year</i>	<i>Category</i>	<i>Mean Error</i> ¹	<i>Mean ABS Error</i> ²	<i>Range</i> ³	<i>Direction Accuracy</i> ⁴	<i>Over-estimated / Under-estimated</i> ⁵
First Year (obs = 12)	Total NHE	0.4	1.0	-1 to 1.7	83.3%	8 / 4
	PHC	0.1	0.9	-1.1 to 1.3	75.0%	8 / 4
	Hospital	-0.2	1.0	-1.8 to 2	50.0%	6 / 6
	Physician	0.2	1.0	-1.8 to 2.3	75.0%	7 / 5
	Drugs	0.1	2.5	-6.1 to 3.3	66.7%	8 / 4
Second Year (obs = 11)	Total NHE	0.3	0.8	-1 to 1.9	81.8%	7 / 4
	PHC	0.1	0.8	-1 to 1.6	72.7%	6 / 5
	Hospital	-0.4	1.3	-2.6 to 2.1	63.6%	5 / 6
	Physician	0.3	1.2	-1.3 to 2.5	81.8%	5 / 6
	Drugs	0.6	3.3	-6.3 to 5.4	63.6%	6 / 5
Third Year (obs = 10)	Total NHE	0.3	1.3	-1.4 to 2.7	70.0%	6 / 4
	PHC	0.4	1.0	-1.8 to 2.1	60.0%	6 / 4
	Hospital	-0.6	1.8	-2.7 to 2	70.0%	3 / 7
	Physician	0.7	1.2	-1.4 to 2.4	60.0%	6 / 4
	Drugs	1.1	4.2	-10.2 to 6.4	80.0%	8 / 2
Fourth Year (obs = 9)	Total NHE	0.7	1.5	-2.8 to 3.3	22.2%	6 / 3
	PHC	0.7	1.2	-1.9 to 2.6	33.3%	7 / 2
	Hospital	-0.3	1.4	-2.7 to 2.5	22.2%	3 / 6
	Physician	0.9	1.4	-1.7 to 3	66.7%	7 / 2
	Drugs	2.1	4.4	-7.1 to 6	66.7%	7 / 2
Fifth Year (obs = 8)	Total NHE	0.8	1.4	-1.7 to 3.7	75.0%	6 / 2
	PHC	0.7	1.2	-1.5 to 2.7	75.0%	6 / 2
	Hospital	-0.5	1.3	-2.3 to 2.5	87.5%	3 / 5
	Physician	0.9	1.5	-1.8 to 3.1	75.0%	6 / 2
	Drugs	2.8	3.9	-6.3 to 7.4	75.0%	6 / 2

¹ Mean Error measures the average annual difference between the projected growth rate and the most recent published estimates in the National Health Expenditure Accounts for a particular category and year. Since the sign of the error is retained, it is possible that a positive error in projection would be offset by a negative error of the same magnitude in another projection.

² Mean Absolute Error measures the average annual difference (in absolute value) between the projected growth rate and the most recent published estimates in the National Health Expenditure Accounts for a particular category and year.

³ Range shows the maximum amount that the projected growth rate was above and below the most recent published estimates in the National Health Expenditure Accounts for a particular category and year.

⁴ Direction Accuracy shows how often the direction of projected growth rate for a particular category and year matched the direction of most recent published estimates in the National Health Expenditure Accounts for a same category and year.

⁵ Over-estimated / Underestimated compares the projected growth rate and the most recent published estimates in the National Health Expenditure Accounts for a particular category and year and states how often the projection was over the published estimate and then how often the projection was under the published estimate.

SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary.