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

Health care spending has grown, on average, 2.7 percentage points faster than the overall economy over the last 30 years. Consequently, health care expenditures, which consumed just 8.5 percent of Gross Domestic Product (GDP) in 1978, now comprise nearly double that at 16.0 percent as of 2006. As this share grows, so too does the interest in health care spending 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 examines the accuracy of the NHE Projections by comparing each set of those projections from 1997 through 2006 (representing a total of 9 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, private and public payer 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

- Projected growth rates of total NHE tend to be more accurate than projections of specific payers or sectors.
- On average, CMS' projections of growth in total NHE have overestimated actual spending growth by 0.2 percentage point in the first projected year (with a range of -0.9 to 1.3 percentage points).
- In the second projected year, the growth rate projections have averaged a 0.0 percentage point difference with a range of -0.9 to 0.8 percentage point.
- The mean absolute difference between projected and actual NHE growth in the first and second years has been 0.7 percentage point and 0.4 percentage point, respectively.
- On average, projections of the health share of GDP have tended to underestimate the actual share by 0.3 percentage point in both the first and second projected years. The mean absolute difference is 0.4 percentage point in both the first and second years.

Personal Health Care (PHC)

- Over the nine sets of projections, projections of growth in personal health care, the largest subset of national health expenditures, have, on average, matched historical estimates of the first projected year; on a year-to-year basis, the difference between projected and historical growth in PHC has ranged from -0.8 to 1.5 percentage points.
- The second year of each projection has been, on average, underestimated 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 -0.8 to 0.9 percentage point.
- In absolute terms, projected PHC growth has varied from actual PHC growth by an average of 0.7 percentage point in the first year and an average of 0.5 percentage point in the second year.

Total Private Spending and Total Public Spending

- The CMS year-one projection of public spending growth has tended to be more accurate than that of private spending growth; however, the range of year-to-year differences between the projected growth and the actual growth in the second year of the projection period has been larger for the public estimates compared to the private estimates.
- Since 1997, private spending growth has been overestimated by an average of 0.3 percentage point and 0.2 percentage point in the first and second years of the projection periods, respectively. On a year-to-year basis, the difference between projected and historical growth rates has ranged from -2.1 to 2.3 percentage points for the first projected year and -2.3 to 3.2 percentage points for the second projected year. The mean absolute difference between projected and actual spending growth has been 1.3 percentage points in both year one and year two.
- Spending growth for public sources of funding has been estimated within 0.1 percentage point, on average, in both the first and second years of the projection periods dating back to 1997. On a year-to-year basis, the difference between projected and historical growth rates has ranged from -1.4 to 1.8 percentage points for the first year of the projection and from -3.9 to 5.1 percentage points for the second projected year. The mean absolute difference between projected and actual public spending growth is 0.8 percentage point in the first year and 2.3 percentage points in the second year.

Sector-Specific Projections

- Projection accuracy of growth rates tends to vary somewhat more widely among the major sectors when compared to aggregate-level projections.[2]
- CMS' hospital growth estimates have averaged an underestimation of 0.4 percentage point in the first year and 0.8 percentage point in the second year. The mean absolute difference between projected and actual hospital spending has been 0.7 percentage point in the first year and 1.1 percentage points in the second year.
- The projection of spending growth for physician services tends to be underestimated and varies from the historical estimate by an average of 0.4 percentage point in both the first and second years of the projection. The mean absolute difference is 0.6 percentage point in the first year and 1.0 percentage point in the second year.
- Projections of drug spending growth have, on average, overestimated actual spending growth by 0.1 percentage point and 0.4 percentage point in the first and second years, respectively. The mean absolute difference is 2.7 percentage points in the first year and 3.2 percentage points in the second 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 (9 sets) to the corresponding current historical NHE estimates for 2006. 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 nine projections sets in which the correct direction of growth was estimated (acceleration/deceleration), and the frequency of over- and under-projections over the nine 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.[3] Given the limited number of projections and the fact that we do not yet have historical data for a full projection period, the analysis presented here focuses primarily on accuracy in estimating the growth rate the first and second years of the projection period. As years pass, a more comprehensive analysis that includes the latter years of each projection will become possible.

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 benchmarks, where changes in methodology and definitions are incorporated and the full time series (1960 - forward) is open for revision.[4]

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.[5]

An additional 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, the most important of which 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]

The second 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, and the Medicare Modernization, Prescription Drug, and Improvement Act (MMA) of 2003. 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 7.0 percent per year since 1997. Projections of growth in overall NHE have, on average, overestimated actual spending growth by 0.2 percentage point in the first projected year, but averaged a 0.0 percentage point difference in the second projected year. The mean absolute difference in the first and second years has been 0.7 percentage point and 0.4 percentage point, respectively. The direction of growth for the first year of the period has been correctly projected in 8 of 9 sets of projections while the direction of growth for the second year has been correctly estimated 7 of 8 times.

The health share of GDP has increased from 13.6 percent in 1997 to 16.0 percent in 2006. 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, on average, been underestimated by 0.3 percentage point in both the first and second years of the projection. The mean absolute difference is 0.4 percentage point in both the first and second years. The direction (increase or decrease in the health share) for the first projected year has been correctly estimated in 8 of the 9 sets of projections.

Growth in personal health care, a subset of NHE, has averaged 6.8 percent per year since 1997. For the projection sets analyzed, PHC growth has been projected with an average difference of 0.0 percentage point in year one, and has averaged an underestimation of 0.1 percentage point in year two. In absolute terms, projected PHC growth has varied from actual growth by an average of 0.7 percentage point in the first year and 0.5 percentage point in the second year. The direction of growth in the first year of the projection period has been correctly estimated in 8 of 9 sets of projections while the second year has been correctly estimated 6 of 8 times.

Total Private and Total Public Spending

Private spending has averaged growth of 6.9 percent per year since 1997. Projections of spending growth for private sources of funding have been on average overestimated by 0.3 percentage point and 0.2 percentage point in the first and second years of the projection periods, respectively. The mean absolute difference is 1.3 percentage points in both years one and two. The direction of growth in the first year has been correctly estimated in 6 of 9 sets of projections, and the direction of growth in the second year has been correctly estimated in 5 of 8 sets of projections. This projection is sensitive to changes in projections of macroeconomic variables, as well as revisions to source data.

Public spending has grown, on average, 7.1 percent per year since 1997. In terms of the mean difference, projections of spending growth for public sources of funding have been estimated within 0.1 percentage point in both the first and second years of the projection periods. The first year has tended to be overestimated, on average, while the second year has tended to be underestimated. The mean absolute difference is 0.8 percentage point in the first year and 2.3 percentage points in the second year. The direction of growth has been projected correctly in 6 of the 9 sets of projections for the first year and 4 of 8 times for the second year. Given the adherence of the public spending projections to current law, these projections are sensitive to legislative changes over the projection horizon.

Hospital

Hospital spending growth has averaged 6.3 percent per year since 1997. The hospital spending projections have, on average, tended to be underestimated, with a mean difference of 0.4 percentage point below actual growth (with a range of -1.8 to 0.8 percentage points) and 0.8 percentage point below actual spending growth in the second year (with a range of -2.0 to 0.5 percentage points). The mean absolute difference between projected and actual hospital spending has been 0.7 percentage point in the first

year and 1.1 percentage points in the second year. The direction of growth has been correct in 7 of 9 sets of projections for the first year, and 7 of 8 for the second 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 public spending growth 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 recent hospital construction boom and so-called "medical arms race," and any changes in private insurance reimbursement to hospitals or in insurance benefit design.[7] Finally, hospital use patterns may influence spending estimates in unanticipated ways (e.g. higher use due to a strong flu season, etc.)

Physician and Clinical Services

Spending for physician and clinical services has grown 6.9 percent per year, on average, since 1997. As with hospital spending growth, physician and clinical services spending growth has tended, on average, to be underestimated in the first and second year of the projection period, by 0.4 percentage point in each year. The ranges for those projections were -1.7 to 0.3 percentage points in the first year and -1.7 to 1.9 percentage points in the second year. In absolute terms, projected growth has varied from actual growth an average of 0.6 percentage point in the first year and 1.0 percentage point in the second year. The direction of growth in the first year of the projection period has been correct in 6 of 9 sets of projections while the second year has been correct in 6 of 8 sets of projections.

The primary reason physician spending growth has tended to be underestimated 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, thus resulting in an understatement of Medicare physician expenditure growth.

Prescription Drugs

Prescription drug spending growth has averaged an increase of 12.2 percent per year since 1997. The projections of drug spending growth have, on average, overestimated historical spending in the first and second years of the projection period by 0.1 and 0.4 percentage point, respectively. The mean absolute difference is 2.7 percentage points in the first year and 3.2 percentage points in the second year. The direction of growth for the first year was correct in 5 of 9 sets of projections and correct for the second year in 6 of 8 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 5.6 percentage points below to 3.5 percentage points above the actual spending growth estimate. For the second year of the projection period, the projection range was larger, from 6.4 percentage points below to 5.7 percentage points above the actual spending growth estimate. 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 a nearly all-time low in growth in 2005. Although CMS projected double-digit growth of 14.1 percent in 1999, the actual growth rate was 18.1 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.

The 2005 projection of prescription drugs anticipated a deceleration in spending growth to 8.0 percent from 8.2 percent in 2004. However, growth actually decelerated to 5.8 percent, largely influenced by a significant shift in drug fills from more-expensive brand-name drugs to lesser-expensive generic drugs. This increase in generic use is believed to have been brought on by the restructuring of drug benefits industry-wide. Partially in response to historically high rates of drug spending growth in the preceding 5 to 7 years, many health plans and pharmacy benefit managers altered their cost-sharing mechanisms to favor generics over brands. Also contributing to the rapid growth in the generic dispensing rate was the slow down in the number of new drugs gaining Food and Drug Administration approval (a development not anticipated by industry experts).

Another significant contributor to the rapid deceleration in growth for 2005 was the concern on safety for particular drugs that affected utilization in entire therapeutic classes. Specifically, drug safety issues with hormone replacement therapy and the COX-2 inhibitors cut drug use not just in those therapeutic classes, but also in unrelated therapeutic classes as users became more aware of the risks and possible side effects of prescription drugs.

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 the first comprehensive and publicly-available analysis on the accuracy of CMS' NHE projections. 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 update this review on an annual basis in order to foster a better understanding of the future outlook for national health care spending.

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[1] The NHE Projections were not constructed in 1998.

[2] "Major sectors" include hospital, physician and clinical services, and prescription drugs.

[3] Early publications (1991-1995) include S. Sonnefield, 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 February 2008).

[4] "Summary of Benchmark Changes (NHEA 2004)," http://www.cms.hhs.gov/NationalHealthExpendData/ downloads/benchmark.pdf (accessed 21 February 2008)

[5] 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.

[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/sgr2007f.pdf (accessed 23 January 2008).

Table 1 – NHE Projection Accuracy for selected components and years

Year	*Category*	*Mean Error*[1]	*Mean ABS Error*[2]	*Range*[3]	*Direction Accuracy*[4]	*Over-estimated / Under-estimated*[5]
First Year (obs = 9)	Total NHE	0.2	0.7	-0.9 to 1.3	89%	5 / 4
	PHC	0.0	0.7	-0.8 to 1.5	78%	4 / 5
	Public	0.1	0.8	-1.4 to 1.8	67%	4 / 5
	Private	0.3	1.3	-2.1 to 2.3	67%	6 / 3
	Hospital	-0.4	0.7	-1.8 to 0.8	77%	3 / 6
	Physician	-0.4	0.6	-1.7 to 0.3	67%	4 / 5
	Drugs	0.1	2.7	-5.6 to 3.5	56%	6 / 3
Second Year (obs = 8)	Total NHE	0.0	0.4	-0.9 to 0.8	88%	4 / 4
	PHC	-0.1	0.5	-0.9 to 0.8	75%	3 / 5
	Public	-0.1	2.3	-3.9 to 5.1	50%	3 / 5
	Private	0.2	1.3	-2.3 to 3.2	75%	5 / 3
	Hospital	-0.8	1.1	-2.0 to 0.5	88%	2 / 6
	Physician	-0.4	1.0	-1.7 to 1.9	75%	2 / 6
	Drugs	0.4	3.2	-6.4 to 5.7	75%	4 / 4
Third Year (obs = 7)	Total NHE	-0.3	0.7	-1.5 to 0.3	100%	3 / 4
	PHC	-0.2	0.6	-2.0 to 0.5	71%	5 / 2
	Public	-0.6	2.2	-4.8 to 5.6	29%	1 / 6
	Private	-0.1	1.1	-3.4 to 1.3	57%	4 / 3
	Hospital	-1.5	1.5	-2.6 to -0.9	71%	0 / 7
	Physician	-0.2	0.9	-1.4 to 1.4	29%	3 / 4
	Drugs	0.4	4.2	-9.9 to 6.6	100%	5 / 2
Fourth Year (obs = 6)	Total NHE	-0.2	0.8	-1.5 to 0.4	100%	4 / 2
	PHC	0.0	0.6	-1.6 to 0.9	50%	4 / 2
	Public	-0.8	1.1	-3.0 to 0.9	33%	2 / 4
	Private	0.3	1.0	-2.0 to 1.1	67%	5 / 1
	Hospital	-1.2	1.2	-2.7 to -0.7	33%	0 / 6
	Physician	-0.2	0.7	-1.3 to 1.2	50%	3 / 3
	Drugs	1.1	4.4	-6.9 to 5.9	67%	4 / 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.