

COMMONWEALTH OF MASSACHUSETTS
HEALTH POLICY COMMISSION



TECHNICAL APPENDIX A4
HIGH-COST PATIENTS

ADDENDUM TO 2013 COST TRENDS REPORT

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Summary

This technical appendix lays out our approach for examining the small subgroup of the population that represents a large proportion of medical expenditures in both commercial and Medicare markets. The purpose of this study is examine the concentration of health care spending in Massachusetts, to determine the extent to which patients who are high cost in one year are also high cost in the next, and to identify the patient-level characteristics that are predictive of high and persistent spending.

The Health Policy Commission (Commission) conducted this analysis using claims data from 2010 and 2011.

1 Sample

We used the Massachusetts's All Payer Claims Database (APCD) for calendar years 2010 and 2011 for our analysis. Our sample included data for the state's three largest commercial payers -- Blue Cross Blue Shield of Massachusetts (BCBS), Harvard Pilgrim Health Care (HPHC), and Tufts Health Plan (THP) -- and Medicare Fee-For-Service, and was further limited to Massachusetts residents who were enrolled with the same insurer for at least six months in 2010 and at least six months in 2011.

Patients with missing data for age and gender, who lacked the diagnostic data needed to calculate risk scores and condition indicators, and with less than \$1 in expenditure in either 2010 or 2011 were removed from the dataset.

Due to data limitations, spending variables do not capture pharmacy costs, payments outside the claims system, or Medicare cost-sharing. As a result of our sample definition, spending variables do not capture end-of-life care for patients who died in 2010 or 2011.

Our sample size contained 1,473,465 commercial patients and 647,628 Medicare patients. This sample represented close to one-third of the population in Massachusetts in our study period.

2 Analysis

2.1 Definitions of high-cost and persistent patients

We defined high-cost patients as patients with annual spending at the 95th percentile and above in 2010, and persistently high-cost patients as patients with annual spending in the 95th percentile and above for 2 years, 2010 and 2011. The 95 percentile was calculated separately for each population (commercial, Medicare) and each year.

2.2 Definitions of clinical conditions

To determine each patient's clinical conditions, we used Optum's Symmetry Episode Risk Group (ERG) risk adjustment grouper. The ERG grouper evaluated diagnosis codes on 2010 medical claims to identify the chronic and acute conditions that were present for each enrollee and that typically have a material impact on health care costs. The data output included indicators for the presence of 34 clinical conditions.

The HPC was particularly interested in analyzing chronic medical conditions and chronic behavioral health conditions. Working together with clinical consultants, we refined Optum's ERG clinical conditions into 17 chronic conditions (arthritis, asthma, child psychology, blood, diabetes, epilepsy, glaucoma, cardiology, HIV/AIDS, hyperlipidemia, hypertension, mental health, multiple sclerosis (MS) and ALS (amyotrophic lateral sclerosis), psychiatric disorders, renal failure, mood disorders, and substance abuse). We categorized five of these conditions as behavioral health (child psychology, mental health, psychiatric disorders, mood disorders and substance abuse) and the remainder as chronic medical.

2.3 Regional and demographic variables

To determine region of residence, we mapped patients' home zip codes into 15 regions: Berkshires, Pioneer Valley / Franklin, Central Massachusetts, West Merrimack / Middlesex, East Merrimack, Upper North Shore, Metro West, Metro Boston, Lower North Shore, Norwood / Attleboro, Metro South, South Shore, Fall River, New Bedford, Cape and Islands.ⁱ

Because patient-level income was not available, patients were assigned to an income level based on the median incomes in their zip code in 2011, as reported by the US Census' American Community Survey. Enrollees with missing median incomes were assigned the state's average median income.

For age category, our sample was grouped into 9 age categories, (1) 0-18, (2) 19-24, (3) 25-34, (4) 35-44, (5) 45-54, (6) 55-64, (7) 65-74, (8) 75-84, (9) 85 plus.

2.4 Adjustment for age and sex

The analysis of the concentration of high-cost patients by region, were adjusted for age and sex. In order to calculate the adjusted concentration by region, the HPC calculated the average concentration within cells defined by region, age, and sex. The concentration for the region was then estimated as a weighted sum of the age/sex estimates within the region, in which the weights were derived using the statewide age/sex distribution.

2.5 Multivariate analysis

The HPC used logit regression models to estimate the probability that an enrollee would be high-cost in 2010 based on his clinical profile, region of residence, age, gender, and community income.

In these models, the dependent variable was an indicator for whether or not the patient was high-cost in 2010. To capture the clinical profile, the independent variables included indicators for each of the 34 conditions produced by the risk adjustment grouper, an indicator for the presence of both a chronic behavioral and a chronic medical condition, an indicator for the presence of two chronic conditions, and an indicator for the presence of three or more chronic conditions. A positive (or negative) coefficient on the indicator for multiple conditions indicates that the combination of conditions has an effect that is greater (or less) than would be expected if the individual effects were simply combined. Exhibits A4.1 – A4.6 show descriptive statistics for all variables used in the study, and Exhibits A4.7 – A4.10 show the estimated odds ratios and other outputs of the estimation process.

We selected 23 of the 34 conditions for presentation in the text. As a general rule, these conditions were selected either because of a strong association with high or persistent spending or because they were relatively common.

ⁱ Home zip code was measured using 2011 data. Less than four percent of the study population moved between 2010 and 2011.

The model also included indicators for each region, indicators for demographic categories (defined by age group interacted with sex), and indicators for the quartile of community income.

The regional effects are presented as odds ratios, relative to the Pioneer Valley/Franklin, the region with the lowest mean expenditures.

We used the same model to estimate the probability that a patient would be high-cost in 2011. Here the dependent variable was an indicator for whether or not the patient was high-cost in 2011, the sample was limited to patients who were high-cost in 2010, and all clinical variables were calculated based on diagnoses present in 2010.

Table A4.1: Commercial sample summary statistics

Dollars for expenditure and income variables; years for age variable

	Mean	SD	Min	Max
<i>Total sample</i>				
Per Member Expenditure 2010	\$4,625	\$14,512	\$2	\$2,640,924
Per Member Expenditure 2011	\$4,836	\$16,389	\$1	\$4,846,419
Age	36	20	0	88
Median Income 2011	\$34,652	\$11,247	\$2,500	\$158,153
<i>High Cost 2010</i>				
Per Member Expenditure 2010	\$41,633	\$50,873	\$16,528	\$2,640,924
Per Member Expenditure 2011	\$21,955	\$53,087	\$9	\$4,846,419
Age	45	18	0	88
Median Income 2011	\$34,924	\$11,234	\$2,500	\$158,153
<i>Not High Cost 2010</i>				
Per Member Expenditure 2010	\$2,677	\$3,095	\$2	\$16,528
Per Member Expenditure 2011	\$3,934	\$10,870	\$1	\$1,625,579
Age	36	20	0	88
Median Income 2011	\$34,638	\$11,247	\$2,500	\$158,153
<i>Persistent 2011</i>				
Per Member Expenditure 2010	\$61,018	\$79,246	\$16,529	\$2,640,924
Per Member Expenditure 2011	\$62,898	\$85,812	\$17,522	\$4,846,419
Age	47	18	0	88
Median Income 2011	\$34,983	\$11,328	\$8,977	\$158,153
<i>Not Persistent 2011</i>				
Per Member Expenditure 2010	\$33,774	\$29,618	\$16,528	\$783,074
Per Member Expenditure 2011	\$5,356	\$4,519	\$9	\$17,521
Age	44	18	0	88
Median Income 2011	\$34,900	\$11,196	\$2,500	\$158,153

Note: Total Sample N = 1473465, High Cost 2010 N=73675, Not High Cost 2010 N=1399790, Persistent 2011 N=21253, Not Persistent 2011 N=52422

Source: All-Payer Claims Database; HPC analysis

Table A4.2: Medicare sample summary statistics

Dollars for expenditure and income variables; years for age variable

	Mean	SD	Min	Max
<i>Total sample</i>				
Per Member Expenditure 2010	\$9,692	\$21,839	\$1	\$5,015,596
Per Member Expenditure 2011	\$11,759	\$30,465	\$1	\$14,600,000
Age	71	14	2	111
Median Income 2011	\$38,828	\$14,236	\$2,500	\$158,153
<i>High Cost 2010</i>				
Per Member Expenditure 2010	\$81,414	\$51,674	\$45,828	\$5,015,596
Per Member Expenditure 2011	\$45,601	\$96,163	\$2	\$14,600,000
Age	73	15	3	106
Median Income 2011	\$39,330	\$14,545	\$8,698	\$158,153
<i>Not High Cost 2010</i>				
Per Member Expenditure 2010	\$5,917	\$8,748	\$1	\$45,827
Per Member Expenditure 2011	\$9,978	\$20,659	\$1	\$628,810
Age	71	14	2	111
Median Income 2011	\$38,801	\$14,219	\$2,500	\$158,153
<i>Persistent 2011</i>				
Per Member Expenditure 2010	\$95,749	\$74,983	\$45,831	\$5,015,596
Per Member Expenditure 2011	\$108,417	\$159,291	\$56,579	\$14,600,000
Age	71	15	6	104
Median Income 2011	\$40,064	\$15,001	\$8,977	\$158,153
<i>Not Persistent 2011</i>				
Per Member Expenditure 2010	\$75,486	\$36,462	\$45,828	\$554,273
Per Member Expenditure 2011	\$19,625	\$16,523	\$2	\$56,555
Age	74	14	3	106
Median Income 2011	\$39,026	\$14,342	\$8,698	\$158,153

Note: Total Sample N = 647628, High Cost 2010 N=32381, Not High Cost 2010 N=615247, Persistent 2011 N=9473, Not Persistent 2011 N=22908

Source: All-Payer Claims Database; HPC analysis

Table A4.3: Commercial sample - demographic indicator summary statistics

Percent of sample meeting each indicator condition

	Total Sample		High-cost 2010		Not High-cost 2010		Persistently High-cost 2011		Not Persistently High-cost 2011		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
<i>High-cost indicators</i>											
High-cost 2010	5%		22%		0%		0%		100%		0%
Persistently High-cost 2011	1%		12%		0%		0%		100%		0%
<i>Demographic indicators</i>											
age1 (0-18)	26%		44%		31%		44%		10%		30%
age2 (19-24)	7%		25%		20%		7%		4%		19%
age2 (25-34)	10%		31%		32%		10%		8%		27%
age4 (35-44)	15%		36%		37%		15%		14%		34%
age5 (45-54)	20%		40%		41%		20%		23%		42%
age6 (55-64)	18%		38%		45%		17%		32%		46%
age7 (65-74)	3%		16%		24%		3%		7%		26%
age8 (75-84)	1%		7%		11%		0%		2%		13%
age9 (85+)	0%		3%		4%		0%		0%		6%
Female	55%		50%		49%		54%		58%		49%
age1gender	13%		33%		22%		13%		5%		21%
age2gender	4%		19%		15%		4%		2%		14%
age3gender	7%		25%		29%		6%		6%		24%
age4gender	9%		29%		33%		9%		10%		31%
age5gender	11%		32%		34%		11%		14%		35%
age6gender	10%		29%		35%		9%		17%		37%
age7gender	1%		11%		15%		1%		3%		17%
age8gender	0%		5%		7%		0%		1%		8%
age9gender	0%		2%		3%		0%		0%		4%
Med Income Q1	26%		44%		43%		26%		23%		42%
Med Income Q2	25%		43%		43%		25%		25%		43%
Med Income Q3	25%		43%		44%		25%		26%		44%
Med Income Q4	25%		43%		44%		25%		26%		44%
<i>Region indicators</i>											
Berkshires	1%		12%		13%		1%		2%		13%
Pioneer Valley / Franklin	5%		21%		20%		5%		4%		19%
Central Massachusetts	9%		29%		28%		10%		8%		28%
West Merrimack / Middlesex	13%		34%		33%		13%		13%		34%
East Merrimack	3%		18%		18%		3%		3%		18%
Upper North Shore	1%		11%		11%		1%		1%		11%
Metro West	6%		24%		24%		6%		6%		24%
Metro Boston	24%		43%		44%		24%		26%		44%
Lower North Shore	7%		25%		26%		7%		7%		26%
Norwood / Attleboro	6%		24%		23%		6%		6%		23%
Metro South	7%		26%		26%		7%		7%		26%
South Shore	8%		28%		28%		8%		8%		28%
Fall River	2%		12%		12%		2%		2%		12%
New Bedford	2%		15%		15%		2%		2%		15%
Cape and Islands	4%		19%		22%		4%		5%		22%

Note: Total Sample N = 1473465, High-cost 2010 N=73675, Not High-cost 2010 N=1399790, Persistently High-cost 2011 N=21253, Not Persistently High-cost 2011 N=52422

Source: All-Payer Claims Database; HPC analysis

Table A4.4: Medicare sample - demographic indicator summary statistics

Percent of sample meeting each indicator condition

	Total Sample		High-cost 2010		Not High-cost 2010		Persistently High-cost 2011		Not Persistently High-cost 2011	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>High-cost indicators</i>										
High-cost 2010	5%	22%	100%	0%	0%	0%	100%	0%	100%	0%
Persistent 2011	1%	12%	29%	45%	0%	0%	100%	0%	0%	0%
<i>Demographic indicators</i>										
age1 (0-18)	0%	1%	0%	2%	0%	0%	0%	2%	0%	1%
age2 (19-24)	0%	6%	0%	5%	0%	0%	0%	6%	0%	5%
age2 (25-34)	2%	14%	2%	13%	2%	14%	2%	14%	2%	12%
age4 (35-44)	3%	18%	3%	17%	3%	18%	4%	19%	3%	16%
age5 (45-54)	7%	25%	7%	26%	7%	25%	9%	28%	7%	25%
age6 (55-64)	8%	27%	10%	30%	7%	26%	13%	34%	8%	28%
age7 (65-74)	37%	48%	25%	43%	37%	48%	25%	43%	25%	43%
age8 (75-84)	29%	45%	30%	46%	28%	45%	29%	45%	31%	46%
age9 (85+)	15%	36%	23%	42%	14%	35%	18%	39%	24%	43%
Female	59%	49%	57%	50%	59%	49%	54%	50%	58%	49%
age1gender	0%	0%	0%	1%	0%	0%	0%	1%	0%	1%
age2gender	0%	3%	0%	4%	0%	3%	0%	4%	0%	3%
age3gender	1%	10%	1%	9%	1%	10%	1%	10%	1%	8%
age4gender	2%	13%	1%	12%	2%	13%	2%	13%	1%	11%
age5gender	3%	18%	3%	17%	3%	18%	4%	19%	3%	17%
age6gender	4%	19%	5%	21%	4%	19%	6%	24%	4%	20%
age7gender	19%	39%	12%	33%	20%	40%	13%	33%	12%	33%
age8gender	17%	38%	17%	37%	18%	38%	15%	36%	17%	38%
age9gender	12%	32%	18%	38%	12%	32%	13%	34%	19%	40%
Med Income Q1	25%	43%	24%	43%	25%	43%	23%	42%	24%	43%
Med Income Q2	25%	43%	25%	44%	25%	43%	25%	43%	26%	44%
Med Income Q3	25%	43%	24%	43%	25%	43%	24%	42%	24%	43%
Med Income Q4	25%	43%	27%	44%	24%	43%	29%	45%	25%	44%
<i>Region indicators</i>										
Berkshires	4%	19%	3%	18%	4%	19%	3%	17%	3%	18%
Pioneer Valley / Franklin	11%	32%	9%	29%	12%	32%	8%	26%	10%	30%
Central Massachusetts	8%	27%	8%	28%	8%	27%	8%	28%	8%	28%
West Merrimack / Middlesex	9%	28%	9%	28%	9%	28%	9%	28%	9%	28%
East Merrimack	4%	19%	4%	20%	4%	19%	4%	20%	4%	19%
Upper North Shore	1%	10%	1%	11%	1%	10%	1%	10%	1%	11%
Metro West	4%	20%	4%	20%	4%	20%	4%	20%	4%	20%
Metro Boston	20%	40%	23%	42%	19%	40%	25%	44%	22%	41%
Lower North Shore	7%	25%	6%	24%	7%	25%	6%	23%	6%	25%
Norwood / Attleboro	5%	22%	5%	21%	5%	22%	5%	21%	5%	21%
Metro South	6%	24%	7%	25%	6%	24%	7%	26%	7%	25%
South Shore	7%	26%	7%	26%	7%	25%	7%	26%	7%	26%
Fall River	3%	17%	3%	16%	3%	17%	3%	17%	3%	16%
New Bedford	4%	20%	4%	19%	4%	20%	4%	19%	4%	19%
Cape and Islands	8%	27%	7%	25%	8%	27%	6%	23%	7%	25%

Note: Total Sample N = 647628, High-cost 2010 N = 32381, Not High-cost 2010 N = 615247, Persistent 2011 N = 9473, Not Persistent 2011 N = 22908

Source: All-Payer Claims Database; HPC analysis

Table A4.5: Commercial sample - clinical condition indicator summary statistics

Percent of sample meeting each indicator condition

	Total Sample		High-cost 2010		Not High-cost 2010		Persistently High-cost 2010		Not Persistently High-cost 2010	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Clinical condition indicators</i>										
Acute	83%	38%	85%	36%	82%	38%	88%	32%	84%	37%
HIV/AIDS	0%	4%	0%	6%	0%	4%	1%	7%	0%	5%
Arthritis	10%	30%	28%	45%	9%	29%	32%	47%	27%	44%
Asthma	7%	26%	14%	34%	7%	25%	17%	38%	12%	33%
Child psychiatric disorders	4%	19%	3%	18%	4%	19%	4%	20%	3%	17%
Neoplastic blood diseases and leukemia	0%	7%	4%	18%	0%	5%	7%	26%	2%	14%
Cardiology	7%	25%	20%	40%	6%	24%	7%	42%	18%	38%
High-cost dermatology	0%	2%	1%	10%	0%	1%	2%	14%	0%	6%
Diabetes	5%	22%	12%	33%	5%	21%	16%	37%	10%	31%
Endocrinology	5%	22%	18%	38%	4%	20%	24%	43%	16%	36%
Ophthalmology	23%	42%	28%	45%	22%	42%	32%	47%	27%	44%
High-cost gastroenterology	3%	17%	15%	36%	2%	15%	21%	41%	13%	34%
High-cost cardiology	2%	15%	13%	34%	2%	13%	17%	37%	11%	32%
Hematology	3%	17%	10%	30%	2%	15%	12%	33%	9%	29%
Hepatology	2%	13%	8%	27%	1%	12%	10%	30%	8%	26%
MS & ALS	0%	5%	1%	11%	0%	5%	2%	15%	1%	9%
Hyperlipidemia	10%	30%	12%	33%	10%	30%	12%	33%	12%	33%
Hypertension	14%	34%	25%	43%	13%	34%	28%	45%	24%	43%
Infectious diseases	0%	7%	4%	20%	0%	5%	7%	26%	3%	16%
Malignant neoplasms (cancer)	3%	16%	14%	35%	2%	14%	22%	41%	12%	32%
Mental health	7%	26%	15%	35%	7%	26%	17%	38%	14%	34%
Neo-natal conditions	1%	10%	4%	20%	1%	9%	3%	16%	4%	21%
Neurology	6%	25%	21%	41%	6%	23%	27%	45%	18%	39%
OB-GYN	13%	34%	21%	41%	13%	34%	20%	40%	22%	41%
Orthopedics	13%	34%	24%	43%	12%	33%	25%	43%	24%	43%
Pregnancy	2%	14%	12%	33%	1%	12%	5%	21%	15%	36%
High-cost pulmonary	0%	7%	5%	21%	0%	5%	8%	27%	3%	18%
Renal Failures	1%	8%	5%	21%	0%	6%	9%	28%	3%	17%
High-cost pharmacy	0%	1%	0%	3%	0%	0%	0%	5%	0%	2%
Mood disorders	2%	14%	9%	28%	2%	13%	13%	33%	7%	26%
Substance Abuse	3%	16%	8%	27%	2%	15%	11%	31%	7%	25%
Poisoning and toxic drug effects	2%	13%	6%	23%	2%	13%	8%	27%	5%	21%
Transplants	0%	1%	0%	4%	0%	0%	0%	5%	0%	3%
Urology	2%	12%	7%	26%	1%	11%	10%	29%	6%	25%
<i>Clinical comorbidity indicators</i>										
Both Chronic and Behavioral Health	8%	26%	23%	42%	7%	25%	30%	46%	20%	40%
2 Chronic without Behavioral Health	7%	26%	12%	33%	7%	25%	12%	33%	12%	33%
3 plus Chronic without Behavioral Health	3%	16%	9%	29%	2%	15%	12%	33%	8%	27%

Note: Total Sample N = 1473465, High-cost 2010 N=73675, Not High-cost 2010 N=1399790, Persistently High-cost 2010 N=52422
Source: All-Payer Claims Database; HPC analysis

Table A4.6: Medicare sample - clinical condition indicator summary statistics

Percent of sample meeting each indicator condition

Clinical condition indicators	Total Sample		High-cost 2010		Not High-cost 2010		Persistently High-cost 2011		Not Persistently High-cost 2011	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Clinical condition indicators</i>										
Acute	83%	38%	93%	25%	82%	38%	93%	25%	93%	25%
HIV/AIDS	1%	7%	1%	9%	1%	7%	1%	11%	1%	8%
Arthritis	28%	45%	42%	49%	27%	44%	41%	49%	43%	50%
Asthma	13%	34%	27%	44%	13%	33%	32%	47%	25%	43%
Child psychiatric disorders	0%	7%	0%	7%	0%	7%	0%	7%	0%	7%
Neoplastic blood diseases and leukemia	2%	13%	6%	25%	1%	12%	8%	28%	6%	23%
Cardiology	21%	41%	43%	49%	20%	40%	44%	50%	42%	49%
High-cost dermatology	1%	10%	10%	30%	0%	7%	14%	34%	8%	27%
Diabetes	23%	42%	38%	48%	22%	42%	44%	50%	35%	48%
Endocrinology	12%	33%	43%	50%	11%	31%	50%	50%	41%	49%
Ophthalmology	54%	50%	49%	50%	54%	50%	47%	50%	50%	50%
High-cost gastroenterology	8%	27%	30%	46%	7%	25%	34%	47%	29%	45%
High-cost cardiology	21%	41%	57%	50%	19%	39%	61%	49%	55%	50%
Hematology	9%	28%	26%	44%	8%	27%	31%	46%	24%	43%
Hepatology	4%	20%	12%	33%	4%	19%	15%	36%	11%	31%
MS & ALS	1%	8%	1%	12%	1%	8%	2%	14%	1%	11%
Hyperlipidemia	24%	42%	15%	36%	24%	43%	12%	33%	16%	37%
Hypertension	45%	50%	34%	47%	45%	50%	30%	46%	35%	48%
Infectious diseases	2%	15%	19%	39%	1%	12%	25%	43%	17%	38%
Malignant neoplasms (cancer)	11%	32%	20%	40%	11%	31%	21%	41%	20%	40%
Mental health	14%	35%	34%	47%	13%	34%	34%	47%	34%	47%
Neo-natal conditions	0%	5%	0%	7%	0%	5%	0%	7%	0%	7%
Neurology	21%	40%	53%	50%	19%	39%	55%	50%	52%	50%
OB-GYN	9%	29%	8%	27%	9%	29%	8%	27%	8%	27%
Orthopedics	14%	35%	34%	47%	13%	34%	34%	48%	33%	47%
Pregnancy	0%	5%	0%	6%	0%	5%	0%	6%	0%	6%
High-cost pulmonary	4%	20%	28%	45%	3%	17%	32%	47%	26%	44%
Renal Failures	8%	26%	34%	48%	6%	24%	47%	50%	29%	46%
High-cost pharmacy	0%	1%	0%	3%	0%	1%	0%	4%	0%	2%
Mood disorders	9%	28%	26%	44%	8%	27%	29%	45%	25%	43%
Substance Abuse	5%	22%	11%	31%	5%	22%	13%	34%	10%	30%
Poisoning and toxic drug effects	3%	16%	12%	33%	2%	14%	16%	37%	10%	31%
Transplants	0%	2%	1%	8%	0%	0%	0%	6%	1%	8%
Urology	7%	25%	28%	45%	5%	23%	30%	46%	28%	45%
<i>Clinical comorbidity indicators</i>										
Both Chronic and Behavioral Health	22%	42%	56%	50%	20%	40%	57%	49%	55%	50%
2 Chronic without Behavioral Health	23%	42%	12%	32%	23%	42%	10%	30%	13%	33%
3 plus Chronic without Behavioral Health	19%	39%	22%	42%	19%	39%	25%	43%	21%	41%

Note: Total Sample N = 647628, High-cost 2010 N = 32381, Not High-cost 2010 N = 615247, Persistently High-cost 2011 N = 9473, Not Persistently High-cost 2011 N = 22908

Source: All-Payer Claims Database; HPC analysis

Table A4.7: Commercial sample - demographic indicator regression results

Odds ratio

	High-cost 2010		Persistently High-cost 2011	
	Odds ratio	Std. Err	Odds ratio	Std. Err
<i>Demographic indicators</i>				
age1 (0-18)	1.31 **	0.05	1.11	0.08
age2 (19-24)	1.54 **	0.07	1.20 *	0.11
age4 (35-44)	1.02	0.04	0.93	0.07
age5 (45-54)	1.23 **	0.04	0.96	0.07
age6 (55-64)	1.26 **	0.04	0.93	0.07
age7 (65-74)	0.95	0.04	0.99	0.08
age8 (75-84)	0.29 **	0.02	1.19	0.14
age9 (85+)	0.08 **	0.02	1.86 *	0.56
age1gender	0.81 **	0.02	1.00	0.05
age2gender	0.54 **	0.02	0.90	0.08
age3gender	1.14 **	0.04	1.34 **	0.10
age4gender	1.37 **	0.04	1.32 **	0.07
age5gender	0.91 **	0.02	1.03	0.04
age6gender	0.88 **	0.02	1.04	0.03
age7gender	0.89 **	0.04	0.94	0.06
age8gender	0.86	0.09	0.94	0.14
age9gender	1.38	0.36	0.65	0.25
Med Income Q2	0.97 *	0.01	1.01	0.03
Med Income Q3	0.91 **	0.01	1.00	0.03
Med Income Q4	0.85 **	0.01	0.97	0.03
<i>Region indicators</i>				
Berkshires	1.64 **	0.07	1.15	0.09
Central Massachusetts	1.08 **	0.03	1.15 **	0.06
West Merrimack / Middlesex	1.15 **	0.03	1.22 **	0.06
East Merrimack	1.18 **	0.04	1.22 **	0.08
Upper North Shore	1.09	0.05	1.15	0.11
Metro West	1.15 **	0.03	1.15 *	0.07
Metro Boston	1.32 **	0.03	1.25 **	0.06
Lower North Shore	1.38 **	0.04	1.18 **	0.06
Norwood / Attleboro	1.18 **	0.04	1.20 **	0.07
Metro South	1.12 **	0.03	1.06	0.06
South Shore	1.21 **	0.03	1.11	0.06
Fall River	1.06	0.05	1.18 *	0.10
New Bedford	1.10 **	0.04	1.13	0.08
Cape and Islands	1.57 **	0.05	1.20 **	0.07

* $p \leq 0.05$

** $p \leq 0.01$

Note: High-cost N = 1473465, Persistently High-cost N=73675, pseudo R-squared = 0.31 for high-cost, 0.08 for persistence

Source: All-Payer Claims Database; HPC analysis

Table A4.8: Medicare sample - demographic indicator regression results

Odds ratio

	High-cost 2010		Persistently High-cost 2011	
	Odds ratio	Std. Err	Odds ratio	Std. Err
<i>Demographic indicators</i>				
age1 (0-18)	10.26 **	7.38	0.88	0.78
age2 (19-24)	1.04	0.19	1.02	0.33
age4 (35-44)	0.62 **	0.05	1.02	0.15
age5 (45-54)	0.59 **	0.05	0.92	0.12
age6 (55-64)	0.56 **	0.04	1.01	0.13
age7 (65-74)	0.60 **	0.04	0.70 **	0.09
age8 (75-84)	0.58 **	0.04	0.70 **	0.09
age9 (85+)	0.54 **	0.04	0.61 **	0.08
age1gender	0.06 *	0.08	1.23	2.05
age2gender	1.15	0.30	1.27	0.57
age3gender	0.65 **	0.07	1.13	0.21
age4gender	0.71 **	0.05	0.99	0.13
age5gender	0.72 **	0.04	0.91	0.08
age6gender	0.81 **	0.04	0.96	0.07
age7gender	0.96	0.03	1.07	0.05
age8gender	1.06 *	0.03	0.92	0.04
age9gender	1.22 **	0.03	0.87 **	0.05
Med Income Q2	1.02	0.02	0.99	0.04
Med Income Q3	0.99	0.02	1.03	0.04
Med Income Q4	1.05 *	0.02	1.11 *	0.05
<i>Region indicators</i>				
Berkshires	1.41 **	0.06	1.22 *	0.10
Central Massachusetts	1.29 **	0.04	1.41 **	0.09
West Merrimack / Middlesex	1.26 **	0.04	1.52 **	0.10
East Merrimack	1.39 **	0.06	1.52 **	0.12
Upper North Shore	1.28 **	0.09	1.51 **	0.20
Metro West	1.22 **	0.05	1.56 **	0.12
Metro Boston	1.54 **	0.04	1.67 **	0.09
Lower North Shore	1.20 **	0.04	1.38 **	0.10
Norwood / Attleboro	1.42 **	0.06	1.62 **	0.12
Metro South	1.51 **	0.05	1.57 **	0.10
South Shore	1.44 **	0.05	1.53 **	0.10
Fall River	1.15 **	0.06	1.47 **	0.13
New Bedford	1.32 **	0.06	1.43 **	0.11
Cape and Islands	1.45 **	0.05	1.46 **	0.10

* $p \leq 0.05$

** $p \leq 0.01$

Note: High-cost N = 647628, Persistently High-cost N=32381, pseudo R-squared = 0.40 for high-cost, 0.06 for persistence

Source: All-Payer Claims Database; HPC analysis

Table A4.9: Commercial sample - clinical condition indicator regression results

Odds ratio

	High-cost 2010		Persistently High-cost 2011	
	Odds ratio	Std. Err	Odds ratio	Std. Err
<i>Clinical condition indicators</i>				
Acute	1.25 **	0.02	1.11 **	0.03
HIV/AIDS	1.35 **	0.11	1.40 *	0.19
Arthritis	2.50 **	0.03	1.18 **	0.03
Asthma	1.60 **	0.02	1.22 **	0.03
Child psychiatric disorders	1.63 **	0.04	1.39 **	0.07
Neoplastic blood diseases and leukemia	8.84 **	0.30	3.06 **	0.13
Cardiology	2.64 **	0.03	1.13 **	0.02
High-cost dermatology	8.15 **	0.86	2.49 **	0.22
Diabetes	1.29 **	0.02	1.20 **	0.04
Endocrinology	2.27 **	0.03	1.21 **	0.03
Ophthalmology	1.07 **	0.01	1.10 **	0.02
High-cost gastroenterology	4.90 **	0.07	1.47 **	0.03
High-cost cardiology	7.25 **	0.14	1.26 **	0.04
Hematology	2.31 **	0.04	1.13 **	0.03
Hepatology	3.44 **	0.07	1.04	0.03
MS & ALS	4.04 **	0.20	3.15 **	0.22
Hyperlipidemia	0.78 **	0.01	0.79 **	0.02
Hypertension	1.76 **	0.02	0.96	0.02
Infectious diseases	4.43 **	0.16	1.57 **	0.07
Malignant neoplasms (cancer)	8.62 **	0.14	2.22 **	0.05
Mental health	1.76 **	0.03	1.22 **	0.03
Neo-natal conditions	4.98 **	0.14	1.01	0.05
Neurology	2.38 **	0.03	1.32 **	0.03
OB-GYN	1.56 **	0.02	1.06 *	0.03
Orthopedics	2.04 **	0.02	0.99	0.02
Pregnancy	22.00 **	0.42	0.40 *	0.02
High cost pulmonary	5.42 **	0.19	1.32 **	0.05
Renal Failures	2.61 **	0.08	1.80 **	0.07
High cost pharmacy	28.82 **	9.93	2.62 **	0.64
Mood disorders	3.29 **	0.07	1.37 **	0.04
Substance Abuse	1.89 **	0.04	1.31 **	0.05
Poisoning and toxic drug effects	2.57 **	0.06	1.25 **	0.04
Transplants	66.16 **	22.65	1.54 *	0.32
Urology	3.01 **	0.06	1.11 **	0.04
<i>Clinical comorbidity indicators</i>				
Both Chronic and Behavioral Health	1.10 **	0.02	1.15 **	0.04
2 Chronic without Behavioral Health	1.14 **	0.02	1.08 *	0.04
3 plus Chronic without Behavioral Health	1.21 **	0.03	1.36 **	0.06

* $p \leq 0.05$

** $p \leq 0.01$

Note: High-cost N = 1473465, Persistently High-cost N=73675, pseudo R-squared = 0.31 for high-cost, 0.08 for persistence

Source: All-Payer Claims Database; HPC analysis

Table A4.10: Medicare sample - clinical condition indicator regression results

Odds ratio

	High-cost 2010		Persistently High-cost 2011	
	Odds ratio	Std. Err	Odds ratio	Std. Err
<i>Clinical condition indicators</i>				
Acute	1.37 **	0.04	0.99	0.05
HIV/AIDS	1.58 **	0.13	1.35 *	0.18
Arthritis	1.23 **	0.02	0.98	0.03
Asthma	1.31 **	0.02	1.28 **	0.04
Child psychiatric disorders	0.81 *	0.08	0.89	0.17
Neoplastic blood diseases and leukemia	4.21 **	0.14	1.79 **	0.09
Cardiology	1.75 **	0.03	1.06 *	0.03
High-cost dermatology	3.42 **	0.12	1.38 **	0.06
Diabetes	1.21 **	0.02	1.23 **	0.04
Endocrinology	2.16 **	0.03	1.17 **	0.03
Ophthalmology	0.72 **	0.01	0.95 *	0.02
High-cost gastroenterology	2.08 **	0.04	1.05	0.03
High-cost cardiology	4.21 **	0.09	1.09 *	0.04
Hematology	2.14 **	0.04	1.39 **	0.04
Hepatology	1.63 **	0.04	1.12 **	0.04
MS & ALS	2.25 **	0.15	1.59 **	0.16
Hyperlipidemia	0.70 **	0.01	0.75 **	0.03
Hypertension	1.35 **	0.03	0.85 **	0.03
Infectious diseases	2.91 **	0.07	1.20 **	0.04
Malignant neoplasms (cancer)	2.12 **	0.04	1.22 **	0.04
Mental health	1.62 **	0.04	1.06	0.04
Neo-natal conditions	1.23	0.15	0.93	0.17
Neurology	2.18 **	0.03	1.12 **	0.03
OB-GYN	0.79 **	0.02	0.95	0.05
Orthopedics	2.05 **	0.03	1.06 *	0.03
Pregnancy	1.29 *	0.17	0.83	0.17
High cost pulmonary	3.07 **	0.06	1.13 **	0.03
Renal Failures	2.68 **	0.05	1.79 **	0.05
High cost pharmacy	4.33 **	1.28	3.22 **	1.33
Mood disorders	2.26 **	0.05	1.06	0.04
Substance Abuse	1.20 **	0.03	1.16 **	0.05
Poisoning and toxic drug effects	2.54 **	0.07	1.26 **	0.05
Transplants	292.53 **	90.80	0.42 **	0.08
Urology	1.59 **	0.03	1.02	0.03
<i>Clinical comorbidity indicators</i>				
Both Chronic and Behavioral Health	1.53 **	0.05	0.93	0.05
2 Chronic without Behavioral Health	1.05	0.03	0.95	0.06
3 plus Chronic without Behavioral Health	1.15 **	0.04	1.05	0.07

* $p \leq 0.05$

** $p \leq 0.01$

Note: High-cost N = 647628, Persistently High-cost N=32381, pseudo R-squared = 0.40 for high-cost, 0.06 for persistence

Source: All-Payer Claims Database; HPC analysis