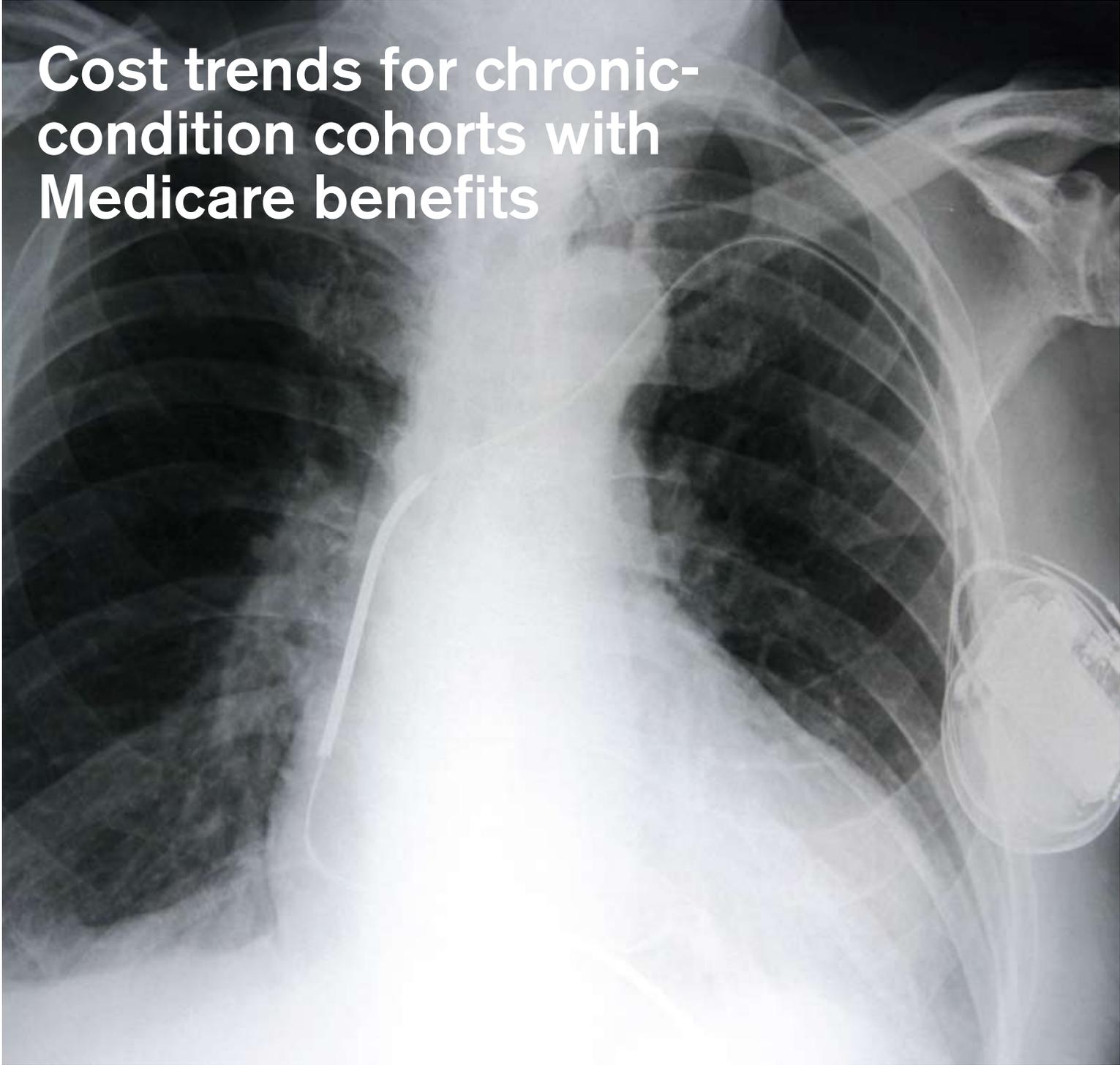


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May 2008

A grayscale chest X-ray image showing the ribcage, lungs, and heart. The image is semi-transparent, allowing the white text to be overlaid clearly.

# Cost trends for chronic-condition cohorts with Medicare benefits



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## EXECUTIVE SUMMARY

Are today's escalating healthcare costs caused by higher medical costs among people with chronic conditions? Are increasing costs driven by increasing prevalence of chronic conditions? Or could it be that rising costs are driven by increased utilization of medical services by the non-chronic population? This study shows that per-patient Medicare costs for major chronic conditions are not, in fact, increasing as fast as costs for beneficiaries without these conditions. This result appears to run counter to prevailing wisdom and the importance that prominent healthcare organizations have given to chronic-care efforts. Although significant opportunity remains to reduce chronic-care costs and the numbers of individuals developing chronic disease, our analysis shows that the cost trend of Medicare enrollees with chronic disease during our study period has been lower than the trend of those without chronic disease.

We analyzed five chronic conditions most frequently targeted by disease management (DM) programs and refer to individuals identified with these conditions as "chronics":

- Coronary artery disease (CAD), which includes angina
- Diabetes
- Chronic obstructive pulmonary disease (COPD), often referred to as emphysema
- Congestive heart failure (CHF)
- Asthma

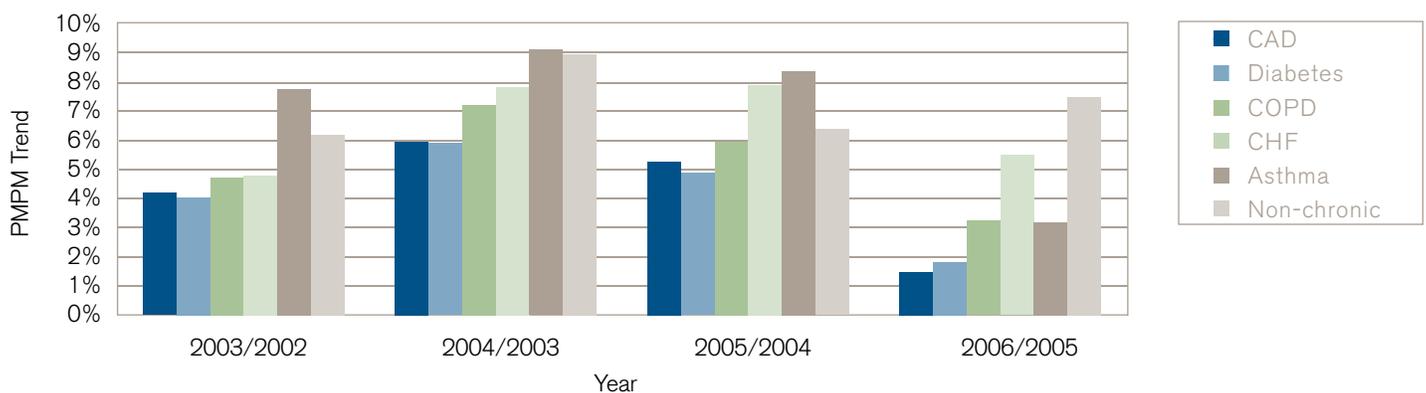
Our examination of fee-for-service Medicare data<sup>1</sup> shows that annual per-patient cost trends for individuals with these five chronic conditions, viewed as a group, have been lower than those for the non-chronic population in each of the past four years. Chart 1 illustrates that this pattern holds for all years for CAD, diabetes, and COPD. It holds for three of the past four years for CHF and for one of the past four years for asthma. The data we examined is from the Medicare fee-for-service sector; as such it is unlikely to reflect the impact of DM programs. This data excludes enrollees in Medicare Advantage plans, and the recent growth in those plans may affect some of these results, as described in the "Discussion" section.

**This study shows that per-patient Medicare costs for major chronic conditions are not, in fact, increasing as fast as costs for beneficiaries without these conditions.**

**Our examination of fee-for-service Medicare data<sup>1</sup> shows that annual per-patient cost trends for individuals with these five chronic conditions, viewed as a group, have been lower than those for the non-chronic population in each of the past four years.**

CHART 1

### TRENDS BY CHRONIC CONDITION



---

### Why chronic-condition trends are important

There is no question that chronic conditions cause a huge burden on both individuals and the economy.<sup>2</sup> The attention to chronic conditions is due in part to our society's success in combating non-chronic infectious disease and accidental injuries. To quote the Centers for Disease Control and Prevention (CDC):

The profile of diseases contributing most heavily to death, illness, and disability among Americans changed dramatically during the last century. Today, chronic diseases—such as cardiovascular disease (primarily heart disease and stroke), cancer, and diabetes—are among the most prevalent, costly, and preventable of all health problems. Seven of every 10 Americans who die each year, or more than 1.7 million people, die of a chronic disease. The prolonged course of illness and disability from such chronic diseases as diabetes and arthritis results in extended pain and suffering and decreased quality of life for millions of Americans. Chronic disabling conditions cause major limitations in activity for more than one of every 10 Americans, or 25 million people.<sup>3</sup>

Hence, the focus on chronic conditions is not surprising. That focus is reflected in the rapid growth of the disease management industry, which concentrates on the five chronic conditions mentioned above and has grown from \$78 million in revenue to almost \$2 billion over the past 10 years.<sup>4</sup> DM programs provide education, outreach, and health promotion to affected individuals.<sup>5</sup> The DM industry often justifies its fees through promises of cost savings; these promises are typically constructed as contractual reductions in trend. This report is especially relevant to such arrangements.

### Disease management contractual promises and beyond

A typical DM contract will promise to control the treatment costs of patients with specified types of diseases. Frequently, the success of a DM contract is contractually defined by whether or not the cost trend for people with a chronic condition falls below the trend of the non-chronic population. However, this is a sure win for the DM vendor if trends for people with chronic conditions are already significantly lower than the trends for the non-chronic population; the typical promise would be very difficult to meet if the opposite were true.

The Disease Management Association of America, the DM industry trade group, recognizes the need to understand how per member per month (PMPM) cost trends differ among chronic conditions. Its policy statement in the second-edition "Return on Investment" methodology<sup>6</sup> calls for examining historical trend differences between non-chronic and chronic cohorts before DM programs start, and using that information as part of the DM contract guarantee.

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**This paper provides a look at differential trends by chronic condition. We examine people covered by traditional Medicare, while many DM programs focus on the commercial population insured through employer-sponsored benefits.**

This paper provides a look at differential trends by chronic condition. We examine people covered by traditional Medicare, while many DM programs focus on the commercial population insured through employer-sponsored benefits.

These findings have implications far beyond the DM industry. Lower trends for these chronic conditions would seem to be at odds with major public policy pronouncements, which warn about the growth in the cost of chronic conditions:

The United States cannot effectively address escalating health care costs without addressing the problem of chronic diseases.<sup>7</sup>

In any event, chronic conditions account for such a large portion of costs that costs will not be controlled without addressing them.

---

### What has caused the lower trends for chronic conditions?

Further research is needed to determine the causes for the lower trends among the five chronic conditions. We offer the following suggestions:

1. Efforts to reduce errors and waste in the healthcare system, such as the evidence-based medicine movement and quality-improvement efforts, have naturally focused on services provided to the patients receiving the most services. The trend figures may reflect the progress of these efforts.
2. Wellness, preventive care, routine, or diagnostic services for people without the chronic conditions may be driving the trend. For example, increases in colonoscopy screening for colon cancer would, in the short term, add significant costs to many patients who are healthy and low-cost.
3. Patients with other conditions that we did not examine, such as cancer, pneumonia, depression, or arthritis, may have greater increases in trend than the patients with the five chronic conditions.
4. The burden of treatment for people with the chronic conditions may have made it difficult to further increase services for these people.
5. Some expensive and often elective treatments, such as knee or hip replacement surgery, may be less frequently provided to individuals with chronic conditions than to Medicare enrollees in better health.
6. Cost trends for Medicare services vary by type of service. A different “market basket” for individuals with chronic conditions may account for part of the differential in trend rates observed in our analysis.

As actuaries, we have frequently observed cyclical patterns in the trends of many metrics, and we would expect the observed trend differentials to change in coming years.

### Relevance to commercial programs

The trends reported here are for people with both Medicare Part A and Part B, without Medicaid, age 65 or older, and who are not enrolled in Medicare Advantage plans (Medicare HMOs). We do not examine costs of Medicare Part D, the prescription drug coverage.

These Medicare population results may provide a guide to differential chronic-condition trends for commercial or Medicaid populations, but important differences in populations and programs that could affect trends should be considered. The absence of Medicare Part D prescription drug data in our analysis is one difference from the usual DM methodology. These differences are discussed further in this report.

### Limitations

The healthcare trend for a particular organization is determined by numerous factors, including changes in general inflation, fee schedules, health status, demographics, utilization management, practice patterns, and random fluctuations (see “Background on Trend” section). These are generally too numerous and complex to define precisely, especially for smaller organizations.

Actuarial analyses and estimates cannot capture unforeseen forces or all relevant factors; for these reasons, and because our analysis is not customized for any particular health plan or delivery system, actual results for any particular organization are likely to differ from those we present here. Other researchers can produce estimates that differ from ours because they use different assumptions, different data, or different methodology. If this report is copied, it must be distributed in its entirety, as pieces taken out of context could cause misinterpretation.

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**We have frequently observed cyclical patterns in the trends of many metrics, and we would expect the observed trend differentials to change in coming years.**

## FINDINGS

This paper reports on trends in per-capita Medicare spending for 2002-2006 for beneficiaries with the following five chronic conditions (see Appendix for details on identification criteria):

- Coronary artery disease (CAD), which includes angina
- Diabetes
- Chronic obstructive pulmonary disease (COPD), often referred to as emphysema
- Congestive heart failure (CHF)
- Asthma

**Medicare beneficiaries with these five chronic conditions (chronics) are much more expensive than beneficiaries without those conditions (non-chronics), but their costs are increasing at a slower rate than for non-chronics.**

Medicare beneficiaries with these five chronic conditions (chronics) are much more expensive than beneficiaries without those conditions (non-chronics), but their costs are increasing at a slower rate than for non-chronics. The figures in this report are from our analysis of Medicare beneficiaries who are age 65 and over, not enrolled in managed care, and not enrolled in Medicaid.

For the studied population, Tables 1 and 2 display the distribution of the Medicare population and allowed spending between the chronic and non-chronic populations for 2002-2006.

TABLE 1

### CHRONICS ARE ABOUT ONE-THIRD OF THE POPULATION BUT ACCOUNT FOR ABOUT TWO-THIRDS OF MEDICARE ALLOWED SPENDING

YEAR	% OF TOTAL POPULATION		% OF MEDICARE ALLOWED SPENDING	
	CHRONIC	NON-CHRONIC	CHRONIC	NON-CHRONIC
2002	32.5%	67.5%	65.6%	34.4%
2003	33.0%	67.0%	65.7%	34.3%
2004	33.6%	66.4%	65.8%	34.2%
2005	33.7%	66.3%	65.7%	34.3%
2006	33.7%	66.3%	64.6%	35.4%

TABLE 2

### MEDICARE PMPM ALLOWED SPENDING FOR CHRONICS IS ABOUT FOUR TIMES THAT OF NON-CHRONICS

YEAR	CHRONIC	NON-CHRONIC
2002	\$1,233	\$310
2003	\$1,284	\$329
2004	\$1,364	\$357
2005	\$1,435	\$381
2006	\$1,473	\$410

From 2002 through 2006, the rate of inpatient admission for individuals with chronic conditions decreased 1.5% per year compared to a decrease of 1.1% for non-chronics (Table 3).

**TABLE 3**

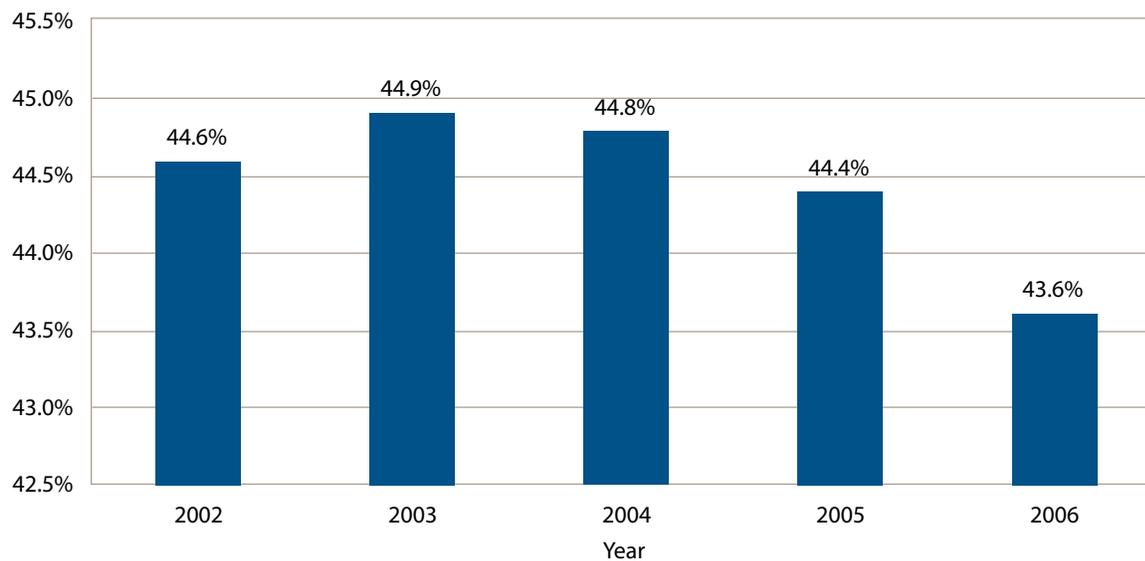
**INPATIENT HOSPITAL ADMISSIONS PER 1,000 MEMBERS FOR CHRONICS ARE ABOUT SIX TIMES THOSE OF NON-CHRONICS**

YEAR	CHRONIC	NON-CHRONIC
2002	845	138
2003	835	135
2004	816	134
2005	808	132
2006	794	132

Chart 2 presents frequency of chronics having multiple comorbidities. At least 40% of the chronics with any one of the chronic conditions have more than one of the chronic conditions (Chart 2).

**CHART 2**

**BENEFICIARIES WITH MORE THAN ONE OF THE FIVE CHRONIC CONDITIONS**



We describe our *trend* and *cost* findings below. As described in the “Methodology” section, our costs do not include prescription drug costs, as data is not readily available. As we describe in the “Discussion” section, we believe this does not significantly affect our main conclusions.

### Trends

In keeping with customary insurance and Medicare tabulations, our per-capita cost analysis considers the number of beneficiary member months in each year that are used to calculate per member per month (PMPM) cost trends.

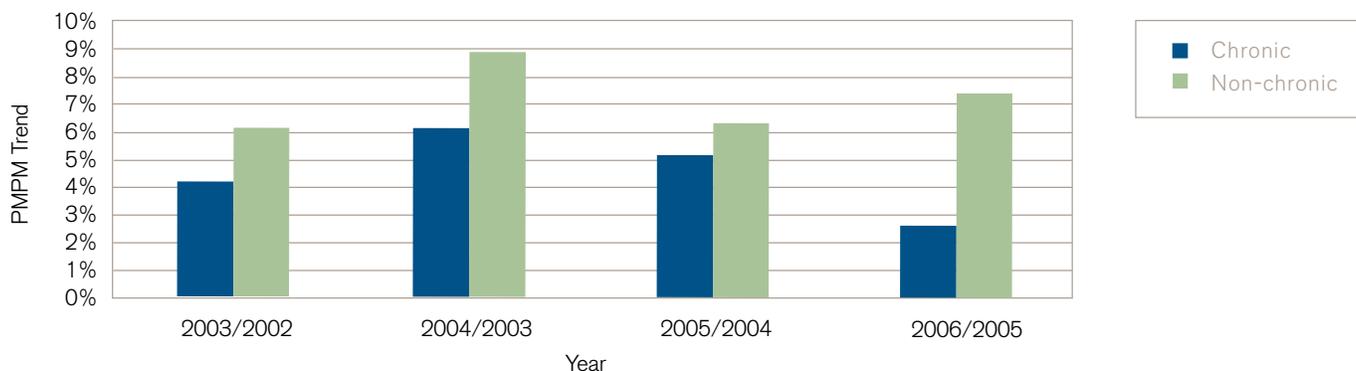
**The annual growth in per-capita spending for non-chronic Medicare beneficiaries has been consistently higher than for chronics.**

The annual growth in per-capita spending for non-chronic Medicare beneficiaries has been consistently higher than for chronics. Chart 3 displays historical PMPM cost trends of chronic and non-chronic beneficiaries for four years, 2003 to 2006.

The differential appears highest for 2006/2005. In 2006, managed-care enrollment grew significantly. The differential for 2006/2005 may reflect a tendency for healthier people within the non-chronic cohort to shift to a managed-care environment (and out of the data we analyzed). The differential may also reflect the impact of the 2006 introduction of Medicare Part D and better access to drug therapy for chronic diseases. However, we believe this dynamic does not explain the trends in previous years, as managed-care growth had been relatively stable during that period. We explore this further in the “Discussion” section.

CHART 3

#### GROWTH IN PER CAPITA SPENDING SPLIT BETWEEN CHRONICS AND NON-CHRONICS

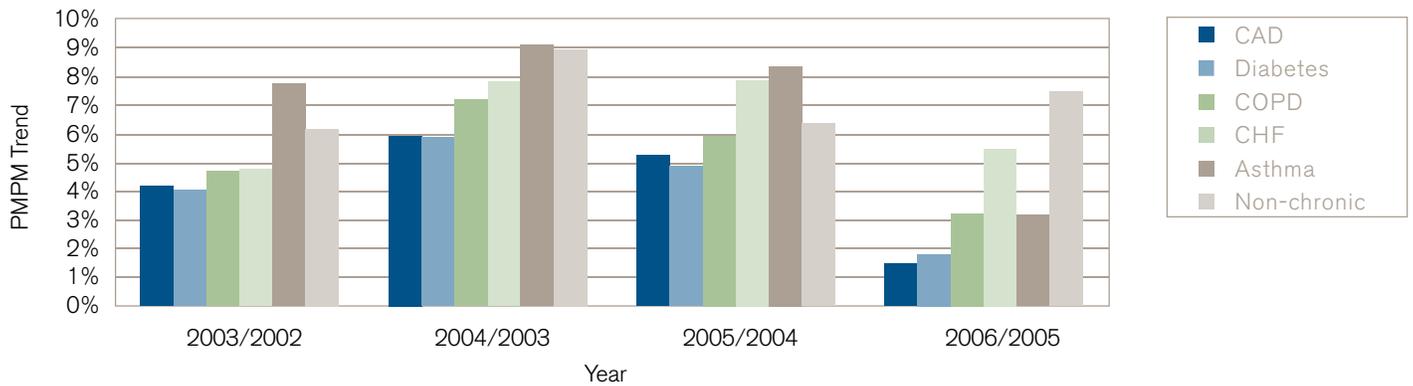


The pattern of higher trend among non-chronic beneficiaries is fairly consistent across chronic conditions. Chart 4 illustrates that this pattern holds for all years for CAD, diabetes, and COPD. It holds for three of the past four years for CHF and for one of the past four years for asthma. Each of the chronic-condition cohorts was identified separately. That is, no hierarchy was used, and beneficiaries in any chronic-condition category may also appear in other chronic-condition categories.

Asthma is, by far, the smallest of the cohorts. The different pattern for asthma may reflect coding issues, diagnosis overlap, or confusion between COPD and asthma. The introduction of the Medicare Part D prescription drug benefit in 2006 and the precursor Prescription Drug Discount Card introduced in 2004 may be related to the dramatic trend reduction for asthma. Access to and compliance with asthma drug therapy, particularly asthma-recovery drug therapy, which can be costly, is critical in preventing asthma exacerbations and hospitalizations. Better access to asthma drug therapy could have an immediate impact on emergency room and inpatient utilization.

**CHART 4**

**TRENDS BY CHRONIC CONDITION**



The pattern of higher trends for non-chronics also appears for most types of medical service. Charts 5 through 8 display historic PMPM cost trends for inpatient facility, outpatient facility, physician, and skilled nursing facility (SNF) services, respectively. The higher trend of non-chronic beneficiaries is very prominent in 2006, the most current year.

Chart 5 shows the PMPM trend for inpatient allowed costs. These include inpatient acute-care admissions for medical, surgical, behavioral, or acute inpatient rehabilitation services. The PMPM trends shown are for inpatient facility costs, mostly paid by Medicare under its diagnosis-related group (DRG) reimbursement structure. The impact of Medicare Part D may help to explain the dramatic reduction in chronic inpatient admission trend.

**CHART 5**

**INPATIENT SERVICES TREND**

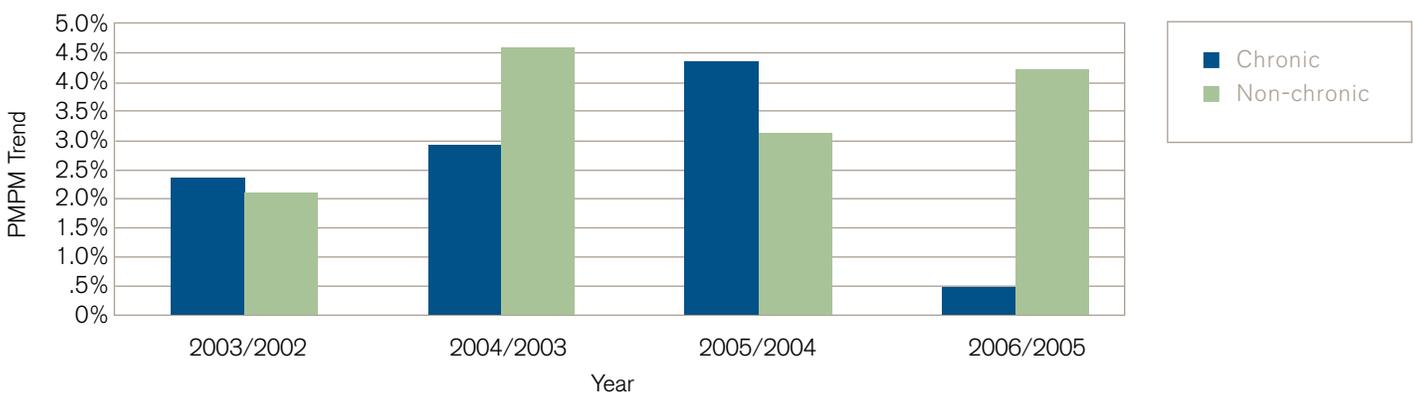
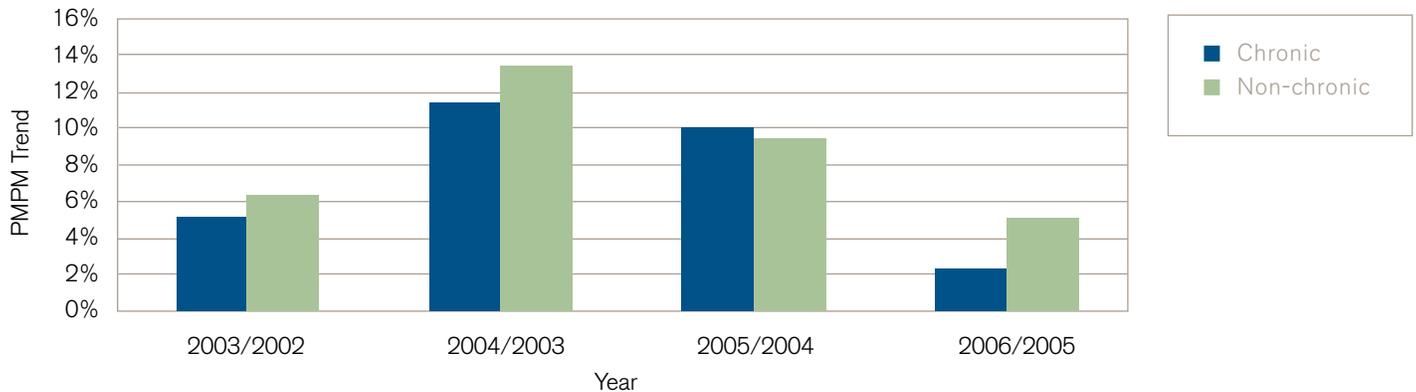


Chart 6 shows PMPM trends in outpatient allowed costs. Outpatient facility costs include ambulatory surgery, emergency room, and the facility costs for services provided in an outpatient setting (e.g., imaging, lab).

**CHART 6**

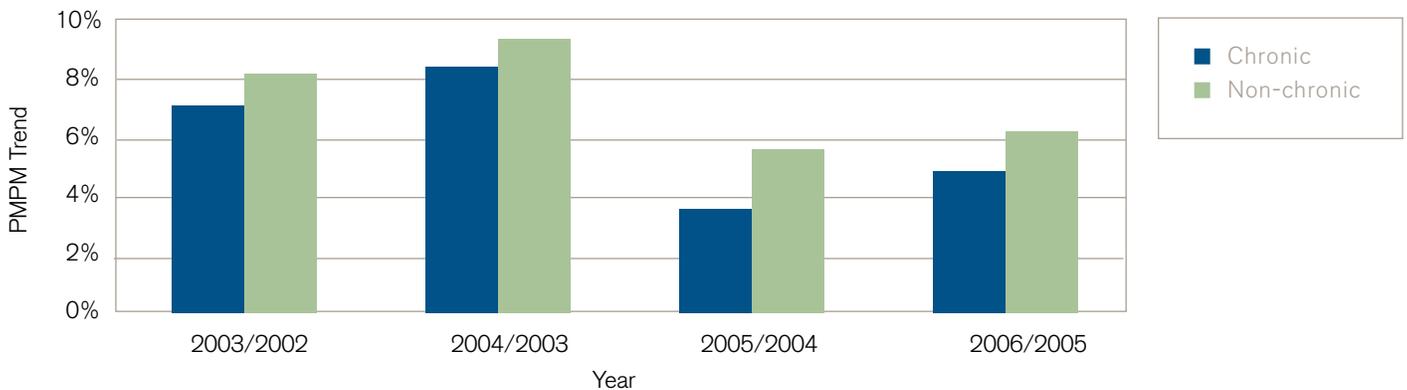
**OUTPATIENT SERVICES TREND**



Physician allowed costs, Chart 7, include professional services provided in an office, outpatient, inpatient, or other setting and consistently trend at a higher rate for non-chronic compared to chronic.

**CHART 7**

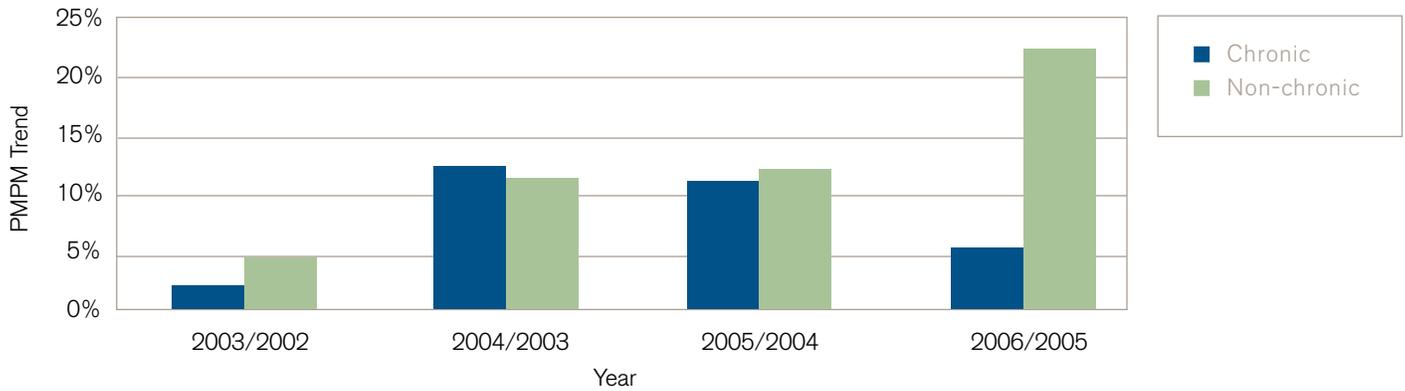
**PHYSICIAN SERVICES TREND**



PMPM trends in SNF allowed costs, shown in Chart 8, exhibit a dramatic increase for non-chronic patients for 2006/2005. This may be related to an increase in post-surgical care in SNFs for non-chronic conditions such as those associated with orthopedic surgery or cardiac surgery. It is possible that shifting this type of care from acute rehabilitation hospitals to SNFs accounts for some of the recent high trend.

CHART 8

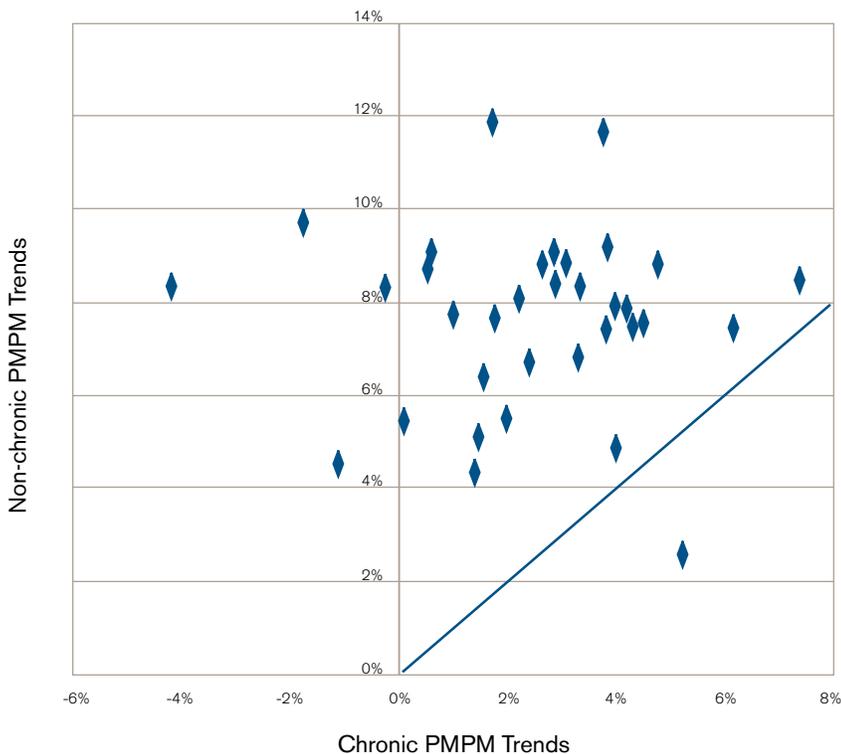
SKILLED NURSING FACILITY SERVICES TREND



The higher trend of non-chronic people is consistent across states, but the numeric relationship varies by state. Chart 9 shows 2006/2005 PMPM cost trends in 34 states (states with more than 10,000 Medicare beneficiaries meeting our criteria) for chronics and non-chronics. All but one state show higher trends for the non-chronic cohort. The diagonal line represents equal chronic and non-chronic trends. All but one state are above that line.

CHART 9

TRENDS BY STATE FOR 2006/2005



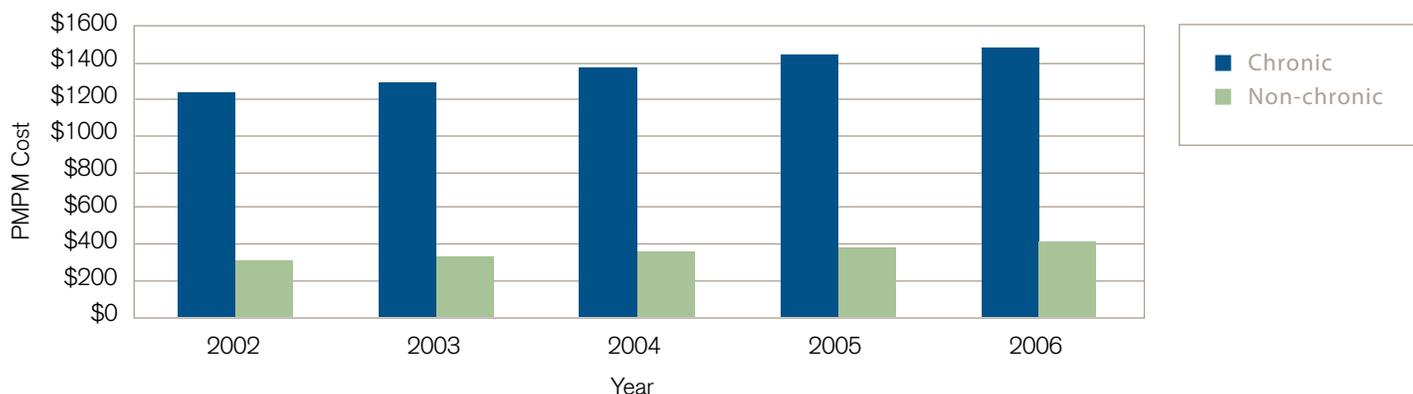
### Costs

Chronics remain more expensive than non-chronics.

Chart 10 shows that, over the last five years, PMPM spending for chronics is about four times that of non-chronics.

CHART 10

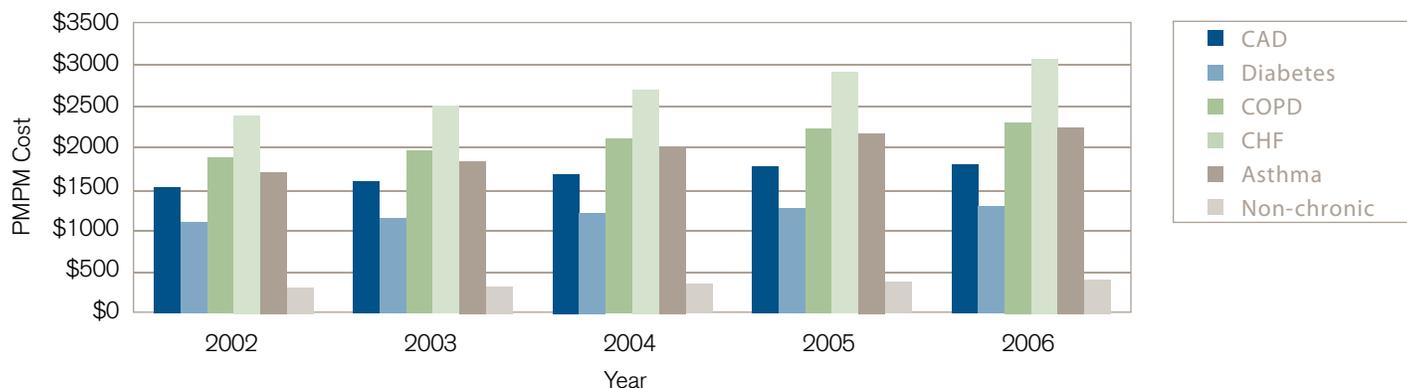
#### CHRONIC AND NON-CHRONIC PMPM COSTS



The higher cost for chronics is consistent for each of the five conditions. Chart 11 shows that chronics are more expensive and that their year-to-year costs are rising steadily, as are those of the non-chronics. Of those with a chronic condition, the lowest costs are in the diabetes cohort, and they cost about three times more than non-chronics. The highest costs are for those with CHF, almost eight times more than non-chronics.

CHART 11

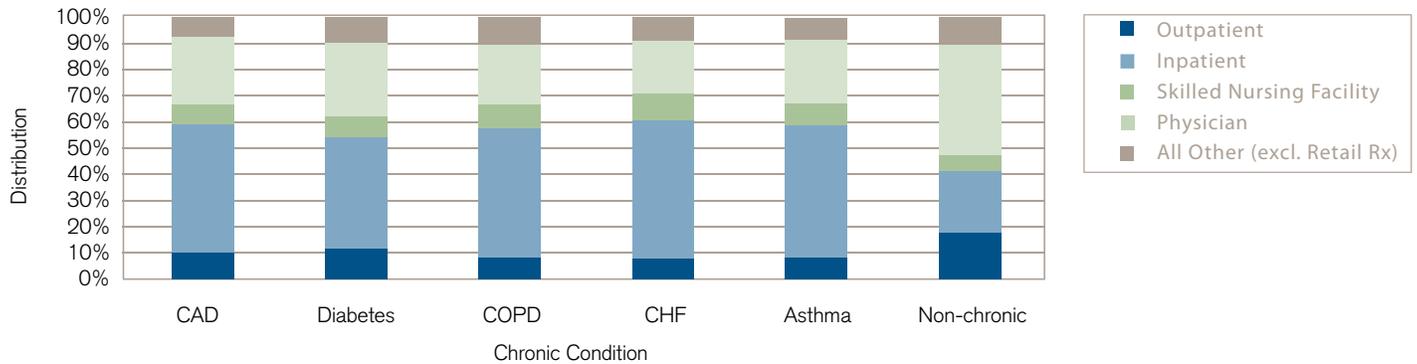
#### PMPM COSTS BY CHRONIC CONDITION



The distribution of costs by type of service is significantly different for the chronics, as their inpatient costs account for a much larger portion of the total costs. Chart 12 displays the 2006 cost distribution by service category (retail prescription drugs are not included) for chronics and non-chronics.

**CHART 12**

**2006 COST DISTRIBUTION BY MAJOR SERVICE CATEGORY**

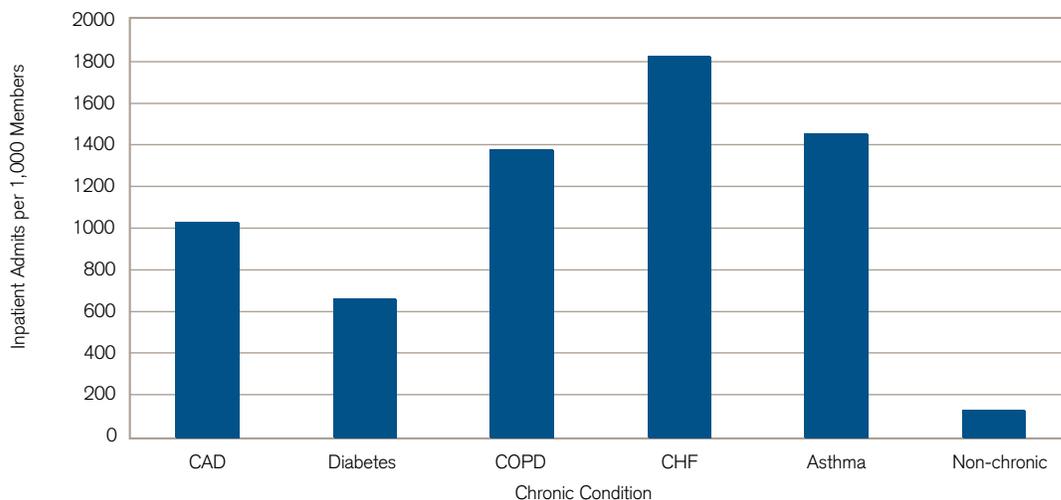


Inpatient costs account for about 50% of the cost for chronics, but only about 25% for non-chronics. By contrast, physician services make up a higher portion of the non-chronic spending: about 40% of total cost compared to 25% for chronics.

Inpatient hospital admissions for chronics are dramatically higher than for non-chronics, as would be expected. The differences range from 5 to 14 times the non-chronic figure for diabetes and CHF, respectively. Chart 13 displays the rate of 2006 inpatient admissions per 1,000 members, with rates for CHF approaching two admissions per person per year.

**CHART 13**

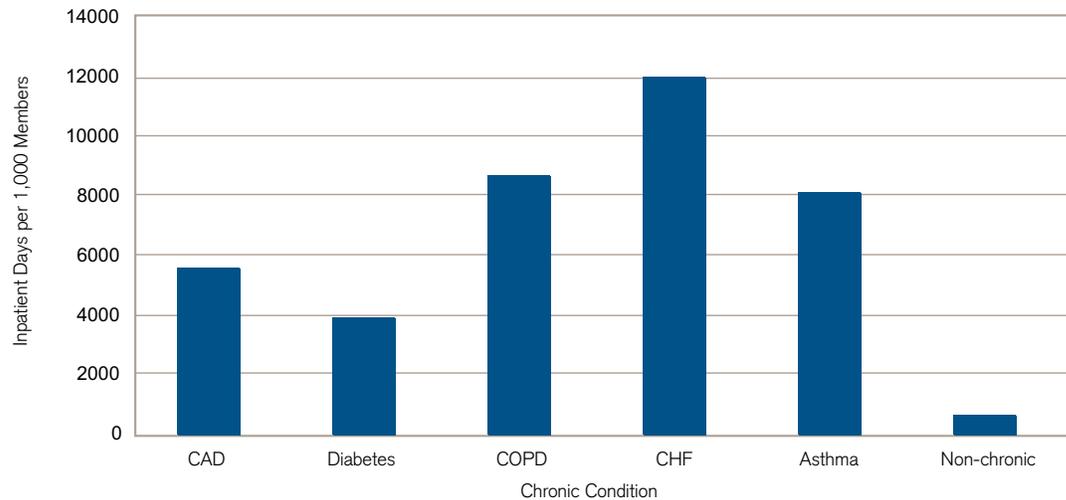
**2006 INPATIENT ADMISSIONS PER 1,000 MEMBERS**



Inpatient hospital days for chronics are dramatically higher. The differences range from six to 18 times that of non-chronics for diabetes and CHF, respectively. Chart 14 displays the 2006 inpatient days per 1,000 members.

CHART 14

2006 INPATIENT DAYS PER 1,000 MEMBERS



Estimating the impact of prescription drug coverage

Our analysis does not include prescription drug costs, which are not readily available in a form linked to medical claims for the Medicare fee-for-service population. However, to illustrate the impact that including prescription drug costs would have on trends, we estimated Medicare-allowed costs of prescription drug coverage.<sup>8</sup> We applied the risk score model and total spend coefficients of the Centers for Medicare and Medicaid Services (CMS) prescription drug hierarchical condition categories (RxHCC)<sup>9</sup> to the CMS Medicare 5% Sample. The RxHCC process yielded risk scores for individuals in the Medicare 5% Sample, and we aggregated these scores by cohort and applied an average allowed prescription drug PMPM for 2006.

To test the impact of including prescription drug coverage, we constructed a “stress scenario” under which annual prescription drug trends were 10% for non-chronics and 35% for chronics. We then measured the impact of adding expected prescription drug allowed costs, along with trends, to the medical costs developed in our analysis. Even under this highly unlikely trend scenario, PMPM trends for chronics remain lower than for non-chronics. The stress scenario’s impact of prescription drug coverage on 2006 PMPM trends is shown in Table 4.

TABLE 4

STRESS SCENARIO’S IMPACT OF PRESCRIPTION DRUGS ON 2006 PMPM TRENDS

COHORT	%RX	MEDICAL TREND	RX TREND	TOTAL TREND
CAD	13%	1%	35%	5.8%
DIABETES	18%	2%	35%	7.7%
COPD	11%	3%	35%	6.7%
CHF	9%	6%	35%	8.2%
ASTHMA	11%	3%	35%	6.8%
NON-CHRONIC	29%	8%	10%	8.3%

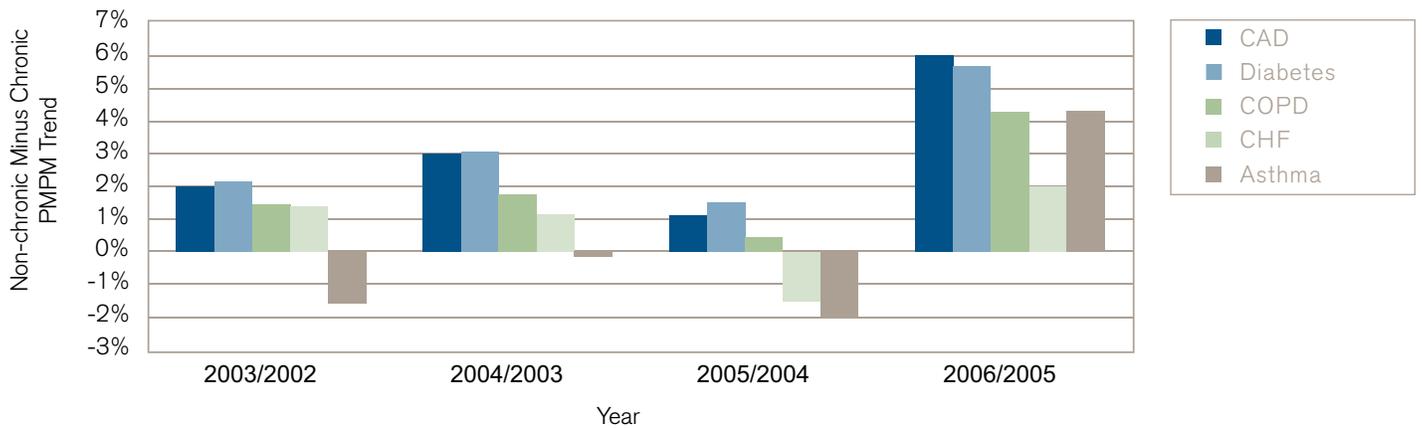
**Relationship between trends**

To measure the financial impact of DM programs, the Disease Management Association of America (DMAA) recommends that the costs of chronics after DM begins should be compared to projected costs assuming no management. To perform this type of measurement, the DMAA recommends trending the baseline year PMPM costs of chronics by an adjusted non-chronic cost trend observed between the baseline and operational year. It recommends that non-chronic cost trend be adjusted by any historical difference in chronic and non-chronic cost trend (before management).<sup>10</sup> Without adjusting for any historical trend difference between the chronic and non-chronic populations, the methodology would be flawed, particularly in light of our findings that chronics trend at a lower rate than non-chronics. Chart 15 displays the differences between chronic and non-chronic PMPM trends by chronic-condition cohort. As mentioned above, we can safely assume that the Medicare fee-for-service population studied was not receiving DM services during these years.

**Without adjusting for any historical trend difference between the chronic and non-chronic populations, the methodology would be flawed, particularly in light of our findings that chronics trend at a lower rate than non-chronics.**

**CHART 15**

**NON-CHRONIC TREND MINUS CHRONIC TREND**

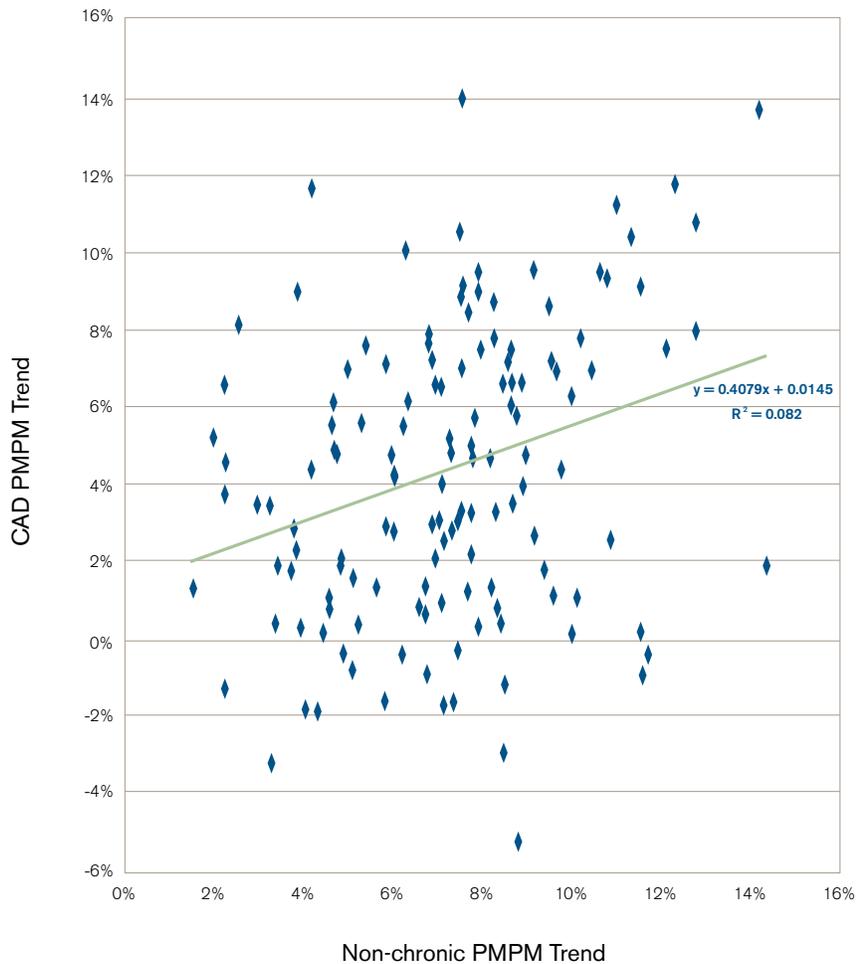


These data allow us to test the DMAA method of using historical, chronic/non-chronic trend differences as a “trend adjuster” to the non-chronic trend. The average of the 2003/2002 and 2004/2003 trend differentials produces a trend differential much higher than the actual 2005/2004 trend differential for all chronic-condition cohorts. The three-year average of the 2003/2002, 2004/2003, and 2005/2004 differentials produces an even more dramatic trend differential than the actual 2006/2005 trend differential. This suggests that the DMAA method may not accurately adjust non-chronic trends for chronic populations.

Analyzing trends by state provides another test of the reasonability of using historical differences between chronic and non-chronic trends. Chart 16 displays four years (2003 to 2006) of PMPM cost trends in 34 states (states with more than 10,000 Medicare beneficiaries) for CAD and non-chronic cohorts. The solid line in Chart 16 is the trend line (least squares linear regression) for all trend points displayed.

**CHART 16**

**NON-CHRONIC AND CAD TRENDS IN 34 STATES FOR  
2006/2005, 2005/2004, 2004/2003, AND 2003/2002**



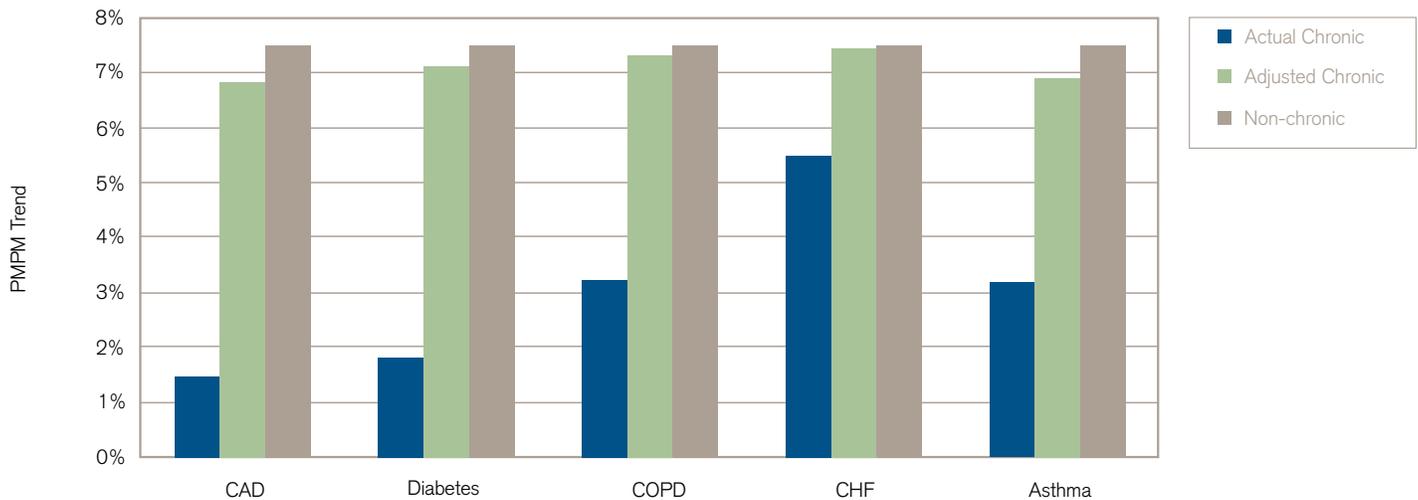
The low R-squared value of 0.082 suggests that trend line values do not correspond well to the actual data. Similar results were obtained for the other four chronic-condition cohorts. Based on these findings, there is very little positive correlation between the trends of the chronic and non-chronic populations. This variability implies that using the non-chronic trend to project the trend of the chronic population may not be reliable. A similar result is visually apparent in Chart 9. While chronic trends are consistently lower than non-chronic, the variability in that relationship is large.

### Service category mix

To test the impact on trend of the differences in mix of services and trends by service category between chronics and non-chronics, we applied the chronic service category mix of services to the non-chronic service category trends to develop an “adjusted” trend. Chart 17 displays the effect of service category mix on trend in 2006.

**CHART 17**

#### IMPACT OF SERVICE CATEGORY MIX ON 2006 TRENDS



For each chronic-condition cohort, Chart 17 compares the following:

- The actual chronic 2006 PMPM trend (blue bar).
- The adjusted chronic 2006 PMPM trend (green bar). This is the resulting trend when we combined the chronic cohort’s mix of services with the non-chronic service category trends.
- The actual non-chronic 2006 PMPM trend (gray bar).

When using the non-chronic service category trends with the chronic mix of services, the chronic trends continue to remain lower than the non-chronic trends, but more closely approach the non-chronic trends. This suggests that the lower trend of the chronics is caused, in part, by their higher proportionate consumption of services that exhibit a lower trend.

---

## DISCUSSION

This section provides our insights regarding our differential trend findings in addition to the following:

- Disease management contracts
- Potential causes for the differential trend
- Relevance to non-Medicare programs

### Disease management contracts

DM programs often focus on the five conditions that we investigated. Although this paper investigated Medicare costs and trends, we believe many of our findings also apply to the commercial population, although differences between commercial and Medicare reimbursement methodologies and levels will certainly affect results. The attention given to these five conditions is not surprising, given their higher per-capita costs.

As with other health management efforts, DM vendors and in-house programs must justify the value the program brings in light of the cost. The industry's economic rationale has shifted over time. Although quality and clinical outcomes have gained more attention as a valuable result of DM programs, many purchasers of DM services as well as those running in-house health plan programs continue to expect financial gains from DM programs.

The methodology to measure DM financial impact has evolved over the past 10 years. In its early days, DM vendors claimed value as the enrolled patients' costs decreased compared to their "baseline" costs before enrolling. This approach has been abandoned by most as a bias toward regression to the mean became evident: on average, patients identified with an acute condition during a baseline period will recover over time and their costs will decrease, often dramatically, with or without DM intervention.

In the authors' experience, most DM programs today attempt to demonstrate financial value by showing that the trend in PMPM costs of chronics falls below that of the entire or non-chronic population. The findings in this report suggest that, for a Medicare population, chronics often have lower trends even without any DM program intervention. In this population, direct comparison of chronic and non-chronic cohorts will show a lower trend for chronics without DM.

Financial performance measurement typically compares the claims experience of each operational year for the membership meeting DM identification criteria, to a trended (typically by the non-chronic population trend) baseline year claims experience, again for the membership meeting DM identification criteria. The implied savings is the difference between the operational year claims experience and trended baseline year claims experience net any fees. This pre-post design methodology has been recommended by the DMAA in its Outcomes Guidelines Report Volume II<sup>11</sup> for measuring DM program impact for diabetes, CHF, CAD, COPD, and asthma.

The DMAA currently recommends using the average difference between historical chronic and non-chronic population trends to adjust the non-chronic trend before applying to the chronic baseline PMPM.<sup>12</sup> This relatively new approach, applying a factor to the non-chronic trend, has not been widely adopted. However, we found a very weak correlation between the trends of the chronic and non-chronic populations. Although our result is for the Medicare population, and much DM focuses on the commercial population, our findings raise questions about the practicality of the DMAA's current methodology.

### Potential causes for the differential trend

As described in the "Methodology" section, we examined Medicare, non-Medicaid fee-for-service enrollees age 65 and over. We excluded Medicare managed-care enrollees because these plans may have care management programs that affect the costs of chronic conditions.

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**The findings in this report suggest that, for a Medicare population, chronics often have lower trends even without any DM program intervention.**

In general, healthier people tend to enroll in managed-care programs and sicker people tend to remain in fee-for-service programs. On a simple basis, we would expect fewer people with chronic conditions to enroll in managed care. Table 5 indicates that the portion of people with a chronic condition has remained relatively constant across the years we studied.

**TABLE 5**

**PREVALENCE OF PEOPLE WITH A CHRONIC CONDITION**

YEAR	STUDY POPULATION	% CHRONIC
2002	1,167,585	33.0%
2003	1,186,983	33.5%
2004	1,193,870	34.1%
2005	1,177,977	34.3%
2006	1,142,374	34.2%

If the sicker people with chronic conditions joined managed-care plans in more recent years, it would depress the trend in the fee-for-service chronic cohort. However, such selection would run counter to normal expectations and would be surprising. Still, it is possible that the healthier, lower-cost people in the non-chronic cohort selectively joined managed-care plans. If this happened, it could cause the remaining non-chronic people in the fee-for-service program to have a higher trend.

The decrease in the study population in 2005 and 2006 reflects the growth of managed care. During the study period, total Medicare enrollment grew by about 1% per year.<sup>13</sup>

Table 6 displays the changes in fee-for-service enrollment of the chronic and non-chronic cohorts over the study period.

**TABLE 6**

**FEE-FOR-SERVICE ENROLLMENT BY CHRONIC/NON-CHRONIC COHORTS**

YEAR	CHRONIC	INCREASE	NON-CHRONIC	INCREASE
2002	385,484		782,101	
2003	397,718	3.2%	789,265	0.9%
2004	407,486	2.5%	786,384	-0.4%
2005	403,952	-0.9%	774,025	-1.6%
2006	390,125	-3.4%	752,249	-2.8%

During the period from 2002 to 2006, Medicare dramatically shifted its options with the 2006 introduction of Medicare Advantage prescription drug plans (MA-PDs) for managed care and the Medicare Part D prescription drug benefit. The data shows that the rate of growth in the chronic and non-chronic populations was variable through this period. We believe that the consistently lower trend for chronics through this period, despite the changes in Medicare products and other variability, is evidence that selection did not cause the observed trend differential.

We believe the trends identified here may be greatly influenced by medical practice and the unit costs of services and products, more so than selection issues. The higher trends for the non-chronic cohort may reflect medical practices that affect chronic and non-chronic patients differently. Of course, it is also important to keep in mind that a relatively small dollar increase for healthy people can appear as a large percentage increase (large trend) because their expenditures are relatively low.

Determining the causes of the differential trends falls beyond the scope of our study. The different mix of services (Chart 17) appears to account for much of the difference. In addition, we hypothesize that the trend differential may be due to the following:

- Increased cost in prevention and diagnostic costs for lower-cost people not in the chronic cohorts
- Slower growth in higher-cost people in the chronic cohorts, perhaps associated with trends in hospital care practices

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**Among people in the non-chronic cohort, the emphasis on preventive care could be contributing to increased cost as well as increased use of diagnostic services.**

#### **Increased cost in low-cost people in the non-chronic cohort**

Among people in the non-chronic cohort, the emphasis on preventive care could be contributing to increased cost as well as increased use of diagnostic services. Medicare and private payers have promoted services such as mammograms, colonoscopies, bone mineral density tests, PSA tests, immunizations, the “welcome to Medicare” visit, and others. Screening services often generate follow-up diagnostics to rule out potentially serious conditions; interactions with the medical system create more opportunities to interact with the medical system, which includes diagnosing previously undiagnosed conditions. For healthy people, new routine interactions may be creating extra costs beyond the preventive care they receive.

#### **Slower growth in higher-cost people in the chronic cohorts**

People in the chronic cohorts have much greater interaction with the healthcare system, as shown in our “Findings” section. Hospital care makes up a significant portion of their cost, and hospitals have been the focus of quality improvement efforts such as the Institute for Healthcare Improvement’s widely publicized “Protecting 5 Million Lives From Harm” campaign,<sup>14</sup> which may be holding down costs. Statistics from CMS show a decline in hospital utilization overall; because the chronic cohorts are high users of hospital services, the decline may strongly affect these cohorts.

People who are already high-cost or receiving intense medical attention may face practical limits in the number of drugs, physician visits, or other interventions they receive.

Studies such as the Dartmouth Atlas have brought attention to inefficiencies in medical treatment in the Medicare fee-for-service population, with a recent focus on chronic illness.<sup>15</sup> These studies point to the dramatic potential to improve quality and reduce costs for those with chronic illness, although we cannot say that the trend differential reflects success in addressing these inefficiencies.

Clearly, the reasons for the lower trend deserve additional investigation.

#### **Application to non-Medicare populations**

Our analysis used Medicare fee-for-service data. However, we believe our results probably apply to other populations such as Medicare managed care, commercial, and Medicaid, for the following reasons:

1. Medical treatment for chronic conditions is similar across payer types. Of course, the Medicare population is older and Medicare beneficiaries tend to have more comorbidity. Medicare beneficiaries are more likely than others to have more than one of the five conditions.
2. The consistent, lower trends across service categories and ages suggest to us that the presence of a chronic condition rather than other characteristics is likely to be the most important determinant of the differential trend.
3. The reasons we suggest above for the observed trend differential would also apply to other populations—that is, increased preventive and diagnostic services among the non-chronic cohort (which could increase its trend) and inefficiency reductions in the chronic cohorts (which could decrease trend for these people).

Clearly, the relationships we find should be applied cautiously to non-Medicare populations and programs.

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## BACKGROUND ON TREND

Understanding trends in cost and utilization are a core responsibility of actuaries in both private insurance (such as HMOs) and social insurance (such as Medicare). The purpose of this section is to provide insights into this complex area, and we hope our explanation will help the reader consider how to interpret or apply the information in this report. Not all these considerations are relevant to our study, but they may be relevant to readers from employer-sponsored programs or private insurers.

Cost trend is a measure of the increase in healthcare costs from one time period to the next, typically year to year. Clearly, the actual trend experienced by a population or health plan will reflect changes in the cost of services (as does the trend in the Consumer Price Index), as well as changes in the utilization of services and changes in the intensity of services provided.

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**Cost trend is a measure of the increase in healthcare costs from one time period to the next, typically year to year.**

The introduction of new technology generally increases trends, as new technologies almost always are more expensive than the technologies they replace. Changing physician practice patterns also can affect trend rates because those changes will cause the “market basket” of medical goods and services to evolve as physicians adopt new treatment protocols. Because health costs vary by age and gender, changes in population composition also affect trend rates. A trend toward delayed retirement, for example, can increase trend rates in a commercial population, as the proportion of older (and probably more expensive) workers increases. Other factors (including benefits covered, cost sharing required, and random fluctuations) also have an impact on trend rates.

Medical trends for the same time period will vary significantly from organization to organization and may depend on facts unique to each situation. Important factors include type of plan, benefit structure, and geographic area. In practice, these factors tend to be dynamic and require continuous analysis and subjective evaluation, typically by the actuary responsible for trend analysis. For these reasons, it is difficult to establish a set of recommended trend factors or even considerations for all situations.

Past (historical) trends, such as those reported here, are calculated as the change in cost per covered member. In this report, for example, we calculated the trend from 2005 to 2006 for our cohorts as the ratio:

$$\frac{(\text{Claims incurred in 2006/Member months in 2006})}{(\text{Claims incurred in 2005/Member months in 2005})}$$

In a period of increasing costs, this produces a number greater than 1.00 (for example, 1.05), and it is customary to subtract 1.00 from the above quotient (to produce, for example, a 5% trend).

While the above formula may seem simple, in practice, numerous issues can influence the numbers and their interpretation:

1. “Claims incurred” may require estimating runout (often called IBNR, or incurred but not reported claims); inaccurate estimates, or the failure to consider runout, could distort trend measurement. The Medicare 5% Sample data set we used for this study is produced on a consistent basis from year to year and includes significant runout.
2. The benefits may have changed between the two time periods. In recent years, the average member cost sharing of many health plans has increased—for example, deductibles and copays have increased. Increased cost sharing reduces the health plan’s costs and reduces trends in paid claim amounts. Medicare benefits are stable and we used allowed claim amounts (which include both Medicare’s payment and patient-paid deductibles and coinsurance), so cost-sharing differences between chronic and non-chronic cohorts would not be a significant issue.
3. The demographics may have shifted between the two time periods. For example, a health plan’s portion of Medicare beneficiaries may have increased from 10% to 20% and its portion of commercial enrollees decreased from 90% to 80%. Because Medicare beneficiaries are much more expensive than commercial, a higher portion of Medicare beneficiaries in the second time period would make an aggregate trend look very high. For this reason, health plans generally analyze cost trend separately for different populations.

The Medicare 5% Sample data set is produced on a consistent basis from year to year and maintains a stable representation of the Medicare population in each year. Chart 18 displays the stable year-to-year age/gender distribution of the chronic cohorts of the Medicare 5% Sample data set. The lines that start on top for the young ages and end on the bottom for the older ages (square pattern) represent the number of males for each year, while the other lines (triangle pattern) represent females. The lines are rather stable across years.

CHART 18

AGE/GENDER DISTRIBUTION OF CHRONIC COHORTS

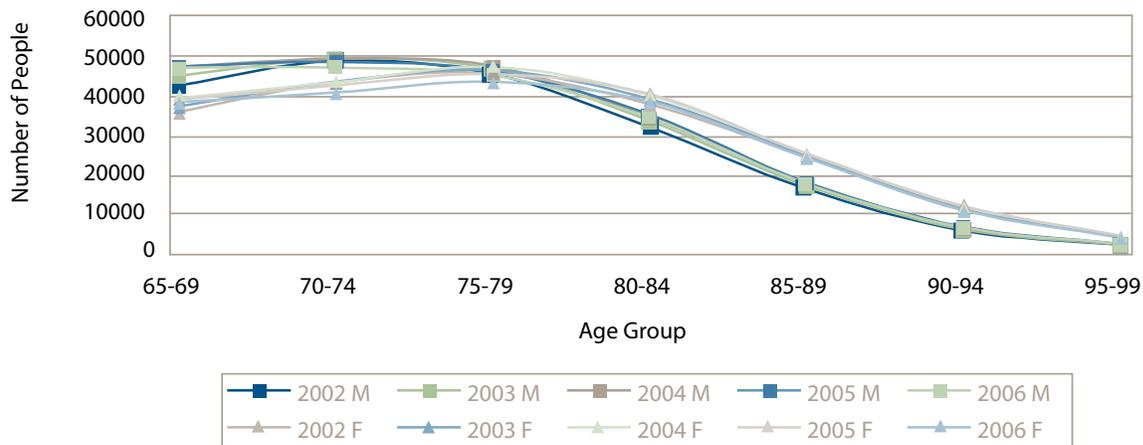
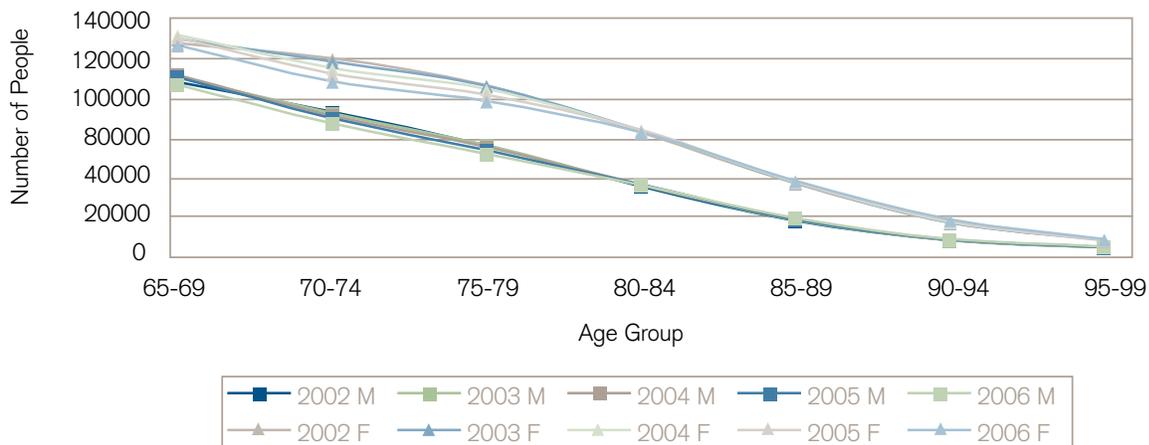


Chart 19 displays the stable year-to-year age/gender distribution of the non-chronic cohort of the Medicare 5% Sample data set. The top lines (triangle pattern) are the females for each year, while the bottom lines (square pattern) are the males. Again, the lines are rather stable.

CHART 19

AGE/GENDER DISTRIBUTION OF NON-CHRONIC COHORTS



4. Random fluctuations, including catastrophic claims (perhaps covered by stop-loss), can influence the claims of either period. We believe that the large size of the national cohorts we used reduces the risk of random fluctuations, although some of the state-level data for smaller states certainly exhibit such fluctuations.

Insurance companies, HMOs, and social insurance programs generally devote significant resources to addressing these influences and others. However, few of even the largest employers have the staff to perform a thorough analysis and often rely on outside consultants. These challenges become magnified in DM programs because the chronic cohorts are smaller subsets of the total population.

#### Considerations in establishing trend assumptions

Ideally, trend analysis should include consideration of historical trend patterns and the factors that may affect future trends. In many instances, these factors require a subjective evaluation of the potential impact of these factors.

We hope the information that follows will assist the reader in analyzing historical trends and also in evaluating possible future trends. While this information can prove useful in providing a proper framework for establishing trend assumptions, it must be emphasized that a purely objective approach to establishing trend assumptions is not possible. Experience, judgment, and evaluation of risks, combined with analytical techniques, should be part of the process of establishing future trend assumptions.

1. Trend behavior—Trends in claim costs change in direction and magnitude over time, frequently in cyclical patterns. These patterns may be similar to that exhibited by the Consumer Price Index (CPI), although the cycles may vary in timing and healthcare trends have generally been much higher than CPI. While the trend experienced in a particular situation may vary significantly from broad market averages, trend *patterns* generally tend to behave in a manner similar to aggregate medical-care trends. However, specific variations from the overall environment can easily produce important differences.
2. Experience analysis—Actual experience trends should be measured by relating incurred claims to units of exposure, such as number of beneficiaries, employees, or people covered. Examining the resulting claim costs for consecutive 3-month and 12-month periods can provide important insight. The 12-month pattern indicates the magnitude of annual trends, while the 3-month pattern can sometimes serve as a leading indicator of trend direction. While historical trend patterns may provide some indication of future trends, future trends will almost certainly differ from immediate past trends.
3. Secular trend—We define secular trend as the percentage change in average claim costs resulting from only those factors that affect a static population with a fixed set of benefits. The two major components of secular trend are (1) changes in the utilization of services, and (2) changes in unit cost per service. Secular trend assumptions may be established separately by type of service or on an aggregate basis for an overall plan of benefits. A suitable approach will depend on the degree of information available and the use of the resulting trends.

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**While the trend experienced in a particular situation may vary significantly from broad market averages, trend patterns generally tend to behave in a manner similar to aggregate medical-care trends.**

The factors mentioned below apply to most employer-sponsored programs and private insurance. However, some of them do not apply to social insurance programs such as Medicare or Medicaid.

- a. Utilization: Numerous factors may affect utilization patterns, including the following:
  - Evolutionary or radical changes in medical-care practice may lead to the use of more services, the introduction of new and expensive technologies and drugs, or the use of alternative treatments such as home healthcare.
  - Increases in the supply of services, such as the number of hospital beds, number of physicians, or number of freestanding surgical centers, may lead to increased utilization of these services.
  - Improvements in overall health and/or attitude of the exposed population, perhaps resulting from increased involvement in self-care or preventive activities, may produce changes in utilization or morbidity patterns.
  - Epidemics or catastrophes may cause sharp temporary increases or decreases in utilization.

- Utilization may tend to follow seasonal patterns, such as an increase in hospital utilization during the month of January.
- Trends in malpractice suits or changes in institutional policy may affect defensive medical practice.
- Benefit plan design changes may discourage utilization through required copayments for certain services or may encourage utilization through generous coverage of services such as behavioral care.
- Medical management programs may reduce the unnecessary use of services.
- Anticipated loss of benefit coverage, such as that which occurs in industries planning large layoffs, may lead to surges in utilization.
- Variations in underwriting and administrative practices frequently lead to variations in average morbidity patterns or in use of certain services that are subject to over-utilization.
- Changes in the number of covered individuals using managed-care delivery systems, such as HMOs, may affect the utilization patterns of the remaining covered population.

**Useful measurement of utilization trends depends on consistent and meaningful definitions of the service unit, such as number of hospital admissions, average length of hospital stay, number of primary-care physician visits, or number of mail-order drug claims submitted.**

Useful measurement of utilization trends depends on consistent and meaningful definitions of the service unit, such as number of hospital admissions, average length of hospital stay, number of primary-care physician visits, or number of mail-order drug claims submitted. Different organizations may use many different methods for defining service units, and often different services units are used by different departments within the same organization. The introduction of new technology can also challenge the interpretation of utilization trends. However, any method used must clearly define service units to allow consistency between utilization and average cost-per-service measures and across time periods.

b. Unit cost: Factors affecting unit costs, unique to the healthcare industry, include the following:

- Providers may shift costs to private payers to offset reduced levels of reimbursement from government-sponsored programs. Providers may shift costs from managed-care networks with tight reimbursement or approval processes to those with looser terms.
- A percentage of charge discounts may be subject to high inflation because they depend on the charge master policy of the provider. Outlier features that cause payment to revert to charges at some thresholds will face the same challenge.
- Capitation or other special provider reimbursement agreements may sometimes replace encounter or claims data. The renegotiation of these agreements can cause a surge in unit cost.
- Medical practice patterns may lead to changes in the mix or intensity of services, such as an increased number of tests per average hospital stay or shifts toward more specialized physician care. In addition, changes in practice or technology may affect procedure-code assignment and cause a change in mix of services.
- The increased use of expensive modern technology, new drugs or devices, advanced imaging, or tissue transplants leads to a higher volume of high-cost services, perhaps without any corresponding reduction in other services.
- Regulatory changes such as mandated benefits or shifts in Medicare reimbursements (DRGs, RBRVS fee schedule, prospective payment for home care, etc.) can also significantly affect short-term trends and long-term tendencies in the unit cost and use of medical services in both Medicare and non-Medicare populations.

4. Changes in exposed population/benefits—The actual measured trend for a population that is not static may reflect changes in benefits, age differences, or other factors. Adjustments to reflect anticipated changes in a particular population include the following:

- *Changes in the age/gender distribution.* The impact of these changes can be estimated by applying actuarially determined age/gender factors using the current and the prior population distributions.
- *Changes in benefits.* The impact of benefit changes can be estimated by determining the normative, actuarially determined costs for the current and prior benefits to derive the percentage impact of benefit changes.
- *Shifts in geographic concentration.* To measure the impact of such shifts, composite area factors can be derived from the current and prior geographic distributions through factors that reflect area differences.

- *Selection.* Private and social insurance programs recognize selection—the tendency for people to choose options or enrollment that maximizes their benefits—and usually payer cost. If the subject population has experienced favorable or adverse selection, the average morbidity and cost of the population may change significantly. If possible, the effects of such shifts should be analyzed by comparing risk scores or the average claim levels of the new and/or terminating population segments with those of the entire population. Frequently, such a study is not feasible, and the impact of these changes must be estimated using judgment.

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**If the subject population has experienced favorable or adverse selection, the average morbidity and cost of the population may change significantly.**

5. Impact of benefit structure—Trends in claim costs are affected by the underlying benefit structure. For a large insurer, it may not be feasible to directly account for every benefit variation, but the analyst should consider the general direction of benefit changes and how it will affect trend pattern. Key considerations include the following:

- *Deductible.* Fixed deductibles have a leveraging effect on trends, increasing the percentage impact of the trend. The costs above a fixed deductible increase more than the costs below the deductible. The degree of leveraging will vary depending on the magnitude of the deductible, deductible structure (e.g., all benefits or certain benefits), and trend forces involved (e.g., changes in utilization generally result in less leveraging than changes in costs). Medicare deductibles may increase annually. Such increases tend to reduce the amount of leveraging.
- *Internal limits and benefit maximums.* Benefit limits and maximums tend to dampen the impact of trends. The extent of such dampening depends upon the relative level at which these limits occur. Relatively high limits, such as a \$5 million lifetime maximum, may have little impact on underlying trends. However, benefit plans with relatively low limits, such as an annual \$50,000 limit, may experience much lower trends than unlimited plans.
- *Out-of-pocket limits.* A limit on aggregate out-of-pocket costs tends to affect trends in the same manner as deductibles, i.e., this provision has a leveraging effect. The impact depends upon the level of the limit, but generally will not be as strong as that of a deductible.
- *Stop-loss coverage.* If stop-loss coverage is superimposed over a full coverage plan, the impact of the stop-loss is comparable to that of a benefit maximum, i.e., a dampening of trends. The stop-loss coverage itself is subject to trend leveraging if the stop-loss limit is defined as a fixed dollar amount rather than as a percentage of expected claims; generally, this will affect individual stop-loss coverage.

## METHODOLOGY

**We used the Centers for Medicare and Medicaid Services' (CMS) 2002-2006 Medicare 5% Sample which contains facility and professional claims data for services paid by Medicare.**

### Dataset

We used the Centers for Medicare and Medicaid Services' (CMS) 2002-2006 Medicare 5% Sample (issued as a limited data set), which contains facility and professional claims data for services paid by Medicare. The Medicare Part D prescription drug benefit was not introduced until 2006, and prescription drug data is not yet available. The Medicare 5% Sample size is created from 100% of the Medicare-eligible beneficiaries. It is a statistically representative, longitudinal data set. The 5% Sample contains claims from about 2 million members.

### Exclusions

We excluded beneficiaries identified as under age 65, dual eligible (Medicare/Medicaid), or enrolled in managed care. We also excluded individuals from each year of the data in which they were identified with HIV or transplants to avoid outlier cases. We were left with a remaining population of about 1 million Medicare beneficiaries (Table 6).

TABLE 6

STUDY POPULATION FROM THE MEDICARE 5% SAMPLE DATA SET

YEAR	STUDY POPULATION
2002	1,167,585
2003	1,186,983
2004	1,193,870
2005	1,177,977
2006	1,142,374

### Identification criteria for chronics

Our methodology for identification of members with any of the five chronic conditions follows the DMAA guidelines as well as National Committee for Quality Assurance (NCQA) Healthcare Effectiveness Data and Information Set (HEDIS) disease identification criteria for several of the chronic conditions. Identification criteria were applied annually to claims to query for individuals having any of the five chronic conditions: asthma, COPD, CAD, CHF, and diabetes. We did not roll forward individuals who were identified in a previous year to the subsequent year, but instead performed an annual qualification.

Individuals may appear in more than one chronic condition cohort as we present individual chronic condition cohort findings for all who are identified with a particular chronic condition, regardless of whether they have more than one of the chronic conditions.

The identification criteria appear in the Appendix.

## Costs

We analyzed allowed claims by provider type. The Medicare 5% Sample as provided by CMS consists of the following seven distinct files, each containing claims from a particular provider type:

- Physician/supplier Part B
- Inpatient facility
- Outpatient facility
- Home health agency
- Hospice
- Skilled nursing facility
- Durable medical equipment

## Estimating the impact of prescription drugs

Estimated prescription-drug claims costs for each beneficiary in our sample population were calculated by multiplying the total average population claim cost for prescription drugs<sup>16</sup> by the beneficiary's risk factor. The risk factors reflect the health status of the beneficiaries. The risk factors were derived from the CMS prescription drug hierarchical condition categories (RxHCC) risk-score model with total spend coefficients.<sup>17</sup>

## APPENDIX

### Definition of congestive heart failure (CHF) patients

Identification criteria for CHF follows the NCQA HEDIS CHF identification criteria.<sup>18</sup> This category is defined as one inpatient admission or emergency room claim, or two outpatient physician evaluation and management (E&M) claims with a CHF ICD-9 in any position of the claim.

DESCRIPTION	ICD-9-CM DIAGNOSIS CODE
Hypertensive heart disease with heart failure	402.01, 402.11, 402.91 404.01, 404.11, 404.91
Heart Failure	428xx

DESCRIPTION	CPT CODES
Physician E&M codes	92002-92014, 99201-99205, 99211-99215, 99217-99220, 99241-99245, 99271-99275, 99301-99303, 99311-99313, 99321-99323, 99331-99333, 99341-99355, 99384-99387, 99394-99397, 99401-99404, 99411, 99412, 99420, 99429, 99499

### Definition of coronary artery disease (CAD) patients

Identification criteria for CAD follows the NCQA HEDIS CAD identification criteria.<sup>19</sup> This category is defined as one inpatient admission or emergency room claim, or two outpatient physician E&M claims with a CAD ICD-9 in any position of the claim.

DESCRIPTION	ICD-9-CM CODES
AMI subsequent episode/unspecified	410.x0,410.x2
Angina	411.xx, 413.xx
Chronic ischemic heart disease	414.xx
Old myocardial infarction	412.xx

DESCRIPTION	CPT CODES
Physician E&M codes	92002-92014, 99201-99205, 99211-99215, 99217-99220, 99241-99245, 99271-99275, 99301-99303, 99311-99313, 99321-99323, 99331-99333, 99341-99355, 99384-99387, 99394-99397, 99401-99404, 99411, 99412, 99420, 99429, 99499

The category may also consist of one claim (inpatient or outpatient) coded with PTCA or CABG CPT or ICD-9 procedure code.

DESCRIPTION	CPT CODES	ICD-9-CM CODES
PTCA	33140, 92980-92982, 92984, 92995, 92996	Procedure: 36.01, 36.02, 36.05, 36.09
CABG	33510-33514, 33516-33519, 33521-33523, 33533-33536, 35600, 33572	Procedure: 36.1, 36.2x

#### Definition of diabetes patients

Identification criteria for diabetes follows the NCQA HEDIS diabetes identification criteria.<sup>20</sup> This category is defined as one inpatient admission or one emergency room claim, or two outpatient physician E&M claims with a diabetes ICD-9 in any position of the claim.

DESCRIPTION	ICD-9-CM DIAGNOSIS CODE
Diseases of other endocrine glands—diabetes	250.xx
Polyneuropathy in diabetes	357.2x
Diabetic retinopathy	362.0x
Diabetic cataract	366.41

DESCRIPTION	CPT CODES
Physician E&M codes	92002-92014, 99201-99205, 99211-99215, 99217-99220, 99241-99245, 99271-99275, 99301-99303, 99311-99313, 99321-99323, 99331-99333, 99341-99355, 99384-99387, 99394-99397, 99401-99404, 99411, 99412, 99420, 99429, 99499

### Definition of chronic obstructive pulmonary disease (COPD) patients

This category is defined as one inpatient admission or emergency room claim, or two outpatient physician E&M claims with a COPD ICD-9 in any position of the claim.

DESCRIPTION	ICD-9-CM DIAGNOSIS CODE
Chronic bronchitis	491.xx
Emphysema	492.xx
COPD	496.xx

DESCRIPTION	CPT CODES
Physician E&M codes	92002-92014, 99201-99205, 99211-99215, 99217-99220, 99241-99245, 99271-99275, 99301-99303, 99311-99313, 99321-99323, 99331-99333, 99341-99355, 99384-99387, 99394-99397, 99401-99404, 99411, 99412, 99420, 99429, 99499

### Definition of asthma patients

This category is defined as one inpatient admission or emergency room claim, or two outpatient physician E&M claims with an asthma ICD-9 in any position of the claim.

DESCRIPTION	ICD-9-CM DIAGNOSIS CODE
Asthma	493.xx

DESCRIPTION	CPT CODES
Physician E&M codes	92002-92014, 99201-99205, 99211-99215, 99217-99220, 99241-99245, 99271-99275, 99301-99303, 99311-99313, 99321-99323, 99331-99333, 99341-99355, 99384-99387, 99394-99397, 99401-99404, 99411, 99412, 99420, 99429, 99499

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## THE AUTHORS

The following Milliman employees are the primary authors of this research report: Kate Fitch, Kosuke Iwasaki, Donna Kalin, and Bruce Pyenson.

The authors would like to also thank Arthur Baldwin for his contribution.

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