REGRESSION TO THE MEAN

This section describes research intended to provide insight into the degree and pace at which costs change after a significant event that may trigger DM initiation. Significant events are defined as hospitalizations or emergency room visits coded with a diagnosis of, or related to, CHF, CAD, diabetes, or comorbid diabetes. Please see the section titled "Methodology" on page 19 for more detail.

Our results are in 2001 US dollars and by disease state. Data limitations prevented us from incorporating many of the factors that should be considered in disease management analyses, including changes in benefits, provider reimbursement, and patient mix.

We did not define the mean cost for several reasons.

- *Defining the population.* Use of claims data as the only means to identify a population with a disease state may introduce selection bias because a portion of the population is identifiable through the advent of a high cost event. Therefore, costs of our population with a disease state could be inflated.

- *Time period.* Mean cost is different the year before a significant event, the year after a significant event, and over the entire study period. There is no correct answer. Therefore, we look at the change in costs rather than a return to a mean.

Only the commercial database contains drug information. Therefore, our commercial and Medicare costs are not comparable. Population characteristics may differ between our commercial and Medicare populations as well. In addition to medical claims data, we use drug data to identify diabetes and comorbid diabetes in commercial populations. As a result, our commercial population may be less sick or less compliant than the Medicare population.

Findings

For commercial and Medicare populations, all disease states show different degrees of regression and mean cost. Please see Appendix A for detailed quarterly results.

The population size studied varies considerably by disease state, by age, and over time as seen in Appendix B. Although the populations are generally large enough to present credible results, population size should be referenced when reviewing the results.

We examined aggregate cost data in two ways. The first looks at the four quarters pre-event (Q-3 – Q0), the next four quarters including the event (Q1 – Q4), and each four quarters thereafter (Q5 – Q8, Q9 – Q12, Q13 – Q16). If a DM program targets a population for DM based on a significant event, the pre-implementation period includes the significant event. Therefore, the second view of data looks at the event and the three quarters prior to the event (Q-2 – Q1 or pre-implementation), and the four quarters after the event (Q2 – Q5 or post-implementation).

We track costs of people surrounding a significant event (Q1). The period before a significant event does not include data on the population with a significant event during the first year studied or anyone not enrolled in the year prior to their significant event. The population after a significant event changes when people drop out of the data due to death or disenrollment. Clearly, these populations may be different, with the high-cost population leaving the data and artificially lowering cost. Therefore, we tested the similarity between the continuously enrolled population and those not continuously enrolled for the period pre-implementation and post-implementation. As seen in Table 4, although mean cost is different between those continuously enrolled and the entire population enrolled, we did not find significant difference in the relationship between pre-implementation and post-implementation findings. We did note that in the comorbid continuously enrolled population, cost increased post-implementation. We tested all pre-implementation and post-implementation results and found them to be statistically significantly different at the 95% confidence level.

TABLE 4

MEDICARE POPULATION MEAN COST

Population	Continuously Enrolled Only		Continuously and Not Continuously Enrolled	
	Pre-Implementation[1]	Post-Implementation[2]	Pre-Implementation	Post-Implementation
Diabetes	$7,004	$5,198	$9,206	$6,204
CAD	$8,877	$4,697	$10,593	$5,428
CHF	$10,329	$8,631	$13,232	$10,192
Comorbid	$8,735	$9,682	$11,646	$11,278

[1] Pre-Implementation is defined as Q-2 through Q1

[2] Post-Implementation is defined as Q2 through Q5

TABLE 5

DIABETES AVERAGE CLAIM COST BY AGE BAND

Population	Age Band	Pre-Event	Q1 - Q2	Q3 - Q8	Q9 - Q12	Q13 - Q16
Commercial	All	$2,884	$9,153	$4,753	$4,372	$4,223
	<18	$1,402	$4,706	$2,703	$2,255	$2,255
	18+	$2,995	$9,533	$4,957	$4,420	$4,450
Medicare	All	$2,322	$11,253	$3,842	$3,261	$2,804
	<65	$3,131	$12,598	$5,736	$5,178	$4,563
	65-85	$2,141	$10,977	$3,464	$2,915	$2,475
	85+	$2,075	$10,496	$2,878	$2,120	$1,568

Diabetes

As seen in Table 5, there are differences in mean cost of diabetes by age. The pattern of regression is different in the Medicare and commercial populations. As seen in Figure 2, in aggregate, at the end of the study period Medicare cost regresses slightly higher than cost pre-event. This varies by age group.

For Medicare, substantial regression continues throughout the study period. It is much slower in the population under age 65, whose mean cost is higher than other age groups throughout the study period. At the end of the study period, cost of the below 65 age population regresses to a point much higher than pre-event. The age 85+ population cost regresses to a point lower than that of the other age groups.

As seen in Figure 3, for a commercial population, the >18 and ≤ 18 age categories have similar regression patterns although the mean cost for the >18 group is much higher throughout the study period. Post-event, the cost regresses to a level higher than that pre-event in all age groups although the difference is more pronounced in the >18 population.

FIGURE 2

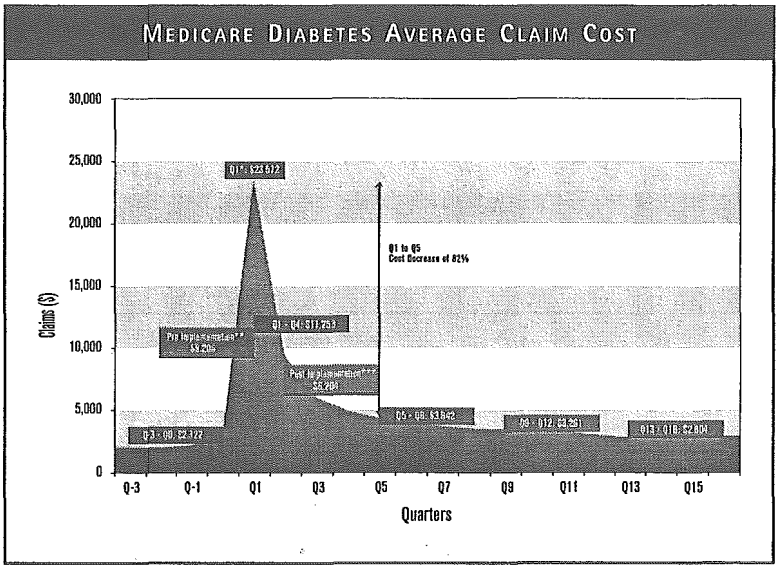


FIGURE 3

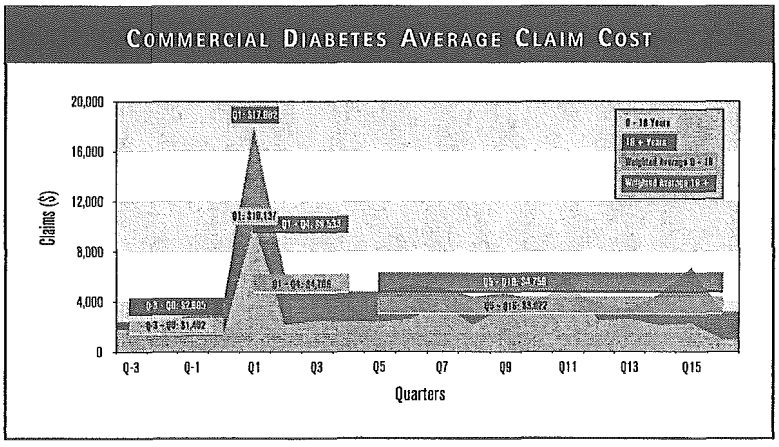


TABLE 6

CORONARY ARTERY DISEASE AVERAGE CLAIM COST BY AGE BAND

Population	Age Band	Pre-Event	Q1 - Q4	Q5 - Q8	Q9 - Q12	Q13 - Q16
Commercial	All	$2,326	$11,344	$2,683	$2,615	$2,599
Medicare	All	$2,119	$11,890	$3,533	$3,080	$2,641
	<65	$2,793	$12,065	$4,990	$4,323	$3,787
	65-85	$2,022	$12,081	$3,396	$3,029	$2,631
	85+	$2,278	$10,762	$3,423	$2,631	$1,994

Coronary Artery Disease (CAD)

As seen in Table 6, CAD mean cost and the pattern of regression are different in the Medicare and commercial populations.

As seen in Figure 4 for the Medicare population with CAD, significant cost regression occurs from Q1-Q4 and continues slowly throughout the study period. In Table 6, we note the regression is much slower in the population under age 65 compared to other age groups. The mean cost of the under age 65 population is higher than other ages throughout the study period. In all ages except the population under 65, the difference between pre-event and post-event cost is not large.

As seen in Figure 5, in the commercial CAD population cost after Q4 remains relatively level at a mean close to pre-event.

FIGURE 4

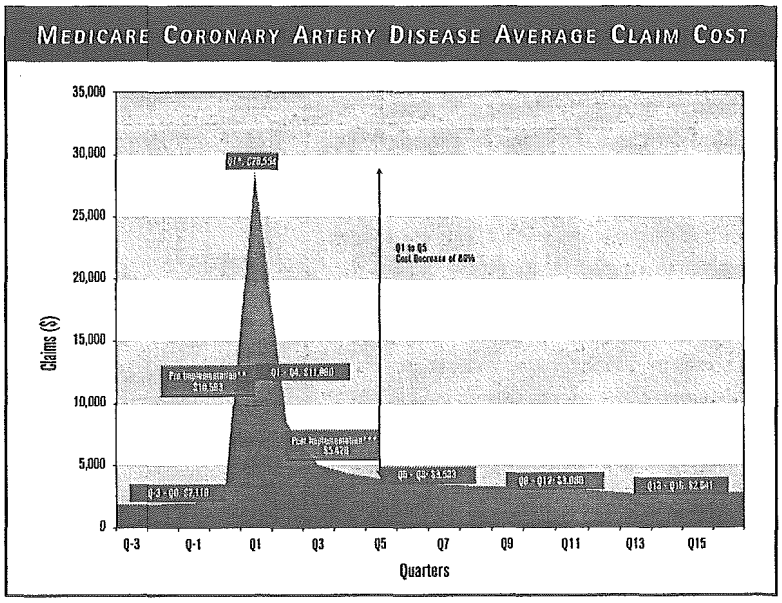


FIGURE 5

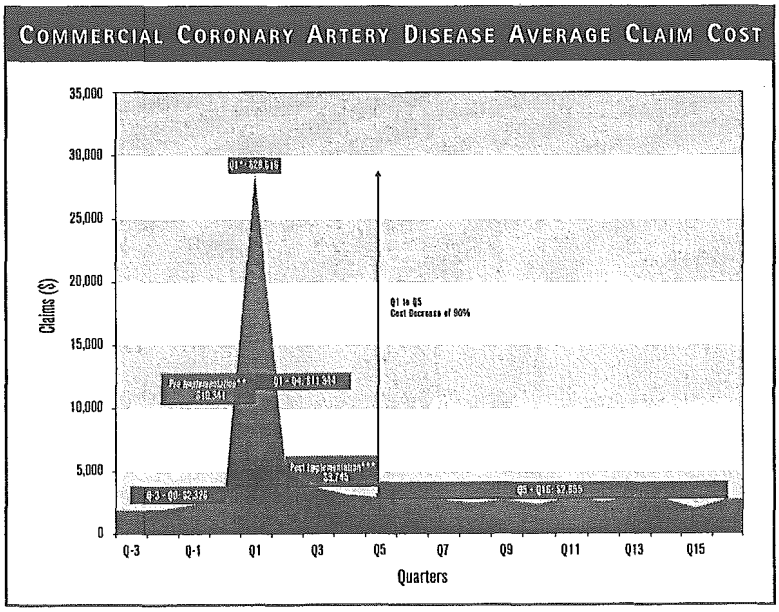


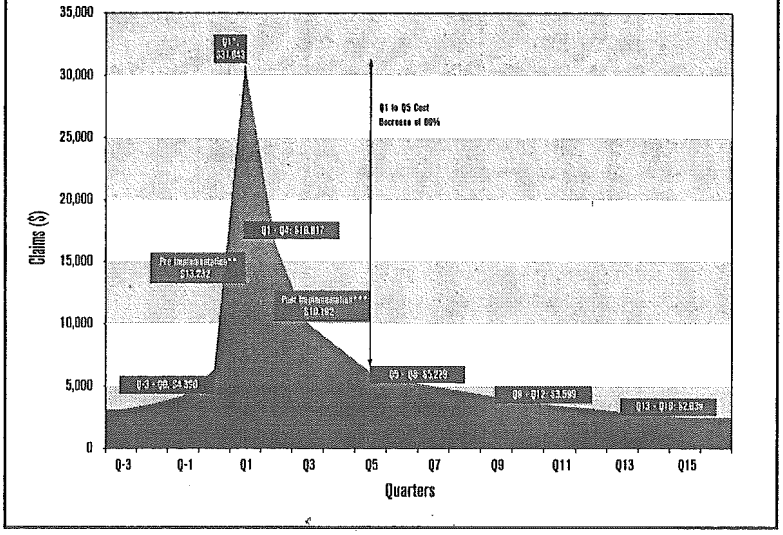
TABLE 7

CONGESTIVE HEART FAILURE AVERAGE CLAIM COST BY AGE BAND

Population	Age Band	Pre-Event	Q1 - Q4	Q5 - Q8	Q9 - Q12	Q13 - Q16
Commercial	All	$5,644	$19,098	$7,161	$5,596	$6,835
Medicare	All	$4,390	$16,817	$5,229	$3,599	$2,639
	<65	$7,040	$21,535	$9,103	$6,287	$5,650
	65-85	$4,517	$18,063	$5,418	$3,859	$2,874
	85+	$3,720	$13,730	$4,308	$2,774	$1,856

FIGURE 6

MEDICARE CHF AVERAGE CLAIM COST



Congestive Heart Failure (CHF)

As seen in Table 7, CHF mean cost and the pattern of regression are different in the Medicare and commercial populations.

As shown in Figure 6, the cost of the Medicare population with CHF continues to regress throughout the study period to a point lower than pre-event.

As shown in Table 7, this occurs in all age groups. Cost regression is much slower in the population under age 65. This age group's cost is higher than the rest of the Medicare population's throughout the study period. Generally, younger individuals regress to a mean cost higher than older individuals.

As seen in Figure 7 (on page 13), in the commercial CHF population, cost fluctuates after Q5. Throughout the study period, the cost remains higher than mean pre-event cost.

FIGURE 7

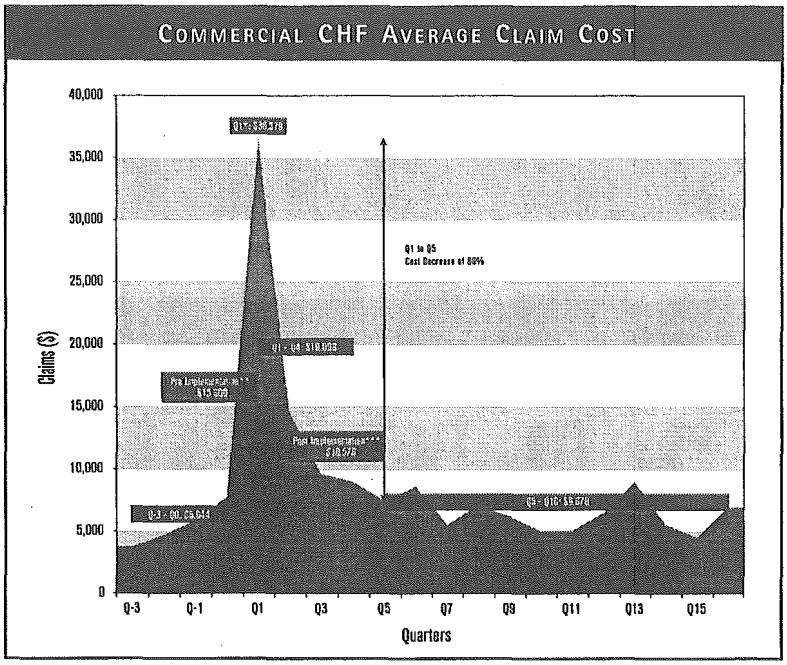

COMMERCIAL CHF AVERAGE CLAIM COST
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Claims ($)
Q1 to Q5
Cost Decrease of 80%
Q-3
Q-1
Q1
Q3
Q5
Q7
Q9
Q11
Q13
Q15
Quarters

TABLE 8

COMORBID DIABETES AVERAGE CLAIM COST BY AGE BAND

Population	Age Band	Pre-Event	Q1 – Q4	Q5 – Q8	Q9 – Q12	Q13 – Q16
Commercial	All	$4,058	$17,829	$8,151	$8,454	$10,038
Medicare	All	$2,066	$16,339	$7,894	$6,240	$4,838
	<65	$2,762	$18,540	$11,335	$9,230	$7,456
	65-85	$1,962	$16,448	$7,608	$6,095	$4,799
	85+	$2,044	$13,828	$6,475	$4,546	$2,947

FIGURE 8

MEDICARE COMORBID DIABETES AVERAGE CLAIM COST

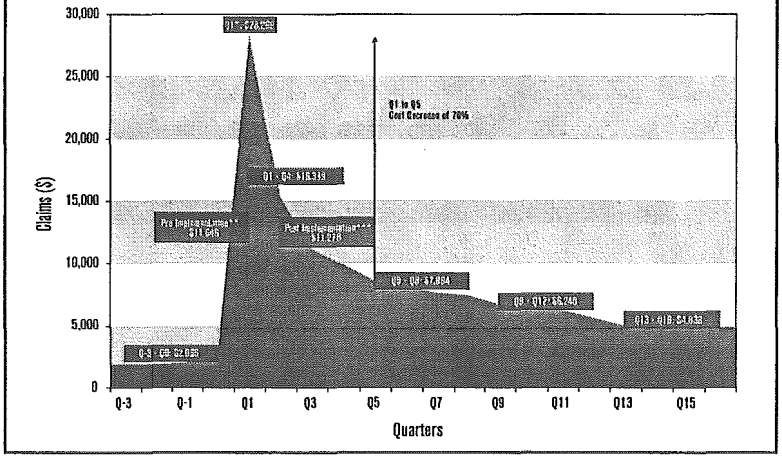
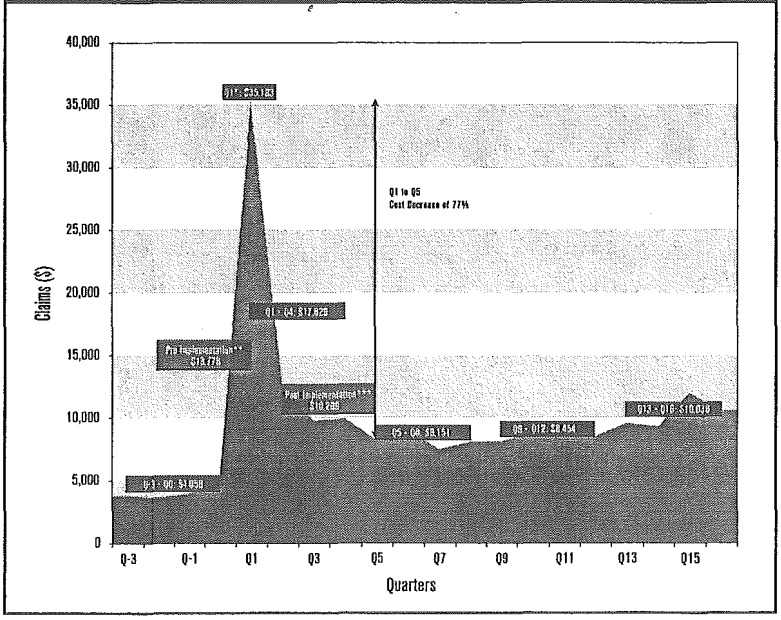


FIGURE 9

COMMERCIAL COMORBID DIABETES AVERAGE CLAIM COST



Comorbid Diabetes

As seen in Table 8, comorbid diabetes mean cost and the pattern of regression are different in the Medicare and commercial populations.

As seen in Figure 8, the Medicare population has a slow and continuous regression post-event throughout the study period.

In fact, the pre-implementation (Q-2 – Q1) cost and post-implementation (Q2 – Q5) cost is about the same. As seen in Table 8 the regression is much slower in the population under age 65.

The mean cost of the under age 65 population is higher than other age groups throughout the study period. Except in the population 85+, post-event cost stays much higher than pre-event cost throughout the study period.

As seen in Figure 9, the commercial population's cost regresses through Q4 post-event, levels off Q5 – Q8, and then begins to climb. Post-event cost never reaches the level of pre-event cost.

SELECTION BIAS

This section describes research intended to provide insight into the variation in health costs of the populations that may be opting in and out of DM as well as the high-risk population that may be excluded from DM programs.

There are several reasons DM outcomes may differ between programs and between populations participating and not participating in DM. The DM program's selection criteria, the population's ability to opt into the program, and the outcomes measurement criteria are significant factors that may explain much of the utilization and cost variation.

- Geographic, economic, cultural, and other population-based factors may change the prevalence of a condition as well as a population's compliance with treatment protocols.
- Personal factors such as age, illness severity, and motivation may influence a person's willingness to enroll in a DM program and their response to the program.
- A DM program may not enroll persons with cancer, undergoing treatment related to a transplant, or known to be terminally ill.
- A DM program may exclude certain individuals enrolled in the program from their outcomes measurement. This may include anyone who dies while in the program, persons enrolled in the program for a short period of time, or persons undergoing cancer treatment or transplant while enrolled in the program.

We present mean cost and cost distribution for the following population subgroups to demonstrate the potential affect of selection bias on DM program savings calculations. We present results from 2001 data in 2001 US dollars by disease category.

TABLE 9

CATEGORY NAME	DESCRIPTION
Terminally Ill/Potentially High Cost	Population with malignant cancer or transplants
Compliant	Population meeting criteria for compliance
Neither	Population with the disease state who are neither compliant nor terminally ill/potential high cost

We provide information for the following disease states:

- Diabetes only
- Coronary Artery Disease (CAD) only
- Congestive Heart Failure; with or without CAD (CHF)

Findings

Following is a summary of findings related to our analysis of select populations:

- Compliant populations are high cost
- The "neither" population has lower cost than all other subgroups.
- Except in commercial diabetes and CHF, terminally ill/potential high cost populations have lower costs than the compliant populations.

TABLE 10

MEAN COST IN 2001 US DOLLARS

Disease State	Source	Terminally Ill/Potential High Cost	Compliant	Neither
Diabetes	Commercial	$11,806	$4,561	$1,768
	Medicare	$42,784	$43,809	$16,859
CHF	Commercial	$30,532	$19,637	$11,457
	Medicare	$44,823	$50,678	$21,433
CAD	Commercial	$12,448	$14,813	$5,870
	Medicare	$36,760	$41,451	$14,680

An individual's non-compliant behavior may lead to a significant event and, because people are more likely to change behavior after such an event, they are classified as compliant due to behavior subsequent to the event.

Because compliance is defined by appropriate use of health maintenance services, all of this population has claims. A portion of the neither and terminally ill/potential high cost populations have no claims cost.

Consistent with studies on the cost of end of life care, terminally ill patients have high cost claims compared to the other subsets of the population. This is also true of the class of patients we define as potential high cost, which includes patients with malignant cancer and solid organ transplants.

IMPLICATIONS FOR DM PROGRAMS

Our results have important implications for DM program analyses and by association, for DM program contracting.

Regression to the Mean

To identify potential DM candidates, many DM programs use direct patient referral by hospital and health plan case managers often triggered by a patient's ER use or an admission. Our findings indicate regression to the mean should be accounted for in every year-to-year analysis of a DM population. This is the case even when a DM program manages an entire population with a disease state. The method used to identify the population with the disease may select more individuals having a significant event and inadvertently introduce the need to account for regression to the mean.

Most DM programs measure results for the 12 months preceding and after DM implementation. Therefore, *in the 12 months post-implementation,* DM programs may find the following results solely as a result of normal regression patterns.

- In most instances, pre-implementation cost will likely be higher than post-implementation cost.
- Diabetes or CAD DM programs managing a disabled Medicare population (i.e., under age 65) will likely have post-implementation medical cost higher than cost pre-event.
- Programs managing an older Medicare population will likely show a bigger drop between pre- and post-implementation cost compared to programs managing younger Medicare populations.
- Commercial DM programs will likely show a larger decrease in cost from pre- to post-implementation compared to programs managing Medicare populations, particularly those managing diabetes.
- A commercial diabetes DM program with a higher portion of comorbid members will likely have a greater difference in pre- and post-implementation cost compared to programs managing a smaller comorbid population.
- A commercial diabetes DM program enrolling juveniles will likely have lower cost than a diabetes program for adults only.
- Programs measuring results beyond the 12 months post-implementation may still see the cost impact of the natural course of the disease managed.
- Post-implementation cost in a commercial DM program will likely be higher than cost before the event that triggered DM enrollment.
- Due to the comorbid population, commercial diabetes programs will likely see post-implementation cost climb.
- Compared to a commercial population, a Medicare population's mean cost after DM will likely be closer to the mean cost before the DM triggering event.

Selection Bias

Analyses comparing cost and cost trends in populations enrolled and not enrolled a DM program need to adjust for age differences. Age differences will likely cause the two groups to have different cost and different changes in cost over time.

Using a cohort comparison savings calculation method, selection bias may mask any savings in Medicare DM programs selecting a high portion of compliant individuals.

If a DM program is attracting non-compliant patients who are motivated to become compliant, their population's costs may increase in subsequent years. The "cost of compliance" does vary by disease state.

METHODOLOGY

Databases

We analyzed the following databases:

- *Commercial:* MarketScan 1998 – 2001 active employees and dependents with pharmacy benefits. We excluded HMO and point of service (POS) with capitation.
- *Medicare:* Medicare 5% sample 1998 – 2001 fee for service (non-HMO) beneficiaries.

Costs and Trends

- *Commercial:* We trend all claim costs to 2001 US dollars. We apply trends based on the total per member per year increase for the population identified with the disease state and were continuously enrolled over the four-year period.
- *Medicare:* We trend all claim costs to 2001 US dollars. We use trend estimates in the 2003 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds.

Population Identification

To identify the population with each disease state, we used ICD-9 CM diagnoses codes as listed in Appendix C, in any diagnoses code position (e.g., primary or other). We looked at all claims except laboratory. For commercial diabetes, we also used the NDC codes for diabetic drugs as defined in HEDIS specifications.

We selected only those individuals who, in a calendar year,

- In an ambulatory or non-acute inpatient setting, had at least two services with one of the diagnoses criteria on different dates; or
- Had at least one encounter in an acute inpatient or emergency room setting with the diagnoses criteria.

Once we identified an individual as having a diagnosis, we considered them to have the diagnosis throughout the entire study period as long as they remained in the enrollment files.

A person with CAD and CHF in any of the years was classified as CHF. A person with diabetes and any of the other conditions in any of the years is classified as comorbid diabetes.

We used the last classification for an individual throughout the study period. For example, if an individual was identified as diabetes in 1998 and CAD in 1999, we classified them as comorbid diabetes from 1998 throughout the study period.

Analysis One: Impact of a Significant Event

Taking the population assigned to each disease category, using the following criteria (see Appendix C for codes) we identified individuals who had a significant event in any of the years:

- Hospitalization for the disease or common complication of the disease
  - Any diagnosis position for CAD or diabetes
  - First diagnosis position for CHF
- Emergency room visit for the disease or common complication of the disease

We calculated average allowed amount in quarterly intervals from the significant event with the earliest service date forward. The quarter of the significant event is Q1 in our summary results.

Analysis Two: Cost of Population Subgroups

We analyzed 2001 claims for people in the 2001 enrollment file and identified as diabetes, CAD, and CHF in any year of data. We divide them into subgroups:

Subgroup 1: Terminally Ill/Potential High Cost Population

We identified populations with diagnoses of malignant cancer or solid organ transplant or who are terminally ill. We identified the terminally ill as:

- Discharge disposition = death or hospice
- Any outpatient hospice care
- Individuals with a date of death (Medicare 5% sample only)

Subgroup 2: Compliant Population

We identified populations not included in Subgroup 1 who meet the compliant criteria. We defined compliant as:

- Diabetes
  - Any recommended diabetic specific diagnostic study/exam in the year (e.g., HbA1C, eye exam, foot exam)
  - One face-to-face ambulatory encounter not in the emergency room
- CAD
  - One lipid/cholesterol test in the year
  - One face-to-face ambulatory encounter not in the emergency room
- CHF (with or without CAD)
  - One face-to-face ambulatory encounter not in the emergency room
  - One prescription for an ACE Inhibitor (not applicable to Medicare)
  - Commercial: No readmissions or emergency room visits within 30 days for CHF
  - Medicare: No more than one admission or emergency room visit for CHF in the quarter of a significant event

Subgroup 3: Neither

We identified the population that is neither compliant (Subgroup 2) nor Terminally Ill/Potential High Cost (Subgroup 1).

Based on the allowed amount, we calculated mean cost for each subset.

OUTSTANDING RESEARCH ISSUES

This research study identified issues deserving further investigation.

Using claims to identify a compliant population is limited. A more comprehensive study on the costs of compliant and non-complaint populations would be valuable in further understanding the relationship to DM savings analyses.

For some disease states in some age groups, regression slows but continues throughout the full period studied. A study with a longer duration would help establish the time required for complete regression.

This research does not address the complex interrelationship between regression to the mean and selection bias. If individuals become motivated to improve their health status because they recently experienced an acute event, they may become less motivated to maintain their health after a long period of no acute events. Therefore, a DM population may experience a short-term decrease in costs, attributable to selection bias and regression to the mean but long-term may return to higher costs due to selection bias. Further studies on this interrelationship will greatly expand body of knowledge needed to account for either of these in DM cost analysis.

CAVEATS AND LIMITATIONS

Our research is intended to present cost patterns in a typical US population. The data are not intended to represent a DM population. If the populations analyzed are different than the population in the US or different than a population in a health plan, health costs may vary significantly. In addition:

- We analyzed the comorbid and non-comorbid populations separately. Most likely, DM programs will include and analyze these populations in aggregate.
- We identified the population with the disease state using claims data. Most DM programs have multiple sources of referral. Therefore, our population may be sicker or otherwise different from DM populations.
- Although we attempted to select populations not likely to have been enrolled in DM, some of the population results presented may in fact be a result of DM interventions.
- This report reflects the methodology and findings of its authors and does not represent an endorsement of any product, policy, DM vendor, or its savings methodology by Milliman. The clinical and actuarial descriptions presented here must not replace sound independent judgment. We urge the reader to review the report in its entirety and carefully examine the assumptions we have made.

APPENDIX

Appendix A

COMMERCIAL
AVERAGE CLAIM COST BY QUARTER AND DISEASE

Age Band	Q-3	Q-2	Q-1	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
									Quarters											
Diabetes																				
All Ages	2,377	2,394	2,763	3,657	17,392	5,845	5,177	4,577	4,596	5,130	4,992	4,168	4,549	4,066	4,955	3,790	3,384	4,292	6,312	2,924
0 - 18 Years	1,786	1,477	1,270	1,254	10,137	2,141	2,455	2,419	2,345	2,617	3,802	2,130	3,619	3,445	6,113	2,478	2,626	2,091	2,244	987
19 + Years	2,418	2,461	2,877	3,845	17,982	6,156	5,412	4,780	4,822	5,380	5,110	4,373	4,642	4,135	4,824	3,940	3,477	4,535	6,751	3,155
Coronary Artery Disease																				
All Ages	1,859	1,927	2,284	2,971	28,616	4,934	3,634	3,064	2,845	2,691	2,670	2,438	2,712	2,310	2,915	2,524	2,820	2,690	1,985	2,677
0 - 18 Years	2,686	972	1,668	3,657	16,110	1,133	4,364	1,086	4,840	2,740	1,681	4,799	3,478	1,830	3,349	85	6,536	1,244	683	0
19 + Years	1,858	1,929	2,285	2,970	28,640	4,942	3,633	3,068	2,840	2,691	2,672	2,432	2,709	2,312	2,913	2,532	2,808	2,693	1,989	2,677
CHF/CAD																				
All Ages	3,663	4,609	5,744	7,665	36,379	14,554	9,501	8,884	7,364	8,529	5,462	7,002	6,124	4,973	4,981	6,415	8,959	5,493	4,441	6,849
0 - 18 Years	704	857	57,121	32,954	89,142	62,784	37,461	18,980	3,648	2,132	2,164	2,092	714	365	1,456	3,710	789	512	0	0
19 + Years	3,682	4,629	5,211	7,297	35,262	13,699	9,044	8,698	7,416	8,623	5,509	7,059	6,181	5,014	5,036	6,455	9,042	5,563	4,441	6,849
Comorbid Diabetes																				
All Ages	3,722	3,576	3,872	4,788	35,183	12,554	9,710	9,883	8,119	8,948	7,415	8,000	8,047	8,682	8,801	8,419	9,510	9,242	11,951	10,489
0 - 18 Years	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 + Years	3,722	3,576	3,872	4,788	35,183	12,554	9,710	9,883	8,119	8,948	7,415	8,000	8,047	8,682	8,801	8,419	9,510	9,242	11,951	10,489

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MEDICARE
AVERAGE CLAIM COST BY QUARTER AND DISEASE

Age Band	Q1 '97	Q2 '97	Q3 '97	Q4 '97	Q1 '98	Q2 '98	Q3 '98	Q4 '98	Q1 '99	Q2 '99	Q3 '99	Q4 '99	Q1 '00	Q2 '00	Q3 '00	Q4 '00	Q1 '01	Q2 '01	Q3 '01	Q4 '01
Diabetes																				
All Ages	2,022	1,974	2,146	2,909	23,572	9,328	5,969	4,898	4,327	3,845	3,676	3,481	3,425	3,371	3,209	2,959	2,782	2,680	2,960	2,883
Ages <65	2,656	2,801	2,948	3,819	23,265	10,910	8,132	7,146	6,185	5,815	5,577	5,312	5,332	5,519	4,896	4,879	4,353	4,299	5,274	4,492
Ages 65-69	1,591	1,636	1,693	2,592	23,369	8,610	5,562	4,267	3,876	3,299	3,194	2,967	2,978	2,729	2,652	2,433	2,483	2,322	2,356	2,343
Ages 70-74	1,884	1,756	1,944	2,709	23,537	8,774	5,173	4,306	3,838	3,698	3,468	3,205	3,156	3,253	3,200	2,703	2,552	2,428	3,070	3,653
Ages 75-79	2,133	1,903	2,204	2,792	24,844	9,370	5,756	4,583	4,108	3,407	3,119	3,173	3,115	3,026	2,739	2,828	2,559	2,438	2,185	2,142
Ages 80-84	1,963	1,758	2,047	2,928	23,812	8,882	5,247	4,618	4,019	3,328	3,548	3,120	3,116	2,746	3,054	2,601	2,409	2,286	2,168	1,965
Ages 85+	1,802	1,935	1,980	2,421	22,172	9,135	5,246	3,771	3,372	2,872	2,609	2,632	2,309	2,285	2,216	1,561	1,655	1,556	1,481	1,512
Coronary Artery Disease																				
All Ages	1,833	1,876	1,954	2,613	28,554	8,373	5,017	4,281	3,862	3,534	3,414	3,286	3,203	3,137	3,051	2,877	2,640	2,617	2,603	2,766
Ages <65	2,506	2,515	2,545	3,356	26,337	8,837	6,249	5,829	5,521	5,075	4,699	4,604	4,337	4,690	4,132	4,081	3,592	3,744	3,838	4,329
Ages 65-69	1,224	1,550	1,489	2,163	30,344	7,719	4,226	3,412	3,131	2,969	2,870	2,606	2,721	2,657	2,451	2,425	2,233	2,066	2,234	2,440
Ages 70-74	1,826	1,645	1,777	2,681	30,210	8,257	4,786	3,980	3,717	3,335	3,210	3,145	3,225	3,096	3,207	2,855	2,782	2,625	2,781	2,847
Ages 75-79	1,889	1,962	2,019	2,530	30,033	8,841	5,177	4,321	3,906	3,583	3,593	3,501	3,318	3,198	3,222	3,073	2,683	2,762	2,929	2,937
Ages 80-84	2,012	2,022	2,099	2,754	27,813	8,652	5,468	4,724	4,065	3,679	3,524	3,475	3,257	3,325	3,146	3,064	2,766	2,890	2,510	2,777
Ages 85+	2,005	2,016	2,251	2,660	23,925	8,148	4,957	4,433	3,797	3,451	3,302	3,105	2,925	2,619	2,607	2,281	2,165	2,076	1,701	1,843
CHF/CAD																				
All Ages	3,044	3,469	4,127	6,254	31,043	16,363	10,016	8,023	6,081	5,312	4,916	4,505	4,099	3,630	3,361	3,146	2,879	2,672	2,416	2,382
Ages <65	5,475	6,226	6,853	8,945	37,259	21,503	14,206	11,199	10,310	8,822	8,811	8,325	6,802	5,928	6,194	6,134	6,426	6,131	4,570	4,529
Ages 65-69	2,786	3,587	4,413	6,487	37,601	18,974	11,024	8,674	6,197	4,880	4,778	4,425	4,730	3,917	3,552	3,304	3,186	3,292	2,924	2,748
Ages 70-74	3,211	3,736	4,337	6,915	37,077	18,406	10,539	8,670	6,357	5,787	5,733	4,487	4,226	4,253	3,941	3,543	3,120	3,080	2,783	3,069
Ages 75-79	3,187	3,647	4,485	6,768	34,077	18,600	10,698	8,377	6,474	5,654	5,361	5,017	4,568	4,253	3,751	3,490	3,338	3,397	2,764	3,511
Ages 80-84	2,954	3,137	3,926	6,128	30,747	15,770	9,788	7,806	5,926	5,654	4,758	4,449	4,167	3,443	3,140	3,306	2,756	2,374	2,194	1,873
Ages 85+	2,622	2,993	3,445	5,271	24,502	13,131	8,620	7,023	5,188	4,310	3,911	3,735	3,224	2,789	2,648	2,290	2,075	1,737	1,866	1,600
Comorbid Diabetes																				
All Ages	1,818	1,828	1,952	2,453	28,269	15,318	11,112	9,873	8,535	7,975	7,601	7,397	6,666	6,421	6,175	5,580	4,947	4,775	4,768	4,824
Ages <65	2,260	2,291	2,717	3,390	27,984	17,170	14,766	13,759	12,089	11,546	11,064	10,549	9,431	9,444	9,706	8,233	7,461	7,099	7,607	7,879
Ages 65-69	1,469	1,507	1,761	2,224	30,490	15,387	10,920	9,492	8,019	7,547	7,093	6,947	6,533	6,097	5,874	5,333	4,744	4,473	4,887	4,983
Ages 70-74	1,719	1,777	1,711	2,373	29,879	15,305	10,758	9,491	8,150	7,583	7,278	7,182	6,367	6,098	5,945	5,665	5,080	5,046	4,741	5,343
Ages 75-79	1,795	1,822	1,879	2,354	29,488	16,231	11,025	9,729	8,761	7,927	7,779	7,691	6,982	6,713	6,200	5,792	5,295	5,152	5,060	4,962
Ages 80-84	1,947	1,889	2,067	2,392	26,725	14,634	10,449	9,103	7,801	7,452	6,928	6,926	6,354	6,017	5,779	4,929	4,354	4,107	3,981	3,799
Ages 85+	1,958	1,899	1,910	2,289	23,319	13,032	9,512	8,575	7,182	6,669	6,250	5,719	4,912	4,821	4,367	3,984	3,120	3,060	2,833	2,558

Appendix B

Commercial
Population by Quarter and Disease

Age Band	Quarter 0-3	0-2	0-1	00	01	02	03	04	05	06	07	08	09	010	011	012	013	014	015	016
Diabetes																				
All Ages	3,317	3,900	4,596	5,374	6,157	5,268	4,330	3,516	2,748	2,318	1,910	1,542	1,248	1,064	870	688	516	393	259	104
0 - 18 Years	212	268	327	390	463	408	344	302	250	209	172	141	114	107	88	71	56	39	25	11
19 + Years	3,105	3,632	4,269	4,984	5,694	4,860	3,986	3,213	2,498	2,108	1,739	1,401	1,134	958	782	617	460	354	234	93
Coronary Artery Disease																				
All Ages	3,345	3,888	4,464	5,130	5,828	5,190	4,532	3,917	3,341	2,952	2,565	2,184	1,838	1,519	1,230	923	627	450	310	149
0 - 18 Years	6	7	9	9	12	11	7	8	8	7	6	6	6	6	5	3	2	1	1	0
19 + Years	3,339	3,881	4,456	5,121	5,816	5,178	4,525	3,909	3,333	2,945	2,559	2,178	1,832	1,513	1,225	920	625	449	309	149
CHF/CAD																				
All Ages	636	726	843	954	1,096	958	810	666	566	485	425	350	285	231	196	140	100	73	48	24
0 - 18 Years	4	4	9	14	23	17	13	12	8	7	6	4	3	2	3	2	1	1	0	0
19 + Years	632	722	834	940	1,073	942	797	654	558	478	419	346	282	229	193	138	99	72	48	24
Comorbid Diabetes																				
All Ages	1,459	1,690	1,929	2,285	2,658	2,445	2,195	1,938	1,680	1,501	1,315	1,137	954	803	642	495	361	287	196	97
0 - 18 Years	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 + Years	1,459	1,690	1,929	2,285	2,658	2,445	2,195	1,938	1,680	1,501	1,315	1,137	954	803	642	495	361	287	196	97

Medicare
Population by Quarter and Disease

Age Band	Q1-2	Q2-2	Q3-2	Q4	Q1	Q2	Q3	Q4	Q1	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Diabetes																				
All Ages	33,115	38,628	45,113	53,412	65,031	62,060	59,689	57,635	55,665	54,361	52,832	51,100	49,592	45,403	41,204	36,654	31,322	25,543	19,100	11,203
Ages <65	6,417	7,265	8,484	10,181	12,917	12,525	12,065	11,510	10,893	10,555	10,152	9,707	9,288	8,625	7,900	7,149	6,239	5,254	4,035	2,459
Ages 65-69	6,584	7,792	9,077	10,735	12,903	12,379	11,941	11,554	11,151	10,886	10,565	10,228	9,889	8,980	8,093	7,135	6,104	4,831	3,533	2,001
Ages 70-74	6,528	7,666	8,973	10,627	12,738	12,190	11,715	11,397	11,052	10,804	10,525	10,225	9,953	9,079	8,230	7,295	6,176	5,028	3,721	2,104
Ages 75-79	5,961	6,968	8,162	9,544	11,512	10,979	10,564	10,214	9,892	9,693	9,476	9,197	8,931	8,145	7,368	6,487	5,497	4,474	3,299	1,959
Ages 80-84	4,227	4,941	5,739	6,745	8,114	7,651	7,348	7,080	6,920	6,790	6,607	6,366	6,216	5,667	5,111	4,568	3,855	3,126	2,345	1,383
Ages 85+	3,398	3,996	4,678	5,579	6,847	6,336	6,056	5,880	5,757	5,634	5,506	5,377	5,315	4,907	4,502	4,020	3,451	2,831	2,166	1,297
Coronary Artery Disease																				
All Ages	62,770	73,697	86,177	101,692	122,398	117,118	113,857	111,110	108,921	105,021	100,783	96,438	92,268	84,530	76,872	68,594	58,965	47,610	35,241	20,396
Ages <65	4,754	5,624	6,792	8,199	10,334	10,032	9,719	9,393	9,107	8,759	8,415	8,053	7,722	7,223	6,708	6,106	5,435	4,508	3,351	2,010
Ages 65-69	11,974	14,092	16,555	19,521	23,214	22,528	21,966	21,436	20,946	20,089	19,152	18,197	17,179	15,628	14,104	12,534	10,804	8,511	6,106	3,396
Ages 70-74	13,173	15,554	18,171	21,352	25,460	24,601	24,022	23,519	23,073	22,214	21,302	20,346	19,387	17,791	16,124	14,306	12,264	9,858	7,241	4,115
Ages 75-79	13,393	15,710	18,249	21,461	25,555	24,496	23,811	23,269	22,753	22,001	21,117	20,191	19,255	17,569	15,908	14,213	12,147	9,766	7,236	4,106
Ages 80-84	10,224	11,946	13,853	16,308	19,704	18,661	18,079	17,637	17,348	16,758	16,125	15,427	14,812	13,566	12,369	10,993	9,395	7,639	5,762	3,405
Ages 85+	9,251	10,771	12,557	14,851	18,132	16,800	16,260	15,855	15,695	15,201	14,672	14,224	13,912	12,753	11,659	10,443	8,920	7,327	5,544	3,364
CHF/CAD																				
All Ages	42,467	47,431	53,253	61,700	77,398	71,958	69,104	68,065	69,127	66,436	63,849	61,424	59,627	54,624	49,626	43,385	35,020	29,700	23,863	15,762
Ages <65	2,267	2,486	2,761	3,195	3,937	3,719	3,549	3,462	3,434	3,280	3,133	2,975	2,797	2,569	2,275	1,982	1,627	1,352	1,066	678
Ages 65-69	3,786	4,279	4,829	5,593	6,806	6,407	6,201	6,108	6,147	5,899	5,658	5,435	5,159	4,688	4,223	3,632	2,942	2,416	1,874	1,162
Ages 70-74	5,685	6,371	7,157	8,288	10,133	9,566	9,281	9,113	9,118	8,763	8,394	8,057	7,774	7,122	6,453	5,607	4,481	3,776	3,002	1,908
Ages 75-79	7,927	8,863	10,017	11,569	14,314	13,407	12,900	12,724	12,781	12,329	11,833	11,335	10,903	9,925	9,001	7,863	6,391	5,406	4,256	2,753
Ages 80-84	8,991	10,030	11,251	13,005	16,393	15,250	14,655	14,457	14,675	14,055	13,496	13,028	12,693	11,664	10,569	9,212	7,442	6,337	5,105	3,427
Ages 85+	13,810	15,402	17,238	20,050	25,815	23,609	22,517	22,203	22,972	22,111	21,336	20,594	20,301	18,655	17,105	15,089	12,136	10,413	8,560	5,834
Comorbid Diabetes																				
All Ages	48,135	57,045	68,858	86,623	121,765	118,530	115,539	112,501	109,941	105,977	102,222	98,817	97,293	91,796	86,136	79,493	71,532	61,688	49,529	32,538
Ages <65	5,761	6,685	7,982	10,163	14,651	14,475	14,105	13,664	13,134	12,679	12,163	11,626	11,335	10,799	10,185	9,444	8,474	7,406	6,031	3,981
Ages 65-69	9,135	10,791	12,895	15,989	21,400	20,974	20,443	19,887	19,301	18,582	17,818	17,102	16,463	15,472	14,375	13,174	11,730	9,888	7,749	4,851
Ages 70-74	9,836	11,816	14,423	18,122	25,007	24,396	23,873	23,339	22,635	22,056	21,348	20,699	20,294	19,135	17,995	16,579	14,896	12,768	10,133	6,521
Ages 75-79	9,830	11,672	14,033	17,662	24,763	24,087	23,536	22,953	22,498	21,670	20,907	20,229	19,871	18,790	17,577	16,204	14,603	12,603	10,179	6,690
Ages 80-84	7,277	8,648	10,461	13,157	18,806	18,169	17,691	17,236	16,915	16,312	15,784	15,331	15,326	14,402	13,514	12,517	11,264	9,747	7,874	5,281
Ages 85+	6,296	7,433	9,064	11,530	17,137	16,429	15,892	15,422	15,257	14,675	14,202	13,831	14,003	13,198	12,491	11,575	10,566	9,277	7,663	5,213

Appendix C

Diagnosis and Procedure Codes

Population Identification

Diabetes: ICD9 diagnosis: 250.XX, 357.2, 362.0X, 366.41, DRG: 294, 205
Coronary Artery Disease: ICD9 diagnosis: 410.X, 411.X, 412, 413.X, 414.X
Congestive Heart Failure: ICD9 diagnosis: 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.XX

Diabetes Complication:

Renal Failure: ICD9 diagnosis: 584.XX- 586.X
Peripheral Vascular Disease: ICD9 diagnosis: 440.X
Cellulitis: ICD9 diagnosis: 682.6, 682.7, 681.1
Gangrene: ICD9 diagnosis: 785.4

CAD Complication

MI: ICD9 diagnosis: 410.xx, DRG: 121, 122, 516
PTCA: CPT: 33140, 92980-92982, 92984, 92995-92996
ICD9 procedure: 36.01, 36.02, 36.05, 36.09
DRG: 516, 517, 518
CABG: CPT: 33510-33514, 33516-33519, 33521-33523, 33533-33536
ICD9 procedure: 36.1, 36.2
DRG: 106, 107, 109
Angina: ICD9 diagnosis: 411.1, 411.8x, 413.X

Potential High Cost

Transplants: CPT: 33945, 33935, 44133-44136, 47135-47136, 32851-32854, 48160, 48551-48556, 60512, 50365, 50360, 50380
ICD9 diagnosis: 996.83, V42.1, 996.87, V42.84, 996.82, V42.7, 996.84, V42.6, V42.83, 996.86, V42.83, 996.81, V42.0
(Excludes skin, bone, cornea, cartilage, bone marrow, hair, autotransplants, muscle and stem cell)
Malignant Cancer: ICD9 diagnosis: 140.xx-208.xx
Laboratory: CPT: 80000-89999