# V

# An Application of Study Findings to a Risk Adjustment Process

We simulated the risk adjustment process within a hypothetical purchasing alliance, using four risk assessment methods: age and sex, ADGs, PIPDCGs, and EDCGDXs. Age and sex have been commonly used as risk adjusters. We chose the other three models based on the findings for predictive accuracy. Our goal was twofold: (1) to obtain an indication of the magnitudes of the transfers across pools that would occur under the various methods; and (2) to relate differences in the patterns of transfers to specific features of the various methods.

## A. Methods

We simulated a risk adjustment process using seven risk pools that together account for about 860,000 lives and $1.2 billion in claims—the same data used in the analysis of high-cost conditions in Chapter IV.[1] We used the entire data from these pools for both estimation and prediction. We did this for two reasons. First, we found that using this approach versus a split sample design had a negligible impact on the results. Second, the estimation of risk weights for such a process would most likely involve the use of all data available for each pool. Because we did the estimation and prediction on the same sample, the average actual expenditures across all plans and average predicted expenditures (whichever method is used) across all plans are necessarily the same, $1,364. We truncated expenditures at $50,000, on the assumption that some mechanism would be used to compensate pools for high-cost cases. Finally, due to data availability, we used a 1992 retrospective application of the models.

Table 27 shows the calculations used to compute transfers between plans, using the numbers derived from the age and sex method of risk assessment. These calculations are based on the following assumptions:

- The plan designs are close enough so that we have not adjusted for plan design differences.[2]
- The carriers will base their premiums to be charged on their preadjusted premiums plus the transfer amounts. In other words, carriers needing to "pay" into the pool will not fund the payment from surplus.
- Retention charges have been ignored.
- Actual average claims costs have been used as a proxy for premium prior to transfer amount.
- The purchasing alliance is in a particular geographic area and no further adjustments are needed for geography.
- We have ignored the impact of family status on premiums to be charged and have illustrated "per-capita" risk adjustment.

Table 27 includes the following information:

a. *Ratio of each pool predicted cost to average.* The ratio of the predicted claim cost in (b) for each pool to the average cost of all pools (measured relative risk).

b. *Predicted average claims cost per person.* The result of applying the risk assessment weights for each risk class to the number of individuals in that risk class and adding the results for all risk classes. Note that the risk assessment weights are developed for the entire purchasing alliance.

c. *Actual average claims cost per person.* This is the actual per capita average claims cost for each risk

**TABLE 27**
**SIMULATION OF RISK-ADJUSTMENT TRANSFER PROCESS**
**USING DIFFERENT RISK ASSESSMENT METHODS**
**EXAMPLE OF CALCULATION OF TRANSFER AMOUNTS USING AGE-SEX METHOD**

| | Pool | | | | | | | All Seven Pools |
|---|---|---|---|---|---|---|---|---|
| | IA | IH | PA | PC | HA | HB | HD | |
| (a) Ratio of each pool predicted to average | 0.932 | 1.185 | 0.919 | 0.979 | 0.923 | 0.990 | 0.953 | 1.000 |
| (b) Predicted average claims cost per person | $1,271 | $1,617 | $1,254 | $1,335 | $1,259 | $1,351 | $1,300 | $1,364 |
| (c) Actual average claims cost per person | $1,330 | $1,806 | $1,339 | $1,102 | $1,400 | $1,246 | $1,375 | $1,364 |
| (d) Transfer ratio | 0.068 | (0.185) | 0.081 | 0.021 | 0.077 | 0.010 | 0.047 | 0.000 |
| (e) Transfer based on "average cost" per capita | 93 | (253) | 110 | 29 | 105 | 13 | 64 | |
| (f) Adjusted pure premium (c) +(e) | $1,423 | $1,553 | $1,449 | $1,131 | $1,505 | $1,259 | $1,439 | $1,364 |
| (g) Number of enrollees | 153,526 | 171,764 | 169,513 | 204,351 | 20,098 | 120,965 | 18,498 | 858,715 |
| (h) Total Transfer (e) x (f) ('000s) | $14,278 | ($43,456) | $18,646 | $5,926 | $2,110 | $1,573 | $1,184 | $259 |
| (i) Adjustments to achieve zero as sum of amounts in (h) ('000s) | ($58) | $0 | ($64) | ($78) | ($8) | ($46) | ($7) | ($259) |
| (j) Transfer after adjustment ('000s) | $14,220 | ($43,456) | $18,582 | $5,849 | $2,103 | $1,527 | $1,177 | $0 |

pool. We are using this as a "proxy" to a non-risk-adjusted premium.

d. *Transfer ratio.* The difference between the ratios in (a) and 1.00.
e. *Transfer based on average cost per capita.* The transfer ratios in (d) applied to the average alliance claims cost per person. The transfer ratios could also be applied to the lowest or highest alliance average claims cost per person.
f. *Adjusted pure premium.* The sum of (c) and (e). This assumes each carrier will develop the adjusted pure premium as the sum of the actual average claims cost and the transfer amount. The term "pure premium" is being used to reflect the fact that we are working with claims costs and have no information available concerning retention charges.
g. *Number of enrollees.* The number of insureds in each pool for the period studied.
h. *Total transfer.* The number of enrollees times the transfer amounts.
i. *Adjustments to achieve zero as sum of amounts in (h).* Since the risk transfers should sum to zero over the entire purchasing alliance, it is necessary to adjust all transfer amounts. Where a negative balance was observed (too many dollars transfered), we decreased the transfers for each of the pools transferring funds by an amount proportionate to their total number of enrollees. In the same way, where a positive balance was observed, we increased the transfers of those pools transferring funds.
j. *Transfer after adjustment.* The sum of (h) and (i). The transfers shown on this row are budget-neutral, that is, the transfers across pools cancel each other out.

## B. Results

Table 28 summarizes the key results across the four methods simulated. In particular, the table reports the ratio of each pool's predicted average cost to the mean actual cost across all pools for each method (measured relative risk), as well as the net (budget-neutral) transfer to or from each pool implied by the method. Negative transfers (shown in parentheses) represent a net transfer to a pool. Ratios less than 1.0 represent a measured relative risk less than the weighted average for all participating pools, the weights being the number of enrollees in each pool.

As shown, there are some differences between the risk transfers and relative risk measures produced by the four models. The transfers produced by the age and sex and PIPDCG models are most similar. Under both models, all pools would transfer funds to pool IH. One trend observable between these two models is a net increase in transfers to the indemnity pools (IA and IH) relative to the other pools when moving from age and sex to PIPDCGs. The PIPDCG model produces a higher relative risk measure for these two pools than age and sex, about 3.5% higher.

The differences in transfers are considerably larger between the PIPDCG and age and sex models and the

## TABLE 28
## SIMULATION OF RISK-ADJUSTMENT TRANSFER PROCESS USING DIFFERENT RISK ASSESSMENT METHODS PROJECTED TRANSFERS ACROSS POOLS, BY METHOD

| | Pool | | | | | | | All Seven Pools |
|---|---|---|---|---|---|---|---|---|
| | IA | IH | PA | PC | HA | HB | HD | |
| Actual claims cost per person | $1,330 | $1,806 | $1,339 | $1,102 | $1,400 | $1,246 | $1,375 | $1,364 |
| Ratio of each pool predicted to average | | | | | | | | |
| Age and sex | 0.932 | 1.185 | 0.919 | 0.979 | 0.923 | 0.990 | 0.953 | 0.000 |
| ADG | 0.916 | 0.895 | 1.046 | 1.007 | 1.080 | 1.065 | 1.638 | 0.000 |
| PIPDCG | 0.968 | 1.227 | 0.904 | 0.942 | 0.905 | 0.974 | 0.933 | 0.000 |
| EDCGDX | 0.927 | 1.044 | 0.985 | 0.983 | 1.035 | 1.016 | 1.361 | 0.000 |
| Net transfer to pool (millions of $'s) | | | | | | | | |
| Age and sex | $14.2M | ($43.5M) | $18.6M | $5.9M | $2.1M | $1.6M | $1.2M | $0 |
| ADG | $17.3M | $24.2M | ($10.7M) | ($1.8M) | ($2.2M) | ($10.8M) | ($16.1M) | $0 |
| PIPDCG | $6.5M | ($53.2M) | $22.1M | $16.0M | $2.6M | $4.3M | $1.7M | $0 |
| EDCGDX | $15.2M | ($10.3M) | $3.4M | $4.5M | ($1.0M) | ($2.7M) | ($9.1M) | $0 |

ADG and EDCGDX models. This is particularly true for pools IH and HD. Under the age-sex and PIPDCG models, pool IH, having the highest measured risk, would receive a transfer from each of the other pools. However, using the ADG method, pool IH would actually transfer funds *to* all of the other pools, with the exception of pool IA. Pool IH would also transfer funds to other pools using the EDCGDX method to assess risk. Consistent with these results, pool IH has high relative measured risk under the age-sex and PIPDCG methods and below average and average risk using the ADG and EDCGDX models.

For pool HD, when using age-sex or PIPDCGs, lower than average relative risk results (ratios of 0.953 and 0.933). Using these models, pool HD would transfer funds to other pools. In contrast, using the ADG or EDCGDX models, pool HD would *receive* significant transfers from other pools. In fact, the ratio of predicted claims for the pool to the average for all pools was 1.638 under ADGs, suggesting measured risk 64 percent above the average for all pools in the Alliance. This ratio was 1.361 for the EDCGDX model.

For the other pools—with the exception of pool IA—net transfers decrease when moving from the PIPDCG or age and sex models to the ADG or EDCGDX models. The differences for these pools are in part due to the measurable decrease in relative risk and increase in transfers for pool IH. Since this is a "zero-sum game," an increase in transfers for some pools is always balanced by decreases for others.

The marked differences in transfers between the methods is troubling. We investigated further these findings by first examining the distribution of risk groups within a pool for each method and comparing them with those for all other pools. In other words, we compared the percent frequency with which each enrollee was assigned to a particular age-sex, PIPDCG, ADG, or EDCGDX group. Since these distributions are largely responsible for the relative risk for a pool, they may provide us with some further insight into the transfers we observed. Given their wider differences in results, we focused this analysis on pools IH and HD.

In general, the risk group distributions for the age-sex and PIPDCG models appeared to be reasonable for all seven pools and were supported by other data. Pool IH had a somewhat older population, a finding reflected in its higher risk measure for the age-sex model. (While most pools had 15–20% of enrollees over age 45, this figure was 40% for pool IH.) The PIPDCG distributions also appeared to be appropriate. The higher number of admissions per enrollee for pool IH (and a presumably greater mix of admissions with higher expected costs related to its older population) is consistent with its high relative measured risk for the model.

In contrast, the distribution of enrollees across ADGs and EDCGDX groups for pools IH and HD were quite different—from each other and from other pools. Table 29 shows pool HD had a greater percentage of enrollees in almost all ADGs (a person can have more than one ADG) than all pools in the study database. The reverse is true for pool IH.

Table 30 presents a similar picture for EDCGs (the main component of the EDCGDX model). Pool HD has a different mix of EDCG assignments (a person can

## TABLE 29
## ADGs USED IN THE ANALYSIS

| ADG | Description | All Pools | Pool IH | Pool HD |
|---|---|---|---|---|
| 1 | Time Limited: Minor | 9.6% | 5.4% | 16.7% |
| 2 | Time Limited: Minor-Primary Infections | 1.6 | 8.0 | 31.8 |
| 3 | Time Limited: Major | 3.8 | 2.6 | 9.0 |
| 4 | Time Limited: Major-Primary Infections | 3.1 | 1.5 | 5.9 |
| 5 | Allergies | 1.4 | 0.9 | 4.7 |
| 6 | Asthma | 1.5 | 0.7 | 3.0 |
| 7 | Likely to Recur: Discrete | 8.2 | 4.4 | 14.5 |
| 8 | Likely to Recur: Discrete-Infections | 13.0 | 6.1 | 25.8 |
| 9 | Likely to Recur: Progressive | 0.4 | 0.3 | 0.6 |
| 10 | Chronic Medical: Stable | 10.8 | 8.9 | 24.1 |
| 11 | Chronic Medical: Unstable | 4.8 | 4.5 | 7.7 |
| 12 | Chronic Specialty: Stable Orthopedic | 0.9 | 0.5 | 1.5 |
| 13 | Chronic Specialty: Stable-Ear, Nose, Throat | 0.6 | 0.3 | 0.8 |
| 14 | Chronic Specialty: Stable-Eye | 1.4 | 3.3 | 9.3 |
| 15 | Chronic Specialty: Stable-Other | 0.1 | 0.1 | 0.1 |
| 16 | Chronic Specialty: Unstable-Orthopedic | 1.2 | 0.7 | 1.7 |
| 17 | Chronic Specialty: Unstable-Ear, Nose, Throat | 2.3 | 0.8 | 5.1 |
| 18 | Chronic Specialty: Unstable Eye | 1.6 | 1.8 | 3.3 |
| 19 | Chronic Specialty : Unstable-Other | 0.5 | 0.2 | 1.0 |
| 20 | Dermatologic | 4.3 | 2.6 | 7.0 |
| 21 | Injuries/Adverse Effects : Minor | 4.2 | 4.3 | 12.1 |
| 22 | Injuries/Adverse Effects: Major | 4.5 | 4.3 | 8.0 |
| 23 | Psychosocial: Major | 4.8 | 4.0 | 4.5 |
| 24 | Psychosocial: Other | 1.4 | 0.4 | 1.1 |
| 25 | Psychophysiologic | 2.3 | 1.1 | 4.0 |
| 26 | Signs/Symptoms: Minor | 11.9 | 5.2 | 15.3 |
| 27 | Signs/Symptoms: Uncertain | 4.8 | 3.0 | 7.3 |
| 28 | Signs/Symptoms: Major | 1.3 | 7.9 | 23.7 |
| 29 | Discretionary | 6.9 | 3.8 | 11.4 |
| 30 | See and Reassure | 0.8 | 0.5 | 1.6 |
| 31 | Prevention/Administrative | 17.9 | 7.6 | 50.3 |
| 32 | Malignancy | 2.1 | 1.9 | 4.0 |
| 33 | Pregnancy | 2.2 | 0.9 | 3.3 |
| 34 | Dental | 1.8 | 1.4 | 0.1 |
| | No ADGs | 38.4% | 47.5% | 13.7% |

## TABLE 30
## PERCENTAGE OF ENROLLEES WITH EDCGs

| EDCG# | All Pools | Pool IH | Pool HD |
|---|---|---|---|
| 1 | 61.4% | 62.0% | 33.3% |
| 2 | 30.0 | 29.1 | 53.7 |
| 3 | NA | NA | NA |
| 4 | 6.5 | 6.1 | 10.5 |
| 5 | 0.2 | 0.3 | 0.2 |
| 6 | 0.8 | 0.9 | 1.2 |
| 7 | 0.1 | 0.2 | 0.2 |
| 8 | 0.5 | 0.7 | 0.6 |
| 10 | 0.2 | 0.3 | 0.2 |
| 12 | 0.1 | 0.1 | 0.1 |
| 14 | 0.1 | 0.2 | 0.1 |
| 17 | 0.05 | 0.09 | 0.04 |
| 23 | 0.02 | 0.01 | 0.03 |

only have one EDCG) than that found for all pools. This is particularly true for the first two EDCGs where pool HD has a greater number of individuals in EDCG 2 relative to EDCG 1. The distribution of EDCGs for pool IH is comparable to that for all pools—a finding inconsistent with its older population.

We further examined these differences by comparing the percentage of nonclaimants in each of the pools. We did this for two reasons. First, as described in Section III-2, carriers were asked to submit all claims for an individual, before copayments and deductibles. Although all of the pools studied described plans with low deductibles (less than $500), some nonreporting of claims may have occurred. Some of the plans, in particular the HMO pools in the study, would be expected to have no, or lower, deductibles. As a result, they may have a greater likelihood of capturing all claims and would show a lower percentage of nonclaimants. Second, some plans, in particular HMOs, may provide a greater number of ambulatory services per enrollee such as primary care services, including prevention. This hypothesis is supported by the distribution in Table 29, which shows 50% of the enrollees in pool HD were assigned ADG 31, "Preventive/Administrative," in comparison to 18% for all pools. More services of this type would also be consistent with a lower percentage of nonclaimants and more ambulatory encounters.

We found differences in the percentage of nonclaimants across the seven pools. With the exception of two of the HMO plans, most of the plans showed no claims for 30–35% of enrollees. In contrast, for HMO pools HA and HD, this percentage was 17% and 14%, respectively. For pool IH, this percentage was 32%.

As described previously, the ADG model measures risk for each individual based on his or her ambulatory diagnoses, and each unique diagnosis code is grouped into an ADG. As a result, a greater number of unique ICD9 codings for each individual will potentially result in more ADGs and a higher measure of risk. In the same way, the presence of an ambulatory diagnosis in the EDCGDX model may result in a higher DCG. However, with DCGs, only one DCG is assigned per person. The age and sex and PIPDCG models are not influenced by ambulatory codings.

Table 29 shows Pool HD to clearly have a greater intensity of ambulatory diagnosis codings and therefore a greater intensity of ADG assignments. The opposite situation holds for pool IH. The comparison in Table 30 for EDCGs, which uses both inpatient and ambulatory diagnoses is also consistent with greater ambulatory coding for pool HD.

# C. Discussion and Conclusions

In simulating a risk adjustment process, we observed significant differences in risk transfer amounts between two sets of models: those using ambulatory diagnoses (ADG and EDCGDX models) and those not using ambulatory diagnoses (age and sex and PIPDCGs). We conclude that these differences are due to differences in the reporting and coding of diagnoses for ambulatory encounters across pools. Pool HD in the simulation showed both a greater percentage of enrollees with claims and a greater intensity of diagnoses per enrollee. Pool IH had a lesser intensity of ambulatory diagnoses per enrollee, even relative to other indemnity plans. This was so despite having a significantly older enrollee mix.

There are three possible explanations for this finding. First, some plans may do a better job of capturing diagnoses for all ambulatory encounters. This may be result from better data systems, incentives for providers to submit claims, or incentives for enrollees to submit claims. (The HMO plans likely had lower deductibles.) Second, the better data systems of some plans may produce more accurate and complete coding for each ambulatory encounter. Third, some plans (HMOs in particular) may provide a different mix of ambulatory services, including preventive care. As a result, a greater percentage of enrollees may have ambulatory encounters, as well as a greater number of these encounters may occur per enrollee.

The first two explanations present problems that could be overcome by more uniform and comprehensive data collection for ambulatory care. The third explanation—that plans may differ in their mix of selected services—is more of a policy question. Plans should not be penalized for providing services such as preventive care. However, how such services and their diagnoses are incorporated into a risk assessment method warrants some discussion.

Whatever the reason for the differences in the risk transfers we observed across methods, they emphasize the important issues of data quality, consistency, and completeness in a risk adjustment transfer process. When risk assessment is performed within a plan such as for the pool by pool analyses of predictive accuracy we performed (described in Chapter III) or for a plan setting provider capitation rates or profiling physicians, this issue has lesser importance. (Data quality is likely to be more consistent within a plan.) However, using risk assessment across plans for a risk transfer process presents significant data challenges, particularly for methods using ambulatory diagnoses.

### END NOTES

1. As described previously, IA and IH are indemnity pools; PA and PC are PPO pools; and HA, HD, and HB are HMO pools.
2. Technically, this means that in estimating the risk weights, no plan dummy variables were included in the regression models.