TECHNICAL APPENDIX C

# Chronic Care ECR Estimator

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PROMETHEUS Payment is designed to be a "win-win-win" for patients, physicians and health care purchasers. Patients benefit by avoiding PACs and achieving better health outcomes, and purchasers from lower health costs. Physicians who help patients stay healthy should benefit by retaining the portion of the episode case rate that normally would go to pay for the cost of avoidable PACs. To test the proposition that physicians will benefit under this new payment system, PROMETHEUS (with support from Discern Consulting) built a simulation of a primary care physician practice called the Chronic Care ECR Estimator.

The ECR Estimator is an Excel-based model used to simulate a population of chronically ill patients being treated in a primary care practice. Wherever possible, the data in the ECR Estimator are based on analysis of a large database for a commercially insured population. For example, the average fee-for-service (FFS) costs and the prevalence of chronic conditions and associated risk factors are all based on this database.

As a baseline, we assumed[4] a total population of 2,000 patients in the practice, or which 500 are chronically ill. Chronic conditions within this population are distributed as follows:

- Hypertension – 310 patients (62%)
- Coronary Artery Disease – 70 patients (14%)
- Diabetes – 50 patients (10%)
- Asthma – 35 Patients (7%)
- Chronic Obstructive Pulmonary Disease – 25 patients (5%)
- Congestive Heart Failure – 10 patients (2%)

Next, using randomization functions in Excel, we modeled each of the individual chronically ill patients in the physician practice. Parameters for each patient included age, gender and whether certain risk factors were present. (The risk factors included are those that were found to have a significant impact on total costs based on the analysis of the commercial insurance database.) While each patient was randomly generated, the probabilities for each parameter followed the probabilities observed in the commercially insured population. For example, each chronic disease has a certain age distribution, and each risk factor has a certain probability associated with the patient's age.

[4] All of the assumptions in the Chronic Care ECR Estimator can be adjusted to: 1) test different parameters; 2) cover the details of a specific primary care practice or community; and/or 3) integrate new evidence as it becomes available.

Here is an example of a diabetes patient from the model:

- Age: 60
- Gender: Female
- Risk Factors Present

**Medical**

- Diabetes – IDDM, Uncontrolled
- Thyroid Disorders
- Ancillary, home health, transport
- DME, visual, hearing aids

**Pharmacy**

- Insulin
- Other anti-diabetics
- Other cardiovascular agents
- Statins and other anti-lipid agents

This process is replicated for each of the 500 patients, thus generating a patient population that a typical primary care physician might treat. For each patient, the ECR estimator then completes two calculations: 1) what the patient's costs would be under traditional FFS reimbursement and 2) the PROMETHEUS ECR payment for that patient. In general, the PROMETHEUS payment will be higher than the FFS reimbursement, because the PROMETHEUS payment includes allowances for care coordination and some PACs. The difference between the FFS and PROMETHEUS payment is the physician's "bonus potential" for that patient. By summing the bonus potential across all patients, we can calculate the physicians' total PROMETHEUS bonus potential for the population. In this example, running 1,000 iterations of the ECR Estimator, we find that the bonus potential is $541,339 with a standard deviation of $7,610 (the variation is due to random fluctuations in patients' risk profiles).

Of course, the crucial word here is "potential." In PROMETHEUS Payment, the physician is responsible for extra costs incurred when a patient experiences a PAC. If too many patients have PACs, the costs of treatment will exceed the extra payment, and the physician will lose money compared to FFS. It is therefore in the physician's interest to expend some resources to reduce the potential occurrence of PACs. However, it is still likely that some patients will experience PACs, and these costs must also be deducted from the bonus potential. Aggregating these concepts allows us to develop a model for "net bonus." Net bonus equals potential bonus minus PAC costs and minus dollars invested to reduce the PAC rate. For the ECR Estimator, we account for two types of investments to reduce PACs. Physicians may make a fixed-cost investment that impacts the care received by all patients (adding an electronic medical record system is an example of such an investment). Physicians may also make variable per patient investments, and the amounts of these investments may be different for each chronic condition. For example, the physician might spend $1,000 per patient to reduce PACs in CHF patients, since PACs for these patients tend to be very expensive. The physician might spend less per hypertension patient, because related PACs cost relatively less.

The physician's goal will be to optimize the investment in reducing PACs. Invest too little, and the rate of PACs will not drop, and the physician may spend too much money treating those PACs. Invest too much, and much of the potential bonus will be eroded by the investment.

It is at this point that we leave the empirical aspects of the ECR Estimator and enter the theoretical. Specifically, we need to predict the physician's PAC rate for each of the chronic conditions, given the physician's investment to avoid PACs and the characteristics of the population. To make this prediction, we posit the following equation:

Predicted PAC Rate = Min PAC Rate + (Max PAC Rate - Min PAC Rate) * (1 - PAC Avoidance Effort)^Factor + Risk Adjustment

*Where:*

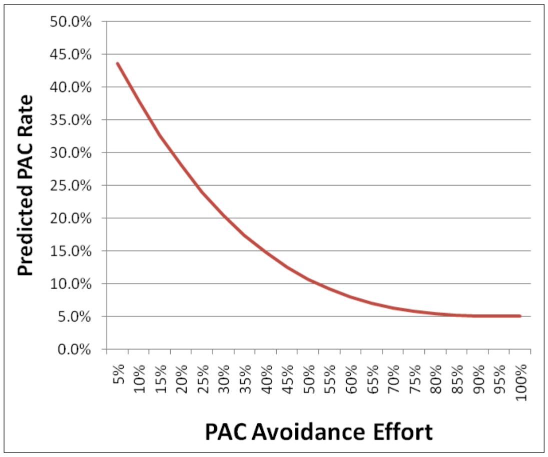
- Min PAC rate = the minimum possible PAC rate achievable for the chronic condition. This number should always be above 0 percent, because even with the physician's best efforts, some patients will still experience PACs. The current ECR Estimator assumes 5 percent for all chronic conditions.
- Max PAC rate = the maximum PAC rate for the chronic condition. The model assumes that the physician's maximum PAC rate is equal to the physician's current PAC rate. This assumption is based on the belief that, even if a physician gets no better at avoiding PACs under PROMETHEUS, he or she will get no worse. Current average PAC rates are observable in the commercial insurance database, as follows, and these are used for the Max PAC Rate in the model:
    - Hypertension – 29%
    - Coronary Artery Disease – 28%
    - Diabetes – 67%
    - Asthma – 31%
    - Chronic Obstructive Pulmonary Disease – 44%
    - Congestive Heart Failure – 67%
- PAC Avoidance Effort = the percentage of the potential bonus that the physician invests in reducing the PAC rate (including both fixed and variable investments). This is admittedly a difficult variable to quantify, and our method may not capture intangible efforts by the physician. However, real quality improvement will demand new systems and tools, and these require financial investment. The maximum PAC Avoidance Effort is 100 percent. However, physicians will not want to make this level of effort, as it would mean all of the potential bonus has been expended.

- Factor = a number that reflects the non-linearity of effort to reduce PACs. We believe that there will be diminishing returns on investment as the PAC rate approaches the minimum. In other words, some PACs may be easily avoidable, and these will yield to even modest investments. The next round of PAC avoidance will be harder to achieve and will require more investment and so on. For the model we have set the Factor value at 2, though future research may help to calculate a more precise value.

- Risk Adjustment = Any increase/decrease in the PAC rate due to riskier/less risky patients.[5]

The graph at right illustrates the PAC reduction curve as a function of PAC Avoidance Effort using the following values:

- Min PAC Rate = 5%
- Max PAC Rate = 50%
- Factor = 2
- Risk Adjustment = 0%




As stated earlier, we recognize that this is a theoretical model, and that reality may differ in terms of the parameters and values of the equation. In some ways, this equation addresses the great unknown of health care quality improvement: how do investments in systems of care translate into actual improvements in patient outcomes and cost reduction? While we cannot claim that our PAC rate equation answers this question definitively, we do assert that it has the correct *properties* that one would expect from any such equation. These properties are:

- The max PAC rate is the current PAC rate, since physicians won't get worse at avoiding PACs under a payment system that rewards them for reducing PACs.

- The minimum PAC rate is above zero –physicians cannot prevent every PAC.

[5] In our model, the method of calculating PAC avoidance effort already adjust for risk, so we don't add any additional risk adjustment values (though we have constructed the model to accept such values as new evidence emergences). To see how PAC avoidance effort already includes risk adjustment, consider the following example: Two physicians are each treating a population of diabetics. Physician A has a bonus potential of $200,000. Physician B has a riskier population and a bonus potential of $250,000. Each physician invests $50,000 to prevent PACs. Physician A's PAC avoidance effort = 50,000/200,000 = 25%. Physician B's PAC avoidance effort = 50,000/250,000 = 20%. Feeding these values into the PAC prediction equation, we find that Physician A has a predicted PAC rate of 40%, while Physician B is expected to have a 45% PAC rate. The equation has accounted for the difference in risk.

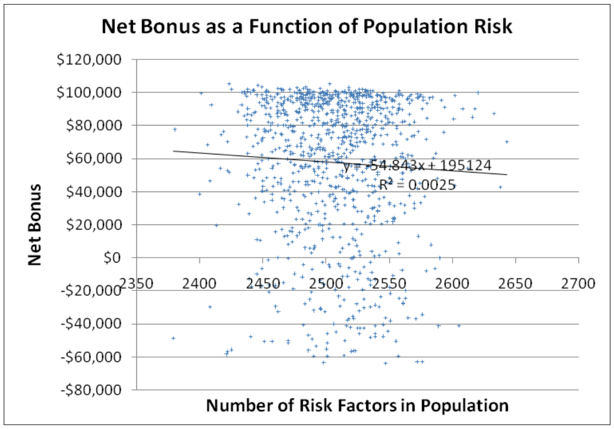
- The predicted PAC rate is a function of how much the physician invests in avoiding PACs. This is a non-linear relationship, with diminishing returns as the PAC rate approaches the lower limit.
- The PAC rate is adjusted based on the riskiness of the population.

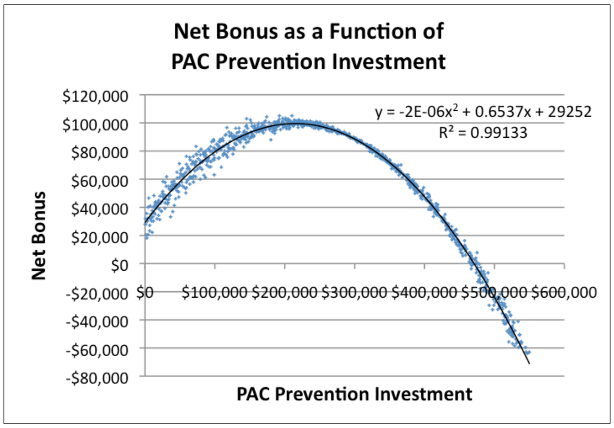
*We now have all the components we need to operate the model:*

- A population of 500 chronically ill patients
- A method to predict payment for each patient based on their risk profile:
  - FFS payment
  - PROMETHEUS ECR payment
  - The difference between FFS and ECR is the "potential bonus"
- A method to predict the PAC rate and costs within the population as a function of the physician's efforts to reduce the PAC rate.

We set up the model to run through 1,000 iterations. In each iteration, the physician's investment in avoiding PACs varied randomly between $0 and $500,000. Recall that the average total bonus potential was about $540,000. A physician investing $0 would be making no effort to reduce PACs, while a $500,000 investment would represent a very significant effort, as it would consume almost the entire potential bonus. Each iteration of the model also generated a new patient population; while the underlying probabilities remained the same, random variation meant that some patient populations had more risk factors present than others. While such riskier populations have higher bonus potentials than average populations (because PROMETHEUS ECRs are adjusted based on patient risk and complexity), they also have a higher probability of PACs and the higher costs associated with PACs.

For each iteration, the key output was the physician's net bonus. Recall that the potential bonus is the difference between the PROMETHEUS ECR payments for all the patients and what the physician would have received under FFS payment. The net bonus is the potential bonus minus any investments the physicians makes to prevent PACs and any costs for treating those PACs that do occur. Over 1,000 iterations, the average net bonus was about $57,500, with a standard deviation of $43,000. The maximum net bonus was $105,000, and the worst outcome was negative $64,000 (that is, in that iteration the physician was $64,000 worse off than under FFS.) These initial results suggest a high volatility, with the standard deviation being very large.

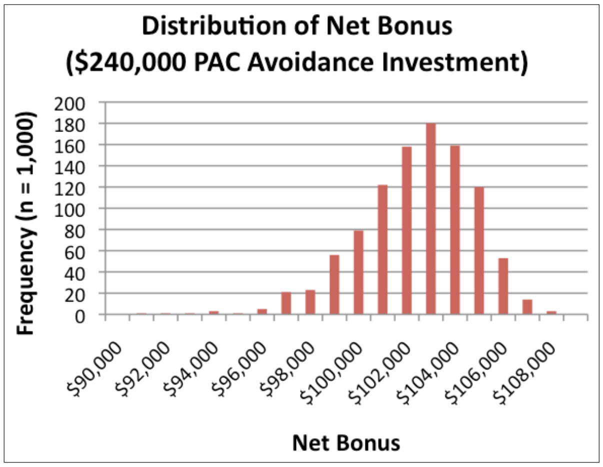



What is driving this volatility? First, one might look at population risk. Are physicians that have a riskier population losing money, while physicians lucky enough to get a healthy population making money? A glance at the scatter plot at right shows that this is not the case. In the graph, each point represents one of the 1,000 iterations of the model. The x-axis is a count of the total number of risk factors in the population; more risk factors means a riskier population with a higher probability of PACs. The y-axis is the physicians net bonus. Visual examination of the scatter plot suggests there is little if any relationship between the x and y variables (and this conclusion is confirmed by the very low r-square number). It appears that PROMETHEUS Payment's adjustment for riskier patients is fulfilling its purpose, and physicians are not better or worse off with a less risky/riskier patient population.

If population risk is not driving the variation in net bonus, then what is? Next we look at the physician's efforts to prevent PACs. Here, a clear pattern emerges, as illustrated in the scatter plot on the following page. As before, each dot represents one of the 1,000 iterations of the model. In this graph, the x-axis is the physician's investment to reduce PACs (which is one of the inputs for our PAC prediction equation). The y-axis is the physician's net bonus. There is an obvious connection between these two variables, following a curve that peaks around $240,000 on the x-axis. Note that the upper and lower limits of the curve are the same as in the previous scatter plot. In fact, each dot in this scatter plot has a counterpart in the previous graph, since they are the results of the same iterations of the model. The difference is that using PAC Prevention Investment as the explanatory variable results in a clear pattern not present when we looked at risk factors.

What is producing this pattern? The answer is that at very low PAC prevention efforts, the PAC rate is not reduced significantly, and the physician ends up spending a lot of money treating PACs, which consumes most of the potential bonus. As the physician's PAC prevention efforts increase, the PAC rates and costs go down, so the net bonus increases. However, past a certain point, the physician is spending too much on reducing PACs. That is, the money spent preventing PACs is more than the money it would cost to treat the PACs themselves. It is past this point where the curve begins to slope downward (and crosses into negative numbers when the PAC prevention investment is very high). A physician operating under a PROMETHEUS-type payment system would seek to optimize his PAC prevention investment to balance the cost of PACs versus the cost of avoiding them. Given the parameters we have used for the model, the optimal PAC prevention investment for a physician treating a typical population of 500 chronically ill patients is about $240,000 (the peak of the curve).




Armed with this knowledge, we can then ask: what is the volatility of the physician's net bonus when the PAC prevention investment is optimized? The answer to this question, we ran another thousand iterations of the model, setting the PAC prevention investment to $240,000 (instead of allowing it to vary randomly). The results of this simulation are illustrated at right. The average net bonus was $102,000 (which is very close to the maximum net bonus we observed for the previous simulation). Perhaps more importantly, the standard deviation was $2,350, suggesting that physicians who optimize their PAC prevention efforts would have a high confidence of achieving the average net bonus +/- $6,000.

Overall, the results of the model support the idea that PROMETHEUS ECR payment can:

- Align payment so that physicians have an incentive to keep patients healthy and out of the hospital;
- Adjust for risk so that physicians do not have an incentive to avoid riskier patients;
- Increase physician payment while yielding net savings from fewer complications.