PART 2: ACTUARIAL ISSUES IN CARE MANAGEMENT INTERVENTIONS

Paper 4: Understanding the Economics of Disease Management Programs

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As managed care and health insurance organizations struggle to control their enrollees' utilization of medical resources, they seek less obtrusive and more cost-effective ways to reduce costs and improve patient outcomes. As discussed in Paper 1, Disease Management (DM) is a widely proposed solution for cost-reduction and quality improvement. Despite the interest in DM and the number of programs that have been implemented in different health plans, the reaction to DM on the part of health insurers and other payers remains skeptical. Vendors and carriers seldom discuss their programs without claims of positive financial results, yet somehow the buyers seem unconvinced. Some of the skepticism arises because it is difficult to reconcile savings claims with health plan cost trends that seem to move inexorably upwards.

Two important meta-analyses have recently been completed of DM outcomes. A meta-analysis is a survey of literature on a subject that results in a summary of the reported outcomes. Weingarten[2] et al. examined over 100 studies of clinical outcomes from DM programs. David Krause's[3] study is unpublished. Krause examined financial outcomes from a number of DM programs. The conclusions from the two meta-analyses appear to be inconsistent: the Weingarten study found a preponderance of studies that showed significant improvement in the clinical outcomes of participants in DM programs; the Krause study found little or no evidence of financial improvement to the payer. The Krause conclusion is similar to that of a recently published Congressional Budget Office study of Disease Management outcomes[4] which finds evidence of improvement in health outcomes, but little evidence of cost savings. Our own review of the literature as found in Paper 3 comes to a similar conclusion: there is evidence of improvement in health outcomes, but limited evidence of savings in published, peer-reviewed studies of disease management. What evidence there is is seldom from commercial applications to large populations.

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[2] Weingarten, S., Henning, J.M., Badamgarav, E., Knight, K., Hasselblad, V., Gano, A., and Ofman, J. "Interventions used in disease management programmes for patients with chronic illness—which ones work? Meta-analysis of published reports." British Medical Journal, October 2002, Vol. 325.

[3] Krause, David S. "Review of the Literature: The Financial Effectiveness of Disease Management." Unpublished. Presented to the Conference Maximizing DM ROI. San Francisco, CA. November 10, 2003.

[4] Congressional Budget Office (CBO). "An Analysis of the Literature on Disease Management." Washington, DC, October 13, 2004.

What is the source of the apparent inconsistency between health outcomes and financial savings?

We suggest three possible causes for these inconsistent outcomes:

1. The measurement of financial outcomes is not sufficiently stable, or our measurement techniques are not sufficiently sensitive to be able to detect positive financial outcomes. Other papers in this series address rigorous measurement methods.

2. Programs (particularly early DM programs) were either not focused on financial outcomes, or were not structured to optimize the financial outcomes. Programs were often implemented by the Medical Management Department, or were established to achieve clinical improvement (for example, programs designed to improve HEDIS scores or improve patient outcomes). The achievement and measurement of financial outcomes was an afterthought in these early programs, so it should not be surprising that such programs do not produce financial results as favorable as the later programs.

3. Program sponsors do not understand the economics of DM programs and therefore do not optimize the programs for financial return.

Three factors may help to resolve the contradiction:

1. A better understanding of the economics of DM programs. This may allow those who are responsible for designing and implementing programs to set reasonable expectations.

2. More rigorous measurement of financial outcomes. We believe that the core problem with measurement is not the methodology employed to measure outcomes, as measurement methodologies are, for the most part, reasonably well understood. Rather it is the way a methodology is applied to a particular analysis, the assumptions made and decisions taken with regard to data that will affect the outcomes. Factors that potentially influence the outcomes range from the way that claims data completion is handled to who is included in and excluded from measurement. How these issues are addressed in a study will impact the final outcomes, sometimes significantly. A later paper in this series will assess the impact of some key factors on actual outcomes, using actual health plan data.

3. Reconciliation between program savings, overall claims costs and cost increase trends. Elsewhere in this series of papers, we address a number of issues concerning Trend[5].

This paper addresses the economics of DM programs and the factors that must be considered to achieve optimal financial returns.

What is the appropriate financial statistic to measure?

Return on Investment is the metric favored by the DM industry for reporting the value of a DM program. Unfortunately, for many reasons, it can be a misleading metric, making conclusions and comparisons between programs difficult to draw. ROI is the total savings attributable to a program divided by the total cost of the program. The Appendix further defines the components of the numerator and denominator of the ROI calculation. As we discuss in Paper 5, there is no agreement in the industry regarding the calculation of savings (numerator) or the components that should be included in cost (denominator).

There may be divergence between planned and actual ROI as well. The ROI term defined in the Appendix is the *ex ante* or planned ROI. Planned ROI is a helpful metric to use in deciding whether to proceed with a program, or how large a program to implement. The *ex post*, or actual measured ROI will be subject to the operational and stochastic factors that will cause actual ROI to diverge from the planned level. Because of definitional issues and the random variability in the components that are used in its calculation, ROI can be misleading for comparing actual program outcomes.

However, a more important measure is total savings. In the following section, we will explain how ROI is calculated, and why total savings is a potentially less misleading measurement.

Return on Investment and Total Savings Measures

In assessing whether to implement a DM program, the projected Return on Investment is an appropriate metric. A DM program requires investment, and like any investment, should provide a measurable return. A health plan uses a "hurdle rate" (Minimum Rate of Return on Investment required for a viable project) against which the planned or projected return on a DM program should be assessed. For example, this hurdle rate could be 15 percent post-tax. This post-tax hurdle rate can be converted to a pre-tax rate, using the corporation's effective tax rate, as follows:

$$\text{Pre-tax hurdle rate} = \frac{15\%}{(1 - 0.35)} = 23\%$$

(assuming that institutions pay a 35 percent corporate tax rate).

[5] Medical trend is defined as the percentage change, period over period, in per member per month cost (or other metric such as inpatient hospitalizations per 1000 members per year).

Because DM outcomes are subject to uncertainty as well as statistical fluctuation, they may represent additional risk, compared with other projects that a company could invest in. A risk-margin, or addition to the minimum, risk-free hurdle rate, is sometimes added to the hurdle rate of return when assessing a proposed project. The pre-tax, risk-adjusted hurdle rate is unlikely to exceed 30 percent to 35 percent. A planned return of more than 30 percent to 35 percent (implying a planned ROI of greater than 1.35) results from one (or both) of two causes:

- A very high risk-margin has been used, indicating that the company estimates a high risk of the proposed project not being equal to the expected return due to high variation around the expected return; or

- The project has been planned to a sub-optimal scope. Because of the diminishing returns of additional interventions and penetration into the population, penetration at the highest risk-level in a population returns high savings relative to cost. As penetration into a chronic population increases, additional interventions could be performed that increase savings, but at a decreasing rate. As long as penetration can be increased at a marginal return greater than the hurdle rate, absolute savings can be increased while maintaining an average return above the hurdle rate. An average return greater than the hurdle rate could imply that unexploited savings opportunities exist.

Although both DM organizations and health plans focus discussion on ROI, a more important measure to a health plan is total savings. After all, if a plan achieves a high ROI but manages only 100 members, the total savings will have negligible impact on health plan trend, and probably will not cover the fixed costs of implementation. Total savings is the appropriate bottom-line measure for the health plan to aim to achieve.

A further distinction needs to be made between marginal and average savings. Average savings (which equals total savings net of program cost, divided by the total population) tells the sponsor how profitable a program is overall. Marginal savings (the increase in savings net of program cost due to intervention on the marginal population, divided by the number of members of the marginal population) is critical for deciding what kind of program to implement, how large it should be, and whether the marginal intervention is economically justifiable.

In the following example, the use of ROI as a measure suggests that Program 1 is the better investment. However, use of net savings as the basis of comparison suggests that ROI is a misleading measure, and that the health plan is better off investing in Program 2.

Table 1

	Program 1	Program 2
Number of health plan Members	10,000	10,000
Number of Chronic Members	100	500
Annual Cost	$50,000	$250,000
Annual Gross Savings	$150,000	$400,000
ROI	3.0	1.6
Pmpm[6] (net)	$0.83	$1.25

Using the information from the above table, Table 2 illustrates the calculation of the terms Average Savings and Marginal Savings.

Table 2

	Program 1	Program 2
Average Net Savings	$\frac{150{,}000 - 50{,}000}{10{,}000}$ = $0.83 pmpm	$\frac{400{,}000 - 250{,}000}{10{,}000}$ = $1.25 pmpm
Average Net Savings per chronic member per month	$\frac{150{,}000 - 50{,}000}{100}$ = $83.33 pcmpm	$\frac{400{,}000 - 250{,}000}{500}$ = $25.00 pcmpm
Marginal Net Savings per chronic member per month: first 100 members	$\frac{150{,}000 - 50{,}000}{100}$ = $83.33 pcmpm	$\frac{150{,}000 - 50{,}000}{100}$ = $83.33 pcmpm
Marginal Net Savings per chronic member per month: next 400 members		$\frac{250{,}000 - 200{,}000}{400}$ = $10.42 pcmpm

[6] Per member per month. Per chronic member per month is abbreviated as pcmpm. Per member per year is abbreviated as pmpy.

It is generally impossible to determine whether high reported ROI results are the consequence of high savings, low costs (either because of DM organization efficiency or because of failure to include all costs), sub-optimal program design or random fluctuation. Savings measured on a per member (or per chronic member) per month basis may provide more insight into program value.

Reporting savings on a per health plan member per month basis allows us to determine whether a program delivers meaningful savings (absolutely or on a per member per month basis). Actuaries and others responsible for the financial management of a health plan, monitor health cost trend as a key metric for whether the plan is able to control its costs. For a program to be of value to financial management, it must contribute positively to the control of health care trend. An absolute level of savings that is significant (relative to the underlying claims cost of the health plan) will positively impact trend, and may be worth pursuing—provided its cost and expected variability of outcomes are not excessive. This is the point at which cost-benefit analysis, or ROI calculation, becomes meaningful.

In order to achieve the optimal financial measures, a Risk Management Economic Model can be constructed to examine the link between DM program risk, cost, and savings. We refer to this as the Risk Management Economic Model because it is not limited to DM and can be applied to any area of medical management. It is particularly well suited to the broad populations included in DM. The remainder of the paper defines the model, discusses the considerations and metrics for designing the Model, and examines the factors of DM programs that impact financial outcomes.

The Risk Management Economic Model

The Risk Management Economic Model, which we discuss next, was developed to help program sponsors and vendors of programs understand the interaction between risk level, program cost and potential savings. The model aims to achieve several practical goals. It has been successfully used in a number of practical client situations to understand the economics of DM programs, develop a common framework for use in discussions of programs and their economics, understand contribution of different factors that influence economic outcomes, as well as to plan the scope of a program. In addition, the Risk Management Economic Model helps to facilitate discussion of the distribution of member-risk.

Table 3 below shows an application of the Risk Management Economic Model. This model applies the population risk ranking, in combination with various assumptions about the expected event rate, cost per event, and program effectiveness (events avoided) achieved by the DM program, at different penetration levels. The DM economic model provides a systematic way of quantifying the potential for gross and net savings at different points in the risk distribution.

This example includes both fixed and variable costs. Because of the fixed costs, ROI initially rises, and then falls, as the marginal cost of additional interventions is greater than the marginal savings achievable from those interventions. A graphical example of the effect of penetration of a population by risk-rank on savings is shown in Figure 1.

Table 3: Application of the Risk Management Economic Model

Penetration %	Number of members (Cumulative)	Event Rate	Expected Events	Cost/ event	Events Avoided	Gross Savings	Cumulative Gross Savings	Cumulative Expenses	Cumulative Net Savings	ROI
2%	18	75.0%	13	$ 30,000	40%	$ 159,763	$ 159,763	262,130	(102,367)	0.61
7%	68	55.0%	37	27,000	33%	332,016	491,779	437,130	54,649	1.13
12%	118	45.0%	53	25,000	25%	331,176	822,955	612,130	210,825	1.34
17%	168	40.0%	67	22,000	20%	295,243	1,118,198	787,130	331,068	1.42
22%	218	33.0%	72	17,000	15%	183,238	1,301,436	962,130	339,306	1.35
27%	268	30.0%	80	15,000	15%	180,732	1,482,168	1,137,130	345,038	1.30
32%	318	25.0%	79	12,000	15%	142,988	1,625,156	1,312,130	313,026	1.24
37%	368	22.0%	81	10,000	15%	121,358	1,746,514	1,487,130	259,384	1.17
42%	418	18.0%	75	9,500	15%	107,153	1,853,668	1,662,130	191,537	1.12
47%	468	16.5%	77	9,000	15%	104,192	1,957,859	1,837,130	120,729	1.07
52%	518	15.4%	80	8,500	15%	101,661	2,059,520	2,012,130	47,390	1.02
57%	568	13.3%	76	8,250	15%	93,445	2,152,965	2,187,130	(34,166)	0.98
62%	618	12.5%	77	8,000	15%	92,663	2,245,627	2,362,130	(116,503)	0.95
67%	668	10.6%	71	7,750	15%	82,284	2,327,911	2,537,130	(209,219)	0.92
72%	718	9.0%	65	7,500	15%	72,672	2,400,583	2,712,130	(311,547)	0.89
77%	768	8.3%	64	7,250	15%	69,299	2,469,882	2,887,130	(417,248)	0.86
82%	818	7.9%	65	7,000	15%	67,832	2,537,715	3,062,130	(524,415)	0.83
87%	868	7.5%	65	6,750	15%	65,895	2,603,610	3,237,130	(633,520)	0.80
92%	918	7.3%	67	6,500	15%	65,321	2,668,931	3,412,130	(743,199)	0.78
97%	968	7.1%	69	6,250	15%	64,416	2,733,347	3,587,130	(853,783)	0.76
100%	1,000	7.0%	70	6,000	15%	63,000	2,796,347	3,700,000	(903,653)	0.76

Designing a Program

A more sophisticated Risk Management Economic Model **applied** to the entire population allows the user to test the sensitivity of the return from different types of interventions, at different penetration levels in the population. The results may be summarized graphically in a form similar to Figure 1, below. The design of the proposed program will affect the economics through both inputs and results. The Risk Management Economic Model provides a way for users to recognize different factors that influence the economic outcomes. Program metrics that should be explicitly recognized include:

- The number and risk-intensity of members to be targeted. The number of target members is important because without critical mass, a program will not achieve sufficient savings to justify its implementation. As Table 3 shows, not all members are equally likely to experience adverse events, and a point is reached at which targeting more members with a costly, nurse-based program will not be economic.

- Types of interventions to be used in the program, such as mail, automated outbound dialing, or outreach through physician offices. Some interventions are less personalized, but may still be successful at reaching some members and having an effect on behavior. Some interventions are more appropriately targeted at some populations (for example, mail reminders to lower-risk populations). A successful program will combine multiple interventions of different types, cost-structures, and results.

- The number of nurses and other staff required to deliver the program and their cost, and other program costs (such as materials, data processing, or equipment). One fact of life in these programs is that clinical staff are costly and can only manage a relatively small patient load. For example, if we assume that the annual cost of a nurse is $100,000, and 200 is the caseload that can be managed by a telephonic intervention nurse at one time, the annual cost of the nurse component is $500 per member managed. Further assuming that the frequency of events in the managed population is 25 percent and that nurses manage to avoid 25 percent of these events, this implies a nurse cost of $8,000 per member whose event is avoided. This amount is significant, compared to the cost of the hospital admission that is avoided. Some proponents of programs look for savings in areas other than hospital admissions and these may be obtained (for example, in emergency room visits). However, since the objective of many programs is increased compliance with physician-ordered treatments, we would expect increased physician, lab test, and pharmaceutical drug costs to result. The largest component of program savings is achieved through reduced hospital admissions and length-of-stay. It is a good idea to look at the admissions experience and costs of the target population, since this, effectively, is the base of expense that any program can affect.

- The methodology for contacting and engaging or enrolling members (telephone, provider, internet, mail, etc.). The methodology for reaching and engaging

members is critical. Each method has its own cost structure and statistical outcomes in terms of the engagement rates (and behavior change) achieved. Encouraging a member, over the telephone, to participate in a program aimed at changing behavior is difficult. (Think about the analogous problem of persuading the member to change his long distance carrier or credit-card company with a telephone call.) My own unpublished research indicates that those members who are more likely to participate in such a program tend to be those who have lower event rates and costs, while the higher utilizers tend to have lower participation rates. Mail programs have low participation rates, while telephonic programs have higher rates, particularly when the caller is a nurse. Unfortunately this is an area in which there is little published data (in part because companies consider their results to be proprietary, and in part because of a lack of consistent definition in the terms eligible, engaged, etc.) The economic model needs to include very specific assumptions and data for the number of members targeted, the number reached, allowing for data issues like incorrect or outdated telephone numbers, members with caller ID who will not accept a call, and the number enrolling or engaging in the program.

- The rules for integrating the program with the rest of the care management system. DM programs can refer (triage) members elsewhere for services and accept members who are identified elsewhere, for example, due to provider referral. As we discussed earlier, clinical resources are costly and cases should be referred to the appropriate level of management quickly and cost-efficiently. This includes members who, because they are controlling their own conditions or who clearly are not ready to comply, need to be referred to a lower-cost, "maintenance" program.

- The timing and numbers of program members to be contacted, contacts, engagements and interventions.

- The predicted behavior of the target population, absent intervention and the predicted effectiveness of the intervention at modifying that behavior. In particular, if the program is designed to reduce medical admissions among the target population, how successful is the program at reducing this admission rate?

The Risk Management Economic model illustrates the fact of decreasing returns to intervention in a population, as well as the choice of an "optimal" level of penetration, given the availability and cost of resources. The underlying data are shown in Table 3. Figure 1 shows this data in graphical form, where the gross and net savings and program cost levels are compared with the level of penetration (percentage of population targeted) by quintile.

Figure 1

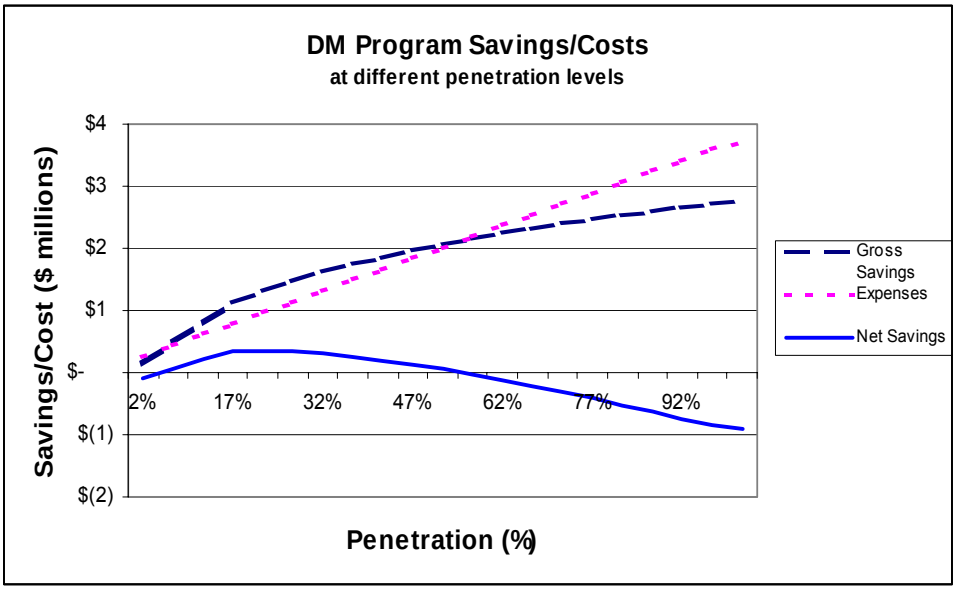
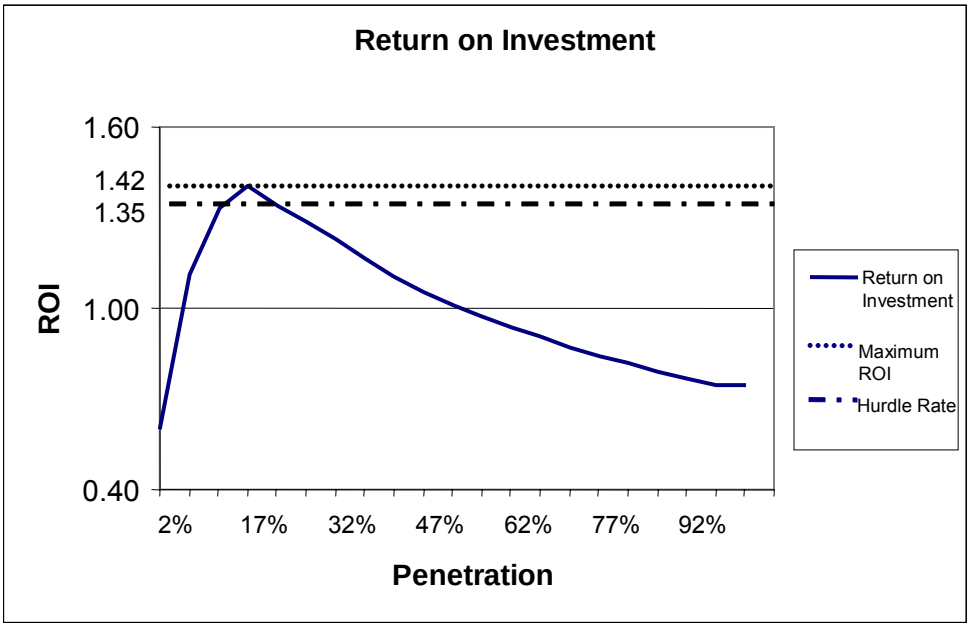


Figure 2 shows the level of gross savings and expense, or ROI, for different levels of penetration into the population. In this example, maximum ROI is achieved with a penetration of 17 percent of the population (1.42), while maximum net savings is achieved at 27 percent penetration (1.30). If the health plan has a hurdle rate of 1.35, the optimal program would be achieved at a 22 percent penetration rate (1.35). (Lower penetration results in lower absolute dollars; higher penetration results in less than the required rate of return on investment.)

Figure 2



This simple approach to DM economics ignores many variables such as health plan member turnover, timing (of interventions and events), termination from the DM program, different types of interventions, etc. Nevertheless, understanding the simple model will provide a basis for assessing and discussing more sophisticated structures.

Components of the Risk Management Economic Model

A number of factors interact in contributing to financial outcomes of DM programs. These include the prevalence of different chronic diseases, payer risk, targeting and risk of members, estimated event cost, contact rate, engagement rate, member re-stratification rates, definition of the proposed program and predicted behavior of the target population. We discuss these factors in more detail below.

Prevalence of Different Chronic Diseases

Generally, chronic disease management addresses five diseases:

- Ischemic Heart Disease
- Heart Failure
- Chronic Obstructive Pulmonary Disease (COPD)
- Asthma
- Diabetes

For a younger population (such as the commercial members of a health plan), the prevalence of these five conditions is relatively low (rarely more than 5 percent to 6 percent, when double-counting of members with more than one disease is excluded). Prevalence of chronic disease within an older population is much higher. For example, approximately one-third of Medicare members will have one or more of these conditions. In a Medicaid population it is not always possible to predict prevalence (or membership) accurately because some Medicaid populations have less stable contact with the health insurance system. Chronic conditions will differ according to the "type" of Medicaid member included. For example, dual eligibles (Medicare members who are also eligible for Medicaid based on income) will have prevalence similar to Medicare; "CHIP" or child health program participants have high prevalence of Asthma; and the disabled population will have a higher prevalence of all conditions than is typical in the commercial age group.

Chronic Disease Cost

Chronic diseases are important financially because of both the prevalence and cost of the diseases. See Paper 1 for a discussion of the cost of chronic disease.

Payer Risk

While prevalence is important, it needs to be related to the financial risk imposed by the affected patients. A health plan is clearly at risk for commercial patients, as well as any Medicare + Choice (now Medicare Advantage) programs that it offers. An employer, on the other hand, does not assume risk except on a supplemental basis for chronic Medicare patients. Therefore, chronic management programs will benefit health plans financially,

but the major portion of the benefit will accrue to Centers for Medicare and Medicaid Services (CMS), not the employer.

Targeting and Risk

The identification and prioritization of target members, and association of different outreach campaigns with member cohorts, is at the heart of the Risk Management Economic Model. With many different programs and interventions possible, it is difficult to prioritize the target members and the programs addressed to them. A necessary component of prioritization is a uniform risk-ranking of the population. An example of a risk distribution or risk-ranking of a population is shown in Table 3 above. Members are ranked according to their predicted probability of experiencing the "targeted event." In this example, the "targeted event" is an inpatient admission, although any type of utilization may be predicted, for example Emergency Room use, Specialist Visits, or costs in excess of a threshold. Different programs and health plans rank members differently. For example, some DM companies use a High, Moderate, Low ranking system (in which members with similar risk ranks are grouped into three categories). Other companies may rank by decile. In Table 3, we use a more detailed ranking system (quintiles). The highest-risk 2 percent of members have an expected event rate of 75 percent, approximately 10 times the expected event rate for the group as a whole. As a practical matter, a uniform measure of risk is also important. If, for example, members were risk ranked according to two different sets of criteria (for example, by a predictive model that predicted their probability of a hospital admission, and also by a model that predicted risk based on clinical factors such as "gaps in care," or clinical markers observed to be missing on the clinical record) it would still be necessary to find a uniform method of ranking members in order to determine where to assign intervention resources.

Estimated Event Cost

In Table 3, which is an analysis of admissions events, the cost per event refers to cost per admission. While the frequency of this event is the primary driver of the financial outcomes, the cost per event is also important; higher cost per event should create more opportunity for savings, provided the events are preventable.

Contact Rate

This is the rate at which the DM company is able to actually make telephonic contact with targeted members.

Engagement Rate

Also called the enrollment rate, this is the rate at which members are selected for ongoing coaching and management. The actual activity engaged in between disease management staff and patients, consists of evaluation, education and "coaching" or encouragement of the member to change behavior and take better care of the condition. The engagement rate will be less than 100 percent because nurses who assess members will find members with non-intervenable conditions or members with good member self-management skills, none of whom will be good candidates for enrollment in an ongoing DM program.

Member Re-stratification Rates

"Stratification" refers to the process of assigning a risk rank to an individual member. Initially, the risk rank is based solely on claims data available to the health plan, and is therefore objective. The nurse interacts with the member, allowing the risk ranking to be varied subjectively, based on the nurse's assessment of diagnosis accuracy, inherent risk factors, member intervenability and readiness to change, member self-management, knowledge of the condition and ability to comply with treatment.

Table 4: Subjective Re-stratification factors

Factor	**Effect on Re-stratification**
Accuracy of diagnosis	Did the identification algorithm correctly identify the member's conditions?
Risk factors	Risk factors may include gaps such as absent prescriptions or tests, potential drug interactions, or a pattern of sporadic prescription refills. If the claims history identifies gaps in prescription refills, for example, was this due to the member failing to fill the prescription, or because the member obtained the drugs from the VA hospital or Canada?
Intervenability of condition(s)	Chronic conditions such as Heart Failure or Diabetes are highly intervenable, because members may be educated to attend to their own conditions. Other conditions--for example some cancers--are not as amenable to the methods of DM.
Receptivity/Readiness to change	Members, particularly those who have had a recent hospitalization, are ready to take charge of their health care, while others may not be ready to change behavior.
Self-management skills	Because risk rank is initially identified from claims, some members will have a high risk ranking, even though they are well aware of their condition and its control, and do the "right thing," such as having regular check-ups and ordering regular prescription refills. Based on the nurse's interaction with the member, members who are inaccurately diagnosed, or who are good at managing their own conditions will be re-stratified with a lower risk rank, while members with a lower risk rank, who indicate problems in these areas, will be assigned a higher rank as a result of the nurse interaction.

Conclusion

Optimizing ROI and Total Savings can result in different program designs. Yet a different program design may also be required if the objective is to optimize clinical outcomes. Because there are many parties involved in implementing a DM program, it is possible that a single, compromise design will be decided on in a particular client situation that optimizes no single objective—for example, achieving adequate ROI without maximizing it—in favor of higher penetration and higher clinical scores. What is important is that all clients understand the factors that influence the *financial* outcomes, and how those results are affected by the choice of program design, and the specific values of those variables in a client situation.

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APPENDIX: Calculating Return on Investment

Definitions

Savings: The estimated reduction in health care claims costs due to the program or intervention being evaluated.

Cost: The economic value of resources committed to the program or intervention being evaluated.

ROI: $\frac{\text{Total Savings attributable to the Program}}{\text{Total Program Cost}}$

In other financial applications, rate of return is generally expressed on a Net basis (i.e. as the difference between gross savings and cost, divided by the cost of the program). In Disease Management applications it is traditional to express the rate of return in gross terms, that is, as gross savings divided by cost. It is important when quoting an ROI that the user of this information clearly define and understand the basis of the calculation.

Rate of Return on Investment = i. Rate of return on investment (i) is found by solving for i in the following expression:

$$i = \sum_{t=1}^{n} S_t / (1 + i)^t = \sum_{t=1}^{n} C_t / (1 + i)^t$$

where:
Measurement or Evaluation period = n (may be greater than or less than 1 year). When the period of measurement is not one year, adjustments should be made to the formula. This expression applies equally when $t < 1$, although the validity of results becomes increasingly less reliable when $t < 1$.

The following two terms are defined in greater detail below.

Savings attributable to the program in year $t = S_t$

Cost of the program attributable to Year $t = C_t$

Calculation of Terms

Program Cost (denominator): There is no single agreed definition in the industry for program costs, with variation often centering on the treatment of internal or indirect costs. Generally, in a program evaluation exercise, total costs should include:

- Direct costs (salaries of internal staff; vendor fees);
- Indirect costs of internal support activities, such as Information Systems, mail and printing, medical director involvement etc.;
- Management costs: costs of internal management involvement, including program management, medical management and financial management;
- Overhead and other allocated costs: generally, expenses allocated to internal resources for overhead such as rent, employee benefits, senior management load, etc.
- "Set-up" costs: one-time expenses that are incurred prior to and coincident with the start of a program. The formula above, which discounts the pattern of future emerging savings, can accommodate set-up costs as an element of total costs without further adjustment.

Savings Due to the Program (numerator)
Savings (Medical Cost Savings) result from decreased health care resource utilization, in turn resulting from the beneficial effects of a DM program or intervention. Savings are usually calculated (rather than being observed directly) in the reconciliation process, and in turn may form part of an ROI calculation.

Because we are attempting to measure something that has *not* occurred (as a result of the intervention) savings usually cannot be measured directly and, instead, are inferred or estimated from other observations. A robust Study Design is crucial to the derivation of the observations that are used in the savings calculation. In Papers 5 and 6, we discuss at length different methods for estimating savings.

Example of a Savings Calculation:
The following is an example of a savings calculation using the actuarially adjusted (or Trended) historical control group methodology. This example has been simplified to illustrate the method (the calculation is limited to a single service category, inpatient admissions only).

This particular example is a Medicare population. The chronic prevalence (33.3 percent) and number of admissions per 1,000 per year (600) are typical of chronic Medicare-eligible populations. Both of these statistics will be lower for Commercial populations, although the principles illustrated here will apply equally to a Commercial population.

Basic data:

	Baseline Period	**Measurement Period**
Period	1/1/2001- 12/31/2001	1/1/2002 – 12/31/2002
Average total population	150,000	150,000
Average chronic population	50,000	50,000
Chronic Member months	600,000	600,000
Chronic population Inpatient Admissions	30,000	28,800
Chronic population Inpatient admissions/1000/ year	600.0	576.0
Cost/admission	$7,500	$8,000
Utilization (admission) trend	-	5.3%

Calculation:

Estimated Savings due to Averted Admissions =	
Baseline Admissions/1000 * Utilization Trend	600.0*1.053 = 631.8
Minus: Actual Admissions/1000/yr	576.0
Equals: Reduced Admissions/1000/yr	55.8
Multiplied by: Actual member years in Measurement Period/1000	50.0
Total reduced admissions	2,790.0
Multiplied by: Trended unit cost/admission	$8,000
Estimated Savings due to Averted Admissions	$22,320,000

In this case, savings are generated by those (estimated) admissions that have not occurred in the observed population, post-intervention. Any estimated savings numbers should be carefully reviewed and reconciled to the underlying expenses of the population. Savings may, accordingly, be expressed in terms of total dollars, dollars per member per month,

dollars per chronic member per month, or dollars per chronic member enrolled in a program.

Measurement of both costs and benefits requires a measurement period during which these quantities are calculated. The two periods (cost measurement period and benefit measurement period) need not be of the same duration. Start-up costs, for example are typically incurred prior to the beginning of enrollment and well before the emergence of savings from interventions. Because costs are incurred differently in different time periods, costs may be “annualized” and, for example, start-up costs may be amortized over the life of the program.