4 ESTIMATING SAVINGS, UTILIZATION RATE CHANGES AND RETURN ON INVESTMENT

A Selective Review of the Literature on Program Evaluation

4.1 INTRODUCTION

A large and rapidly expanding literature exists regarding care management programs. In keeping with the financial theme of this book, our interest in reviewing the literature is selective, limited to specific types of outcomes – either financial or utilization-related outcomes which are indicative of financial improvement or from which financial conclusions may be drawn. Published studies that address our objectives are a limited sub-set of the larger body of peer-reviewed literature.

"Savings" is one of many terms that is commonly used and is often not clearly defined. The Disease Management Association of America's (DMAA 2004) *Dictionary of Disease Management Terminology* [51] defines savings as follows:

> "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 a Return on Investment (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."

The DMAA definition goes on to point out that "savings" may be estimated directly (as the change in per member per month cost, for example) or indirectly (for example, as the change in hospital or Emergency Room utilization, converted to dollars using a unit cost).

Several other factors complicate evaluation and comparison of the financial savings literature:

1. <u>Different Research Designs</u>. Designs range from randomized controlled trials, before-and-after designs, and cohort studies without any reference population other than the population being evaluated (patient as their own control). (See Chapter 7 for discussion of different study designs.)

2. <u>Basis of Savings Calculations</u>. Some studies report savings for the specific (diseased) population only, and others report results for a larger population (from which the target population is drawn). When the reported statistic is a percentage, or a rate of return on investment, it is difficult to relate the results to a basis that enables comparison between studies. Many studies do not provide information about the cost

of the intervention program. We believe that the lack of comparability between studies is one of the greatest shortcomings that the industry must overcome.

3. <u>Timing</u>. As every reader knows, health care costs increase with time, often rapidly (trend), and a patient whose services cost $100 in 1990 might well have cost a health plan $250 for the same bundle of services in 2000.

4. <u>Difference in Sample Size and Study Duration</u>. The size of the study population, and duration of the study vary enormously. Academic studies tend to be smaller and briefer in duration. The competitive nature of managed care and financial pressures on publicly traded firms limit the type of study, and increases the potential for confounding as firms constantly implement new initiatives and business processes.

5. <u>Clinical Focus of Published Studies</u>. Some of the most comprehensive articles are research reviews and **meta-analyses**. A meta-analysis is a survey article that has synthesized and re-analyzed data from other comparable studies that have used the same or similar methods and procedures, to enable the generation of sufficient amounts of data for statistical analysis and more tests of significance than can be achieved by a single study. A meta-analysis often contains a "weighted" summary of results from the surveyed literature. The typical focus of a considerable amount of the literature is clinical, rather than financial outcomes. However, meta-analyses are challenging in care management because the variables, risk factors, and interventions underlying studies are so different, making comparisons particularly difficult. Preferably, information would be required on sub-sets of data (age, sex, risk, geography, etc.) to enable appropriate adjustments to be made for comparison purposes.

We limited our review of published outcomes to the peer-reviewed literature. There are many results from different programs, particularly of DM financial outcomes, that have appeared in "trade" publications. These results may be valid, but we have ignored them because they have not been subjected to the scrutiny of the peer review process. Even in the peer-reviewed literature, however, there are examples of studies that use questionable methodologies, and some of which we note in the detailed discussion below. Nevertheless, the fact that a study has been reviewed by industry experts gives some comfort that its conclusions are credible.

Before we discuss actual results of the literature search, we will briefly describe the tools available to actuaries and others interested in further researching the literature.

4.2 Searching the Health Care Literature

A powerful, comprehensive and widely-used journal literature search system is PubMed® which is available at no charge, at least for accessing article abstracts.[1] This system was developed by the National Library of Medicine (NLM), located at the National Institutes of Health (NIH). The system contains bibliographic citations and author abstracts from more than 4,600 biomedical journals published in the United States and 70 other countries. PubMed includes over 14 million citations for biomedical articles back to the 1950s. These

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[1] Certain services may involve charges, such as gaining access to full-text articles of some journals.

citations are from MEDLINE and additional life science journals. PubMed includes links to many sites providing full text articles and other related resources. New competitors are also entering the market. One example that is likely to grow is a service offered by the popular search engine, Google, which may be accessed at www.scholar.google.com.

Access to PubMed is easily obtained by visiting the Web site www.ncbi.nlm.nih.gov/PubMed. The "PubMed Tutorial," a Web-based learning program, instructs users how to perform literature searches.

In Chapter 2, we discussed seven care management strategies. The earlier forms of care management (preauthorization, utilization review, concurrent review, and case management) were the subject of analyses in the 1980s, and their results are more accepted by the industry. More recently, less research attention has been directed towards the earlier forms of care management and thus fewer recent analyses have been published. The prevalence of these types of programs makes it virtually impossible to find a "virgin" population not subject to some form of utilization management against which to compare the results of a particular program. The three more recently developed forms of care management (disease management, specialty care management, and population management) have been the subject of most recent research attention. These forms of care management tend to be larger in their application and corresponding cost of implementation because the at-risk populations are often much larger than those who were subject to the older forms of interventions. Therefore, purchasers demand more careful scrutiny of the results, and more studies are beginning to be published.

One consequence of the increased focus on DM is the expanding membership in the DMAA. The DMAA has demonstrated its commitment to the evaluation of care management interventions by compiling a database of disease management-related research projects selected from more than 5,000 journal articles, available through a DMAA product called "LitFinder." This database is available to members of DMAA; researchers may access it for a fee. The information may be accessed through the DMAA's website, www.dmaa.org.

4.2.1 Methodology

Our search criteria and methodology for selecting articles for this literature review are described in Appendix 4.1. We used a four-stage method to identify articles in the medical literature that address financial outcomes of care management interventions. First, we adopted broad search criteria that located a very large number of articles dealing with care interventions. Next, we reviewed each article's abstract and eliminated articles in which there was no discussion or analysis of financial and/or utilization outcomes. In Stage 3, we obtained the full-text version of review articles or meta-analyses that led to other "candidate articles." Finally, we reviewed the remaining candidate articles to compile a list of those in which financial outcomes was an important (although not necessarily the principal) component. This process was subsequently supplemented by the addition of articles that were included in the CBO report (CB) [4] that were not identified by our search process, primarily because the CBO report includes articles about clinical as well as financial outcomes.

Without a detailed analysis of each article's methodology and corresponding implications any results should be treated with caution since methodological differences can produce varying fi-

nancial results. We list more detailed information for each of the articles included in the Summary in Appendix 4.2, providing information to help the reader locate each article, assess the study and its results and compare with other studies. The information provided includes:

- Intervention Type
- Disease or condition targeted;
- Length of the intervention or study (or when conducted);
- Sample size (both Intervention and Reference population);
- Research (study) design; and
- Results (financial results: savings; utilization reduction, ROI, etc.).

For those results that are obtained from randomized control trials, readers may have more confidence in the published results than those that are obtained from pre-post or cohort studies. Given these caveats, the key articles and predominant research findings that estimate cost savings, reduced hospital utilization or ROI are summarized in Appendix 4.2.

Estimates of return on investment in the literature are generally rare, because ROI involves a calculation based on the one-time/startup costs of the intervention, estimated savings and the annual operating costs of the program. The reporting of ROI is more prevalent in disease management and to a lesser extent population management than in other interventions. A major impediment to estimating savings or ROI is the lack of reported information on costs of interventions. Where no ROI was published but sufficient data was provided to allow us to estimate an ROI, we have done so (and noted that the ROI is estimated).

4.2.2 Gross and Net Return on Investment

We report ROI using the convention encountered in the clinical and utilization management literature, that is, on what we term a "gross of cost" basis. On this basis, 2.0 ROI means that the program returns the cost of the program plus a 100 percent margin over cost. On a "net of cost" basis, the equivalent ROI is 100 percent. The "net of cost" basis is the more typical reporting method in business and other commercial applications. For some reason, the intervention literature generally reports on a "gross of cost" basis. It is important to understand this difference when reviewing results, but otherwise this convention should not present difficulties.

4.2.3 Publication Bias

Many of the articles reviewed and summarized in Appendix 4.2 demonstrate positive outcomes. Readers should be cautious about extrapolating results of these studies too broadly, because of "publication bias." Publication bias is the phenomenon that occurs because negative or zero results from an intervention tend not to be published, whereas studies with favorable or positive results are published. We found some articles that report either negative or no effect of the intervention, but their frequency in the literature is rare. A different but related issue is that of "self-interest bias," a phenomenon that occurs because entities with an interest in the results of a study are able to finance studies in which they have an interest. We have, of course, no way of estimating the frequency of "unsuccessful" studies that do not find their way to publication, or results that are not of interest to a sponsor.

4.3 SUMMARY OF RESULTS

TABLE 4.1

In all, 86 articles were analyzed in detail. Because some articles can be classified under more than one intervention type, we record results for 107 studies.

Intervention	Total No. of Studies	Major Findings
Preauthorization/ Utilization Review (UR)	9	Early studies show admission and bed-day reductions from UR in the range of 10% to 15%. Recent international studies of data not subject to managed care show considerable opportunity for utilization reduction. Early gains were not maintained as medical management models changed; there is also evidence of increased outpatient utilization due to inpatient UR. More recently these reductions are in the range of 2% to 3%; savings are estimated at between $25 and $74 per member per year; we estimate ROI of 4.60 based on reported intervention cost of $16/member for this study.
Concurrent Review	5	Early gains due to Concurrent Review were not maintained as medical practice patterns changed. Current evidence that Concurrent Review can reduce bed-days by 2% to 3%. One study in a hospital setting showed ROI of 0.9 (savings < cost of review).
Case Management (sometimes called Intensive Case Management) (CM or ICM)	22	Reported results are variable (depending on target condition and program). Evidence exists of clinical improvement and reduction in utilization due to CM, particularly for heart disease. A survey of CM financial outcomes for Diabetes found no valid studies. ROIs in the range of 2 to 6 times reported.
Demand Management	6	Evidence exists that Demand Management reduces unnecessary physician and ER visits. Financial results indicate a return of between 1.37 to 1.0 and 3.86 to 1.0.
Disease Management	52	For one population (multi-disease) program that reported PMPM savings, gross savings are estimated at approximately $1.45 PMPM. For programs that report ROI, the range is 1.2 to 6.4. Highest savings are reported for heart diseases. Moderate savings are reported in diabetes and mixed results (in some cases no savings) for Asthma. A recent study using a randomized control showed no discernible savings.
Specialty Case Management	5	Relatively few studies. Prevalence of members with target conditions makes them a poor candidate for randomized control trials. Evidence shows support for financial outcomes in mental health and some high-cost diseases, such as Renal Diseases.
Population Management	8	Evidence reported of dollar savings within population-wide programs. One study reported an ROI of 5.0 to 1.0. Studies of programs to intervene within entire chronic condition sub-populations report measurable PMPM savings.
TOTAL	107	

4.4 Discussion of Results by Intervention Type

4.4.1 Preauthorization/Utilization Review

The opportunity for reducing utilization by conducting utilization review (UR) is well-demonstrated by a study by DeCoster et al. [39] of Canadian and international data (in which medical management is less prevalent) who found that 51 percent of admissions surveyed were inappropriate, while 67 percent of admissions had inappropriate or unnecessary days of stay. U.S. studies conducted in the 1980s and early 1990s show reductions in admissions and bed-days of between 4 percent and 12 percent due to preauthorization review.

Greater reductions are seen in some studies when UR is combined with other interventions. Wickizer & Lessler [217] surveyed the literature on UR, including preauthorization review. Preauthorization was found to reduce admissions significantly (approximately 10 percent). In combination with concurrent review, preauthorization reduced inpatient hospital days by 12 percent. There was an offsetting increase in outpatient utilization, resulting in a net reduction of approximately 5 percent in net per capita medical costs. Other studies by Wickizer found little evidence of actual hospitalization denial (<2 percent) in insured populations.

Whether reduction in length-of-stay has an impact on quality of care outcomes is researched by many authors: Lessler & Wickizer [115] found that patients who had their length of stay reduced by two or more days were 2.6 times as likely to be readmitted within 60 days of discharge. In specialty areas (e.g., substance abuse), utilization review had a significant impact on length of stay (up to 50 percent reduction in bed-days). Obstetric admissions are heavily reviewed in the preauthorization process (40 percent of all admissions are reviewed), but generate few bed-day reductions, as these admissions are routinely approved. Another study by Wickizer & Lessler [217] showed some relation between reductions in requested length of stay and higher re-admission rates. A study of a randomized controlled population by Rosenberg, et al. [175] showed that patients subject to preauthorization in a population previously not subject to utilization review had fewer procedures per 1000 than a group with automatic approval when procedures were subject to mandatory second opinion. Authorization requirements for admissions and length-of-stay did not appear to have substantial effect, although the authors concluded that there is a secondary (sentinel) effect as doctors learn what procedures are likely to be turned down.

Scheffler Sullivan & Ko [180] analyzed the effect of preauthorization and other interventions on Blue Cross Blue Shield plans over the period 1980 – 1988. This study found that, over the period, the combination of preadmission and concurrent review resulted in reduced admissions of 5.3 percent, a 4.8 percent reduction in days/1000 and a 4.2 percent reduction in inpatient payments. Preadmission certification and concurrent review programs saved $26.59 per enrollee in 1988.

Khandker et al. [107] conducted a large study in the early 1990s, which found that net, after costs, utilization review accounted for reductions of 4.5 percent in costs, or $57.60 per member per year, for a 3.50 return on investment. Finally, a recent study by Flynn et al. [64] showed how medical management and medical practice has changed and adapted over time. While early results of utilization review showed impressive reductions of 10 percent to 15 percent in admissions, later studies showed that only 2 percent to 3 percent of admissions were denied.

4.4.2 Concurrent Review

We found relatively few studies of concurrent review on its own. The majority of references for this intervention are review articles. Murray & Henriques [142] studied concurrent reviews conducted by hospital staff in a hospital setting, and found 313 days denied (94 patients) for an average savings of $478 per day saved. The estimated cost per review was $12.64 (13,126 reviews conducted). "The most startling result of this study is the high cost of conducting the review process". Although not addressed directly by the study, the concurrent review process observed in this study does not pay for itself (we estimate a return on investment of 0.90).

The study by Scheffler, Sullivan & Ko [180] estimates the effect of preauthorization and concurrent review interventions together at between 4 percent and 5 percent, depending on whether costs, bed-days or admissions are measured. Flynn et al. [64] found that extended stays are requested in one-third of admissions, and that 5 percent to 10 percent of these were reduced by concurrent review. Wickizer et al. [217]) found similar results to the Flynn study: between 2 percent and 3 percent of all days are reduced by concurrent review.

The conclusion on this intervention is similar to that on UR (preauthorization). After significant early success, the effect of the intervention has been internalized by the system, resulting in only a small but positive beneficial effect on utilization. The Murray & Henriques finding, that the economics of concurrent review are unfavorable, is a conclusion that deserves further analysis. We address the economics of intervention programs ourselves in Chapter 6 of this book.

4.4.3 Case Management

Flynn, Smith and Davis [64] in their survey of the utilization management literature report state that "Case management results appear to be highly variable, depending on the specifics of the populations and programs. Some programs even increase utilization." The study by Capomolla et al. [22] is an example of a study that shows increased utilization, in this case, of prescription drugs – a 50 percent higher rate of utilization by the intervention group compared with the control group. This study does not, however, follow the population long enough to determine whether the increased prescription drug utilization ultimately led to reduced consumption of other services. Calhoun and Casey [20] published one of the few studies that report savings on a PMPM basis, in this case $1.90 PMPM in a large managed care plan case management program for different conditions. Many of the studies reviewed report clinical, not financial, outcomes.

Many of the favorable financial outcomes appear in populations with heart failure. Cline et al. [29] show a 36 percent reduction in annual cost of a heart failure intervention group, compared with a control group. U.S. studies by Laramee [112] (cost reductions of between 14 percent and 26 percent in costs in heart failure patients); Heidenreich et al. [94], (over 100 percent difference in costs between intervention and control populations followed between two and six months of an event); and Naylor [145], (50 percent cost reduction in the intervention population) showed favorable outcomes in small, randomized studies of heart failure

populations. An indication of the suspect quality of many of the published studies is evident in the extensive analysis of results of case and disease management in diabetes populations by Norris et al. [149] who found that out of a total of 602 articles considered, no studies of case management met the authors' requirements for study validity, and that only two studies met the quality criteria for evaluation of outcomes from disease management.

Studies that report costs and ROI are rare, although several exist on heart failure management programs. Phillips et al. [164] report the components of an ROI calculation. For U.S. programs, this study reports an intervention cost of $80.76 PMPM and average savings of $536 PMPM, from which we estimate an implied ROI of 6.60. Riegel et al. [174] report an ROI of 2.26 and a study by Rich [171] reports results of $460 (savings) and $216 (cost of intervention) for an ROI of 2.13, but this result may be understated because the study period is less than one year. The Phillips article discusses discharge planning, an important component of case management, which was found to have little effect on surgical patients but reduced readmissions for medical patients (who have more opportunity for self-care).

4.4.4 Specialty Case Management

The study by Wickizer & Lessler [217] found significant positive impact of specialty care management programs. Behavioral health programs are particularly able to demonstrate favorable results of utilization management. For example, a preauthorization program reduced length of stay (up to 50 percent reduction in bed-days) in a mental health/substance abuse setting. On the other hand, obstetric admissions are heavily reviewed in the preauthorization process (40 percent of all cases are reviewed), but generate few bed-day reductions, as these admissions are routinely approved. In another study, Liu, Sturm & Cuffel [123] examined the effect of preauthorization on outpatient behavioral health utilization and found that the length of treatment authorized drove total treatment duration.

Cancer DM is an example of a specialty case management program that has grown in the last few years. A recent paper by Costich & Lee [32] demonstrated 14 percent reduction in services, 11.1 percent reduction in average case cost, 30 percent reduction in injectable drug costs for support care and 47 percent increase in home/hospice care. As cases were more likely to be referred to a hospice setting, the average length of hospice stay increased from 11.2 days to 33.7 days.

Bruce [16] reported an estimated reduction of medical costs of 8 to 10 percent among patients with chronic renal failure. As care management becomes more specialized, the specialized management (and "carving out") of rare and costly diseases, such as End-stage renal disease, is likely to grow, with increasing methodological problems for those who are interested in validating outcomes.

4.4.5 Demand Management

An early study of Demand Management was conducted by Vickery et al. [202]. This study is included in our bibliography because of its importance, although it falls technically outside our date parameters for articles. The Vickery study, which used a randomized design, found reduced ambulatory care (17 percent reduction) and reduced minor illness utilization (35 percent reduction) as a result of a program of education and telephonic access to clinical resources. However, there was no significant difference in hospital inpatient utilization between intervention and con-

trol groups. Vickery estimates returns of $2.50 to $3.50 for each dollar spent on education interventions, largely through reduced physician and Emergency Room utilization.

Delichatsios et al. [40] in a survey study reported a 33 percent reduction in emergency department visits, as a result of telephone medical care provided by physicians. A study by Viner et al. [205] (reported later under Population Management) has data about self-referral to the Emergency Room, and awareness of Emergency Room authorization requirements in a health plan setting. This study indicates a significant opportunity to educate members about both authorization procedures and responsibility for their own care.

Lattimer et al. [113] investigated the use of telephone nurse consultations using decision support software. This UK study analyzed the value of a nurse support line making available after hours information and triage to patients. This study found that nurses were able to manage 50 percent of all calls without referral to a physician, and without adverse quality impact. The study also estimated the financial aspects of the program. The authors report savings of £94,422 (U.S. $172,580) arising from reduced emergency admissions and an additional £16,928 (U.S. $30,939) savings from reduced physician office costs, for a total of £111,350 (U.S. $203,519). The cost of the telephone consultation program was £81,237 per year (U.S. $148,480), implying a return on investment of 1.37. O'Connell, et al. [150] conducted a pre-post study of medical claims data in a health plan setting. Access to nurse triage services resulted in significant reduction in emergency room visits (3 to 4 percent reduction) and physician office utilization (4 to 5 percent reduction). Claims costs were reduced $1.12 PMPM for all plan members. The estimated program costs were $0.55. A range of estimated Return on Investment is calculated, varying between 1.37 and 2.03.

A survey article by Sabin [178] reports on two studies. The first study involves Blue Cross Blue Shield of Oregon, in which savings of $184 per member per year were reported due to the introduction of a triage line (no costs are reported). A second study by Ernst & Young for the George Washington University Health Plan (Sabin op. cit.) found returns of between 2.69 and 3.86 for each dollar invested in a triage line from reduced ER and physician visits, over a one-year period.

4.4.6 Disease Management

The literature on disease management burgeoned in the mid-1990s. The early focus was on individual diseases, particularly asthma, congestive heart failure (CHF), and diabetes. In Appendix 4.2 we list a number of studies that analyze the effect of DM on individual disease states. It is not always possible to classify a study uniquely into a particular category of intervention (for example when a case management program is targeted at members who have a chronic, rather than an acute condition). In these cases we have classified the results of the study under both disease management and case management.

The disease management literature is more extensive than other interventions. Studies that are reviewed here range from single, disease-specific, case management-type interventions with the highest-risk patients, to chronic-population interventions and even multi-disease population studies. While certain care management interventions such as preauthorization and demand management are older, standardized and reasonably mature, disease management

programs are newer with relatively little standardization around the techniques used, the individuals targeted, intervention types (ranging from educational interventions through more-intensive case management models) or the outcomes reported. For this reason we report findings by disease and intervention type, when available. Studies of DM are more likely, however, to report financial results; nearly one-third of our surveyed articles reported useable ROI data. Reported ROI for disease management programs ranged from 1.2 – 6.4 annually per dollar invested with one or two outliers above this level. The broad disparity is due to differing diseases, enrollment, cost structures of DM programs, measurement methodologies and costs included in analysis. A recent, highly-valid study of a telephonic program for CHF patients (Galbreath [67a]) indicates no observable savings in the intervention group. This study is important because it uses a randomized control approach, covers a credible population of patients and follows them for a total of 18 months.

Below, we examine the literature on individual disease DM as well as multiple disease states.

1. Asthma
   Evidence of financial improvement from asthma DM is mixed. While there is one randomized control study that reports savings (Ghosh et al. [70]), other randomized trials do not appear to indicate significant differences between intervention and control groups. Where significant savings are reported (e.g. by Gomaa et al. [85], and Lucas et al. [125]), the studies use pre-post designs, or claims exclude outpatient pharmacy, and results must therefore be viewed with caution. A Dutch study by Schermer et al. [181] showed increased costs in the intervention group when compared with the control group. A review of the literature on financial outcomes by Bodenheimer et al. [12] finds three asthma studies with either no significant savings or higher costs in the intervention group.

2. Diabetes
   There is a wide variety of literature on diabetes management, both clinical and behavioral. The CBO study [4], in particular, cites a number of clinical and operational studies (including several in the United Kingdom). Examples of the clinical literature include a Center for Disease Control (CDC) study that examined two interventions, one for hypertension control and the other for glycemic control. Cost of the hypertension control intervention was more than offset by reduced complications, while the reverse is true of the glycemic control intervention. A summary of the studies that include a claims cost element is provided in Table 4.2 below, although (unlike for studies of heart disease) the data are fewer and in no case was ROI directly reported. In only one article was sufficient information provided to derive an ROI. Savings per diabetic member per month ranged from $11 to $145.

TABLE 4.2

Summary of Diabetes Studies That Include a Claims Cost Element			
Author(s)	Savings (PMPM)	Cost (PMPM)	ROI
Gomaa, Muntendam & Morrow [85]	$145	Not reported	N/A
Klonoff & Schwartz [110]	Not reported	Not reported	1.44 to over 8.0
Leatherman et al. [114]	Not reported	Not reported	1.2
Lynne [129]	27%; estimated by author at $40 PMPM	Not reported	Not reported
Rubin, Dietrich & Hawk [177]	$50	Not reported	N/A
Sidorov, et al. [185]	$108	$83	1.2
Snyder, et al.[186]	$98	$56	1.8
Testa & Simonson [193]	$11	Not reported	N/A
Villagra & Ahmed [203]	$26	Not reported	N/A

The study by Klonoff & Schwartz specifically looked at the economics of diabetes management programs and found that the effect of improved glycemic control differs between Type 1 and Type 2 diabetics,[2] with glycemic control producing savings for Type 2 diabetes, but not Type 1. These authors report studies indicating that diabetes self-management programs produce ROI ranging from 1.44 to over 8.00. The authors conclude, however, that: "the economic value of case management for diabetes is unclear," as is the evidence of specific programs aimed at lipid control, weight reduction or smoking cessation for diabetics."

A study of a program at the New York PPO, GHI Incorporated by Lynne, reported significant savings in a diabetic population (27 percent lower cost in the intervention period, compared with the baseline period). We estimated PMPM savings by applying the non-participant trend ($584/$440) to the participant baseline cost ($320). The difference between projected baseline cost ($426) and actual cost ($386) is the estimated savings. However, this study is typical of many in the literature that track a cohort of participants both pre- and post-intervention, making the results highly susceptible to regression to the mean.

The Snyder study reports an ROI for the program. The program costs are $56 per diabetic member per month (no information is provided regarding costs that are included in this amount). The reported ROI is 3.37. However, the authors achieve this level of ROI by "grossing up" their earlier reported savings of $98.49 per diabetic member per month by a trend factor (24.7 percent) derived from the non-chronic population. Without the trend adjustment, ROI would be 1.76. This study follows the same cohort, both pre- and post-program, and in addition reports the continuously-enrolled members over this period only. The choice of a continuously enrolled cohort potentially excludes those members who die during the program (and who are known to incur high expenses in the last few weeks of life) so that this methodology is likely

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[2] A discussion of differences between Type I and Type II diabetes may be found in Chapter 3.

to over-state the intervention program savings. We report these results to illustrate the importance of methodological issues and the difficulty in drawing meaningful conclusions, even from the peer-reviewed literature.

Even more problematic, with respect to diabetes, are two aspects of the clinical literature. First, there are numerous valid studies that show clinical improvement in diabetic populations as a result of DM interventions. For example, the studies of Aubert et al. [7], Domurat [46], Litzelman et al. [122], O'Connor et al. [151] and Sadur et al. [179], many of which are cited in the CBO study, all show improved clinical measures as a result of the intervention. However, as noted elsewhere in this book, a causal link between clinical and financial improvement has not been proven. There are occasional references in some of the literature to the fact that any financial improvement may take a considerable time to emerge. For example, the studies of Bodenheimer et al. [12] and Leatherman et al. [114] both note that the time for savings emergence may be as long as 10 years. A UK study (Jolly et al. [101] of heart patients, but relevant here because of the link between diabetes and heart disease), notes the difficulty of maintaining improvement in a population, once the intervention is over.

Second, a number of the studies in the bibliography are of UK programs. The health risk environment is, of course, different in the U.S., so direct comparisons are not possible. However, many of the UK programs focus on changing behavior at the physician practice level, rather than at the patient level, and results are decidedly mixed. In some, but by no means all cases, clinical improvements are achieved. In no case is financial information provided, so that it is not possible to determine whether the improvements were financially positive or negative. These results need to be considered carefully by those bodies (for example CMS) that believe that the future improvement of chronic care and the cost of chronic care lie with physician practices.

3. Heart Failure
   The largest literature on the effectiveness of disease specific interventions exists for heart failure (which also has the largest per patient and per event costs). Reported results, both clinical and financial, are uniformly favorable. A number of studies had generally comparable results for both savings and cost of interventions, as summarized in Table 4.3, below:

TABLE 4.3

Summary of Heart Failure Studies That Include a Claims Cost Element			
Author(s)	**Savings (PMPM)**	**Cost (PMPM)**	**ROI**
Wheeler [215]	$150	$31	4.8
Cline, Israelsson, Willenheimer, Broms & Erhardt [29]	$108	$17	6.4
Rich, Beckham. Wittenberg et al. [171]	$38	$28	1.4
Riegel, Carlson, Kopp, LePetri, Glaser & Unger [174]	$83	$37	2.2
Gomaa, Muntendam & Morrow [85]	$145	Not reported	N/A
Fonarow, Stevenson, Walden et al. [65]	$817	$25	32,7
Hoffman (Commercial) [98]	$685	Not reported	N/A
Hoffman (Medicare) [98]	$386	Not reported	N/A
Vaccaro, Cherry, Harper & O'Connell [200]	$439	$219	2.0
Whellan, Gaulden, Gattis et al. [216]	$714	Not reported	N/A
Galbreath, Krasuski, Smith et al. [67a]	Not material	Not reported	N/A

The results of the Rich et al. [172] paper are not included in this table since they are the same as Rich et al. [171].

In the case of the Vaccaro study (2001), the population represented among the sickest of the heart failure population, and the intervention delivered was intense. The populations analyzed by Fonarow et al. and Hoffman were similarly high-risk heart failure populations, which may account for the high ROI result in terms of ROI for the Fonarow study (which appears inconsistent with other studies). The interventions and target population with lower reported cost savings in the Wheeler and Gomaa et al. studies represent less-risky populations and less-intensive interventions. In the case of both Rich and Riegel, the populations and interventions are similar to those of Whellan and Vaccaro, although both the Rich and Riegel studies follow patients for less than one year. The Galbreath study is the most-recently published, covers a credible population, and uses a randomized control methodology. This study indicates no discernable savings, and therefore implies negative return on investment (although ROI and costs are not reported).

4. Multiple diseases

There are few studies of multiple diseases published in the peer-reviewed literature. The study by Cousins et al. [33] is an early example, and reports savings of $1.45 PMPM and cost of $0.51 PMPM for an ROI of 2.84. Unlike the other studies reported above for which PMPM cost numbers are calculated for the chronic population only, the Cousins data are for the entire population (both chronic and non-chronic). Chronic prevalence in a commercial population is generally in the range of 5 percent to 6 percent, which implies the use of a multiplier in the range of 15.0 to 20.0. Applying such a multiplier to the Cousins reported savings would produce comparable per chronic member savings data to that reported above.

4.4.7 Population Management

A study by Viner [205] demonstrates the opportunity for population management. One of the enduring issues of health utilization is the number of patients presenting at the Emergency Room for treatment, rather than seeking treatment through a primary care physician. It is generally believed that considerable savings could be achieved in the healthcare system by encouraging use of primary providers and discouraging use of emergency facilities. Viner's study found that 83 percent of members with Emergency Room visits were self-referred. Eleven percent of members with an ER visit are re-admitted to the ER later. A high percentage of these patients were unaware that payment for their visits could be denied.

Lynch et al. [128] evaluated a population-based approach to care management. The population-based approach contrasts with DM in that it is disease-neutral, whereas DM focuses on patients with target conditions. The population-based approach incorporates data analysis, predictive modeling and selective management of those members predicted to be at the greatest risk. The Lynch study reports a reduction of 5.3 percent in total commercial admissions, and 3.0 percent reduction in total Medicare population admissions. The study also reports a reduction of 35.7 percent in claims for the high-risk sub-set of the combined Medicare and commercial populations. This study illustrates a common problem with sub-population management: an external vendor seldom has access to the full population's claims data to conduct a population-wide paid claims analysis. Because no other information is provided, it is not possible to relate these savings to overall population costs.

Ketner [105] reported program savings in the initial year in the range of $.03 PMPM for asthma, $0.13 PMPM for CHF, and $0.27 for diabetes in their population health management program. Morgan et al. [140] reported a randomized controlled study of a Canadian program aimed at patients with cardiovascular disease who were provided with information about treatment choices. They report a significant reduction (21 percent) in the number of patients seeking revascularization (an invasive technique) versus alternative treatments, with no reduction in health status or satisfaction. Gomaa, Muntendam & Morrow [85] report on the results of a telephonic program that uses automated interventions to deliver educational materials to members with certain chronic diseases. These authors report savings of between $400 and $1,000 per member per year, depending on condition. Program costs are not reported, but likely result in ROI between 2.00 and 4.00. (This program is difficult to classify because it contains elements of both DM and Population Management, and thus we have reported it in both the Disease Management and Population Management analyses)

4.5 CONCLUSION

The Congressional Budget Office (CBO) study [4] found that "there is insufficient evidence to conclude that DM programs can generally reduce the overall cost of health care." The CBO analysis concluded (among other things) that there are many studies of DM that show positive clinical outcomes, while the studies that do demonstrate favorable financial outcomes are often small-scale, randomly-controlled (therefore valid), academic studies of high-risk populations.

We have a broader mission with this book, to survey the financial outcomes of seven different types of care management intervention programs. For many of these interventions, (UR, case

management) value was successfully demonstrated in the 1980s and 1990s and this value is no longer questioned. Disease management, the focus of the CBO report and of many purchasers in the health insurance industry, is newer and more subject to question. We have found few published, peer-reviewed studies of large-scale programs that met the CBO's criterion of "generally reducing the overall cost of healthcare." However, there are many studies that show sufficient promise to suggest that DM is worth pursuing, but with care. We should also note here that in no cases were any of the reviewed DM programs specifically implemented to achieve the CBO's objective of "reducing the overall cost of health care." In Chapter 6, we return to this topic in more detail, arguing that a program designed to achieve financial savings will be different than one designed to improve member satisfaction, or to improve quality, or interact with providers. Our selective review of the program evaluation literature suggests that, as we broaden programs from the small-scale interventions to the larger populations, we should keep in mind certain principles of program design and management:

1. The population that is to be subject to the intervention should be chosen with care. In part, this is because not all diseases are equally promising financially. But the capability of the patient to take responsibility for his/her own care is also a factor;

2. Due concern needs to be given to the economics of the intervention program, particularly bearing in mind that the personnel who perform the interventions are relatively costly;

3. The objectives of a program should be clearly defined, and the program should be designed and managed to achieve those goals. If the objective is financial savings, the program will be different than one whose goal is increased member satisfaction;

4. Interventions require the active, engaged participation of both providers and patients. Programs that aim at one or the other seem to be less successful; and

5. Financial savings may take a long time to emerge. During this period, active follow-up and continued engagement may be required to maintain the gains from the program.

Our review of approximately 2,000 abstracts resulted in the identification of 85 articles that reported useable utilization or financial outcomes, or both. In most cases, the literature supports the hypothesis that interventions result in both clinical and financial improvement (there are some exceptions, such as asthma disease management, and some case management interventions). The effect of publication bias must, however, be noted here.

The early literature on preauthorization and utilization management supported the hypothesis that these interventions significantly reduced cost, although this effect has lessened over the years. There is an extensive literature on case management, some of which supports the hypothesis of savings, although the methods used to produce these estimates are often less robust than some of the population-based evaluation methods for other interventions. Some of the newer intervention types, such as demand management and population management, appear to show promise of both savings (from much larger populations than the more traditional interventions), lower administrative cost per plan member and the potential for earlier intervention.
Many of the articles reviewed, and much of the more recent literature in this area, involve

disease management programs. The number of disease management articles reporting useable financial outcomes data is encouraging. The literature supports the hypothesis that DM programs produce measurable financial savings, at least in most cases. The reporting of cost data is weaker than the reporting of clinical or savings data, however, making it difficult to assess a return on investment in many cases. In addition, many of the reported studies took place in either academic settings, or were followed for relatively short time periods. The value of similar interventions within large commercial applications and implementations, over periods of longer than one year, remains to be conclusively demonstrated. Also remaining to be satisfactorily demonstrated is the causal link from input to (savings) outcome. Many studies show improvement in utilization as a result of a Disease Management Program. These studies are rarely accompanied by similar financial improvement, an anomaly that has yet to be explained. Similarly, the few valid studies that show financial savings have not demonstrated the changes (behavior change, improved compliance, etc.) that imply the causality.

APPENDIX 4.1 METHODS USED TO FIND ARTICLES

We used a four-stage method to identify articles in the medical literature that address financial outcomes of care management interventions. First, we adopted broad search criteria that identified a very large number of articles dealing with care interventions. Next, we reviewed each article's abstract and eliminated articles in which there was no discussion or analysis of financial and/or utilization outcomes. In Stage 3, we obtained the full-text version of review articles or meta-analyses that led to other "candidate articles." Finally, we reviewed the remaining candidate articles to compile a list of articles in which financial outcomes was an important (although not necessarily the principal) component. This process was subsequently supplemented by the addition of articles that were included in the CBO report [4] that were not identified by our search process, primarily because the CBO report includes articles about clinical as well as financial outcomes.

The source of articles was PubMed and the DMAA database (LitFinder). We used the following PubMed MeSH[3] terms, subheadings or descriptors: care management, disease management, utilization review, economic evaluation, utilization management, case management, predictive modeling, cost control. We decided to use these MeSH descriptors after trying various other terms, as well as noticing the MeSH terms in some of the most widely quoted or seminal articles.

The number of articles in LitFinder is much smaller and organized by disease. We reviewed the abstract of each article in LitFinder; most of them were not relevant to our needs because of their emphasis on clinical outcomes.

We found it convenient to conduct eight separate searches using PubMedd – one run using each of the eight MeSH terms. We limited our initial search to articles published in 1990 or later, and in peer-reviewed journals. The date cut-off was relaxed in three instances. The Vickery [202] article was included because it is a seminal contribution to demand management analysis (a topic that has not seen many articles published in the last 10 years). Second, we included articles from the CBO study with financial outcomes published prior to 1990. Finally, a small number of articles published prior to 1990 were identified in Stage 3 of our search strategy as described below. The result was eight sets of articles. It was possible, of course, for an article to appear in more than one set. Each of the articles in each file (a total of approximately 2,500 articles) was reviewed, based on the information available in PubMed. Any article with no clearly identified author was eliminated from further consideration. Articles without an abstract were removed unless the article's title suggested an emphasis on financial outcomes.

In Stage 3, the full-text versions of three types of articles were obtained:

- articles which focused on the *evaluation* of an intervention;
- "review" articles, which summarized previous research on a particular intervention; and
- meta-analyses.

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[3] MeSH is the National Library of Medicine's controlled vocabulary thesaurus. It consists of sets of terms naming descriptors that permit searching at various levels of specificity. The MeSH terms are assigned by skilled subject analysts at the National Library of Medicine who examine journal articles.

The references in these Stage 3 articles were used to identify other candidate articles, some of which were published prior to 1990.

The Stage 1, Stage 2 and Stage 3 articles are far too lengthy to list here. Detailed descriptions of the 86 articles that met our criteria, which we term "Stage 4 articles," appear in Appendix 4.2. Each of these filtered articles directly or indirectly reported the effect of various managed care interventions on medical costs, utilization, and return on investment. Each article was then categorized by type of intervention: Preauthorization/Utilization Review, Concurrent Review, Case Management, Demand Management, Disease Management, Specialty Care Management and Population Management. In some articles, more than one intervention was used. In these cases, the same article may appear twice (occasionally, three times). Allowing for those articles that appear more than once, 107 articles are analyzed, of which 21 are meta-analyses or review articles and 83 are primary research articles. A summary of articles by intervention type is given in Table 4.4 below:

TABLE 4.4

Intervention	Total Number of Studies	Number of Review Articles
Pre-authorization/Utilization Review	9	3
Concurrent Review	5	5
Case Management	22	3
Specialty Case Management	5	0
Demand Management	6	1
Population Management	8	3
Disease Management	52	6
TOTAL	107	21

Next, data was extracted from the article and summarized by disease, length of study, sample size, medical cost changes, utilization changes, program costs and ROI. Results may be seen in Appendix 4.2.

Approximately one-half of the articles concern Disease Management. This "newer" intervention tends to be implemented in larger and more costly programs, resulting in more interest in cost-benefit. DM has gained acceptance by managed care organizations, patients, and physicians, and become a growth industry in which many new firms have been established and prospered within the last 10 years. Specialty case management has attracted much less interest and hence has been the focus of fewer research projects. Utilization review and case management are older managed care interventions, and research on these interventions tends to be less recent.

Our experience using PubMed convinced us that no literature search in this field can possibly be comprehensive. PubMed results are sensitive to the MeSH terms that are chosen. The MeSH terms that are assigned in PubMed by NLM indexers determine whether an article met (or did not meet) the criteria used in the four stages of our review process. If we had chosen different MeSH terms, we would have extracted a different list of final articles.

APPENDIX 4.2 SUMMARY OF MAJOR ARTICLES BY INTERVENTION TYPE

Preauthorization

1. Bailit, H.L., and C. Sennett. 1991."Utilization Management as a Cost-Containment Strategy." *Health Care Finance Review Annual Supplement* 87-93.
   Intervention: Utilization Management
   Disease/Condition: Varied
   Length of Time of Intervention/Study: Varied
   Sample Size: Varied, but all Medicare patients
   Research Design: Survey Article
   Key Results: Only 2 percent to 3 percent of admissions are denied. Khandker study: IP expenses lowered by 8 percent and total health care costs by 4.5 percent. Gotowka study: psychiatric and substance abuse reduction of 16.6 percent of net inpatient costs. Inpatient and outpatient procedures were reduced by 11 percent.

2. DeCoster, C., N.P. Roos, K.C. Carriere, and S. Peterson. 1997. "Inappropriate Hospital Use by Patients Receiving Care for Medical Conditions: Targeting Utilization Review." *Canadian Medical Association Journal* 157 (7): 889-96.
   Intervention: Utilization review (Pre-authorization)
   Disease/Condition: Varied
   Length of Time of Intervention/Study: 1993-1994
   Sample Size: 3,904 patients receiving care at 26 hospitals
   Research Design: Retrospective chart review
   Key Results: Canadian and International studies show that between 7 percent to 43 percent of admissions for adults are inappropriate. Corresponding statistics for inappropriate days are 20 percent to 48 percent. In this study, inappropriate admissions amount to 51 percent and inappropriate bed-days amount to 67 percent.

3. Flynn, K.E., M.A. Smith, and M.K. Davis. 2002. "From Physician to Consumer: The Effectiveness of Strategies to Manage Health Care Utilization." *Medical Care Research and Review* 59 (4): 455-81.
   Intervention: Utilization Review (pre-authorization, case management, concurrent review)
   Disease/Condition: Varied
   Length of Time of Intervention/Study: N/A
   Sample Size: N/A
   Research Design: Survey Article
   Key Results: Early studies of Utilization Review suggest that Preauthorization for hospitalization reduced admissions by 10 percent to 15 percent. Later studies show that denials have fallen to 2 percent to 3 percent. Inpatient hospitalization has been offset by outpatient services. Concurrent Review: approximately one-third of admissions request extended stays. Studies show that concurrent review reduces these stays by 5 percent to 10 percent. Case Management results appear to be highly variable, depending on the specifics of the populations and programs. Some programs even increase utilization. Population Management: provision of patient information to providers appears to improve the process of care but not financial outcomes.

4. Khandker, R.K., and W.G. Manning. 1992. "The Impact of Utilization Review on Costs and Utilization." *Developments in Health Economics and Public Policy* 1: 47-62.
    Intervention: Utilization Review (pre-authorization).
    Disease/Condition: Varied
    Length of Time of Intervention/Study: Study occurred between 1987 and 1990 based on Aetna claims data.
    Sample Size: 176,000 patients in 828 accounts with UR compared with 468,000 patients in 4,381 accounts without UR.
    Research Design: Historical cohort
    Key Results: UR reduces inpatient costs by approximately 8 percent through reduced length-of-stay. Reduced hospital days was 12 percent. No discernible substitution of out-patient for reduced inpatient services. Overall savings of 4.5 percent.

5. Khandker, R.K., W.G. Manning, and T. Ahmed. 1992. "Utilization Review Savings at the Micro Level." *Medical Care Research and Review* 30(11): 1043-52.
    Intervention: Utilization Review (pre-authorization), case management, physician gate-keeping
    Disease/Condition: Varied
    Length of Time of Intervention/Study: Study occurred between 1997 and 2000 based on Aetna claims data.
    Sample Size: 580,000 patients based on 5,300 employer accounts
    Research Design: Historical cohort
    Key Results: Average reduction in bed-days amounts to about 8 percent. Reduction in admissions was 5.6 percent or $74 per employee per year (1988 dollars). Once administrative costs are subtracted, there is a net savings of 4.5 percent or $57.60. Program cost is $16/member for an implied ROI of 3.50.

6. Lessler, D.S., and T.M. Wickizer. 2000. "The Impact of Utilization Management on Re-admissions Among Patients with Cardiovascular Disease." *Health Services Review* 34 (6): 1315-29.
    Intervention: Utilization Review (Pre-authorization)
    Disease/Condition: Cardiovascular disease
    Length of Time of Intervention/Study: Data based on utilization management decisions made between 1989-1993.
    Sample Size: 4,326 inpatient reviews conducted on patients with cardiovascular disease
    Research Design: Historical cohort
    Key Results: Intervention resulted in few denials for admission. Length-of-stay was re-duced by 17 percent for medical and 19 percent for surgical admissions. Patients who had their l-o-s reduced by two days or more were 2.6 times more likely to be re-admitted within 60 days.

7. Rosenberg, S.N., D.R. Allen, J.S. Handte, T.C. Jackson, L. Leto, B.M. Rodstein, S.D. Stratton, G. Westfall, and R. Yasser. 1995. "Effect of Utilization Review in a Fee-for-Service Health Insurance Plan." *New England Journal of Medicine* 333 (20).
    Intervention: Utilization Review
    Disease/Condition: Varied.
    Length of Time of Intervention/Study: 8 months mean duration
    Sample Size: 3,702 members subject to review and 3,743 control group
    Research Design: Randomized controlled trial
    Key Results: Intervention group experienced 2.6 percent fewer instances of 20 target sur-

gical procedures requiring review, and 3.3 percent fewer physician and outpatient procedures. In the following year, the intervention group had a slightly higher rate of procedures than the control group, though the difference was not statistically significant.

8. Scheffler, R.M., S.D. Sullivan, T.H. Ko. 1991. "The Impact of Blue Cross and Blue Shield Plan Utilization Management Programs." 1980-1988. *Inquiry* 28 (3): 263-75.
    Intervention: Utilization management (Pre-authorization; concurrent review; second surgical opinion)
    Disease/Condition: Varied
    Length of Time of Intervention/Study: 9 years (1990-1998)
    Sample Size: 7 Blue Cross and Blue Shield plans
    Research Design: Historical study based on claims data from Blues plans
    Key Results: Preadmission and concurrent review combined experienced a 5.3 percent reduction in admissions, 4.8 percent reduction in days/1000 and 4.2 percent reduction in inpatient payments. Preadmission certification and concurrent review programs saved $26.59 per enrollee in 1988.

9. Wickizer, T.M., and D. Lessler. 2002. "Utilization Management: Issues, Effects and Future Prospects." *Annual Review of Public Health* (23): 233-35.
    Intervention: Utilization Review (pre-authorization; concurrent review; Case Management
    Disease/Condition: General conditions
    Length of Time of Intervention/Study: Varies
    Sample Size: Varies
    Research Design: Meta-Analysis
    Key Results: Pre-authorization reduces admissions significantly (± 10 percent); concurrent review modestly (2 percent to 3 percent); Combined effect on hospital days $= -12$ percent. (offset by increased outpatient utilization). Net change ± 5 percent. Other studies by Wickizer and Lessler found little evidence of actual hospitalization denial (<2 percent) in insured populations. In specialty areas (e.g. substance abuse) utilization had a significant impact on length of stay (up to 50 percent reduction in bed-days). Obstetric admissions are heavily reviewed (40 percent of all reviews), but generate few bed-day reductions as they are routinely approved. Another study by Wickizer and Leffler showed some relation between reductions in requested length of stay is associated with higher re-admission rates. Case Management Results: discharge planning had little effect on surgical patients but reduced re-admissions for medical patients (who have more opportunity for self-care) in a randomized study (Naylor et al.).

Concurrent Review

1. Flynn, K.E., M.A. Smith, and M.K. Davis. 2002. "From Physician to Consumer: the Effectiveness of Strategies to Manage Health Care Utilization." *Medical Care Research and Review* 59 (4): 455-81.
    Intervention: Utilization Review (pre-authorization, case management, concurrent review)
    Disease/Condition: Varied
    Length of Time of Intervention/Study: N/A
    Sample Size: N/A

Research Design: Survey Article

Key Results: Early studies of Utilization Review suggest that Preauthorization for hospitalization reduced admissions by 10 percent to 15 percent. Later studies show that denials have fallen to 2 percent to 3 percent. Inpatient hospitalization has been offset by outpatient services. Concurrent review: approximately one-third of admissions request extended stays. Studies show that concurrent review reduces these stays by 5 percent to 10 percent. Case Management results appear to be highly variable, depending on the specifics of the populations and programs. Some programs even increase utilization. Population Management: provision of patient information to providers appears to improve the process of care but not financial outcomes.

2. Murray, M.E., and J.B. Henriques. 2003. "An Exploratory Cost Analysis of Performing Hospital-Based Concurrent Utilization Review." *American Journal of Managed Care* 9 (7): 512-18.
    Intervention: Concurrent utilization review
    Disease/Condition: Varied – Inpatient services
    Length of Time of Intervention/Study: 12 months
    Sample Size: 13,126 reviews of preauthorization decisions
    Research Design: Random clinical sample
    Key Results: 313 days denied (94 patients) for an average savings of $478 per day saved. The estimated cost per review was $12.64. ROI was not calculated by the study but equals 0.9 (i.e. Intervention does not pay for itself).

3. Phillips, C.O., S.M. Wright, D.E. Kern, R.M. Singa, S. Shepperd, and H.R. Rubin. 2004. "Comprehensive Discharge Planning With Postdischarge Support for Older Patients With Congestive Heart Failure, A Meta-Analysis." *Journal of the American Medical Association* 291:1358-67.
    Intervention: Concurrent Review (Discharge Planning), Case Management
    Disease/Condition: Heart Failure
    Length of Time of Intervention/Study: 3 to 12 months; 8 months on average
    Sample Size: Meta-Analysis; 18 studies; 3,304 patients;
    Research Design: Meta-Analysis
    Key Results: Re-admission rate in the intervention population was lower by 19 percent; different types of intervention did not produce different outcomes, implying that home visits with or without telephonic interventions are equally efficacious. Increased clinic visits, however, did not result in improvement. ROI estimate of 3.74 based on one home visit and one discharge planning session.

4. Scheffler, R.M., S.D. Sullivan, and T.H. Ko. 1991. "The Impact of Blue Cross and Blue Shield Plan Utilization Management Programs." *Inquiry* 1980-1988; 28 (3): 263-75.
    Intervention: Utilization Management (Pre-authorization; Concurrent Review; second surgical opinion)
    Disease/Condition: Varied
    Length of Time of Intervention/Study: 9 years (1990-1998)
    Sample Size: 7 Blue Cross and Blue Shield plans
    Research Design: Comparative analysis
    Key Results: Historical study based on claims data from Blues plans.

5. Wickizer, T.M., and D. Lessler. 2002. "Utilization Management: Issues, Effects and Future Prospects." *Annual Review of Public Health* (23): 233-54
    Intervention: Utilization management (Pre-authorization; Concurrent Review; Case Management)
    Disease/Condition: General conditions
    Length of Time of Intervention/Study: Varies
    Sample Size: Varies
    Research Design: Meta-Analysis
    Key Results: Pre-authorization reduces admissions significantly (± 10 percent); Concurrent Review modestly (2 percent - to 3 percent); Combined effect on hospital days $= -12$ percent. (offset by increased outpatient utilization). NET change ± 5 percent. Other studies by Wickizer and Lessler found little evidence of actual hospitalization denial (<2 percent) in insured populations. In specialty areas (e.g. substance abuse) utilization had a significant impact on length of stay (up to 50 percent reduction in bed-days). Obstetric admissions are heavily reviewed (40 percent of all reviews), but generate few bed-day reductions as they are routinely approved. Another study by Wickizer and Leffler showed some relation between reductions in requested length of stay is associated with higher re-admission rates. Study by Rosenberg (randomized controlled) showed that patients subject to pre-authorization had fewer procedures per 1000 than a group with automatic approval. Case Management Results: discharge planning had little effect on surgical patients but reduced re-admissions for medical patients (who have more opportunity for self-care) in a randomized study (Naylor et al.).

Case Management

1. Allen, J.K., R.S. Blumenthal, S. Margolis, D.R. Young, E. R. Miller III, and K. Kelly. 2002. "Nurse Case Management of Hypercholesterolemia in Patients with Coronary Heart Disease: Results of a Randomized Clinical Trial." *American Heart Journal* 144 (4): 678-86.
    Intervention: Case Management Disease Management
    Disease/Condition: Nurse case management of hypercholesterolemia in CHD patients post-Revascularization
    Length of Time of Intervention/Study: 1 year
    Sample Size: 228
    Research Design: Randomized Controlled Test
    Key Results: Results in the intervention group were: lower total and LDL cholesterol levels; a significantly higher percentage of the intervention group reached target LDL level; favorable changes in diet and exercise patterns; no significant changes in Body Mass Index in either intervention or control group. No financial outcomes or cost data were provided in the study.

2. Aubert, R.E., et al. 1998. "Nurse Case Management to Improve Glycemic Control in Diabetic Patients in a Health Maintenance Organization." *Annals of Internal Medicine* 129 (8): 605-12.
    Intervention: Case Management Disease Management
    Disease/Condition: Nurse case management of hyperglycemia in Diabetes patients.
    Length of Time of Intervention/Study: 1 year

Sample Size: 138
Research Design: Randomized Controlled Test
Key Results: 72 percent of patients completed follow-up. Primary outcome measure was Hemoglobin A1c score (HbA1c). HbA1c score was reduced in the intervention group from 9.0 to 7.3 versus 8.9 to 8.3 in the control group. (Well-controlled HbA1c is considered to be 7.0 or below.) Patients in the intervention group were twice as likely to report improved health status. No financial outcomes or cost data were provided in the study.

3. Calhoun, J., and P. Casey. 2002. "Case Management Redesign in a Managed Care System: One Company's Experience." *Managed Care Quarterly* 10 (4): 8-12.
   Intervention: Case Management
   Disease/Condition: Five types of Case Management: high-risk medical, catastrophic, maternal and child, and disease management (asthma and diabetes)
   Length of Time of Intervention/Study: 1986-2001
   Sample Size: 280,000 enrollees
   Research Design: N/A
   Key Results: Case Management is credited with saving $1.90 PMPM for the entire enrolled population; program costs are not reported.

4. Capomolla, S. 2002. "Cost/Utility Ratio in Chronic Heart Failure: Comparison Between Heart Failure Management Program Delivered by Day Hospital and Usual Care." *Journal of the American College of Cardiology* 40 (7): 1289-66.
   Intervention: Case Management/Disease Management
   Disease/Condition: Heart Failure
   Length of Time of Intervention/Study: 9-15 months
   Sample Size: 234 prospective patients (122 in usual community care and 112 in day hospital)
   Research Design: Randomized Controlled trial--comparing effectiveness and cost/utility between heart failure management program delivered through usual care and a day hospital.
   Key Results: Patients enrolled in the intervention incurred 2.7 percent cardiac events, compared with 10.6 percent in the control group. The intervention group used more prescription drugs ($741 vs. $490). Cost savings are reported in terms of QALYs only and cannot be converted to conventional terms. Savings of $1,068 for each quality adjusted life year gained are reported.

5. Cline, C.M., B.Y. Israelsson, R.B. Willenheimer, K. Broms, and L.R. Erhardt. "1998 Cost Effective Management Program for Heart Failure Reduces Hospitalization." *Heart* 80 (5): 442-46.
   Intervention: Case Management; Disease Management
   Disease/Condition: Heart Failure
   Length of Time of Intervention/Study: 1 Year
   Sample Size: 190 patients in Sweden (aged 65-84) hospitalized for Heart Failure
   Research Design: Prospective control trial
   Key Results: Care managed patients experienced a longer mean time to re-admission, and fewer hospital days. Mean annual cost in the intervention group was $2,294 vs. $3,594 for the control group (a reduction of 36.2 percent).

6. Costantini, O., K. Huck, M.D. Carlson, K. Boyd, C.M. Buchter, P. Raiz, and C.M. Buchter. 2001. "Impact of a Guideline-Based Disease Management Team on Outcomes of Hospitalized Patients with Congestive Heart Failure." *Archives of Internal Medicine* 161:177-82.
    Intervention: Case Management/Disease Management
    Disease/Condition: Heart Failure
    Length of Time of Intervention/Study: one year
    Sample Size: 283 care managed patients and 126 concurrent non-care managed patients
    Research Design: Two groups: pre- program and concurrent control group study
    Key Results: Care managed patients experienced higher rates of ACE inhibitor use and adherence to care guidelines, when compared with both the pre-program and concurrent control groups. The intervention group experienced lower costs than both the pre- and concurrent control groups: 9 percent lower than pre-group, and 39 percent lower than the concurrent group. Cost of interventions is not reported.

7. DeBusk, R.F., et al. 1994. "A Case-Management System for Coronary Risk Factor Modification after Acute Myocardial Infarction." *Annals of Internal Medicine.* 120 (9): 721-29.
    Intervention: Home-based Case Management (telephone/mail).
    Disease/Condition: Heart (Post-MI)
    Length of Time of Intervention/Study: two months
    Sample Size: 293 patients under 70 years old.
    Research Design: Randomized control trial
    Key Results: 70 percent of intervention group ceased smoking versus 53 percent in control group. Cholesterol levels were lower and functional status was higher. No financial data were published.

8. Fitzgerald, J.F., D.M. Smith, D.K. Martin, J.A. Freedman, and B.P. Katz. 1994. "A Case Manager Intervention to Reduce Readmissions." *Archive of Internal Medicine* 154 (15): 1721-29.
    Intervention: Case Management
    Disease/Condition: Varied
    Length of Time of Intervention/Study: 12 months
    Sample Size: 688 patients > 45 years old. Identified through the VA system.
    Research Design: Randomized control trial
    Key Results: Intervention group patients had more frequent visits per patient per month to the general medicine clinic. No significant differences were detected in readmissions or readmission bed-days between intervention and control groups.

9. Flynn, K.E., M.A. Smith, and M.K. Davis. 2002. "From Physician to Consumer: the Effectiveness of Strategies to Manage Health Care Utilization." *Medical Care Research and Review.* 59 (4): 455-81.
    Intervention: Utilization Review (Pre-authorization, Case Management, Concurrent Review)
    Disease/Condition: Varied
    Length of Time of Intervention/Study: N/A
    Sample Size: N/A
    Research Design: Survey Article
    Key Results: Early studies of Utilization Review suggest that Preauthorization for hospitalization reduced admissions by 10 percent to 15 percent. Later studies show that denials have fallen to 2 percent to 3 percent. Inpatient hospitalization has been offset by outpa-

tient services. Concurrent Review: approximately one-third of admissions request extended stays. Studies show that concurrent review reduces these stays by 5 percent to 10 percent. Case Management results appear to be highly variable, depending on the specifics of the populations and programs. Some programs even increase utilization. Population Management: provision of patient information to providers appears to improve the process of care but not financial outcomes.

10. Gordon, N.F., C.D. English, A.S. Contractor, R.D. Salmon, R.F. Leighton, B.A. Franklin, and W.L. Haskell. 2002. "Effectiveness of Three Models for Comprehensive Cardiovascular Disease Risk Reduction." *American Journal of Cardiology* 89 (11): 1263-68.
Intervention: Case Management/Disease Management
Disease/Condition: two less costly approaches compared to contemporary phase II cardiac rehab program; one alternative involved nurse case-managers and the second involved a community-based program.
Length of Time of Intervention/Study: 12 weeks
Sample Size: 155; 52 in the contemporary rehab program, 54 in a nurse-case managed, CV risk reduction program, and 49 in a community-based program.
Research Design: Randomized control trial
Key Results: Programs had similar clinical outcomes. Relative to cost, the community based program had the greatest potential to save costs.

11. Gorski, L.A., and K.A. Johnson. 2003. "Disease Management Program for Heart Failure." *Lippincott's Case Management* 8 (6): 265-73.
Intervention: Case Management/ Disease Management
Disease/Condition: Heart Failure
Length of Time of Intervention/Study: two - six months
Sample Size: 74 patients
Research Design: Cohort follow up study.
Key Results: 35 percent decrease in hospitalizations; $2,200 reduction in claims per patient.

12. Heidenreich, P.A, C.M. Ruggiero, and B.M. Massie. 1999. "Effect of a Home Monitoring System on Hospitalization and Resource Use for Patients with Heart Failure." *American Heart Journal* 138 (4).
Intervention: Case Management
Disease/Condition: Heart Failure
Length of Time of Intervention/Study: two to six months
Sample Size: 68 patients
Research Design: Matched control group (86 patients)
Key Results: 13 percent reduction in intervention group claims (from $8,500 to $7,400); control group claims increased by 104 percent (from $9,200 to $18,800).

13. Laramee, A.S., S.K. Levinsky, J. Sargent, R. Ross, and P. Callas. 2003. "Case Management in a Heterogeneous Congestive Heart Failure Population: A Randomized Controlled Trial." *Archive of Internal Medicine* 163 (7): 809-17.
Intervention: Case Management/Discharge Planning
Disease/Condition: Congestive Heart Failure
Length of Time of Intervention/Study: 90 days
Sample Size: 287
Research Design: Randomized controlled clinical trial
Key Results: Inpatient and outpatient median costs and readmission median cost were reduced 14 percent and 26 percent for intervention group. Intervention group showed im-

proved adherence to treatment. Intervention and Control groups showed equal 90-day readmission rates.

14. Lynch, J.P., S.A. Forman, S. Graff, and M.C. Gunby. 2000. "High Risk Population Health Management – Achieving Improved Patient Outcomes and Near-Term Financial Results." *American Journal of Managed Care* 6 (7): 781-91.
    Intervention: Population Management/Case Management
    Disease/Condition: Varied. 1.1 percent of highest risk patients in this population
    Length of Time of Intervention/Study: two years (first baseline)
    Sample Size: 60,000 commercial; 15,000 Medicare Risk
    Research Design: Pre-Post study (Baseline/Intervention year). Baseline not adjusted.
    Key Results: Commercial admissions reduced by 5.3 percent; Medicare admissions reduced by 3.0 percent; 35.7 percent reduction in cost.

15. Naylor, M.D., D. Brooten, R. Campbell, B.S. Jacobsen, M. Mezey, M.V. Pauley, and J.S. Schwartz. 1999. "Comprehensive Discharge Planning and Home Follow-Up of Hospitalized Elders." *Journal of the American Medical Association* 281 (7): 613-620.
    Intervention: Case Management (Discharge Planning)
    Disease/Condition: Heart Disease.
    Length of Time of Intervention/Study: Up to 24 weeks
    Sample Size: 186 control group; 177 intervention group. Mean age 75.
    Research Design: Randomized control
    Key Results: Intervention group patients less likely to be re-admitted at 24 weeks (20 percent versus 37 percent); Total cost of the intervention group was about 50 percent of that of the control group.

16. Naylor, M.D. D. Brooten, R. Jones, R. Lavizzo-Mourey, M. Mezey, and M.V. Pauley. 1994. "Comprehensive Discharge Planning for the Hospitalized Elderly." *Annals of Internal Medicine* 120 (12): 999-1006.
    Intervention: Case Management (Discharge Planning)
    Disease/Condition: Heart Disease.
    Length of Time of Intervention/Study: Up to 24 weeks
    Sample Size: 276 patients over age 70.
    Research Design: Randomized control
    Key Results: reduced readmissions, hospital days and costs.

17. Norris, S.L. et al. 2002. "The Effectiveness of Disease and Case Management for People with Diabetes." *American Journal of Preventive Medicine* 15-38.
    Intervention: Case Management
    Disease/Condition: Diabetes.
    Length of Time of Intervention/Study: N/a
    Sample Size: N/a
    Research Design: Literature Review
    Key Results: No studies were found of Case Management Financial Outcomes that met the study's requirements for study validity.

18. Phillips, C.O., S.M. Wright, D.E. Kern, R.M. Singa, S. Shepperd, and H.R. Rubin. 2004. "Comprehensive Discharge Planning with Postdischarge Support for Older Patients with Congestive Heart Failure, A Meta-Analysis." *Journal of the American Medical Association.* 291:1358-67.
   Intervention: Utilization Review (Discharge Planning), Case Management
   Disease/Condition: Heart Failure
   Length of Time of Intervention/Study: three to 12 months; eight months on average
   Sample Size: Meta-Analysis; 18 studies; 3,304 patients;
   Research Design: Meta-Analysis
   Key Results: Re-admission rate in the intervention population was lower by 19 percent; different types of intervention did not produce different outcomes, implying that home visits with or without telephonic interventions are equally efficacious. Increased clinic visits, however, did not result in improvement. ROI estimate of 3.74 based on one home visit and one discharge planning session.

19. Rich, M.W., V. Beckham, B. Gray, C. Wittenberg, C.L. Leven, and P. Luther. 1996. "Effect of a Multidisciplinary Intervention on Medication Compliance in Elderly Patients with Congestive Heart Failure." *American Journal of Medicine* 101 (3): 270-6.
   Intervention: Case Management/Disease Management
   Disease/Condition: Heart failure
   Length of Time of Intervention/Study: 30 ± two days
   Sample Size: 156 patients over age 70
   Research Design: Randomized controlled trial
   Key Results: A multi-disciplinary follow up intervention is associated with improved medication compliance in the intervention population (88 percent versus 81 percent in the control group). The intervention group experienced 33 percent fewer re-admissions and 31 percent fewer hospital days than the control group, although the difference is not statistically significant.

20. Rich, M.W., V. Beckham, C. Wittenberg, C.L. Leven, K.E. Freddland, and R.M. Carney. 1995. "A Multidisciplinary Intervention to Prevent the Re-admission of Elderly Patients with Congestive Heart Failure." *New England Journal of Medicine* 333 (18): 1190-95.
   Intervention: Case Management/ Disease Management
   Disease/Condition: Heart failure
   Length of Time of Intervention/Study: 90 day follow up
   Sample Size: 282 patients over age 70; intervention 142, control 140.
   Research Design: Randomized controlled trial
   Key Results: 90-day re-admission rate for the intervention group was 36 percent; 90-day readmission rate for control group was 46 percent. Multiple readmissions were reduced from 16.4 percent in the control group to 6.3 percent in the intervention group. Intervention cost averaged $336; overall cost of care was less in the intervention group by $460, suggesting an ROI of 1.37 (Note that study period was < one year).

21. Riegel, B., B. Carlson, Z. Kopp, B. LePetri, D. Glaser, and A. Unger. 2002. "Effect of a Standardized Nurse Case-Management Telephone Intervention on Resource Use in Patients with Chronic Heart Failure." *Archive of Internal Medicine* 162 (6): 705-12.
   Intervention: Case Management/Disease Management
   Disease/Condition: Heart failure
   Length of Time of Intervention/Study: three- and six-month measurements

Sample Size: 281 physicians/358 patients
Research Design: Randomized controlled clinical trial (physicians randomized)
Key Results: Heart failure (HF) re-hospitalization 45.7 percent lower in intervention group at three months; 47.8 percent lower at six months; HF hospital days and multiple re-admissions were significantly lower in intervention group at six months. Inpatient HF costs were 45.5 percent lower at six months; no evidence of cost shifting to outpatient setting; patient satisfaction with care was higher in intervention group. Savings per patient was estimated at $1,000, and intervention cost was $443, for an ROI of 2.26.

22. Wickizer, T.M. and D. Lessler. 2002. "Utilization Management: Issues, Effects and Future Prospects." *Annual Review of Public Health* 23: 233-54.
Intervention: Utilization Review (Pre-authorization; Concurrent Review)/Case Management
Disease/Condition: General conditions
Length of Time of Intervention/Study: Varies
Sample Size: Varies
Research Design: Meta-Analysis
Key Results: Pre-authorization reduces admissions significantly (± 10 percent); Concurrent Review modestly (2 percent to 3 percent); Combined effect on hospital days $= -12$ percent. (offset by increased outpatient utilization). NET change ± 5 percent. Other studies by Wickizer and Lessler found little evidence of actual hospitalization denial (< 2 percent) in insured populations. In specialty areas (e.g., substance abuse) utilization had a significant impact on length of stay (up to 50 percent reduction in bed-days). Obstetric admissions are heavily reviewed (40 percent of all reviews), but generate few bed-day reductions as they are routinely approved. Another study by Wickizer and Leffler showed some relation between reductions in requested length of stay is associated with higher re-admission rates. Study by Rosenberg (randomized controlled) showed that patients subject to pre-authorization had fewer procedures per 1000 than a group with automatic approval. Case Management Results: discharge planning had little effect on surgical patients, but reduced re-admissions for medical patients (who have more opportunity for self-care) in a randomized study (Naylor et al.).

Specialty Case Management

1. Bruce, D., and J. Dickmeyer. 2001. "Don't Overlook Disease Management Programs for Low-Incidence, High-Cost Diseases to Improve Your Bottom Line." *Journal of Health Care Finance* 28 (2): 45-9.
Intervention: Disease Management/Specialty Case Management
Disease/Condition: Chronic renal failure
Length of Time of Intervention/Study: N/A
Sample Size: 650 Patients
Research Design: N/A
Key Results: 66 percent reduction in bed-days; 35 percent reduction in admissions; 83 percent reduction in ER visits; cost reduction of 8 percent – to 10 percent.

2. Costich, T./ D., and F.C. Lee. 2003. "Improving Cancer Care in a Kentucky Managed Care Plan: A Case Study of Cancer Disease Management." *Disease Management* 6 (1): 9-20.
    Intervention: Disease Management/Specialty Case Management
    Disease/Condition: Cancer
    Length of Time of Intervention/Study: One year; 1999-2000
    Sample Size: 1,146 enrolled patients
    Research Design: Trend adjusted cohort study
    Key Results: 14 percent reduction in services; 11.1 percent reduction in average case cost; 30 percent reduction in injectable drug costs for support care; 47 percent increase in home/hospice care; average length of hospice stay increased from 11.2 days to 33.7 days.

3. Gattis, W.A., V. Hasselblad, D. J. Whellan, and C. M. O'Connor. 1999. "Reduction in Heart Failure Events by the Addition of a Clinical Pharmacist to the Heart Failure Management Team." *Archives of Internal Medicine* 159: 1939-45.
    Intervention: Specialty Case Management (Pharma)
    Disease/Condition: Heart Failure
    Length of Time of Intervention/Study: six months
    Sample Size: 180 enrolled patients; randomly assigned to intervention and control.
    Research Design: Randomized control study
    Key Results: higher use of ACE inhibitors in the intervention population.

4. Leatherman, S., D. Berwick, D. Iles, L.S. Lewin, F. Davidoff, T. Nolan, and M. Bisognano. 2003. "The Business Case for Quality: Case Studies and an Analysis." *Health Affairs* 22 (2): 17-30.
    Intervention: Specialty Case Management (pharma)
    Disease/Condition: Varied
    Length of Time of Intervention/Study: N/A
    Sample Size: Various (Survey article)
    Research Design: Various (Survey article)
    Key Results: One study of Specialty Case Management (Pharma) produced savings of $750 per patient, but program was discontinued because of difficulties with penetrating eligible population (participation was 5.8 percent). Lipid management program produced estimated ROI of 2:1 (cost was $145 per patient).

5. Liu, X., R. Sturm, and B.J. Cuffel. 2000. "The Impact of Prior Authorization on Outpatient Utilization in Managed Behavioral Health Plans." *Medical Care Research and Review* 57 (2): 182-95.
    Intervention: Specialty Care Management (mental health) Pre-authorization.
    Disease/Condition: Managed Mental Health
    Length of Time of Intervention/Study: All plans operated between January 1, 1996 and December 31 1997, and all members were eligible during the two years.
    Sample Size: 7,611 episodes (5,607 patients) in the five-visit group, and 2,703 (or 1,884 patients) in the 10-visit group.
    Research Design: Quasi-experimental. Used conditional logistic regression to model the probability of terminating treatment at visit n conditional on having at least n visits.
    Key Results: Patients whose treatment is authorized in increments of five sessions are nearly three times more likely to terminate treatment at exactly the 5th visit than if their treatment is authorized in increments of 10 sessions conditional on being in treatment until the 5th visit. The likelihood of termination peaks in both the five- and 10-session authorization at the 10th visit, but the difference is not statistically significant. The authorization effect differs by provider type and is weaker among psychiatrists than among non-physician providers.

Demand Management

1. Delichatsios, H., M. Callahan, and M. Charlson. 1998. "Outcomes of Telephone Medical Care." *Journal of General Internal Medicine* 13 (9): 579-85.

   Intervention: Telephone medical care.
   Disease/Condition: Varied
   Length of Time of Intervention/Study: July 29-Aug. 18, 1996.
   Research Design: Cross-sectional study. A scripted telephone survey was administered to each subject within one week of the first call. Survey addressed patient outcomes, symptom relief, patient satisfaction, and alternatives to telephone medical care.
   Key Results: 33 percent of patients reported that their telephone consultation had avoided an Emergency Room visit.

2. Lattimer, V., F. Sassi, S. George, et al. 2000. "Cost Analysis of Nurse Telephone Consultation in Out of Hours Primary Care: Evidence from a Randomized Controlled Trial." *British Medical Journal* 320: 1053-57.
   Intervention: Telephone medical care (UK).
   Disease/Condition: Varied
   Length of Time of Intervention/Study: one year
   Sample Size: 14,000 calls in a cooperative consisting of 55 practitioners servicing 97,000 registered patients.
   Research Design: Randomized controlled clinical trial.
   Key Results: Savings of £94,422 arising from reduced emergency admissions to hospital. Additional £16,928 savings for general practice arose from reduced travel to visit patients at home and fewer surgery appointments within three days of a call. Also showed a reduction in short stays in hospital (one to three days). Total savings were £111,350 and ROI was 1.37.

3. Morgan, M.W., R.B. Deber, H. A. Llewellyn-Thomas, P. Gladstone, R.J. Cusimano, K. O'Rourke, G. Tomlinson, and A.S. Detsky. 2000. "Randomized, Controlled Trial of an Interactive Videodisc Decision Aid for Patients with Ischemic Heart Disease." *Journal of General Internal Medicine* 15 (10): 685-93.
   Intervention: Demand Management (Shared Decision Making)
   Disease/Condition: Coronary Artery Disease
   Length of Time of Intervention/Study: 1995-1996
   Sample Size: 240 ambulatory patients
   Research Design: Randomized controlled trial
   Key Results: Intervention group chose to pursue revascularization less frequently than the control group (58 percent versus 75 percent). At six months, 52 percent of the intervention group and 66 percent of the controls had undergone revascularization (21 percent reduction). Health and patient satisfaction scores were not significantly different in the two groups.

4. O'Connell, J.M., D.A. Johnson, J. Stallmeyer, and D. A. Cokington, 2001. "Satisfaction and Return-on-Investment Study of a Nurse Triage Service." *American Journal of Managed Care* 7 (2): 159-69.
    Intervention: Demand Management
    Disease/Condition: Varied
    Length of Time of Intervention/Study: Varied
    Sample Size: 60,000 members of a health plan
    Research Design: pre-post study design
    Key Results: Access to nurse triage services resulted in significant reduction in emergency room visits (3 to 4 percent) and physician office utilization (4 to 5 percent). Claims costs were reduced $1.12 PMPM for all plan members. The estimated program costs were $0.55. A range of estimated return on investment is calculated, varying between 1.37 and 2.03.

5. Sabin, M. 1998. "Telephone Triage Improves Demand Management Effectiveness." *Healthcare Financial Management* 52(8): 49-52.
    Intervention: Demand Management
    Disease/Condition: Varied
    Length of Time of Intervention/Study: N/A
    Sample Size: N/A
    Research Design: Survey analysis
    Key Results: Reports a Blue Cross Blue Shield of OR study of 14,000 members who showed savings of $184 per member per year. A George Washington University Health Plan study of telephone triage showed returns of 2.69 to 3.86 for investment in the program from reduced emergency room and physician visits over a 12-month period.

6. Vickery, D.M., et al. 1983. "Effect of a Self-Case Education Program on Medical Visits." *Journal of the American Medical Association* 250: 2952-56.
    Intervention: Demand Management
    Disease/Condition: Varied
    Length of Time of Intervention/Study: 1979-1981
    Sample Size: 1,625 households
    Research Design: prospective randomized controlled trial
    Key Results: Reduced ambulatory care (17 percent reduction) and reduced "minor-illness" utilization (35 percent reduction) as a result of a program of education and telephonic access to clinical resources. However, there was no significant difference in hospital inpatient utilization between intervention and control groups. Estimated returns of $2.50 to $3.50 for each dollar spent on education interventions.

Population Management

1. Fries, J.F., D.A. Bloch, H. Harrington, N. Richardson, and R. Beck. 1993. "Two-Year Results of a Randomized Controlled Trial of Health Promotion Program in a Retiree Population: The Bank of America Study." *American Journal of Medicine* 94: 57-64.
    Intervention: Population Management (Educational interventions)
    Disease/Condition: Varied
    Length of Time of Intervention Study: two years
    Sample Size: 4,712
    Research Design: Randomized control trial.

Key Results: Incremental claims reduction averaged $149 in the intervention group; Overall health scores increased 12 percent compared with control group. Program cost $30 per eligible member per year, for an ROI of 5.0 to 1.0.

2. Gomaa, W., P. Muntendam, and T. Morrow. 2001. "Technology-Based Disease Management, a Low-Cost, High-Value Solution for the Management of Chronic Disease." *Disease Management Health Outcomes* 9 (10).
    Intervention: Population Management/Disease Management
    Disease/Condition: Asthma/Diabetes/Heart Disease
    Length of Time of Intervention Study: nine-month follow up
    Sample Size: 93,414 total participants
    Research Design: Adjusted cohort study comparing participant and non-participant outcomes
    Key Results: Asthma savings amounted to $456 per year; Heart Disease: $1,737 and $464 for diabetes. Program cost was not disclosed.

3. Ketner, L. 1999. "Population Management Takes Disease Management to the Next Level." *Health Financial Management.*53 (8): 36-9.
    Intervention: Population Management
    Disease/Condition: Varied
    Length of Time of Intervention Study: Varied by study
    Sample Size: Multiple
    Research Design: Meta-Analysis
    Key Results: Diabetes Program Savings: $0.27 PMPM in year one, $0.25 PMPM in year two and eventually $1.37 PMPM in the fifth year. Asthma Program Savings: $0.03 PMPM. CHF Program Savings: $0.13 PMPM

4. Leatherman, S., D. Berwick, D. Iles, L.S. Lewin, F. Davidoff, T. Nolan, and M. Bisognano. 2003. "The Business Case for Quality: Case Studies and an Analysis." *Health Affairs* 22 (2): 17-30.
    Intervention: Population Management
    Disease/Condition: Varied
    Length of Time of Intervention Study: N/A
    Sample Size: Various (Survey Article)
    Research Design: Various (Survey article)
    Key Results: Population Management (smoking cessation and wellness) showed "weak returns" with the health plan unable to report a predictable, measurable ROI. Reported savings from a wellness program at General Motors amounted to $53 per employee per year, but no data on costs or ROI are reported.

5. Lynch, J.P., S.A. Forman, S. Graff, and M.C. Gunby. 2000. "High Risk Population Health Management – Achieving Improved Patient Outcomes and Near-Term Financial Results." *American Journal of Managed Care* 6 (7): 781-91.
    Intervention: Population Management (Case Management)
    Disease/Condition: Varied. 1.1 percent of highest risk patients in this population
    Length of Time of Intervention Study: two years (first baseline)

Sample Size: 60,000 commercial; 15,000 Medicare Risk
Research Design: Pre-Post study (Baseline/Intervention year). Baseline not adjusted.
Key Results: Overall Commercial Admissions reduced by 5.3 percent; Overall Medicare admissions reduced by 3.0 percent; 35.7 percent reduction in cost (in the high-risk population only).

6. Morgan, M.W., R.B. Deber, H.A. Llewellyn-Thomas, P. Gladstone, R.J. Cusimano, K. O'Rourke, G. Tomlinson, and A.S. Detsky. 2000. "Randomized, Controlled Trial of an Interactive Videodisc Decision Aid for Patients with Ischemic Heart Disease." *Journal of General Internal Medicine* 15 (10): 685-93.
    Intervention: Population Management (Educational Intervention)
    Disease/Condition: Heart Disease
    Length of Time of Intervention Study: six-month follow-up.
    Sample Size: 240 patients with heart disease; candidates for elective revascularization.
    Research Design: Randomized control.
    Key Results: Initial decision: 23 percent lower intent to pursue revascularization. At six-month follow-up, 21 percent lower revascularization rate in the intervention group versus the control group. General health and satisfaction scores were similar for each group.

7. Viner, K.M., M. Bellino, T.D. Kirsch, P. Kivela, and J.C. Silva. 2000. "Managed Care Organization Authorization Denials: Lack of Patient Knowledge and Timely Alternative Ambulatory Care." *Annual of Emergency Medicine* 35 (3): 272-76.
    Intervention: Population Management
    Disease/Condition: Study followed patients denied authorization for Emergency Room visits; assessing patient awareness of health plan preauthorization procedures/requirements.
    Length of Time of Intervention Study: seven months
    Sample Size: 151 did not receive ER authorization; 138 interviewed and 104 responses
    Research Design: Interview
    Key Results: 83 percent of ER visits occurred because of patient-diagnosed emergency; 4 percent instructed to go to ER are denied; (86 percent unaware that health plan could deny payment); 37 percent reported awareness of requirement for pre-authorization; 11 percent returned to Emergency Room with subsequent 4 percent admitted.

8. Vinicor, F., et al. 1987. "Diabeds: A Randomized Trial of the Effects of Physician and/or Patient Education on Diabetes Patient Outcomes." *Journal of Chronic Disease* 40 (4): 345-56.
    Intervention: Population Management (Educational Intervention)/ Disease Management
    Disease/Condition: Diabetes
    Length of Time of Intervention Study: seven months
    Sample Size: 532 patients randomly assigned to different interventions, including routine care.
    Research Design: Randomized control.
    Key Results: Clinical outcomes only were measured. The combination of patient and physician education produced significant improvements in key clinical markers. Some clinical problems persisted (obesity; hyperglycemia) leading the authors to conclude that a more focused program may be more effective. No financial results were reported.

Disease Management

1. Allen, J.K., R.S. Blumenthal, S. Margolis, D.R. Young, E.R. Miller III, and K. Kelly. 2002. "Nurse Case Management of Hypercholesterolemia in Patients with Coronary Heart Disease: Results of a Randomized Clinical Trial." *American Heart Journal* 144 (4): 678-86.
   Intervention: Case Management/Disease Management
   Disease/Condition: Nurse case management of hypercholesterolemia in CHD patients post-revascularization.
   Length of Time of Intervention/Study: one year
   Sample Size: 228
   Research Design: Randomized Controlled Test
   Key Results: Results in the intervention group were: lower total and LDL cholesterol levels; a significantly higher percentage of the intervention group reached target LDL level; favorable changes in diet and exercise patterns; no significant changes in Body Mass Index in either intervention or control group. No financial outcomes or cost data were provided in the study.

2. Aubert R.E., et al., 1998. "Nurse Case Management to Improve Glycemic Control in Diabetic Patients in a Health Maintenance Organization." *Annals of Internal Medicine* 129 (8): 605-12.
   Intervention: Case Management/Disease Management
   Disease/Condition: Nurse case management of hyperglycemia in diabetes patients.
   Length of Time of Intervention/Study: one year
   Sample Size: 138
   Research Design: Randomized Controlled Test
   Key Results: 72 percent of patients completed follow-up. Primary outcome measure was Hemoglobin A1c score (HbA1c). HbA1c score was reduced in the intervention group from 9.0 to 7.3 versus 8.9 to 8.3 in the control group. (Well-controlled HbA1c is considered to be 7.0 or below.) Patients in the intervention group were twice as likely to report improved health status. No financial outcomes or cost data were provided in the study.

3. Bailey, W.C., C.L. Kohler, J.M. Richards Jr., R.A. Windsor, C.M. Brooks, L.B. Gerald, B. Martin, D.M. Higgins, and T. Liu. 1999. "Asthma Self-Management: Do Patient Education Programs Always Have an Impact?" *Archives of Internal Medicine* 159 (20): 2422-88.
   Intervention: Disease Management
   Disease/Condition: Asthma
   Length of Time of Intervention/Study: two years
   Sample Size: 221
   Research Design: RCT. Measured three self-management treatments: (1) replication if the self-management program developed at the University of Alabama at Birmingham that was previously shown to be efficacious. (2) modified version of this program including only the core elements. (3) usual care program.
   Key Results: Patients in educational group did no better in terms of use of health care services than usual care group.

4. Bodenheimer, T., E.H. Wagner, and K. Grumbach. 2002. "Improving Primary Care for Patients with Chronic Illness." *Journal of the American Medical Association* 288 (15): 1909-14.
    Intervention: Disease Management
    Disease/Condition: Multi
    Length of Time of Intervention/Study: n/a
    Sample Size: n/a
    Research Design: Literature review.
    Key Results: Review of 39 studies of ambulatory diabetes and other chronic care programs. Thirty-two studies showed improvement in at least one process or outcome measure. The authors went on to inquire whether there was evidence of cost savings as well. A total of 27 articles were reviewed reporting financial outcomes (many of which are part of this analysis). Results were mixed: some articles show immediate cost-savings; others show no evidence of savings, while three asthma studies show no savings or higher costs in the intervention group than in the control group. The authors, who are diabetes experts, conclude that the time for cost-savings to emerge in diabetes is likely to be longer than in heart disease or asthma. Several studies are cited that show savings in a diabetes population; however, the authors also draw attention to evidence from several studies of "recidivism" or a tendency for the initially favorable results to be reversed over time.

5. Bratton, D.L., M. Price, L. Gavin, K. Glenn, M. Brenner, E.W. Gelfand, and M.D. Klinnert. 2001. "Impact of a Multidisciplinary Day Program on Disease and Health Care Costs in Children and Adolescents with Severe Asthma: a Two-Year Follow-Up Study." *Pediatric Pulmonology* 31(3): 177-89.
    Intervention: Disease Management
    Disease/Condition: Asthma
    Length of Time of Intervention/Study: two years
    Sample Size: 98 pediatric patients under age 18
    Research Design: Cohort study; patients enrolled in the study were compared to patients that had been enrolled in the NJDP 10 years earlier
    Key Results: Total utilization was calculated at $16,250 at time 0, $1,902 at year one, and $690 at year two. (Results should be viewed with caution because of Cohort study design.)

6. Bruce, D., and J. Dickmeyer. 2001. "Don't Overlook Disease Management Programs for Low-Incidence, High-Cost Diseases to Improve Your Bottom Line." *Journal of Health Care Finance* 28 (2): 45-9.
    Intervention: Disease Management/Specialty Case Management
    Disease/Condition: Chronic renal failure
    Length of Time of Intervention/Study: N/A
    Sample Size: 650 Patients
    Research Design: N/A
    Key Results: 66 percent reduction in bed-days; 35 percent reduction in admissions; 83 percent reduction in ER visits; cost reduction of 8 percent – to 10 percent.

7. Centers for Disease Control (CDC). 2002. "Cost-Effectiveness of Intensive Glycemic Control, Intensified Hypertension Control, and Serum Cholesterol Level Reduction for Type 2 Diabetes." *Journal of the American Medical Association* 287 (19): 2542-51.
    Intervention: Disease Management
    Disease/Condition: Diabetes
    Length of Time of Intervention/Study: N/A

Sample Size: N/A
Research Design: QALY analysis using the UK prospective diabetes study
Key Results: Intensified hypertension control in diabetics reduces costs relative to moderate hypertension control. Intensive glycemic control increases costs. Intensive glycemic control leads to a 0.3 increase in life expectancy (0.19 QALY). Cost of intervention was $12,213, offset in part by reduced complications. Result is a cost of $41,384 per QALY. Intensive hypertension control results in 0.47 year increase in life expectancy and 0.40 increase in QALY. Cost of intervention was $3,708 and was completely offset by reduced complications.

8. Cline, C.M., B.Y. Israelsson, R.B. Willenheimer, K. Broms, and L.R. Erhardt. 1998. "Cost Effective Management Program for Heart Failure Reduces Hospitalization." *Heart* 80(5): 442-46.
Intervention: Case Management/Disease Management
Disease/Condition: Heart Failure
Length of Time of Intervention/Study: one Year
Sample Size: 190 patients in Sweden (aged 65-84) hospitalized for Heart Failure
Research Design: Prospective control trial
Key Results: Care managed patients experienced a longer mean time to re-admission, and fewer hospital days. Mean annual cost in the Intervention group was $2,294 versus $3,594 for the control group (a reduction of 36.2 percent).

9. Costantini, O., K. Huck, M.D. Carlson, K. Boyd, C.M. Buchter, P. Raiz, and C.M. Buchter. 2001. "Impact of a Guideline-Based Disease Management Team on Outcomes of Hospitalized Patients with Congestive Heart Failure." *Archives of Internal Medicine* 161: 177-82
Intervention: Case Management/Disease Management
Disease/Condition: Heart Failure
Length of Time of Intervention/Study: one year
Sample Size: 283 care managed patients and 126 concurrent non-care managed patients
Research Design: Two groups: pre-program and concurrent control group study
Key Results: Care managed patients experienced higher rates of ACE inhibitor use and adherence to care guidelines, when compared with both the pre-program and concurrent control groups. The intervention group experienced lower costs than both the pre- and concurrent control groups: nine percent lower than pre-group, and 39 percent lower than the concurrent group. Cost of interventions is not reported.

10. Costich, T.D., and F.C. Lee. 2003. "Improving Cancer Care in a Kentucky Managed Care Plan: A Case Study of Cancer." *Disease Management* 6 (1): 9-20.
Intervention: Disease Management/Specialty Case Management
Disease/Condition: Cancer
Length of Time of Intervention/Study: 1 year; 1999-2000
Sample Size: 1,146 enrolled patients
Research Design: Trend adjusted cohort study
Key Results: 14 percent reduction in services; 11.1 percent reduction in average case cost; 30 percent reduction in injectable drug costs for support care; 47 percent increase in home/hospice care; average length of hospice stay increased from 11.2 days to 33.7 days.

11. Cousins, M., and Y. Liu. 2003. "Cost Savings for a PPO Population with Multi-Condition Disease Management: Evaluating Program Impact Using Predictive Modeling with a Control Group." *Disease Management* 6 (4): 207-17.
    Intervention: Disease Management
    Disease/Condition: Asthma, diabetes, coronary artery disease.
    Length of Time of Intervention/Study Sample Size: two years
    Research Design: Members of PPO plans: 1,009 in study group and 2,491 in control group
    Matched control group constructed from ASO population; costs predicted with predictive model
    Key Results: ROI of 2.84:1.00 and $1.45 gross savings per member per month.

12. Domurat, E.S. 1999. "Diabetes Managed Care and Clinical Outcomes: The Harbor City, California Kaiser Permanente Diabetes Care System." *American Journal of Managed Care* 5 (10): 1299-1307.
    Intervention: Disease Management
    Disease/Condition: Diabetes
    Length of Time of Intervention/Study Sample Size: 1995-1997; 2,617 enrolled; 5,993 usual care.
    Research Design: Enrolled versus non-enrolled populations (this research design is suspect).
    Key Results: An automated system, supporting nurse interventions decreases utilization rates and increases testing in the diabetic population. No financial results are reported.

13. Fonarow, G.C., L.W. Stevenson, J.A. Walden, N.A. Livingston, A.E. Steimle, M.A. Hamilton, J. Moriguchi, J.H. Tillisch, and M.A. Woo. 1997. "Impact of a Comprehensive Heart Failure Management Program in Hospital Re-admission and Functional Status of Patients with Advanced Heart Failure." *Journal of American College of Cardiology* 3 (30): 725-32.
    Intervention: Disease Management
    Disease/Condition: Advanced heart failure; functional status III or IV
    Length of Time of Intervention/Study: three years
    Sample Size: 214 accepted for heart transplantation and discharged after evaluation
    Research Design: cohort study
    Key Results: Intervention group experienced 85 percent reduction in hospital re-admissions. Estimated cost-reduction due to the intervention (net of hospital intervention costs estimated at $300 per patient) was $9,800.

14. Galbreath, A.D., R.A. Krasuski, B. Smith, K.C. Stajduhar, M. Kwan, R. Ellis, and G.L. Freeman. 2004. "Long-Term Health Care and Cost Outcomes of Disease Management in a Large, Randomized, Community-Based Population with Heart Failure." *Circulation* 110; 1-9.
    Intervention: Telephonic Disease Management
    Disease/Condition: Congestive Heart Failure.
    Length of Time of Intervention/Study: 18 months.
    Sample Size: 1,069 patients.
    Research Design: Randomized Control.
    Key Results: Participants in DM enjoyed increased survival probability. Improvement was more marked in sicker patients (NYHA class III and IV). Health care utilization was not reduced by DM and there were no financial savings observed.

15. Ghosh, C.S., P. Ravindran, M. Joshi, and S.C. Stearns. 1998. "Reductions in Hospital use from Self Management Training for Chronic Asthmatics." *Social Science and Medicine* 46 (8): 1087-93
    Intervention: Disease Management
    Disease/Condition: Asthma
    Length of Time of Intervention/Study: one year
    Sample Size: 276 patients in tertiary care in India.
    Research Design: Randomized control trial
    Key Results: 53.2 percent reduction in days hospitalized for intervention group, likelihood of hospitalization decreased by 26 percent, average days hospitalized during year fell 38 days for control group and 22 days for intervention. Intervention experienced 46.7 percent reduction in ER visits, and 14 percent reduction in likelihood of having ER visit. Average number of patients with ER visits fell from 43.6 to 27.2. Indirect costs for intervention group were 48 percent less, direct costs down by 16 percent. Average total cost was 22 percent less for intervention than control.

16. Gomaa, W., P. Muntendam, and T. Morrow. 2001. "Technology-Based Disease Management, a Low-Cost, High-Value Solution for the Management of Chronic Disease." *Disease Management Health Outcomes* 9 (10).
    Intervention: Population Management; Disease Management
    Disease/Condition: Asthma/Diabetes/Heart Disease
    Length of Time of Intervention Study: nine month follow up
    Sample Size: 93,414 total participants
    Research Design: Adjusted cohort study comparing participant and non-participant outcomes
    Key Results: Asthma savings amounted to $456 per year; Heart Disease: $1,737 and $464 for diabetes. Program cost was not disclosed.

17. Gordon, N.F., C.D. English, A.S. Contractor, R.D. Salmon, R.F. Leighton, B.A. Franklin, and W.L. Haskell. 2002. "Effectiveness of Three Models for Comprehensive Cardiovascular Disease Risk Reduction." *American Journal of Cardiology* 89 (11): 1263-68.
    Intervention: Case Management/Disease Management
    Disease/Condition: two less costly approaches compared to contemporary phase II cardiac rehab program; one alternative involved nurse case-managers and the second involved a community-based program.
    Length of Time of Intervention/Study: 12 Weeks
    Sample Size: 155; 52=contemporary rehab program, 54=nurse-case managed CV risk reduction program, 49=community based
    Research Design: Randomized control trial
    Key Results: Programs had similar clinical outcomes. Relative to cost, the community-based program had the greatest potential to save costs.

18. Gorski, L.A., and K. Johnson. 2003. "A Disease Management Program for Heart Failure." *Lippincott's Case Management* 8 (6): 265-73.
    Intervention: Case Management/Disease Management
    Disease/Condition: Heart Failure
    Length of Time of Intervention/Study: two to six months

Sample Size: 74 patients
Research Design: Key Results: 35 percent decrease in hospitalizations. $2,200 reduction in claims per patient.

19. Hoffman, J. 2001. "Broad Disease Management Interventions: Reducing Health Care Costs for Plan Members with Congestive Heart Failure." *Disease Management Health Outcomes* 9 (10): 527-29.
    Intervention: Disease Management
    Disease/Condition: Heart Failure
    Length of Time of Intervention/Study: 12 months baseline (1997-8); 12 months intervention (1998-9).
    Sample Size: 16,000 Commercial member months; 47,000 Medicare member months.
    Research Design: Historical Control (Baseline versus Intervention). No adjustment applied because the underlying trend in costs could not be estimated. Therefore, there is still potentially some confounding from this factor.
    Key Results: Savings of $8,220 per chronic member per year (commercial) and $4,632 per chronic member per year (Medicare) were reported (29 percent and 20 percent reductions respectively).

20. Jolly, K., F. Bradley, S. Sharp, H. Smith, S. Thompson, A.L. Kinmonth, and D. Mant. 1999. "Randomized Controlled Trial of Follow-Up Care in General Practice of Patient with Myocardial Infarction and Angina." *British Medical Journal* 318: 706-11.
    Intervention: Disease Management; nurse-led program to coordinate post-discharge care of at-risk patients in the community. Intervention is both with patient and provider.
    Disease/Condition: Heart Failure
    Length of Time of Intervention/Study: 12 months
    Sample Size: 597 patients
    Research Design: Randomized control. Randomized on medical practice group, not patient.
    Key Results: No difference in smoking cessation rates between intervention and control groups. No significant differences in key clinical measures (lipids, blood pressure) between intervention and control groups. Improved processes in the practice, but not health outcomes of patients.

21. Jolly, K., F. Bradley, S. Sharp, H. Smith, and D. Mant. 1998. "Follow-Up Care in General Practice of Patient with Myocardial Infarction and Angina." *Family Practice* 15 (6): 548-55.
    Intervention: Disease Management; nurse-led program to coordinate post-discharge care of at-risk patients in the community. Intervention is both with patient and provider.
    Disease/Condition: Heart Failure
    Length of Time of Intervention/Study: 12 months
    Sample Size: 597 patients; 67 practices.
    Research Design: Randomized control. Randomized on medical practice group, not patient.
    Key Results: Some evidence of increased follow-up by physicians with patients; however, the authors conclude that, to achieve changes in patient behavior, intervention at the practice level is insufficient and a different model is required to see behavior change in patients.

22. Kauppinen, R., V. Vilkka, H. Sintonen, T. Klaukka, and H. Tukiainen. 2001. "Long-Term Economic Evaluation of Intensive Patient Education During the First Treatment Year in Newly Diagnosed Adult Asthma." *Respiratory Medicine* 95 (1): 56-63.
Intervention: Disease Management
Disease/Condition: Asthma
Length of Time of Intervention/Study: five years
Sample Size: 162 newly diagnosed adult asthmatics.
Research Design: Randomized Control Test; intervention was intensive patient education, control was conventional patient education.
Key Results: Differences in costs for the intervention and control groups in the first year but not cumulatively at five years. First year ROI was 1.5. Intervention group had fewer sick-days than Control Group. Short-term financial advantage to the intervention group was not maintained; no difference in outcome costs or total costs after five years.

23. Kinmonth, A.L., A. Woodcock, S. Griffin, N. Spiegal, and M.J. Campbell. 1998. "Randomized Controlled Trial of Patient-Centered Care of Diabetes in General Practice." *British Medical Journal* 317: 1202-08.
Intervention: Disease Management
Disease/Condition: Diabetes
Length of Time of Intervention/Study Sample Size: 250 intervention versus 360 control. Twelve-month follow-up.
Research Design: Randomized control group.
Key Results: This study aimed to test the effect of training of providers in the management of chronic disease. While some improvement in patient satisfaction was observed, other measures did not show improvement (Body mass index and other markers were higher for the intervention group, and glycemic control was no better for the intervention group).

24. Klonoff, D.C., and D.M. Schwartz. 2000. "An Economic Analysis of Interventions for Diabetes." *Diabetes Care* 23 (3): 390-404.
Intervention: Disease Management
Disease/Condition: Diabetes
Length of Time of Intervention/Study: Varied
Sample Size: Varied
Research Design: Literature review of 17 interventions for diabetes; limited economic analysis.
Key Results: Diabetic Retinopathy screening and treatment was shown to be cost-saving or at least break-even; Pre-conception care: one California study shows savings of $5.19 for each dollar invested; in another health plan study, savings amount to over $3,000 per mother for an ROI of $1.86. Diabetic Nephropathy: savings of over $5,000 per patient were reported. Improved glycemic control: not found to be net cost-saving for Type I diabetes but may be for Type II. Diabetes self-management programs (similar to a DM program) were found to produce ROI from 1.44 to over 8.0. Case Management: evidence of the "economic value of case management for diabetes is unclear." Unclear evidence of Medical Nutrition therapy or Self-monitoring of blood glucose. No evidence of the financial effects of lipid control, blood pressure or weight control, or foot-care has been published.

25. Leatherman, S., D. Berwick, D. Iles, L.S. Lewin, F. Davidoff, T. Nolan, and M. Bisogna-no. 2003. "The Business Case for Quality: Case Studies and An Analysis." *Health Affairs* 22 (2): 17-30.
Intervention: Disease Management
Disease/Condition: Diabetes
Length of Time of Intervention/Study: N/A
Sample Size: Various (Survey article)
Research Design: Various (Survey article)
Key Results: Diabetes Disease Management produced more benefits, although studies at HealthPartners (ROI: 1.23) and Independent Health indicated a long pay-back period (10 years).

26. Litzelman, D.K., C.W. Slemenda, C.D. Langefeld, L.M. Hays, M.A. Welch, D.E. Bild, E. S. Ford, and F. Vinicor. 1993. "Reduction of Lower Extremity Clinical Abnormalities in Patients with Non-Insulin-Dependent Diabetes Mellitus." *Annals of Internal Medicine* 119 (1): 36-41.
Intervention: Disease Management
Disease/Condition: Diabetes
Length of Time of Intervention/Study Sample Size: 395 diabetic patients
Research Design: Randomized control study
Key Results: This intervention focused on a specific outcome for diabetics. Foot-care: Intervention consisted of initial training plus regular follow-ups from professional. Control group patients were approximately 2.4 times more likely to have skin lesions than the intervention population. The intervention population were also more likely to have foot examinations during office visits and to have physician education sessions.

27. Lucas, D.O., L.O. Zimmer, J.E. Paul, D. Jones, G. Slatko, W. Liao, and J. Lashley. 2001. "Two-Year Results from the Asthma Self-Management Program: Long-Term Impact on Health Care Services, Costs, Functional Status and Productivity." *Journal of Asthma* 38(4): 321-33.
Intervention: Disease Management
Disease/Condition: Asthma
Length of Time of Intervention/Study: two years
Sample Size: 137 asthmatics in MCOs or employer groups
Research Design: two-year follow-up Pre-Post design
Key Results: No decrease in work or school missed due to asthma at the end of Year one; 50 percent reduction in lost days reported in Year two. Reduction in smoking at Year one (3.7 percent reduced to 1.3 percent; further reduced to 0.9 percent in Year two). Significant reductions in admissions, ER visits and hospital days, resulting in $175,317 claims savings, MCOs and employer plans saved a net $125,817. ROI of 2.54. (Medication was not included in this analysis.)

28. Lukacs, S.L., E.K. France, A.E. Baron, and L.A. Crane. 2002. "Effectiveness of an Asthma Management Program for Pediatric Members of a Large HMO." *Archives of Pediatric and Adolescent Medicine* 156 (9): 872-76.
Intervention: Disease Management
Disease/Condition: Asthma
Length of Time of Intervention/Study: 18 months
Sample Size: 298 patients under age 18 at Kaiser Permanente having moderate to severe asthma

Research Design: Case/control study: intervention group participated in an outpatient-based program that provides comprehensive evaluation, education, and follow-up. They were compared to a control that did not participate in the program.
Key Results: Increase in inhaled cortico-steroid medications. There was no significant difference in the proportion of patients who were hospitalized or visited the Emergency Room.

29. Lynne, D. 2004. "Diabetes Disease Management in Managed Care Organizations." *Disease Management* 7 (1).
Intervention: Disease Management
Disease/Condition: Diabetes
Length of Time of Intervention/Study: three years (pre and post-enrollment).
Sample Size: GHI (New York) 8,000 eligible; 1,368 followed.
Research Design: Pre- post study (two baseline and one post-program year).
Key Results: Financial results published show 20 percent increase in the PMPM cost for the participant group and 33 percent increase in costs of the non-participant group. Baseline cost of the participant group is significantly lower than that of the non-participant group (27 percent lower) making the results highly susceptible to selection bias.

30. McAlister, F.A., F. Lawson, K K. Teo, and P W. Armstrong. 2001. "Randomized Trials of Secondary Prevention Programmes in Coronary Heart Disease: Systematic Review." *British Medical Journal* 323: 957-62.
Intervention: Disease Management
Disease/Condition: Heart Failure
Length of Time of Intervention/Study Sample Size: 11 trials/2,067 patients. Two weeks-12 months.
Research Design: Review Article
Key Results: Eight studies reported claims data; all but one reported savings. Models that employed nurse follow-up were more successful at savings costs than models using telephonic interventions. No cost data were reported so calculation of ROI and cost-effectiveness of more-intensive nurse-based interventions is not feasible.

31. McAlister, F.A., et al. 2001. "A Systematic Review of Randomized Trials of Disease Management Programs in Heart Failure." *American Journal of Medicine* 110: 378-84.
Intervention: Disease Management
Disease/Condition: Heart failure
Length of Time of Intervention/Study: three months to 12 months
Sample Size: 97 to 1,396
Research Design: Meta-Analysis
Key Results: Authors reviewed 416 citations; only nine met criteria for randomization and reported results for multi-disciplinary teams and hospitalization rates. All studies reported reductions in hospitalizations versus the control; average reduction in hospitalizations was 24 percent. In addition, two studies focusing on providers were reported that these interventions resulted in no significant difference in hospitalizations of the intervention group, compared with the control group.

32. Naji, S. 1994. "Integrated Care for Diabetes: Clinical, Psychosocial, and Economic Evaluation." *British Medical Journal* 308: 1208-12.
    Intervention: Disease Management
    Disease/Condition: Diabetes
    Length of Time of Intervention/Study Sample Size: 274 diabetic patients.
    Research Design: Randomized control.
    Key Results: Many outcomes measured showed no difference between the integrated care model and usual care, including measures of metabolic control, unscheduled admissions, etc. The integrated care group had more (and longer) office visits. Patient cost was lower for these patients.

33. Norris, S.L., et al. 2002. "The Effectiveness of Disease and Case Management for People with Diabetes." *American Journal of Preventive Medicine* 15-38.
    Intervention: Case Management
    Disease/Condition: Diabetes.
    Length of Time of Intervention/Study: N/A
    Sample Size: N/A
    Research Design: Literature Review
    Key Results: No studies were found of Case Management financial outcomes that met the requirements for study validity.

34. O'Connor, P., et al. 1996. "Continuous Quality Improvement Can Improve Glycemic Control for HMO Patients with Diabetes." *Archives of Family Medicine* 5: 502-06.
    Intervention: Disease Management
    Disease/Condition: Diabetes.
    Length of Time of Intervention/Study: 12 months prior/18 months post-implementation.
    Sample Size: 121 intervention/122 comparison population.
    Research Design: Randomized (participating clinic versus non-participating clinic).
    Key Results: HbA1c score fell 6 percent in the intervention group at 12 months and 11 percent at 18 months, compared with no significant change in the control group. Outpatient utilization and claims were not significantly different between intervention and control.

35. Piette, J.D., et al. 2000. "Do Automated Calls with Nurse Follow-Up Improve Self-Care and Glycemic Control among Vulnerable Patients with Diabetes?" *American Journal of Medicine* 108: 20-27.
    Intervention: Disease Management
    Disease/Condition: Diabetes.
    Length of Time of Intervention/Study: N/A
    Sample Size: 280 patients.
    Research Design: Randomized control study
    Key Results: More frequently reported self-care monitoring (foot-monitoring; weight; glycemic control; medication compliance). The intervention group reported a slightly lower HbA1c score. No difference in admission rates.

36. Rich, M.W., V. Beckham, B. Gray, C. Wittenberg, C.L. Leven, and P. Luther. 1996. "Effect of a Multidisciplinary Intervention on Medication Compliance in Elderly Patients with Congestive Heart Failure." *American Journal of Medicine* 101(3): 270-76.
    Intervention: Disease Management /Case Management
    Disease/Condition: Heart failure

Length of Time of Intervention/Study: 30 ± two days
Sample Size: 156 patients over age 70
Research Design: Randomized controlled trial
Key Results: A multidisciplinary follow up intervention is associated with improved medication compliance in the intervention population (88 percent versus 81 percent in the control group). The intervention group experienced 33 percent fewer re-admissions and 31 percent fewer hospital days than the control group, although the difference is not statistically significant.

37. Rich, M.W., V. Beckham, C. Wittenberg, C.L. Leven, K.E. Freddland, and R.M. Carney. 1995. "A Multidisciplinary Intervention to Prevent the Re-admission of Elderly Patients with Congestive Heart Failure." *New England Journal of Medicine* 333 (18): 1190-95.
Intervention: Disease Management/Case Management
Disease/Condition: Heart failure
Length of Time of Intervention/Study: 90-day follow-up
Sample Size: 282 patients over age 70; intervention 142, control 140.
Research Design: Randomized controlled trial
Key Results: 90-day readmission rate for the intervention group was 36 percent; 90-day readmission rate for control group was 46 percent. Multiple re-admissions were reduced from 16.4 percent in the control group to 6.3 percent in the intervention group. Intervention cost averaged $336; overall cost of care was less in the intervention group by $460, suggesting an ROI of 1.37 (Note that study period was < one year).

38. Riegel, B., B. Carlson, Z. Kopp, B. LePetri, D. Glaser, and A. Unger. 2002. "Effect of a Standardized Nurse Case-Management Telephone Intervention on Resource Use in Patients with Chronic Heart Failure." *Archive of Internal Medicine* 162 (6): 705-12.
Intervention: Disease Management/Case Management
Disease/Condition: Heart failure
Length of Time of Intervention/Study: three and six months
Sample Size: 281 physicians/358 patients
Research Design: Randomized controlled clinical trial (physicians randomized)
Key Results: Heart failure (HF) re-hospitalization 45.7 percent lower in intervention group at three months; 47.8 percent lower at six months; HF hospital days and multiple re-admissions were significantly lower in intervention group at six months. Inpatient HF costs were 45.5 percent lower at six months; no evidence of cost shifting to outpatient setting; patient satisfaction with care was higher in intervention group. Savings per patient was estimated at $1,000, and intervention cost was $443, for an ROI of 2.26.

39. Rubin, R.J., K.A. Dietrich, and A.D. Hawk. 1998. "Clinical and Economic Impact of Implementing a Comprehensive Diabetes Management Program in Managed Care." *Journal of Clinical Endocrinology Medicine* 83 (8): 2635-41.
Intervention: Disease Management
Disease/Condition: Diabetes
Length of Time of Intervention/Study: two years; 1/95-12/96.
Sample Size: approximately 7,000 diabetics in a managed care population of 360,000
Research Design: Retrospective Analysis

Key Results: Significant increases in clinical quality indicators are reported (HbA1c scores; cholesterol screening; eye tests; etc.). The specific diabetic care program "Diabetes NetCare" yielded savings of $50 PMPM (12.3 percent reduction). Program costs are not reported.

40. Sadur, C.N., N. Moline, M. Costa, D. Michalik, D. Mendlowitz, S. Roller, R. Watson, B. E. Swain, J.V. Selby, and W.C. Javorski. 1999. "Diabetes Management in a Health Maintenance Organization: Efficacy of Care Management Using Cluster Visits." *Diabetes Care* 22 (12): 2011-17.
    Intervention: Disease Management
    Disease/Condition: Diabetes
    Length of Time of Intervention/Study: six month intervention/18 month follow-up.
    Sample Size: 97 intervention and 88 control patients enrolled in a Kaiser, California HMO.
    Research Design: Randomized controlled trial.
    Key Results: The intervention improved glycemic control: 1.3 percent reduction in the intervention group versus 0.2 percent reduction in control. Lower admission rates in the intervention group than the control group. Seventeen percent increase in physician visits by the intervention group. No cost data were reported.

41. Schermer, T.R., B.P. Thoonen, G. van den Boom, R.P. Akkermans, R.P. Grol, H.T. Folgering, C. van Weel, and C.P. van Schayck. 2002. "Randomized Controlled Economic Evaluation of Asthma Self-Management in Primary Health Care." *American Journal of Respiratory Medicine* 6 (8): 1062-72.
    Intervention: Disease Management
    Disease/Condition: Asthma
    Length of Time of Intervention/Study: two years
    Sample Size: 98 self-management and 95 usual care Dutch patients
    Research Design: Randomized controlled trial.
    Key Results: The cost of the program amounted to Euros 189 per patient; the program resulted in slightly higher costs for the intervention group than the control group (primarily because of higher medication usage). Overall cost is therefore higher for the intervention group. The authors analyze productivity data to estimate the (indirect) value of lower lost-time, which slightly more than offsets the higher program costs.

42. Sidorov, J., R. Shull, J. Tomcavage, S. Girolami, N. Lawton, and R. Harris. 2002. "Does Diabetes Disease Management Save Money and Improve Outcomes? A Report of Simultaneous Short-Term Savings and Quality Improvement Associated with a Health Maintenance Organization-Sponsored Disease Management Program Among Patients Fulfilling Health Employer Data and Information Set Criteria." *Diabetes Care* 25 (4): 684-89.
    Intervention: Disease Management
    Disease/Condition: Diabetes
    Length of Time of Intervention/Study: two years
    Sample Size: 6,799 Health Plan diabetes patients from 295,000 members. Identified through HEDIS criteria
    Research Design: Retrospective claim review of the outcomes of an opt-in program
    Key Results: $394.63 PMPM if in DM program, $502.48 PMPM if not in DM program; Savings of $107.86 PMPM estimated. Program cost for year one is estimated at $83.33 per enrolled member per month, for an ROI of 1.29.

43. Snyder, J. W., J. Malaskovitz, J. Griego, J. Persson, and K. Flatt. 2003. "Quality Improvement and Cost Reduction Realized by a Purchaser through Diabetes." *Disease Management* (6): 233-41.
    Intervention: Disease Management
    Disease/Condition: Diabetes
    Length of Time of Intervention/Study: three years
    Sample Size: 663 (422 continuously participating) diabetics
    Research Design: Pre-post cohort study (Baseline/Intervention year). Baseline not adjusted.
    Key Results: From baseline to year three, medical costs fell 26.8 percent from baseline to intervention year. Per diabetic member per month savings over this period amounted to $98.49. Return on Investment (ROI) was 3.37. Claims did not include prescription drugs.

44. Sullivan, S.D., K.B. Weiss, H. Lynn, H. Mitchell, M. Kattan, P.J. Gergen, R. Evans, and National Cooperative Inner-City Asthma Study (NCICAS) Investigators. 2002. "The Cost-Effectiveness of an Inner-City Asthma Intervention for Children." *Journal of Allergy and Clinical Immunology* 110 (4): 576-81.
    Intervention: Disease Management
    Disease/Condition: Asthma (pediatric)
    Length of Time of Intervention/Study: two years
    Sample Size: 1033 children and their families in eight sites in seven urban inner-city areas completed the first year, and 961 completed the second year.
    Research Design: Prospective cost-effectiveness analysis alongside a randomized trial. Intervention group received comprehensive social worker-based education program and environmental control. Part of the National Cooperative Inner-city Asthma Study.
    Key Results: Cost of the intervention was $337 per child over two years. In Year one, direct medical costs rose by $244.75 in the intervention group, compared with the control group. The intervention improved results in terms of symptom free days but this did not translate into financial savings.

45. Testa, M.A., and D.C. Simonson. 1998. "Health Economic Benefits and Quality of Life During Improved Glycemic Control in Patients with Type 2 Diabetes Mellitus: a Randomized, Controlled, Double-Blind Trial." *Journal of the American Medical Association* 280 (17): 1490-96.
    Intervention: Disease Management
    Disease/Condition: Diabetes (type 2 diabetes)
    Length of Time of Intervention/Study: three-week treatment monitored for 12 weeks.
    Sample Size: 569 volunteers with type 2 diabetes
    Research Design: Double-blind, randomized, placebo-controlled, parallel trial. Intervention group were given hyperglycemic.
    Key Results: Hospitalizations were comparable for both groups. Patients reporting one or more ambulatory care visits decreased by 15 for intervention group, yielding an estimated savings of $11 per patient a month. Intervention group members showed significantly less absence from work.

46. Vaccaro, J., J. Cherry, A. Harper, and M. O'Connell. 2001. "Utilization Reduction, Cost Savings and Return on Investment for the PacifiCare Chronic Heart Failure Program." *Disease Management* 4 (3): 131-38.
Intervention: Disease Management
Disease/Condition: Heart failure
Length of Time of Intervention/Study: six months.
Sample Size: data collected on 52 patients. There were 700 patients enrolled in the program at the time of the study.
Research Design: Cohort study of the PacifiCare "Taking Charge of Your Heart Health Program."
Key Results: $4,882 saved for all-cause hospitalization, $389 for all-cause ER visit, and $5,271 for total cost saved per member per year. ROI estimated at approximately 2.00.

47. Villagra, V., and T. Ahmed. 2004. "Effectiveness of a Disease Management Program for Patients with Diabetes." *Health Affairs* (23) 4: 255-66.
Intervention: Disease Management
Disease/Condition: Diabetes
Length of Time of Intervention/Study: 1998-2000
Sample Size: 55,439 health plan members with Diabetes
Research Design: Two designs: Pre-post and geographic controls
Key Results: Different results were seen in the two different study designs: geographic controls showed $120 PMPM reduction in cost in the intervention group and $26 reduction between intervention and control in the pre- post study. Program cost is not reported although the authors state that savings exceeded costs irrespective of outcomes measurement methodology.

48. Wagner, E., and N. Sandhu. 2001. "Effect of Improved Glycemic Control on Health Care Costs and Utilization." *Journal of the American Medical Association* 285 (2): 182-89.
Intervention: Disease Management
Disease/Condition: Diabetes
Length of Time of Intervention/Study: 1992-1997
Sample Size: 4,749 patients (average age of 60) enrolled in a staff model HMO in Washington state.
Research Design: Historical cohort
Key Results: Mean total health care costs were $685 to $950 less each year in the improved (case) cohort but these differences were only statistically significant after year one. Authors conclude that complicated cases do not lead to cost reductions in initial years.

49. Weingarten, S.R., M.S. Riedinger, L. Conner, T.H. Lee, I. Hoffman, B. Johnson, and A. G. Ellrodt. 1994. "Practice Guidelines and Reminders to Reduce Duration of Hospital Stay for Patients with Chest Pain: An Interventional Trial." *Annals of Internal Medicine* 120 (4): 257-63.
Intervention: Disease Management (Physician intervention)
Disease/Condition: Patients admitted to coronary care/intermediate care units with chest pain at low risk for complications
Length of Time of Intervention/Study: Sept. 1, 1991 – Aug. 31, 1992; one year
Sample Size: 375
Research Design: Prospective controlled clinical trial with alternate method
Key Results: Increase in compliance from 50 percent to 69 percent; decrease of 26 percent

in length of stay; total (direct and indirect) cost reduction $1,397/patient; no difference in complications between intervention and control. When reminders were withdrawn, practice patterns reverted to pre-intervention levels, and even after a year of the program, a significant percentage of physicians failed to practice according to the guidelines.

50. Weingarten, S., J.M. Henning, E. Badamgarav, K. Knight, V. Hasselblad, A. Gano, and J. Ofman. 2002. "Interventions Used in Disease Management Programmes for Patients with Chronic Illness—Which Ones Work? Meta-Analysis of Published Reports." *British Medical Journal* Vol. 325.
Intervention: Disease Management
Disease/Condition: 102 articles evaluating 118 programs; many different diseases. Different types of intervention, both patient- and provider-focused.
Length of study: Varied by study
Sample Size: Multiple
Research Design: Meta-Analysis
Key Results: Provider-focused interventions: modest but significant improvement in disease control; diabetes and depression showed the most significant benefits. Forty-four percent of patient-focused intervention programs produced significant improvement in disease control; greatest improvement was found in depression, asthma and hypertension. Patient education produced a small but significant improvement in control. Patient reminders produced similar results.

51. Wheeler, J. 2003. "Can a Disease Self-Management Program Reduce Health Care Costs? The Case of Older Women with Heart Disease." *Medical Care Volume* 41 (6): 706-15.
Intervention: Disease Management
Disease/Condition: Heart Disease
Length of Time of Intervention/Study: 36 months – three points in time in which data was collected
Sample Size: 227 intervention and 216 control; female only, 60 years and older
Research Design: Randomized controlled trial
Key Results: Program participants experienced 46 percent fewer inpatient days and 49 percent lower inpatient costs. Cost savings were estimated at $150 PMPM, while the program cost was $374 per participant, or $31 PMPM. Hospital cost savings exceeded program costs by a ratio of approximately 5 to 1.

52. Whellan, D.J., L. Gaulden, W.A. Gattis, B. Granger, S.D. Russell, M.A. Blazing, M.S. Cuffe, and C.M. O'Connor. 2001. "The Benefit of Implementing a Heart Failure Disease Management Program." *Archives of Internal Medicine* 161 (18): 2223-28.
Intervention: Disease Management
Disease/Condition: Heart Failure
Length of Time of Intervention/Study: one year. 1998-9
Sample Size: 117 patients enrolled in the Duke Heart Failure Program
Research Design: Pre-enrollment/Post-enrollment study of enrolled patient experience
Key Results: Outpatient costs of participants increased significantly ($55 PMPM) but inpatient costs declined by $580 PMPM. Total cost per PMPM fell by $714 PMPM.