Technical Report

Estimating

The COST of PREVENTIVE SERVICES in Mental Health and Substance Abuse Under Managed Care

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Substance Abuse and Mental Health Services Administration
Center for Mental Health Services
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Acknowledgments

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Disclaimer

This report was prepared under Requisition # 99M0056801D by Pareto Solutions, L.C., for SAMHSA, U.S. Department of Health and Human Services (HHS); Shelagh Smith, Government project officer. The content of this publication does not necessarily reflect the views or policies of SAMHSA or HHS.

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Suggested Citation

Broskowski, A., and Smith, S. *Estimating the Cost of Preventive Services in Mental Health and Substance Abuse Under Managed Care*. DHHS Pub. No. SMA-02-3617. Rockville, MD: Center for Mental Health Services, Substance Abuse and Mental Health Services Administration, 2001.

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Executive Summary

This document presents cost estimates for six preventive interventions previously identified through a literature review and analysis of peer-reviewed, published research in mental health or substance abuse services (Dorfman, 2000). That report was commissioned by the Center for Mental Health Services and yielded a number of well-designed research studies. Twenty-one of those studies supported six preventive interventions that demonstrated patient benefits (i.e., better outcomes) or lower use and cost of medical care. The report by Dorfman should be useful to the reader as a companion to this report, as it provides the background, criteria, and methodology for screening hundreds of articles, selecting and describing 54 studies, and further narrowing the field to 21 articles that directly support the six recommended services. Each intervention had at least two rigorous, peer-reviewed, published studies to support its inclusion.

In this technical report, models are presented to project the range of *potential cost* for the following interventions when they are provided to members of a managed care organization (MCO). The services span the developmental stages from prenatal to later life:

1. Prenatal and infancy home visits for high-risk mothers
2. Targeted cessation education/counseling for smokers
3. Targeted short-term mental health therapy
4. Health promotion through self-care education
5. Presurgical education intervention with adults
6. Brief counseling/advice to reduce alcohol use

The models are spreadsheet-based and include the various factors (input variables) that drive the costs of each intervention: professional and clerical labor, supplies and materials, and general and administrative (G&A) overhead as well as profit margin. Based on the values published in the research studies reviewed by Dorfman (2000) and other published studies or surveys, each model included estimates of each intervention's probable users, units of service per user, and price per unit.

To achieve these estimates, a method of computer simulation in common use, known as "Monte Carlo," was applied to each spreadsheet model to estimate the potential variability in each input variable and combinations of input variables. This simulation method allows for a single, specific variable to be replaced by a distribution of all possible values. Each simulation resulted in a distribution or range of costs expressed as a per member per month (PMPM) cost across four

"scenarios," from a Least Expensive Scenario to a Most Expensive Scenario. Each successive scenario represented increasingly higher estimates in the assumed input variables, such as the professional staff salaries or the number of enrolled women of child-bearing age. To achieve one number, all the variations in input variables or factors were run across thousands of iterations to produce a range of outcome costs with a median and midpoint. Further details on the Monte Carlo simulation are presented in the Technical Appendix, and its application to estimating use and costs can be reviewed in Broskowski and Harshbarger (1998).

The single PMPM cost reported in this publication represents the midpoint value between the median cost of the least expensive scenario and the median cost of the most expensive scenario. In their relative order of cost, here are the calculated midpoints between the median PMPM costs for the six interventions:

Behavioral Preventive Intervention	***Midpoint Median PMPM Cost***
Targeted Cessation Education/ Counseling for Smokers	$0.03
Presurgical Education Intervention With Adults	$0.26
Brief Counseling/Advice to Reduce Alcohol Use	$0.58
Prenatal and Infancy Home Visits for High-Risk Mothers	$1.03
Targeted Short-Term Mental Health Services	$1.48
Health Promotion Through Self-Care Education	$1.54

Even the most expensive of these interventions, Health Promotion Through Self-Care Education, would add less than 1 percent to the average health maintenance organization (HMO) premium, based on 1997 rates reported by Baker, Cantor, Long, and Marquis (2000). In fact, the average increase in premium across all six interventions would be less than 0.5 percent.

A Milliman and Robertson (2000) survey of 591 HMOs, with a one-third response rate, estimated national average HMO premiums in 2000 as $187.49 for a single employee. The average PMPM cost of all six preventive interventions combined is $0.82, which is only 0.44 percent of that average premium.

Since these low-cost interventions have been shown to improve medical outcomes, increase patient satisfaction, and reduce medical use and cost, and given that they would require an increase of less than 0.5 percent of the typical current premiums, MCOs should consider implementing such behavioral interventions. The reader should refer to the original studies, Dorfman's (2000) review of the original 54 published studies, and the attached Technical Appendix, which provides many of the details regarding cost assumptions used for each intervention.

1. Introduction and Background

Dorfman's literature review (2000), commissioned by the Center for Mental Health Services, Substance Abuse and Mental Health Services Administration, screened more than 800 studies and yielded a large number (54) of published research studies documenting effective types of preventive interventions with a link to substance use (alcohol, tobacco, and illicit drugs) or mental health that have been published in peer-reviewed journals, including those addressing the cost impact of the interventions.[1] Of the 54 studies outlined in the report, 21 were used to form the basis of the six recommended interventions, with a minimum of two supporting studies per service and as many as six studies supporting some services.

The following criteria were used for including an article in that literature review:

- The intervention fit within the definition of primary prevention, secondary prevention, or one of the three classifications (universal, selective, or indicated interventions) in the Institute of Medicine's Model of Prevention.
- The study evaluated or reviewed one or more interventions designed to prevent a substance abuse (i.e., alcohol, tobacco, or illicit drug) or mental health problem or a behavioral health intervention designed to prevent an associated health problem—such as a low-birthweight baby—resulting from use of tobacco.
- The intervention was implemented with human subjects; or the intervention model was applied to a hypothetical group of human subjects.
- The intervention was implemented in a medical care or referral setting.
- The intervention was shown to result in cost savings, cost offset, or neutral impact on the cost of care; or the intervention was shown to be effective, with the potential result of cost savings, cost offset, or neutral impact on the cost of care.
- The study was published from 1964 through 1999 in the English language, in a peer-reviewed journal.

[1] Dorfman reported that "the majority of the studies obtained for this review were located through Internet Grateful Med V2.3.2, which includes 11 databases: MEDLINE, HealthSTAR, PREMEDLINE, AIDSLINE, AIDSDRUGS, AIDSTRIALS, DIRLINE, HISTLINE, HSRPROJ, OLDMEDLINE, and SDILINE. The following search terms were used: cost behavior, cost-benefit analysis, cost-effectiveness, cost savings, evaluation studies, health education, health maintenance organizations (HMOs), health promotion, intervention studies, managed care programs, mental health, patient education, prevention, preventive health services, preventive medicine, primary prevention/economics, and substance abuse" (pp. 11–12).

The use of these criteria yielded 54 published studies that were screened against the following additional criteria to be included in the recommendations for consideration by an MCO:

- The intervention's effectiveness has been demonstrated by *two or more* studies included in this review.
- The intervention's appropriateness for provision in a managed care or referral setting has been explicitly stated or is apparent.
- The intervention's feasibility for MCO coverage from a cost perspective has been documented or suggested (Dorfman, 2000, p. 19).

The application of these final criteria yielded six interventions supported by 21 articles. All the articles in Dorfman's review "document positive outcomes of preventive interventions in relation to mental health or substance abuse. Thirteen of the 54 articles address the cost of the intervention. . . . Overall, these studies represent the body of science-based evidence that interventions designed to prevent substance abuse and mental health problems [as well as some medical problems] have been proven effective and, in some cases, have produced net cost savings or have offset costs that would have been incurred absent the preventive intervention" (p. 13).

Based on these criteria and 21 studies (a minimum of two per intervention), Dorfman recommended the following six interventions, spanning the developmental stages from birth to old age (pp. 19–21):

1. Prenatal and Infancy Home Visits for High-Risk Mothers

These articles focused on women with high-risk pregnancies, who included pregnant women under 19 years of age, unmarried, or of low socioeconomic status; and low-birthweight infants born prematurely. The timing of periodic home visits varied, ranging from the prenatal period to age 3. Home visits were made by nurses in one project and by a psychology graduate student teamed with a Comprehensive Education Training Act aide in another. One study focused home visits on maternal functioning and other studies on the training of mothers to stimulate their infants. Fewer subsequent pregnancies, greater spacing between births, less alcohol and drug impairment, and less child abuse and neglect were among the significant findings for mothers who received home visits. Higher weight, better scores on motor developmental tests, and reduced incidence of mental retardation were among the significant findings for infants whose mothers received intervention.

2. Targeted Cessation Education/Counseling for Smokers

Subjects in these articles included a "birth cohort" of women who smoked during pregnancy, pregnant smokers recruited through county maternity clinics, and a hypothetical group of male and female smokers receiving routine medical care. Interventions consisted of a 15-minute counseling session with a nurse or health educator supplemented by written materials and two followup telephone calls; a 15-minute counseling and skill development session with a trained health counselor supplemented by clinical patient reinforcement, social support, newsletter information, and mention in a prenatal education class; and 4 minutes of physician advice to quit smoking supplemented by a self-help booklet and a 1-year followup visit. The birth cohort

model study estimated savings of $3.31 in the cost of caring for low-birth-weight infants in a neonatal intensive care unit for every dollar spent on smoking cessation intervention. In the hypothetical patient group, brief physician advice was estimated to increase the cessation rate at 1 year by 2.7 percent. In the maternity clinics, the intervention produced a 14.3-percent quit rate, compared with an 8.5-percent quit rate in the control group.

3. Targeted Short-Term Mental Health Therapy

In a study of children up to age 15 who received one to six targeted behavioral therapy sessions with their parents from doctoral-level pediatric psychologists or predoctoral clinical psychology interns, those with behavioral problems (such as aggression, noncompliance, tantrums, excessive fears, or sleep or mealtime disturbances) reduced their medical encounters by almost one-third, while those with toileting problems reduced their medical encounters by almost one-half. In another group of individuals who sought short-term psychotherapy from a psychiatrist or other registered psychotherapist on an approved list of community practitioners, index cases significantly decreased days of medical hospitalization compared with matched controls.

4. Health Promotion Through Self-Care Education

Five of the six cited studies were conducted in managed care settings; the sixth was worksite-based. The interventions addressed health promotion and self-care issues that encompassed substance use and mental health. Interventions included group education workshops led by a nurse practitioner and supplemented by a self-care guide and videotapes; written materials, a telephone information service staffed by a nurse coordinator, and an individual health evaluation and planning conference with a trained nurse; computer-based, serial, personal health-risk reports supplemented by individualized recommendation letters and written materials; access to a self-care center; one-on-one education sessions with physicians; and slide-tape shows. The results were an estimated 28-percent savings in laboratory costs and 24-percent savings in x ray costs between experimental and control groups; and a 17-percent decrease in total medical visits and a 35-percent decrease in minor illness visits in experimental versus control groups. Also, significant improvements were noted: decreases in health-risk behaviors, including smoking, alcohol use, and reported stress; decreases ranging from 7.2 to 24 percent in ambulatory physician visits; and a decrease of 15 percent in total medical visits in the experimental group compared with controls. In one study, for every dollar expended on the program, an estimated $5 was saved in direct health care costs for physician visits and hospital days.

5. Presurgical Education Intervention With Adults

In one of the cited studies, the intervention consisted of a workshop to enable staff nurses to provide psychoeducational care to adult surgical patients. Interventions described in the other two articles included giving patients information about what to expect; skills training to help patients prevent complications or reduce anxiety; psychosocial support with a health care provider to reduce anxiety or enhance ability to cope with hospitalization, supplemented with printed and taped materials; and visits to patients by an anesthetist before and after surgery to

provide information and self-care guidance. Interventions were associated with less use of sedatives, antiemetics, hypnotics, and narcotics as well as earlier discharge from the hospital.

6. Brief Counseling/Advice to Reduce Alcohol Use

The four articles reviewed 47 studies conducted in the United States and internationally. Interventions included between 5 and 15 minutes of advice or counseling on reducing alcohol consumption provided by physicians, nurses, psychologists, or other professionals. In some studies, subjects also received a workbook or informational or self-help materials. Other intervention components included followup visits or telephone calls for reinforcement. Significant reductions in alcohol consumption were documented: among middle-aged men, 14 percent, and middle-aged women, 31 percent; among adults 65 and older, 40-percent reduction.

Cost Models of These Six Interventions

This publication reports on the results of cost simulations of these six types of interventions. The interventions were modeled specifically for their potential cost to an MCO when provided to enrolled members; the cost does not include cost offsets or potential savings to the plan. Based on a careful review of all the studies dealing with each category of intervention, financial spreadsheet models were created to reflect the variables that would drive the cost of each type of intervention.

The first part of this report summarizes the calculations and is intended to be useful to MCOs considering implementing the recommendations given in the previous report by Dorfman, *Preventive Interventions Under Managed Care: Mental Health and Substance Abuse Services,* published by the Center for Mental Health Services at SAMHSA. It should be useful to decisionmakers and purchasers of covered benefits packages, managed care organizations, employers, public payers, State health administrators, and mental health services researchers in financing.

Because of the multiple studies supporting each intervention and the fact that no one study provided all of the details in the design and operation of each kind of intervention within each overall category, a generic model was designed for each category using specifications from more than one study. For example, the category of "Prenatal and Infancy Home Visits for High-Risk Mothers" was supported by 11 different publications out of the overall 54 Dorfman reviewed. These 11 studies described a wide variety of interventions, ranging from home visits to classroom-based interventions to on-the-job training of young mothers within a child day-care center. Of these 11 studies, 7 did not provide any information specific to the cost of the intervention, 4 did not specify enough detail about what was done to establish a clear cost model, 3 formed the basis for the final recommendation, and only 2 with the most details were used to design the cost model for the home visit intervention.

General Method of Cost-Based Modeling

Each model was created based on the three primary variables that drive the cost of any intervention or service within a defined population:

1. The percentage of eligible persons who are served by the intervention (Participants, or "**Users**")

2. The intensity, or **Units of Service** within a **Period of Time**, of services provided to each participant
3. The cost of these units of service (**Unit Cost**)

Multiplying the value of each of these variables yields the "Total Cost" of the intervention. The total cost divided by the total number of eligible persons (covered lives, or members) yields the "Cost per Eligible Person." Because most managed care plans calculate their cost of health care benefits on a PMPM basis (in order to determine their monthly premium), the total cost of each type of intervention was calculated on a PMPM basis.

Figure 1 summarizes these three variables. Their multiplicative relationship can be used to calculate the total annual cost. PMPM costs are calculated based on total annual cost, divided by the average annual number of members, divided by 12 months.

Of course, the values of each of these primary variables may be the result of still other variables. For example, the cost of a unit of service delivered by an employee will depend on variables such as the following:

- The employee's salary and fringe-benefit costs
- The average hours in the year that the employee spends in "productive" service (i.e., the cost of a productive hour of service)
- The cost of direct expenses necessary to establish that particular service (e.g., equipment, supplies)
- The cost of G&A expenses necessary to support the general organization and that particular service (e.g., insurance, utilities, administrators' salaries)

Again, these variables may be broken down further and related to one another through formulas such as the following:

Cost of a Staff Person's Hour of Service = [(Salary) + (Fringe Benefits) + (Direct Expenses) + (G&A expenses) / Total Productive Hours]

Figure 1: Two critical formulas for understanding PMPM costs in an MCO

1. **Total Cost = (Users/1000) X (Units/User) X (Cost/Unit)**
2. **Cost per Member per Month (PMPM)**

   ($ PMPM) = (Total costs) / (Total Members) / 12 months

Ongoing Service Costs on an Annualized Basis

Because managed care plans operate on a 1-year budget and members enroll through their employers annually, every model was designed as a "1-year" cost model and as if the MCO provides each intervention on an ongoing basis. Researchers commonly carry out their research on preventive interventions in a controlled environment designed for systematic data collection over a well-defined but limited time period. This method of operation understandably is somewhat different than the way a managed care plan would provide similar services.

Another major difference involves how the intervention is organized and delivered. Some of these interventions were offered as a group service to a well-defined but limited group of cases over a defined time period. Most clinical health services, however, are provided to individual patients on an ongoing basis as they occur intermittently throughout the year.

Furthermore, many of the interventions described in the literature were organized, carried out, and then terminated during a fixed time of less than 1 year. If a managed care plan were to undertake offering such an intervention, it would offer the service on an ongoing basis, probably starting up a new "class" or cohort of persons to receive the intervention at 6-month intervals. Still, other interventions do lend themselves to being offered on an ongoing, case-by-case basis, such as brief advice to reduce the use of alcohol.

In either example, a managed care plan is unlikely to want to incur one-time startup costs, establish some expectations among its enrolled members, and then terminate the program after a short time. Therefore, the model for the cost for a managed care plan assumes that the intervention will be offered throughout the year. At the same time, the cost models do include the startup costs that would have to be incurred during the first year of the service. After the first year, such costs could be omitted in the cost calculations so that the intervention would cost less in the ensuing year than it did in the initial year. The studies on which the models were based were all research with evaluations; obviously, the extra costs associated with carrying out the research, such as tracking outcomes on control group members, were not incorporated in the cost models.

Accounting for Variation

For a detailed discussion of how the model took into account variation due to chance (probability) and unknown values (uncertainty), refer to the Technical Appendix.

Accounting for Scenarios

A cost model of each of these preventive interventions was designed and then simulated under four different scenarios. At one extreme was the Least Expensive Scenario, defined as the scenario that assumed the least expensive values from among a reasonable range of values for each cost driver (e.g., prevalence, intensity of the intervention units/time period, staff salaries). At the other extreme was the Most Expensive Scenario, which assumed the most expensive values from among the same range of reasonable values.

Table 1 summarizes the relative values of the various cost drivers in each model.

The critical dependent variable for each model was the PMPM cost, which is the total cost divided by the total annual membership months (average membership per month over the year, multiplied by 12) of the managed care organization (MCO) that was assumed to sponsor the intervention.

Each model was simulated over 1,000 iterations using Monte Carlo simulation (Winston, 1966), resulting in a distribution of 1,000 possible PMPM cost values for each intervention.

The Technical Appendix presents the details of the four PMPM cost distributions for each intervention and the details of the assumed values of the cost drivers used as inputs to each model.

Table 1: The relative values assumed for each of the four cost scenarios

Cost Drivers	***Scenario***			
	Most Expensive	***Intermediate High***	***Intermediate Low***	***Least Expensive***
Enrollees Covered in the Plan	Primarily Public*	Many Public, Some Commercial	Many Commercial, Some Public	Primarily Commercial
Prevalence of Target Condition	Very High	High	Low	Very Low
Participation Rate	Very High	High	Low	Very Low
Time Period per Intervention	Very Long	Long	Short	Very Short
Intensity (Service Units per Intervention)	Very High	High	Low	Very Low
Staffing Pattern	Very Many Staff	Many Staff	Few Staff	Very Few Staff
Staff Salaries and Fringe Benefits	Highest	High	Low	Lowest
Startup, Fixed, and Variable Expenses	Highest	High	Low	Lowest
Administrative Overhead and Profit	10%	11%	12%	13%

*Public enrollees means persons whose health care coverage is financed through public sector funds (e.g., Medicaid).

11. Model One: Prenatal and Infancy Home Visits for High-Risk Mothers

This intervention was designed based on an amalgamation of two publications—Olds, Henderson, Phelps, Kitzman, and Hanks (1993) and Ramey and Ramey (1992)—and reviewed by Dorfman (2000) in references respectively numbered 2 and 5. Because no study was a strict replication of another, it was necessary to build each intervention model based on major variables that would clearly drive costs, rather than building a separate model for each study. A third study, reviewed by Dorfman and that supported the final recommendations, was not included in this cost model. It used an additional classroom-based intervention and thus would have required a separate cost model (Field, T., Widmayer, S., Greenberg, R., & Stoller, S., 1982).

Further differences between these two studies were in the target population of mothers and infants. Olds et al. (1993) focused on unmarried women under age 19. Ramey and Ramey (1992) selected their subjects because of the infants' low birthweight or premature delivery. While these differences in the types of participants may have had some impact on the relative effectiveness of the interventions, they were not considered to have a major impact on the cost (i.e., "a participant is a participant").

It is important to design the intervention models as generically as reasonably possible in order to allow any given managed care plan to assess the likely cost of the intervention under a variety of circumstances. For example, one plan may wish to target its intervention to a narrow category of enrolled members (e.g., teenage mothers only), while another may wish to target multiple categories (e.g., teenage mothers, older women at prenatal risk due to age, and all mothers at risk for an adverse birth outcome).

In order to get an estimate of the number of potential participants, the model was designed to support three different subcategories of participants from among the eligible members:

1. Teenage mothers
2. Nonteenage mothers of potentially low-birthweight babies
3. Nonteenage mothers with other high-risk pregnancies

The PMPM costs reported for this model are based on the total cost for all three subcategories of participants.

Design and Input Values Used in the Model

This model incorporated a wide range of variables and their assumed values in order to estimate a PMPM cost. The following is a description of the model's general structure. Details on the input variables and the values used to populate these variables are provided in the Technical Appendix.

Assumptions

Number of Lives Covered by the Managed Care Plan

All the models assumed 100,000 enrolled lives (members) in the MCO.

Number of Intervention Cohorts Served Within a 12-Month Operational Cycle

The model assumes that the intervention would last no more than 26 weeks, so that two independent cohorts would be served in 1 year.

Size of the Cohort That Participates in Each Intervention Cycle

Based on the enrolled members, the model used an estimate of the average number of high-risk pregnant females who would be likely to participate in the intervention. In determining what values to use to populate these variables, 1998 U.S. Census Bureau data on the percentages of the general population represented by females of each age group who were potentially able to bear children (i.e., teens = ages 14 to 19, adults = ages 20 to 44) were used, as were separate tables on the birth rates of these age groups. The rate of low-birthweight babies was estimated from the managed care plan "HEDIS Report Card" developed from 1995 to 1996 for the NCQA.

Attrition

Estimates were included for the number of participants who would begin and the number who would complete the intervention, the difference being due to attrition.

Time and Services

This particular model assumed that all participants would undergo an initial private, one-on-one assessment and orientation visit with a social worker, lasting an average of 1 hour. The model assumed that participants would receive one visit every other week and that some home visits would be attempted but not completed ("no shows").

Required Staff Hours and Number of Staff Employed

Using the average number of participants, their average weeks of participation, and the average time spent driving to and from the home, calculations were made of the number of staff hours (total visit time and drive time) that would be required to do the home visits. The total necessary staff hours allows for the calculation of the number of full-time equivalent (FTE) staff that would have to be employed. The calculation of required staff hours assumes these hours are "productive" time. Therefore, the model adjusted upward the number of FTE staff that would need to be hired by a factor representing the percentage of time that the average FTE staff member is not productive (e.g., because of sick leave, vacation, or internal meetings). The model also calls for the *types of staff* to be

hired so average salaries and fringe-benefit rates can be entered.

Other Direct Costs: Startup, Fixed, and Variable

The model also includes estimates of the one-time startup costs directly attributable to the intervention program and the annual fixed and variable expenses on a "per home visit" basis. Startup and fixed expenses would be such items as cost of rent, furniture, computer equipment, and software. Examples of variable costs per visit are any supplies or other items that are consumed at each visit (e.g., sensory stimulation toys for the mother to use with the child, cost of staff transportation for both completed and noncompleted visits).

Administrative Overhead and Profit

The final variable to be valued is the percentage of total expenses that are required to cover G&A expenses plus any profit margin.

Results

PMPM Cost

As noted in Chapter I, the cost simulation of this intervention was done for each of four scenarios, producing four *distributions of possible values* of the output variable, PMPM cost. The single PMPM cost reported represents the midpoint value between the median cost of the Least Expensive Scenario and the median cost of the Most Expensive Scenario. Details on the cost results for all four scenarios are presented in the Technical Appendix.

The median PMPM cost for the Least Expensive Scenario was only $0.58, and the median cost for the Most Expensive Scenario was $1.49. The midpoint between these two median values is $1.03.

Discussion

This intervention has been shown to reduce adverse birth outcomes and produce overall medical cost savings (Olds et al., 1993; Ramey and Ramey, 1992). The annual investment of $1.03 PMPM for 100,000 members comes to an aggregate cost of $1,236,000. Although this is a large sum of money, the MCO could be expected to save a larger amount through the cost savings realized by the prevention of adverse births and their high medical costs. Although most of the medical savings would accrue in the first 5 years of the child's life, additional savings are likely during adolescence. Longitudinal econometric research on early childhood interventions has documented significant net savings in the cost per child (Karoly, Greenwood, Everingham, Houbé, Kilburn, Rydell, Sanders, and Chiesa, 1998). Much of these savings involve reduced costs to the criminal justice system as well as child and adolescent health and welfare costs.

III. Model Two: Smoking Cessation Targeted at Pregnant Women

This cost model was designed on the basis of an amalgamation of three publications—Marks, Koplan, Hogue, and Dalmat (1990); Windsor, Lowe, Perkins, Smith-Yoder, Artz, Crawford, Ambury, and Boyd (1993); and Cummings, Rubin, and Oster (1989)—and reviewed by Dorfman (2000) in references respectively numbered 1, 3, and 26.

The intervention that was most extensive (Windsor et al., 1993), targeted toward pregnant women receiving prenatal care in a public health clinic, consisted of the following components:

- A brief (15-minute) counseling session, supplemented by the use of written materials
- Medical chart reminders during prenatal visits
- Followup phone calls and letters
- A "buddy contact"
- A 2-minute no-smoking reminder embedded within a 20-minute prenatal education class

Marks et al. (1990) reported using only a single 15-minute counseling session, simple instructional materials, and two followup phone calls. Cummings et al. (1989) reported on the cost-effectiveness of a 4-minute counseling session by a physician, a 1-year followup, and a self-help booklet administered to a "hypothetical" group of adult male and female patients.

Once again, in order to make the cost model as generic as possible, it was designed to include the various components across all three studies.

Results

PMPM Cost

The Least Expensive Scenario had a median PMPM cost of $0.02, and the Most Expensive Scenario had a median cost of $0.04, with a midpoint of $0.03. Again, as in the Prenatal and Infancy Home Visits model, variability increased as the average cost increased. Across all four scenarios, 90 percent of the estimated PMPM values were within the range of $0.02 to $0.06.

Design and Input Values Used in the Model

Number of Lives Covered by the Managed Care Plan

This model, like all other models, assumed there are 100,000 enrolled lives (members) in the MCO.

Number of Intervention Cohorts Served Within a 12-Month Operational Cycle

This intervention was assumed to be one that could be offered on an ongoing basis to patients as they came in for their routine medical visits (i.e., prenatal visits in the case of pregnant women).

Number of Likely Participants Completing the Intervention

This model also used estimates of the number of members who would be women in their childbearing years. U.S. Census Bureau data from 1998 were used to determine the percentages of the general population represented by females of each age group who were potentially able to bear children (i.e., teens = ages 14 to 19, adults = ages 20 to 44) and separate tables on the birth rates of these age groups.

It was estimated that an average of 21 percent of the likely pregnant patients in a year would be smokers, as reported by Marks et al. (1990) based on a "1985–1986 Behavioral Risk Factor Surveillance System . . . of American women from 25 states and the District of Columbia" (Dorfman, 2000, p. 31).

Having established the percentage of members who were pregnant and smokers, the model estimated the number of such members who would be willing to participate in the study. Based on a figure of 93.7 percent, reported by Windsor et al. (1993), the model used a range of estimates of the percentage of the pregnant smokers who would agree to *start* participation. The model also estimated the percentage of pregnant smokers who would *complete* the program. These selected values were as low as 68 percent in the Least Expensive Scenario and as high as 78 percent in the Most Expensive Scenario.

The values were selected based on attrition rates reported by Windsor et al. (1993). Women left Windsor's planned intervention for such reasons as losing benefit eligibility, having abortions, or having miscarriages.

Materials, Staff Time, and Related Services

For each of the three studies, the model assumed that all participants would undergo one-on-one counseling with a nurse, lasting an average of 15 minutes.

The model assumed each patient received two pamphlets and a "smoking cessation guidebook" or "self-help book." Items were assumed to cost $4. Cummings et al. (1989) reported an estimate of $2 for a self-help booklet, and Windsor et al. (1993) estimated $6 per patient for the cost of materials, reproduction, and labor.

The value of nurses' time was the same as that used in the first model, based on a salary of $50,000 incrementing in each scenario by $1,000, an average productivity of 70 percent of payroll hours, and a 29 percent fringe-benefit rate.

Windsor et al. (1993) reported that each patient received a "medical letter" emphasizing the importance of smoking cessation, and a reminder was placed in the patient's medical chart so the doctor could ask questions at subsequent prenatal visits. The clerical time required for these activities was estimated at a mean of 10 minutes. Clerical salaries were estimated to start at $20,000 (with $1,000 increments for each successive scenario), with a productivity rate of 80 percent and a fringe-benefit rate of 29 percent. The letter and postage costs were estimated at $0.41 per patient.

Windsor et al. (1993) also reported on "social supports," which consisted of the following activities:

- Sending a "buddy letter," including two pamphlets, to each patient
- Sending a quarterly newsletter to each patient

These five mailings were assumed to require an average of 10 minutes of clerical time (standard deviation [SD] = 3 minutes) and $0.45 for reproduction and postage per patient.

The model also builds in the cost for the 2-minute reminder delivered by a nurse as part of a 20-minute prenatal class.

The model assumed that there were no other variable or one-time startup costs beyond the smoking cessation guides/self-help booklets and pamphlets.

The final variable that had to be valued is the percentage of total expenses required to cover G&A expenses plus any profit margin. A fairly generous amount of 10 percent was used.

Discussion

This intervention entails very little in the way of initial startup costs or other fixed costs, nor does it require any extensive, specialized training for staff. Marks et al. (1990) estimated a savings of $3.31 for every dollar invested, primarily through the prevention of low-birthweight babies and averted perinatal deaths. Windsor et al. (1993) estimated a range of medical savings realized through fewer adverse birth effects from $6.72 to $17.18 for every dollar invested.

IV. Model Three: Targeted Short-Term Mental Health Therapy

This cost model was designed on the basis of interventions described in research by Finney, Riley, and Cataldo (1991) and Goldberg, Allen, Kessler, Carey, Locke, and Cook (1981) and reviewed by Dorfman (2000) in references respectively numbered 15 and 41. This model was designed, as were the others, to estimate PMPM costs for a managed care plan with 100,000 members that implements a brief psychotherapy benefit (6 to 16 visits) for its child and adolescent members (birth to age 17) and for its adult members (ages 18–65).

Finney et al. (1991) focused on children ages 1 to 15 treated with brief therapy in a pediatric clinic of a staff-based HMO. Goldberg et al. (1981) did their research based on the claims paid for psychotherapy provided to adult members of the Federal Employees Health Benefit Plan. This cost model was designed to accommodate both children and adults, and the cost results of each subgroup were combined, assuming that an MCO would use this intervention with all age groups. Both age categories had a similar cost structure but different input assumptions (i.e., values assigned to various stochastic distributions).

Results

PMPM Cost

The median PMPM cost for the Least Expensive Scenario was $1.00. The median PMPM cost for the Most Expensive Scenario was $1.96, resulting in a midpoint value of $1.48.

Design and Input Values Used in the Model

Membership and Treated Prevalence

This model assumed an MCO membership of 100,000. On the basis of 1990 census data, the model assumed that 32 percent of the population would be from birth to age 18, and 68 percent would be ages 19 to 65.

The model assumed that any MCO would use "medical necessity" criteria when evaluating the need for brief psychotherapy, as was used in the study by Goldberg et al. (1981). Therefore, the model assumed that indicators of *treated prevalence* would best estimate the number of persons who would receive brief therapy.

For the child subgroup, the model assumed a prevalence rate of 9 to 12 percent based on median estimates from a meta-

analysis of the epidemiological research reported by Friedman, Katz-Leavy, Manderscheid, and Sondheimer (1996). A study on treated prevalence of mental health problems among children and adolescents indicated that 23 percent of privately insured children with any mental health disorder (serious emotional disturbance [SED] or non-SED) received some outpatient therapy (Burns, 1991).

For the adult subgroup, the model assumed outpatient treated prevalence rates of 14, 14.5, and 15 percent based on epidemiological research reported by Bourdon, Rae, Narrow, Manderscheid, and Regier (1994) on an average treated prevalence rate for adults. That rate of treated prevalence is further reduced by 44 percent, a rate reported by Goldberg et al. (1981) of index patients with psychiatric diagnoses who received zero visits.

Volume of Service, Type of Provider, and Copayments

For the child subgroup, the model assumed an average of 2.75 visits per child. Finney et al. (1991) reported a range of 1 to 6 visits and an average of 2.4 visits, but no measure of variability around this mean. The model assumed that each therapy session per child participant lasted 60 minutes, which includes the 50-minute sessions reported by Finney et al. (1991) and Goldberg et al. (1981) and 10 minutes for clinical record keeping. Based on the data reported by Goldberg et al. (1981), the model assumed eight visits per adult participant, each one requiring 50 minutes of therapist time and 10 minutes for record keeping.

The model assumed that the therapy was provided by a licensed mental health professional (psychologist or psychiatric social worker) with an annual salary of $50,000, a fringe-benefit cost of 29 percent of salary, and a productivity rate of 70 percent, yielding an "effective cost per hour" of $44.30.

Because most insurance plans, including HMOs and behavioral health care carve-outs, have a mental health copayment requirement, the model assumed a copayment of $20, $15, $10, and $5, respectively, for the four scenarios from Least Expensive to Most Expensive. In other words, the copayment effectively reduces the "effective cost per hour" by $20 to $24.30 for the Least Expensive Scenario and by $5 to $39.30 for the Most Expensive Scenario. The model assumed that 100 percent of all copayments were collected.

Other Expenses

Finney et al. (1991) reported that "behavioral treatment guidelines" (e.g., how to respond to bed wetting, the use of "time-outs") were given to the parents of the children in treatment. The model assumed a cost of $2 to $5 in $1 increments for the cost of reproduction and distribution of these guidelines.

Finney et al. (1991) also reported that "most families also received a number of planned telephone contacts after therapy was begun to ensure adequate implementation of recommended therapeutic techniques and to troubleshoot problems" (p. 452). Therefore, the model assumed that 100 percent of the families would each receive two phone calls. The model assumed that the phone calls took 5 minutes and were made by the therapist.

The model assumed no supply or phone call expenses for the adults.

The total cost was also increased by applying a G&A overhead plus profit rate of 10, 11, 12, and 13 percent to the direct

services cost in each of the four respective scenarios from Least Expensive to Most Expensive.

Discussion

Unlike interventions that use traditionally trained medical staff, this intervention generally requires professionals trained in brief psychotherapy—primarily psychologists, but also some psychiatrists and psychiatric social workers. Therefore, some staff-model HMOs or independent practice associations (IPAs) would have to review their staffing patterns to determine whether such personnel were available and trained in brief psychotherapy, especially with children and adolescents. An alternative to hiring such personnel would be to subcontract with a qualified professional to carry out the intervention on a fee-for-service or case-rate basis.

V. Model Four: Health Promotion Through Self-Care Education

This cost model was designed on the basis of an amalgamation of six publications—Kemper (1982); Vickery, Kalmer, Lowry, Constantine, Wright, and Loren (1983); Fries, Fries, Parcell, and Harrington (1992); Kemper, Lorig, and Mettler (1993); Leigh, Richardson, Beck, Kerr, Harrington, Parcell, and Fries (1992); and Vickery, Golaszewski, Wright, and Kalmer (1988)—and reviewed by Dorfman (2000), in references respectively numbered 29, 32, 40, 43, 51, and 52. Each study described a variety of interventions provided to adults (ages 19 to 65) or older adults (age 66 and older). Five of the six studies were conducted in a managed care setting, and one was offered at the worksite.

Across the six studies, a wide range of activities was provided to participants in order to promote positive health behaviors and self-care:

- Workshops to train nurses to provide psychoeducational support to patients, including written materials, pamphlets, and booklets
- Self-care guidelines, newsletters, books, and booklets for participants
- Videotapes covering self-care
- Access to a telephone information service staffed by a nurse
- Individual health conferences with a nurse
- Computer-based, serial, personalized health risk reports
- Individualized recommendation letters and reports
- One-on-one educational sessions with a physician
- Access to a self-care drop-in center (Dorfman, 2000, p. 21)

The model was designed to incorporate all nine of these activities and to estimate the PMPM costs of all nine combined. Therefore, the PMPM costs are overstated for an MCO that uses only a subset of the activities.

Results

PMPM Cost

The median PMPM cost for the Least Expensive Scenario was $1.06. The median PMPM cost for the Most Expensive Scenario was $2.02, with a midpoint of $1.54.

Design and Input Values Used in the Model

Membership and Participation

The model begins with an estimation of the number of adults and older adults who are members of an MCO with 100,000 members. On the basis of 1990 census figures, these percentages were valued at 59 percent for adults and 11 percent for older adults. The model then uses an estimate of the percentage of each age group that is likely to agree to participate in a health promotion campaign (i.e., a series of health promotion and self-care activities throughout the year). These estimates for adults ranged from 45 percent to 90 percent in increments of 15 percent for each scenario (Least Expensive to Most Expensive). For older adults, the percentage started at 60 percent (Least Expensive Scenario) and went as high as 90 percent (Most Expensive Scenario) in increments of 10 percent.

Because some activities are costed out by household (e.g., a videotape mailed to a home), it is necessary to estimate the number of covered members per household for adults and older adult members. Based on data reported by Vickery et al. (1983), the ratio of older adult participants to households was set from 1.26 (Least Expensive) to 1.20 (Most Expensive) in increments of 0.02. For adults, this ratio ranged from 3.0 (Least Expensive) to 2.4 (Most Expensive) in increments of 0.20.

Other Expenses: Materials and Staff Time

The rest of the model consisted of 10 separate modules reflecting the various types of specific intervention activities that were described in the various studies reviewed by Dorfman (2000). Each module allowed for the cost estimation of written material, as well as clerical and professional labor spent in conducting one-on-one activities or group activities. In each module, the model used a separate estimate for the level of participation by adults or older adults. For example, although 9,000 adults may agree to participate in the series of activities, only 25 percent may actually show up to participate in a particular activity, such as an educational workshop.

Slightly different staff salaries, fringe-benefit rates (29 percent), and rates of productivity were assumed in Model 4 than in Models 1 through 3:

- Clerical at $20,000 in $500 increments and 80 percent productivity
- Nurses at $50,000 in $1,000 increments and 70 percent productivity
- Psychologists at $50,000 in $1,000 increments and 70 percent productivity
- Physicians at $100,000 in $2,000 increments and 70 percent productivity

Discussion

This intervention could be integrated easily into most staff- or independent-practice association (IPA)-model HMOs. Unlike some of the other interventions, there is not a heavy reliance on professional medical staff time, with the exception of the visit with a physician to review the health risk appraisal, which would seem to be reasonable medical practice in any case.

It is important to note that the model's estimated total PMPM costs are the highest of all six models. That is because this type of intervention can employ so many different specific activities, *all of which were included in the cost model*. Any MCO considering the implementation of this preventive interven-

tion should read the original research and decide which of all the possible activities it wishes to implement. The PMPM cost for each activity is presented in the Technical Appendix.

VI. Model Five: Presurgical Educational Intervention With Adults

This cost model was based on three research publications—Devine and Cook (1983); Devine, O'Connor, Cook, Wenk, and Curtin (1988); and Egbert, Battit, Welch, and Bartlett (1964)—and reviewed by Dorfman (2000) in references respectively numbered 35, 36, and 38. One publication (Devine and Cook, 1983) was a meta-analysis of 49 other studies. This meta-analysis and the other two studies described a variety of component interventions provided to adults undergoing a wide range of inpatient surgical procedures:

- Nurse-conducted group workshops that focus on the benefits of psychoeducational supports, including written materials and videos
- Presurgical and postsurgical visits by an anesthetist
- Skill or exercise training to promote postsurgical recovery
- Psychosocial support from a health care provider

Results

PMPM Cost

The median PMPM cost for the Least Expensive Scenario was $0.22. The median PMPM cost for the Most Expensive Scenario was $0.31, with a midpoint cost of $0.26.

Design and Input Values Used in the Model

Membership, Target Audience, and Level of Participation

The model begins with an estimation of the number of adults who would undergo an inpatient operative procedure. The number of operative procedures carried out in inpatient settings in the United States was accessed in the most recent results reported by the National Hospital Discharge Survey (NHDS;

Centers for Disease Control and Prevention, 1996) and adjusted down by 71 percent, for an estimate of only those procedures done on adult and elderly patients (ages 18 to 80), the number of which was based on 1998 U.S. Census Bureau numbers. The 1996 inpatient surgical procedure rate was 154 per 1,000 members of the 1996 general population (U.S. Census Bureau, 1998). This value was reduced to 109 per 1,000 adult and elderly lives. The rate was reduced once again by the ratio of operative procedures in HMOs, as reported by the Group Health Association of America (1995), to the rate reported by the NHDS for the general population. HMO members in 1995 had about 36 percent fewer operative procedures than the general population. Therefore, the rate per 100,000 members in the hypothetical MCO was set at 70 per 1,000 adult and elderly lives (estimated at 71 percent of the 100,000).

The level of participation for the Least Expensive Scenario was set at 50 percent, increasing in 5 percent increments up to 65 percent for the Most Expensive Scenario.

Staffing and Materials

While the original research reports that an anesthetist made bedside visits to patients the night before the surgery, the model assumed that a nurse with specialty training in anesthesiology could carry out this task.

The Technical Appendix provides details of the assumed levels of participation for each component activity, the costs of the materials and supplies for each scenario, and the assumed time and effective cost per hour for the nurses, psychologists, nurse anesthesiologist, and health counselor.

Discussion

As in the case of Model 4, this intervention would seem relatively easy to incorporate into the routine operating procedures of most inpatient units. The biggest barrier might be the availability of a trained nurse anesthesiologist. But, given the reported effectiveness of this intervention in improving patients' medical compliance (Devine and Cook, 1983) and reducing the use of narcotics and the average length of inpatient stay (Devine et al., 1988; Egbert et al., 1964), the cost to implement such an intervention could be offset by savings for an MCO that is at risk for inpatient surgical costs.

VII. Model Six: Brief Counseling to Reduce Alcohol Use

This model was designed on the basis of four research publications—Bien, Miller, and Tonigan (1993); Fleming, Barry, Manwell, Johnson, and London (1997); World Health Organization (1996); and Fleming, Barry, Manwell, Adams, and Stauffacher (1999)—and reviewed by Dorfman (2000) in references respectively numbered 33, 39, 50, and 53. As with all the other models, this model was designed to estimate PMPM costs for a managed care plan with 100,000 members that implements a screening and brief intervention to reduce excessive alcohol use by its adult members (ages 18 to 65) as well as its older members (ages 66 and older), male and female.

Results

PMPM Cost

The median PMPM cost for the Least Expensive Scenario was only $0.36. The median PMPM cost for the Most Expensive Scenario was $0.82, with a midpoint range of $0.59.

Design and Input Values Used in the Model

Membership, Target Audience Screened for Alcohol Use, and Participation

Based on 1998 numbers from the U.S. Census Bureau, the model assumed that male and female adults, including persons older than 65, represented a range of 70 to 73 percent (in increments of 1 percent for each scenario) of the 100,000 members.

Based on the research reported by Fleming et al. (1997) and epidemiological household surveys of drug and alcohol use by the Office of Applied Studies, Substance Abuse and Mental Health Administration (1998), the model assumed that 14 to 17 percent (in increments of 1 percent for each scenario) would screen positive for excessive alcohol use or dependency on a self-administered health screening instrument distributed by a receptionist. This percentage *excludes* female adults who were pregnant and all adults (ages 19 to 64) known to be drug or alcohol abusers or having a history of treatment for drug or alcohol abuse.

The model assumed that 68 to 71 percent (in increments of 1 percent for each scenario) of those screening positive would agree to go through the initial 30-minute interview with a nurse to further screen participants and

collect baseline data on health-related behaviors (e.g., smoking, exercise).

Based on data reported by Fleming et al. (1997), the model assumed that 42 to 45 percent (in increments of 1 percent for each scenario) of those completing this interview would go on to start participation in the intervention. The model assumed that 95 to 98 percent (in increments of 1 percent for each scenario) of those who started the intervention would complete it.

Materials and Staff Time

The model assumed that the average time for distribution and scoring of the self-administered health screening instrument by a receptionist was 5 minutes. The model assumed that the health screening instrument would cost $0.75, $1, $1.50, and $2 in the four scenarios.

Each participant was given a workbook. The workbook used by the participant and the physician "contained feedback regarding current health behaviors, a review of the prevalence of problem drinking, a list of the adverse effects of alcohol, a worksheet on drinking cues, a drinking agreement in the form of a prescription, and drinking diary cards" (Dorfman, 2000, p. 61). The model assumed this workbook was provided to 100 percent of the participants. The model assumed the cost per workbook for each of the four scenarios was $5, $6, $7, and $8.

Service Interventions

As described by Fleming et al. (1997), the model assumed that participants would receive two brief counseling sessions with their primary care physician, each lasting 15 minutes. This time includes the few minutes required for the physician to enter brief documentation in the medical record.

The model assumed that 100 percent of participants would receive a followup phone call by a nurse following each of the two sessions with the physician. Each followup call was assumed to last an average of 5 minutes.

The cost of these interventions by clerical staff, nurses, and physicians was determined by multiplying the cost of a productive staff hour (based on salary, fringe benefits, and nonproductive time) by the time required of the trainers. The annual salaries of each category of staff were assumed to be clerical, $20,000 with $500 increments for each scenario and 80-percent productivity; nurses, $50,000 with $1,000 increments and 70-percent productivity; and physicians, $100,000 with $2,000 increments and 70-percent productivity.

Fringe-benefit costs were assumed at 29 percent for all personnel. The model assumed that no expenses were associated with the need for additional supervisory or management staff, because such an intervention could blend into the ongoing clinical operations of each physician's office.

Physician Recruitment and Staff Training

Based on ratios reported by Fleming et al. (1997) of participants to physicians, the number of physicians who would *have to be invited* to participate was estimated. Assuming a rate of agreement to participate at 80 to 95 percent in 5-percent increments for each scenario, the number of physicians to invite and the number needed to participate in order to handle the number of expected participants could be calculated. Invitation costs were estimated at $35 to $50 in $5 increments. For each scenario, the model assumed there would be 4, 3, 2, or 1 doctor per office site. That way, the number

of office sites where personnel and physicians would need to be trained could be calculated.

The model assumed that all involved office personnel would require some training on the use of the protocol. For each office site, the model assumed a 20-minute (SD = 5 minutes) training for clerical personnel who distributed and scored the health screening instrument, and a 60-minute (SD = 5 minutes) training session for the nurses who would administer the interview and make the followup phone calls. The model assumed an initial training session of 60 minutes (SD = 10 minutes) for all physicians working at a single site. The model also assumed two "booster" training sessions for physicians of 15 minutes each (SD = 10 minutes).

The training costs were determined by multiplying the average salary and fringe-benefit costs of a trainer ($40,000 in $1,000 increments for each scenario, 70 percent productivity and 29 percent fringe-benefit cost) by the time required of trainers. The model assumed that no expenses were associated with the need for additional supervisory or management staff, because such an intervention could blend into ongoing office operations.

Because the original research by Fleming et al. (1997) reported a $300 payment to the physicians, the model assumed payments to each participating physician of $300, $500, $700, and $900 for each scenario. This payment would be made to compensate the physician for "lost patient revenue" related to the need for staff and physician to participate in the training.

Finally, the model assumed that some percentage should be added for G&A expenses plus profit. The model assumed a minimum of 10 percent, increasing by 1 percent for each of the four scenarios.

Discussion

Of all the interventions, this one may be most problematic for traditional IPA-model HMOs or preferred provider organizations to implement, largely because of the extensive logistical effort required to train the physicians and their office staff (clerical workers and nurses) to carry out the protocol, and some physicians' likely resistance to confront problem drinking by a patient.

At least one of the four published studies reviewed by Dorfman (2000) was carried out across a number of countries (World Health Organization Brief Intervention Group, 1996) in college or health screening clinics where the stigma associated with alcohol abuse may be lower or the resistance to confronting problem drinkers may be lower. And while all the studies reported success in reducing drinking, there was no explicit analysis of the likely long-term benefits and cost savings associated with reduced use of medical services.

In a review of the medical cost-offset literature, however, Mumford, Schlesinger, and Glass (1981) reviewed 12 studies, 3 in HMOs and 9 in employee-based work settings, that reported significant effectiveness of alcoholism treatment in reducing medical and surgical costs, lost workdays, and injuries and disabilities. A risk-bearing MCO would clearly have an incentive to incur the costs of training personnel to identify and reduce excessive or problem drinking among its membership, on the assumption that the membership would remain with the MCO long enough for the investment to yield long-term benefits and cost savings.

VIII. Summary and Discussion

Before summarizing the estimated PMPM cost of these six preventive interventions, it is important to restate some of the major assumptions and limitations that had to be addressed.

Most of the originally published research did not present enough details regarding the specific costs of the various elements of their intervention. For example, most studies did not indicate the salaries paid to the staff members required to carry out the intervention. Most studies also did not indicate the unit costs of various booklets, brochures, videotapes, or assessment instruments distributed to participants.

A more serious limitation in the published research was the lack of information regarding the incidence or prevalence of the disease, disorder, or poor lifestyle behavior toward which the intervention was directed. While many studies reported the number of persons invited to participate and the number screened in or out, most studies did not describe the size of the population from which these participants were drawn. Therefore, it was necessary to estimate the rate of participation per 100,000 MCO members. Any MCO that considers the feasibility of offering any of these interventions will need to assess the likely volume of users who will start and complete the intervention.

Because MCOs are likely to vary widely with respect to the demographics and health/illness case mix among their members, it was necessary to create alternative scenarios to encompass the full range of low- to high-cost assumptions. For example, the Least Expensive Scenario encompasses all the least costly assumptions about the case mix of members (educated, employed, commercially insured), the salary costs of employees, and the unit costs of material and travel. The Most Expensive Scenario encompasses the most expensive set of assumptions about membership, salary levels, and supplies and materials. A fairly wide range of possible values had to be assumed for such variables to ensure that most of the cost-related values applicable to most MCOs would be encompassed.

Each intervention cost model was an amalgamation of several different, specific interventions that shared a common theme or targeted illness, condition, or behavior. Thus, each model is not an exact cost representation on any one published study but a generic model that was designed to incorporate the essential variables that would drive the overall cost of similar interventions. In some cases, such as the model for Health Promotion Through Self-Care Education, the model was designed to incorporate *all* the component interventions used across all published studies. Thus, the estimated average PMPM costs are likely to overstate the costs

for an MCO that implements only a subset of all the possible components.

Only one model (Targeted Short-Term Mental Health Therapy) assumed any revenue to offset costs.

Table 2 summarizes the midpoint value between the median PMPM cost of the Least Expensive Scenario and the median PMPM cost of the Most Expensive Scenario.

These results suggest that the incremental costs for an MCO to implement any one of these interventions are very small relative to existing monthly premiums.

Table 3 expresses the midpoint between the median PMPM cost of the Least Expensive Scenario and the median PMPM cost of the Most Expensive Scenario of each intervention as a percentage of the average monthly HMO premium rates for single individuals in 1997 as reported by Baker et al. (2000). The average monthly HMO premiums are lowest in regions of the country (Mountain and East South Central) where the highest percentage of the community population is enrolled in an HMO.

As can be seen in Table 3, the most expensive intervention, Health Promotion Through Self-Care Education (midpoint PMPM = $1.54), would add 1.09 percent, at most, to the estimated 1997 average monthly single premium of an HMO in the Mountain region and only 0.84 percent to the premium in the New England region. The average percentage increase across all six interventions in all four regions is only 0.5 percent.

Given the documented effectiveness of these interventions in improved medical outcomes, increased patient satisfaction, reduced use of medical resources, and cost, and their low cost relative to existing premiums, it is highly recommended that MCOs give serious consideration to implementing the interventions.

Table 2: Midpoint PMPM costs between the Least Expensive Scenario and the Most Expensive Scenario for each preventive intervention

Six Preventive Interventions for High-Risk Mothers	***Midpoint Between Median PMPM Cost of Least and Most Expensive Scenarios ($)***
Prenatal and infancy home visits	1.03
Targeted cessation education/ counseling for smokers	0.03
Targeted short-term mental health therapy	1.48
Health promotion through self-care education	1.54
Presurgical education intervention with adults	0.26
Brief counseling/advice to reduce alcohol use	0.59

Table 3: PMPM costs of preventive interventions as a percentage of 1997 HMO premiums for single individuals

Six Preventive Interventions for High-Risk Mothers	*Midpoint Between Median PMPM Cost of Least and Most Expensive Scenarios ($)*	*Average Single Monthly 1997 HMO Premiums in Four USA Regions*			
		Mountain	*East South Central*	*West South Central*	*New England*
		$141.23	**$153.31**	**$165.58**	**$183.23**
		Incremental percentage cost to the average HMO premium			
Prenatal and infancy home visits	1.03	0.73%	0.67%	0.62%	0.56%
Targeted cessation education/ counseling for smokers	0.03	0.02%	0.02%	0.02%	0.02%
Targeted short-term mental health therapy	1.48	1.05%	0.97%	0.90%	0.81%
Health promotion through self-care education	1.54	1.09%	1.00%	0.93%	0.84%
Presurgical education intervention with adults	0.26	0.18%	0.17%	0.16%	0.14%
Brief counseling/advice to reduce alcohol use	0.59	0.42%	0.38%	0.36%	0.32%

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X. Technical Appendix

This Technical Appendix supplements the manuscript by the same title. It contains detailed statistical information on the results of a simulation of costs for the following six preventive interventions:

1. Prenatal and Infancy Home Visits for High-Risk Mothers
2. Targeted Cessation Education/Counseling for Smokers
3. Targeted Short-Term Mental Health Therapy
4. Health Promotion Through Self-Care Education
5. Presurgical Education Intervention With Adults
6. Brief Counseling/Advice to Reduce Alcohol Use

The rationale for the selection of these six interventions and a complete description of each intervention, its intended target audience, and its impact on health outcomes and costs appear in Dorfman (2000) and are summarized in the main text of this report, "Estimating the Cost of Preventive Services in Mental Health and Substance Abuse Under Managed Care."

A cost model of each of these preventive interventions was designed and then simulated under four different scenarios. At one extreme was the Least Expensive Scenario, defined as the scenario that assumed the least expensive values from among a reasonable range of values for each cost driver (e.g., prevalence, intensity of the intervention units/time period, staff salaries). At the other extreme was the Most Expensive Scenario, which assumed the most expensive values from among the same range of reasonable values.

Table A.1 summarizes the relative values of the various cost drivers in each model.

The critical dependent variable for each model was the PMPM cost, which is the total cost divided by the total annual membership months (average membership per month over the year, multiplied by 12) of the managed care organization (MCO) that was assumed to sponsor the intervention.

Each model was simulated over 1,000 iterations using Monte Carlo simulation (Winston, 1966), resulting in a *distribution* of 1,000 possible PMPM cost values for each intervention.

This Technical Appendix presents the details of the four PMPM cost distributions for each intervention and the details of the assumed values of the cost drivers used as inputs to each model.

Monte Carlo Simulation and the "Flaw of Averages"

Each cost model must take into account the fact that the "average" value that is entered for any of the multiple variables represents

Table A.1: The relative values assumed for each of the four cost scenarios

Cost Drivers	Scenario			
	Most Expensive	Intermediate High	Intermediate Low	Least Expensive
Enrollees Covered in the Plan	Primarily Public*	Many Public, Some Commercial	Many Commercial, Some Public	Primarily Commercial
Prevalence of Target Condition	Very High	High	Low	Very Low
Participation Rate	Very High	High	Low	Very Low
Time Period per Intervention	Very Long	Long	Short	Very Short
Intensity (Service Units per Intervention)	Very High	High	Low	Very Low
Staffing Pattern	Very Many Staff	Many Staff	Few Staff	Very Few Staff
Staff Salaries and Fringe Benefits	Highest	High	Low	Lowest
Startup, Fixed, and Variable Expenses	Highest	High	Low	Lowest
Administrative Overhead and Profit	10%	11%	12%	13%

*Public enrollees means persons whose health care coverage is financed through public sector funds (e.g., Medicaid).

nothing more than one of many possible values. In fact, the average value may not even be the most likely value to occur in the real world if the distribution of all possible values is highly skewed, positively or negatively.

Whenever most people are told of an *average* value (e.g., average number of outpatient visits per closed outpatient episode), they generally do *not* consider the impact of variation around that average value. *If* they do consider possible variation, they generally assume a *symmetrical* distribution of variation around the average value. This type of distribution is called a "normal" distribution, and it is the distribution that most people implicitly assume in their heads when they think about risky variation.

The problem with that kind of thinking, however, is that most distributions of health care services and costs are *not* normally distributed. Rather, because there are a small number of very high values that "drag up" the average, they are "skewed" distributions, wherein the average value is greater than the "modal" (i.e., most likely) value. In other words, there are small probabilities of very large values and very large probabilities of moderate or small values.

The page limitations do not allow a full exposition of the various types of theoretical statistical distributions that may best describe such variables as Users/1,000, Units/User, Cost/Episode, and Cost/User/Year. Some of these distributions can be extremely skewed (e.g., Pareto distributions) and others less skewed or nearly normal (e.g., Poisson distributions). Furthermore, the reliability of the average that can be expected is a function of the total number of entities or events being considered. With very large populations and very large numbers of episodes and service units, some skewed distributions will begin to approach "normality" in their shape.

Because variation is not likely to be symmetrical, one should not look only at *average* values for such variables. Understanding and measuring the possible variation *above or below the average* that can occur in both cost and utilization variables is critical to estimating the possible range of costs.

Controllable and Uncontrollable Sources of Variation

Not only does one need to measure the variation, one needs to understand the underlying factors that are driving the variation. Many sources of variation may be managed or controlled in order to reduce the upside variation. For example, formal algorithms for triage-to-service programs and formalized treatment protocols can reduce variation that arises from the day-to-day decisions made by clinicians. Some of the factors that affect variation *cannot* be easily managed and changed in the short run. For example, factors related to characteristics associated with a particular population of eligible members (e.g., poverty, underlying prevalence of disease, culturally learned values about treatment use) may not easily be changed.

Closely related to the distinction between controllable and uncontrollable variables is the distinction between variation that is uncontrollable because of randomness and variation that is controllable but represents uncertainty due to the ignorance of the model builder.

Variation Due to Chance (or "Probabilistic Variability")

The first type, called "stochastic" or "probabilistic" variability, is the effect of chance and uncontrollable variation. Generally, such variation cannot be directly controlled by management decisions. (Note: such variation can sometimes be "influenced" in the long run through policy-related decisions and actions.) Examples of this type of variable are the percentage of mothers in the plan who will deliver a low-birth-weight baby or the percentage of teenagers in the plan who will become pregnant. These are examples of members with a certain type of condition or set of risk factors for which a preventive intervention is intended. MCOs are used to dealing with such variability using historical data that can provide a distribution of previous values from which they can derive a reliable "average" estimate of future demands of use.

For variables known to have systemic variability, the models used stochastic (probability) distributions from which the computer software could sample values from within a defined distribution of all possible values. This functionality in the spreadsheet was possible with an "add-in" type of software that supports Monte Carlo simulation. This "add-in" software, called "@Risk," allows any specific single value of a variable in the model (e.g., the percentage of teenage members who would become pregnant) to be replaced by a *distribution of all possible values,* a method known as Monte Carlo simulation (Winston, 1996).

For example, the variable "percentage of eligible members who will become teenage mothers" is represented in the model by a *triangular* distribution with three parameters:

1. The "minimum possible" value
2. The "most likely" value
3. The "maximum possible" value

During the simulation of the spreadsheet, with each "iteration" of the model, a different value would be "sampled" from among all possible values within the range of minimum and maximum values. For example,

after thousands of iterations ran, an estimate of the "average percentage of member lives that will be teenage mothers" would be based on the average of these thousands of values sampled during the simulation. The initial values used to establish the parameters of the distributions were based on the best available data for each variable. For example, U.S. Census Bureau data listing the percentage of women ages 14 to 19 who had a live birth in the most recent year for which data were available (Bureau of the Census, 1998) were used to estimate the number of eligible members who would become teenage mothers.

Variation Due to "Unknowns"

The second type of variability is due to the uncertain knowledge of the modeler. Such uncertainty represents the model builder's *lack of knowledge* about the actual value of some variables. Although the model builder may lack knowledge about the proper values to give to these types of variables, their values are readily known or controlled by the system operators. For example, the salary level and fringe-benefit costs of various staff working within different managed care plans are "unknown" variables in the model, not because these values randomly fluctuate within any given MCO but because the model builder is not certain what values would fairly represent the universe of all MCOs.

For variables whose values were *uncertain due to lack of knowledge* about the specific operating costs (e.g., salary level of nurses) of a particular managed care plan that may wish to implement an intervention, *four alternative fixed values* were used to reflect a reasonable range. A different one of the four values would be used during each scenario simulation, consisting of 1,000 iterations per simulation. A social worker's salary, for instance, could be set at $30,000 for one 1,000-iteration simulation, $35,000 for another simulation, and $40,000 and $45,000 for the two remaining 1,000-iteration simulations. For example, during each of the four 1,000-iteration simulations of the Prenatal and Infancy Home Visits for High-Risk Mothers model, cost factors that could vary by chance within any given year for any particular managed care plan (e.g., rate of low-birth-weight births per 100 births) were simulated using stochastic distributions. Because there would be more than one uncertain variable in each model (e.g., salary level, average staff productivity level, percent of total expenses due to general and administrative [G&A] expenses), the four values were always ordered from least to most expensive.

Therefore, the first of the four simulations represents the combination of circumstances *when all the least expensive values are assumed for each of the uncertain variables* (the Least Expensive Scenario), while the fourth simulation represents the circumstances *when all the most expensive values are assumed for each of the uncertain variables* (the Most Expensive Scenario). The other two scenarios assumed values for uncertain variables that were intermediate between the least costly values and the most costly values. This pattern of assumed values was illustrated in Table A.1.

The simulation of each of the model's four scenarios produces four *distributions of possible values* of the output variable PMPM cost. Therefore, the result of the cost simulation of each intervention can be expressed as a *distribution* of possible PMPM costs, for *each* of the four scenarios. While the single

PMPM cost reported in the parent publication represents the midpoint value between the median cost of the Least Expensive Scenario and the median cost of the Most Expensive Scenario, this Technical Appendix presents greater details on the cost distributions for all four scenarios.

Thus, by using the Monte Carlo simulation, a continuum of probabilities can be generated, reflecting a continuum of possible PMPM costs based on the potential variabilities of the cost drivers entered into a model, outlined in Table A.1. Such cost drivers include the types of enrollees (public or private), prevalence of conditions, participation rate in the intervention, time, intensity, and staffing pattern to deliver the intervention, salaries of staff, fixed and variable expenses, and administrative overhead. Any managed care plan considering implementing an intervention can assume that its likely PMPM cost is somewhere between the Least Expensive Scenario and the Most Expensive Scenario.

Assessing the Cost for a Specific Managed Care Organization

It was important to design these cost models to allow broad application and generalization over a wide variety of MCO operating circumstances, a wide range of benefit packages, and a range of covered populations (e.g., commercial, Medicaid/Medicare), because different managed care plans might provide a similar intervention in slightly different ways, and the differences could directly affect costs. For example, one might use nurses while another used social workers as staff, or one might employ aides to assist these professional staff while another might not. Even when employing identical types of staff, two managed care plans could experience different PMPM costs because of differences in salary levels, fringe-benefit costs, indirect overhead costs, or targeted profit margin. A particular intervention in a very large membership plan might make use of slack resources already available at no additional costs (e.g., space), while a small plan would have to incur additional costs for rented space.

Which of the four cost scenarios is most applicable to any specific MCO would depend on a number of factors, such as the demographics of its membership and the prevalence of the conditions targeted by each preventive intervention. For example, with reference to the Prenatal and Infancy Home Visits intervention, if the MCO has a predominantly Medicaid-eligible population of members, with a high prevalence of teenage mothers and higher risk pregnancies, it should consider the higher end scenarios that assume a higher prevalence. If its membership is predominantly a commercial population of employed and well-educated members with a lower-than-average birth rate and incidence of high-risk pregnancies, the MCO should choose the Least Expensive Scenario.

Another consideration should affect the choice of scenario. Each preventive intervention model was designed on the basis of a number of different published studies specific to that *type* of intervention; each study was not a strict replication of the other. In most cases, there were variations in the specifics of each intervention. For example, among the various studies on Health Promotion Through Self-Care Education, the research teams used a variety of specific components. One study might have used the following components:

1. Group-based health education classes
2. Self-care guidelines and booklets

3. Videotapes
5. Access to a self-care hotline where questions would be answered by a trained nurse or health counselor
5. Individualized letters from a primary care physician recommending certain health-related behavior changes

Another study of self-care might have used different components:

1. An individualized health risk appraisal assessment
2. Personalized reports on recommended health-related behaviors based on the risk appraisal
3. Individual sessions with a nurse or health counselor
4. Access to a health drop-in center

A particular MCO may wish to use only some of the components of both studies. Therefore, the Self-Care model incorporates all nine components and estimates the PMPM cost for each component as well as the total PMPM costs for all nine combined. For such circumstances, tables in this appendix provide the Least Expensive and Most Expensive PMPM cost for each separate component.

It is highly recommended that any MCO considering the implementation of any of these six preventive interventions read the original research studies to assess the applicability of the specific components used by the researchers.

Other General Assumptions

In addition to the general assumption that such interventions would be offered on an ongoing basis, assumptions of costs were generally fiscally conservative or toward the "high side." For example, some interventions required a receptionist to hand out an assessment form to patients arriving in the waiting room. The time and labor costs for this task were estimated and added to the total cost estimates. In most circumstances, however, such effort, time, and costs would not actually be incremental because they could readily be incorporated into the receptionist's regular patient-related duties.

In addition, each intervention's cost assumptions included the cost of training staff to carry out the intervention. To that extent, the costs are based on the first-year startup costs. The effective PMPM costs would likely go down in subsequent years if the staff did not have to be retrained each year.

The following information is provided for each of the six recommended interventions.

Results

For each intervention, the model assumed an MCO membership of 100,000. The PMPM cost of each scenario within each intervention is calculated as its total aggregate cost divided by 100,000, divided by 12. This publication reports a single PMPM cost, calculated as the midpoint between the median cost of the Least Expensive Scenario and the median cost of the Most Expensive Scenario. This appendix provides statistical details (minimums, maximums, means, medians, and 5th and 95th percentile values) of the cost *distributions* of all scenarios for each intervention.

It is important to note that the PMPM cost of each intervention is calculated on the *entire* membership of 100,000, not just the subset of members that corresponds to the target group for the intervention. For example, if an intervention costing a total of $520,000 is targeted toward children, who represent 26,000 of the 100,000 members, the PMPM would be calculated as

($520,000/100,000/12 = $0.43), not ($520,000/26,000/12 = $1.66). In other words, the preventive intervention costs are calculated at a rate representing the amount that an MCO would have to add to *every* member's premium.

Design and Input Values Used in the Model

"Design" means identifying the set of variables used as inputs for calculating the cost drivers and how these inputs were organized and used in calculations. "Values" are the figures assigned to the input variables used during each simulation. For example, when social worker's salary was an input variable, the model used four values for the salary, ranging from a low value to high value (e.g., $30,000, $35,000, $40,000, and $45,000). In most cases, the values assigned to an input variable were actually a *distribution* of values. For example, a value of 15 minutes for a staff activity may represent a normal distribution with a mean of 15 minutes and a standard deviation of 5 minutes.

In general, when there was no relevant benchmark information available in the published research or other sources, "best guesses" were the basis of reasonable values. When using best guesses, the model always used a value that was biased in the direction that would drive costs up. Therefore, the models are producing a conservative result—that is, cost estimates that are probably on the high side.

Discussion

A brief discussion of any issues specific to that model that could affect its implementation in an MCO follows the presentation of cost results.

Results

Model 1: Prenatal and Infancy Home Visits for High-Risk Mothers

This cost model was designed based on an amalgamation of two publications—Olds, Henderson, Phelps, Kitzman, and Hanks (1993) and Ramey and Ramey (1992)—and reviewed by Dorfman (2000) in references respectively numbered 2 and 5. A third study, reviewed by Dorfman and that supported the final recommendations, was not included in this cost model. It used an additional classroom-based intervention and thus would have required a separate cost model (Field, T., Widmayer, S., Greenberg, R., & Stoller, S., 1982).

PMPM Cost

Table A.2 summarizes the statistical parameters of the distribution of PMPM values for each scenario. The Least Expensive Scenario has a mean PMPM cost of $0.58 and the Most Expensive Scenario has a mean PMPM value of $1.49. The median PMPM cost in all scenarios is lower than the mean cost because the mean value in all four scenarios was being "dragged up" by a few high-cost outlier values.

To further assist with the interpretation of the results, upper and lower limits were established, respectively, at the 95th percentile of the Most Expensive Scenario ($1.47) and at the 5th percentile of the Least Expensive Scenario ($0.30). Across all four scenarios, the lower limit is $0.51 and the upper limit is $1.68, with 90 percent of the estimated 4,000 PMPM values across the four scenarios falling within this range of $1.17. In other words, it can be said with 90 percent certainty that the actual PMPM costs for this type of intervention will be between $0.30 and $1.47. While

that range of $1.17 may seem relatively large, it is more likely that the range will be much smaller depending on which of the four scenarios is representative of the cost structure (e.g., salaries, overhead) of a particular MCO. For example, as shown in Table A.2, the range in the average PMPM cost of Scenario 1 is from a *minimum* of $0.46 to a *maximum* of $0.73 (i.e., a range of $0.27). Scenario 4 has the greatest range ($0.72) between the minimum and maximum PMPM (i.e., $1.17 minimum to $1.89 maximum).

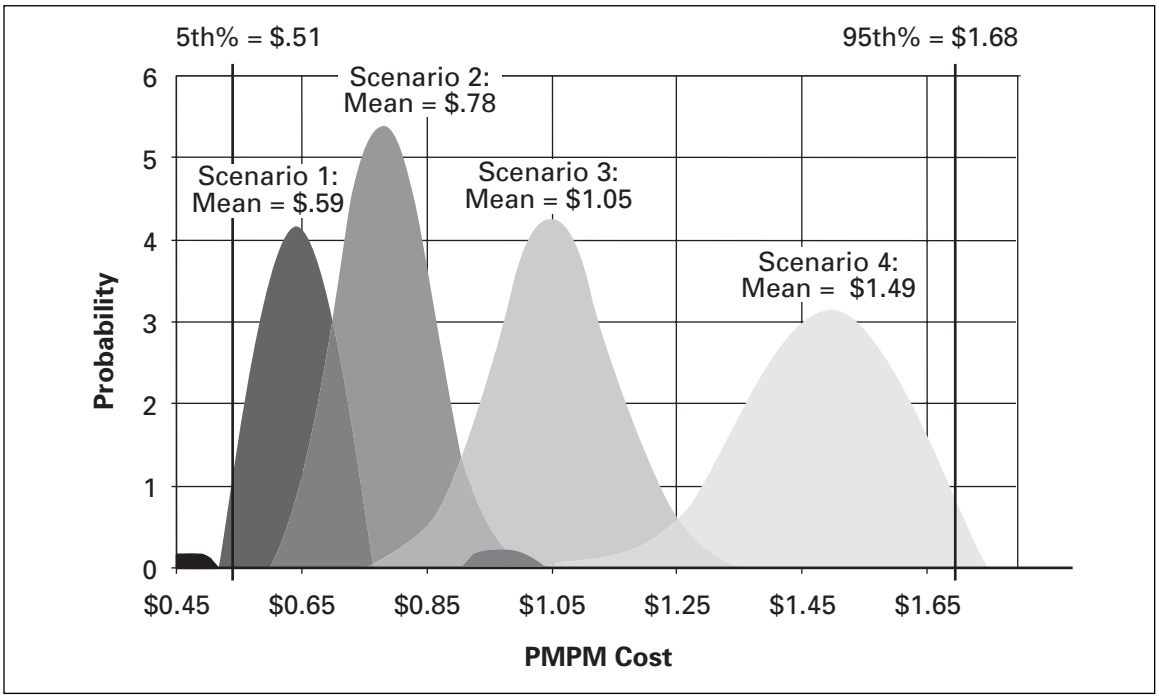
Figure A.1 illustrates the distributions of simulated values for each of the four scenarios.

As can be seen in Figure A.1, as the mean PMPM cost gets higher, so does the variability around the mean. These mean PMPM values are the average of the 1,000 iterations within each scenario, and the values used for uncertain variables got progressively higher with each scenario. These results reveal the amplification effects of variability coupled with uncertainty.

Table A.2: Pre- and postnatal home visits: PMPM costs under four scenarios

	Scenario 1 ***Least Expensive ($)***	***Scenario 2*** ***Intermediate Expenses ($)***	***Scenario 3*** ***Intermediate Expenses ($)***	***Scenario 4*** ***Most Expensive ($)***
Minimum	0.46	0.63	0.85	1.17
Mean	0.58	0.78	1.05	1.49
Median (50th Percentile)	0.40	0.55	0.76	1.12
Maximum	0.73	0.98	1.32	1.89
Standard Deviation	0.05	0.06	0.08	0.12
Variance	0.00	0.00	0.01	0.01
Mode	0.57	0.87	1.08	1.56
5th Percentile	0.51	0.68	0.92	1.29
95th Percentile	0.66	0.88	1.18	1.68
All Scenarios				
Lower Limit	0.51			
Upper Limit	1.68			
Difference Between Lower and Upper Limit	1.17			
Percent of Values Between Lower and Upper Limit	90			

Figure A.1: Pre- and postnatal home visits: Distributions of PMPM costs under four scenarios



Design and Input Values Used in the Model

Number of Lives Covered by the Managed Care Plan

This model, as well as all other models, assumed there are 100,000 enrolled lives (members) in the MCO.

Number of Intervention Cohorts Served Within a 12-month Operational Cycle

Because many of the preventive interventions required less than a full year, the model used 26 weeks (i.e., half a year) as the number of weeks required to start and complete a preventive intervention for a single cohort of participants. The model also assumed that the program would run throughout the year, so the total number of participants could be doubled if the intervention was offered twice in one year.

Size of the Cohort That Participates in Each Intervention Cycle

Based on the enrolled members, the first crucial calculation must estimate the average number of persons who will participate in the intervention. Most often the published research specifies some number of participants but does not provide enough information to allow a calculation of the participation rate from among all the persons who had access to the intervention or were "approached" and invited to participate.

In determining what values to use to populate these variables, U.S. Census Bureau data for 1998 for the percentages of the general population represented by females of each age group (teens = ages 14 to 19, adults = ages 20 to 44) who were potentially able to bear children were reviewed as well as separate tables on the birth rates of these age groups. The rate of low-birth-weight babies

was estimated from the managed care plan "HEDIS Report Card" developed from 1995 to 1996 for the National Council on Quality Assurance (NCQA). (This measure is no longer monitored by NCQA's HEDIS Reports.) Conservatively large percentages for initial rates of participation ("Starters") and for rates of completion ("Completers") were used. The model assumed that adult women would have a higher rate of starting and completing the program than teens.

To establish the average number of participants, a series of assumptions and calculations was required. Starting with the number of enrolled lives (100,000), the following variables were calculated:

1. Percentage of members having the attribute for which the intervention is intended
2. "Starters": the percentage of the above number who agree to start participation
3. "Completers": the percentage of the Starters who complete the program
4. Average number of participants, as estimated by this formula:
   [STARTERS + COMPLETERS] / 2

Attrition

The above calculation assumes that the *rate* of attrition throughout the time period of the intervention is uniform. Therefore, the *average* number of participants is the number active at the midpoint between the start and the end of the program. This "Average Participants" value is used for further calculations of costs. For example, Average Participants is used to calculate the number of classrooms needed if each class were to last X hours and meet Y days a week for Z consecutive weeks and have a limit of no more than N (number of) participants meeting in each classroom.

Time and Services

For each setting, the model assumed that all participants would undergo an initial private, one-on-one assessment and orientation visit with a social worker, lasting an average of 1 hour (standard deviation [SD] = 15 minutes).

The next set of critical calculations was to determine the average time each participant would spend in the program, which is used for subsequent calculations of the units of service that each participant would receive. For example, if the average participant spends 24 weeks in a 26-week program and receives 1 visit per week of participation but has a 5 percent no-show rate, the model can calculate that this participant will receive 23 visits. The following factors were used in making these calculations:

1. Frequency of scheduled visits per week: The model assumed a value of 0.5 or 1 visit every other week.
2. Percentage of scheduled visits that were not completed (e.g., mother is not home when the staff arrive): The model assumed 10 percent were not completed.
3. Average round-trip driving time per visit: The model assumed 20 minutes per round trip.
4. Average visit time in the home: The model assumed 2 hours based on the literature.

Using these estimates, the model can calculate the staff hours spent in driving and the staff hours spent in providing the intervention services within the home.

The model requires the variable costs of scheduled but incomplete visits because of the cost incurred (e.g., variable expenses, gas, staff time) by driving out to a home as well as completed visits because of their costs (e.g., supplies, gas, staff time).

The model also asks for salary levels, fringe-benefit rates, staff productivity, super-

visory staff, and G&A expenses plus profit margin. The same values were used for these as were used in the classroom version.

Because there is inherent variability in the "average weeks per participant" across all participants, the model asks for four parameters that will establish a "beta-subjective" stochastic distribution for the average number of weeks, from which it will sample possible values during a simulation:

1. The minimum number of weeks
2. The maximum number of weeks (which cannot exceed the number of weeks the program is operational)
3. The modal number of weeks (i.e., the number of weeks characteristic of most participants)
4. The average number of weeks (the number of weeks for each participant added together and divided by the number of participants)

The average weeks per participant, along with other estimates such as the maximum size of a group using a classroom, is later used for further "downstream" calculations, such as the average participants active per week, the number of classrooms needed to support this number of participants, and the fixed costs of each classroom.

Once the number of required classrooms was calculated, it was necessary to have estimates of the number of staff present for each group meeting being held in each classroom. The total necessary staff hours, based on the number of classroom meetings per week and the number of weeks the program is operational, allows for the calculation of the number of full-time equivalent (FTE) staff that would have to be employed. The model also calls for the types of staff to be hired so average salaries can be entered. Because Total Staff Hours Required assumes these hours are "productive" time, the number of FTE staff needing to be hired must be adjusted upward by a factor representing the percentage of time that the average FTE staff is not productive (e.g., because of sick leave, vacation, or internal meetings). Again, a very optimistic range for estimating the rate of productivity was used (from a high of 90 percent for the Least Expensive Scenario to a low of 60 percent for the Most Expensive Scenario).

The model also asks for entries of the one-time startup costs and annual fixed, as well as variable, expenses.

Fixed expenses would be such items as rent, furniture, computer equipment and software, and any other supplies that would be required (e.g., sensory stimulation toys for the mothers to use with the children). Direct expenses are entered on a "per classroom" basis, with any equipment that is "shared" being proportionately assigned to each classroom. Again, relatively generous amounts were entered for such items.

The model also asked for the variable expenses on a "per class meeting" basis or a "per home visit" basis. Examples of variable cost per class meeting would be any certain supplies or other items that are consumed at each meeting (e.g., snacks for mother and child, transportation vouchers). A "per home visit" cost would be transportation to the participant's home.

Once it has the number and type of staff needed to meet the demand for each intervention within each modality, the model asks for the percentage of each employee's time devoted to this program. The model assumed 100 percent for each direct service staff member; 50 percent for a manager, but at a higher salary; and 25 percent for FTE support staff for clerical duties (e.g., sending out

invitations to participate, recording attendance, ordering necessary supplies). The model also required their average salary and the percentage of salary spent on fringe benefits.

The final variable that had to be valued is the percentage of total expenses required to cover G&A expenses plus any profit margin. A fairly generous amount of 10 percent, increasing by 1 percent for each of the four scenarios from Least Expensive to Most Expensive, was entered.

Model 2: Smoking Cessation Targeted at Pregnant Women

This cost model was designed on the basis of an amalgamation of three publications—Marks, Koplan, Hogue, and Dalmat, 1990; Windsor, Lowe, Perkins, Smith-Yoder, Artz, Crawford, Amburgy, and Boyd, 1993; and Cummings, Rubin, and Oster, 1989—and reviewed by Dorfman (2000) in references respectively numbered 1, 3, and 26.

The intervention that was *most extensive* (Windsor et al., 1993), targeted toward pregnant women receiving prenatal care in a public health clinic, consisted of the following components:

- A brief (15-minute) counseling session, supplemented by the use of written materials
- Medical chart reminders during prenatal visits
- Followup phone calls and letters
- A "buddy contact"
- A 2-minute no-smoking reminder embedded within a 20-minute prenatal education class

The second publication (Marks et al., 1990) reported using only a single 15-minute counseling session, simple instructional materials, and two followup phone calls. The third publication (Cummings et al., 1989) reported on the cost-effectiveness of a 4-minute counseling session by a physician, a 1-year followup, and a self-help booklet administered to a "hypothetical" group of adult male and female patients.

Once again, in order to make the cost model as generic as possible, it was designed to include all the various types of component interventions across all three studies.

PMPM Cost

Table A.3 summarizes the statistical parameters of the PMPM costs for the *most expensive* smoking cessation intervention (Windsor et al., 1993) of the three publications reviewed by Dorfman (2000). The Least Expensive Scenario estimates an average PMPM of $0.02, with the Most Expensive Scenario totaling not much more ($0.06). Again, as in the Prenatal and Infancy Home Visits model, variability increases as the average cost increases. Across all four scenarios, 90 percent of the estimated PMPM values are within the range of $0.02 to $0.06.

Figure A.2 graphically portrays the range of costs and the variability around the mean PMPM costs of each scenario. Again, as with the first model, as the assumed costs of the unknown variables increases, the variability increases as well.

Design and Input Values Used in the Model

Number of Lives Covered by the Managed Care Plan

This model, as well as all other models, assumed there are 100,000 enrolled lives (members) in the MCO.

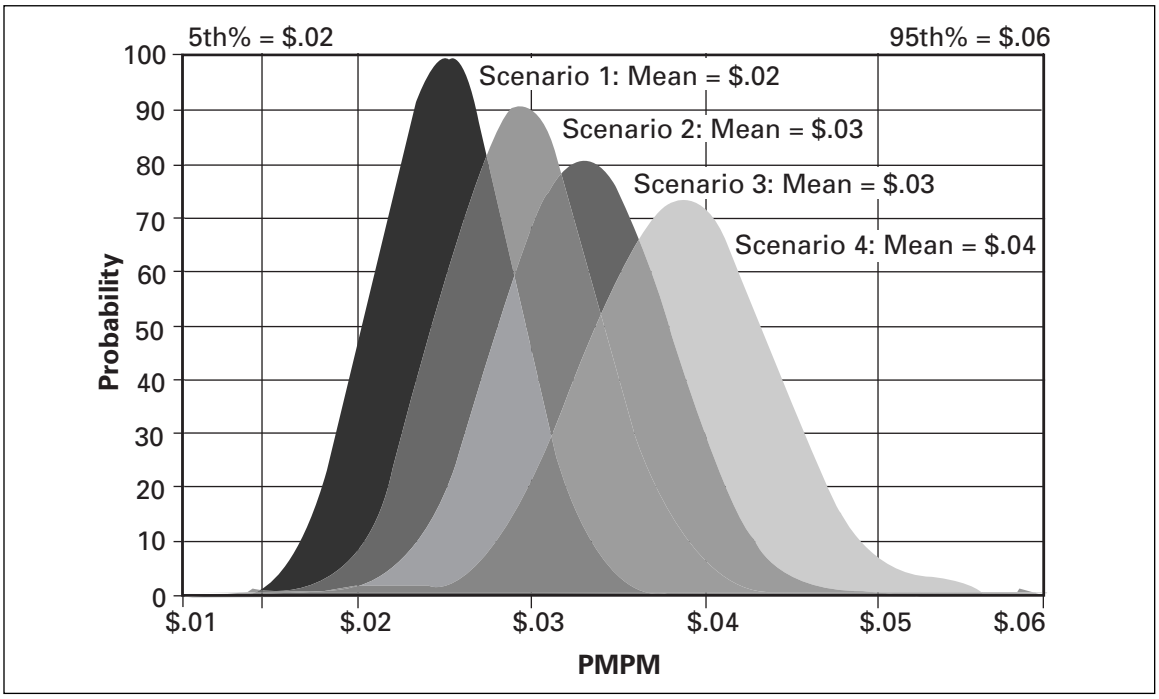
Table A.3: Smoking cessation education/counseling targeted at pregnant women: PMPM costs under four scenarios

	Scenario 1 ***Least Expensive ($)***	***Scenario 2*** ***Intermediate Expenses ($)***	***Scenario 3*** ***Intermediate Expenses ($)***	***Scenario 4*** ***Most Expensive ($)***
Minimum	0.02	0.02	0.02	0.02
Mean	0.02	0.03	0.03	0.04
Median (50th Percentile)	0.02	0.03	0.03	0.04
Maximum	0.04	0.04	0.05	0.06
Standard Deviation	0.00	0.00	0.00	0.01
Variance	0.00	0.00	0.00	0.00
Mode	0.02	0.03	0.03	0.04
5th Percentile	0.02	0.02	0.03	0.03
95th Percentile	0.03	0.04	0.04	0.05

All Scenarios

5th Percentile	0.02
95th Percentile	0.06
Difference Between 5th and 95th Percentile	0.04
Percent of Values Between 5th and 95th Percentile	90

Figure A.2: Smoking cessation education/counseling targeted at pregnant women: Distribution of PMPM costs under four scenarios



Number of Intervention Cohorts Served Within a 12-Month Operational Cycle

This intervention was assumed to be one that could be offered on an *ongoing* basis to patients as they came in for their routine medical visits (i.e., prenatal visits, in the case of pregnant women).

Number of Likely Participants Completing the Intervention

The same information that was used for the first model was used to populate this model, namely, estimates of the number of members who would be women in their childbearing years. In determining what values to use to populate these variables, U.S. Census Bureau data for 1998 were reviewed for the percentages of the general population represented by females of each age group that were potentially able to bear children (teens = ages 14 to 19, adults = ages 20 to 44), and separate tables on the birth rates of these age groups.

Once the number of likely pregnant patients in a year was estimated, an average of 21 percent of them could be estimated to be smokers, as reported by Marks et al. (1990) based on a "1985–1986 Behavioral Risk Factor Surveillance System . . . of American women from 25 states and the District of Columbia" (Dorfman, 2000, p. 31). In the actual calculations, the model used a triangular distribution (minimum, most likely, maximum) of values around this estimate of 21 percent for each of the four scenarios:

	Scenario 1 (%)	***Scenario 2 (%)***	***Scenario 3 (%)***	***Scenario 4 (%)***
Minimum	18	19	20	21
Most likely	20	21	22	23
Maximum	22	23	24	26

In other words, in Scenario 1 the model assumed a minimum prevalence of smoking among pregnant women at 18 percent, a maximum of 22 percent, with a most likely value of 20 percent. Each successive scenario assumed higher values for each of these three parameters, increasing by 1 percent.

Having established the percentage of members having the attributes of pregnancy and smoking, the model estimated the number of such members who would be willing to participate. Based on a figure of 93.7 percent reported by Windsor et al. (1993), the model used a range of estimates of the percentage of "Starters": the percentage of the pregnant smokers that agree to *start* participation:

	Scenario 1 (%)	***Scenario 2 (%)***	***Scenario 3 (%)***	***Scenario 4 (%)***
Minimum	90	92	94	96
Most likely	92	94	96	98
Maximum	94	96	98	100

Next, the model had to estimate the "Completers": the percentage of pregnant smokers that would *complete* the program:

	Scenario 1 (%)	***Scenario 2 (%)***	***Scenario 3 (%)***	***Scenario 4 (%)***
Minimum	68	70	72	74
Most likely	70	72	74	76
Maximum	72	74	76	78

These values were selected based on attrition rates reported by Windsor et al. (1993). Women left Windsor's planned intervention for such reasons as losing benefit eligibility, having abortions, or having miscarriages.

As in Model 1, the Average Number of Participants was estimated by this formula:

[STARTERS + COMPLETERS] / 2.

Materials, Staff Time, and Related Services

For each of the three studies, the model assumed that all participants would undergo the first component, a one-on-one counseling with a nurse, lasting an average of 15 minutes (SD = 3 minutes).

The model assumed each patient received in person two pamphlets and a "smoking cessation guidebook" or "self-help book." Items were assumed to cost $4. Cummings et al. (1989) reported an estimate of $2 for a self-help booklet, and Windsor et al. (1993) estimated $6 per patient for the cost of materials, reproduction, and labor.

The value of nurses' time was the same as that used in the first model, based on a salary of $50,000 incrementing in each scenario by $1,000, an average productivity of 70 percent of payroll hours, and a 29 percent fringe-benefit rate.

In the second component, Windsor et al. (1993) reported that each patient received patient reinforcements through a "medical letter" emphasizing the importance of smoking cessation and had a reminder placed in his or her medical chart so the doctor could ask questions at subsequent prenatal visits. The clerical time required for these activities was estimated at a mean of 10 minutes (SD = 3 minutes). Clerical salaries were estimated to start at $20,000 (with $1,000 increments for each successive scenario) with a productivity rate of 80 percent and a fringe-benefit rate of 29 percent. The letter and postage costs were estimated at $0.41 per patient.

The third component reported by Windsor et al. (1993) also reported on "social sup-

ports," which consisted of the following activities:

- Sending a "buddy letter" with a contract and tipsheet to each patient
- Sending a quarterly newsletter to each patient
- Giving two pamphlets to each patient

These five mailings were assumed to require an average of 10 minutes of clerical time (SD = 3 minutes) and $0.45 for reproduction and postage per patient.

The model also builds in the cost for the 2-minute reminder delivered by a nurse as part of a 20-minute prenatal class.

The model assumed there were no other variable or one-time startup costs beyond the smoking cessation guides/self-help booklets and pamphlets.

The final variable that had to be valued is the percentage of total expenses required to cover G&A plus any profit margin. Each of the four scenarios used 10, 11, 12, and 13 percent, respectively.

Model 3: Targeted Short-Term Mental Health Therapy

This cost model was designed on the basis of interventions described in research by Finney, Riley, and Cataldo (1991) and Goldberg, Allen, Kessler, Carey, Locke, and Cook (1981) and reviewed by Dorfman (2000) in references respectively numbered 15 and 41. As with all the other models, this model was designed to estimate PMPM costs for a managed care plan with 100,000 members that implements a brief psychotherapy (6 to 16 visits) benefit for its members age 0 to 17 and for its adult members (ages 18 to 65).

Finney et al. (1991) focused on children ages 1 to 15 treated with brief therapy within a pediatric clinic of a staff-based health maintenance organization (HMO). Goldberg et al. (1981) did their research based on the claims paid for psychotherapy provided to adult members (ages 18 to 65) of the Federal Employees Health Benefit Plan. The cost model was designed to accommodate both child and adult age categories, and the cost results of each subgroup were combined, assuming an MCO would use this intervention with either group. Both age categories had a similar cost design but different input assumptions (i.e., values assigned to various stochastic distributions).

PMPM Cost

Table A.4 summarizes the primary statistics generated for PMPM costs for each scenario. The average PMPM cost for the Least Expensive Scenario was $1. The average PMPM cost for the Most Expensive Scenario was $1.96. Across all four scenarios, the lower limit (5th percentile) is $0.17 and the upper limit (95th percentile) is $3.60, with 90 percent of the estimated 4,000 PMPM values across the four scenarios falling within this range of $3.43.

This statistical pattern of costs is unusual compared to all the previous models. The distribution of potential costs is well illustrated in Figure A.3.

The distributions of estimated PMPM costs for all four scenarios are considerably more uniform in shape, with more variability. The variability of each scenario's distribution of PMPM costs is quite large, ranging from $0.29 to $1.12. The average range (maximum PMPM cost minus minimum PMPM cost) across all four scenarios is almost $2. Ninety percent of the estimated 4,000 values are between $0.17 and $3.60, a range of $3.43.

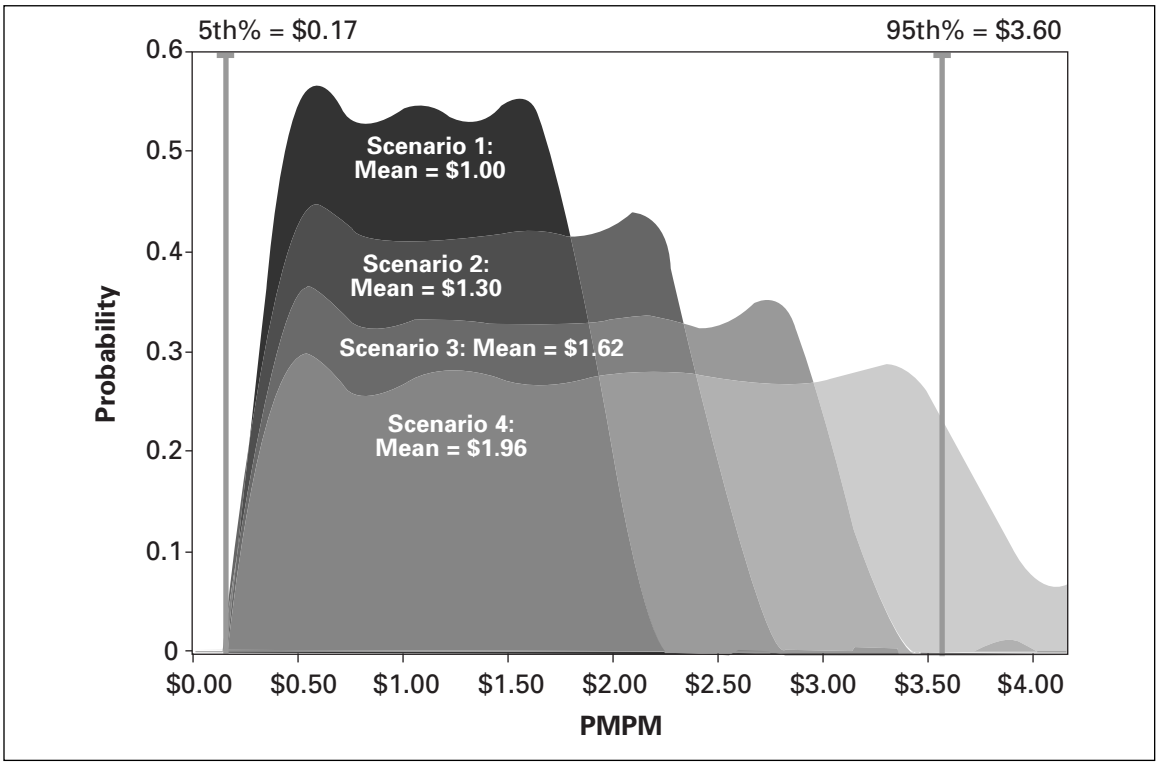
Table A.4: Targeted short-term psychotherapy: Range of PMPM values under four scenarios

	Scenario 1 ***Least Expensive ($)***	***Scenario 2*** ***Intermediate Expenses ($)***	***Scenario 3*** ***Intermediate Expenses ($)***	***Scenario 4*** ***Most Expensive ($)***
Minimum	0.05	0.06	0.07	0.08
Mean	1.00	1.30	1.62	1.96
Median (50th Percentile)	1.00	1.30	1.62	1.96
Maximum	1.98	2.56	3.20	3.88
Standard Deviation	0.54	0.70	0.87	1.06
Variance	0.29	0.49	0.76	1.12
Mode	0.76	1.33	0.63	0.77
5th Percentile	0.17	0.22	0.27	0.33
95th Percentile	1.84	2.38	2.97	3.60
Difference Between 5th and 95th Percentile	1.66	2.16	2.69	3.27

All Scenarios

5th Percentile	0.17
95th Percentile	3.60
Difference Between 5th and 95th Percentile	3.43
Percent of Values Between 5th and 95th Percentile	90

Figure A.3: Targeted brief psychotherapy: Distribution of PMPM costs under four scenarios



The relatively "uniform" shape of each distribution implies that a wide range of PMPM values have about equal likelihood of occurring. Clearly, the Most Expensive Scenario is also the one with the greatest variability.

The uniform shape of these distributions is due to the distributions and values the model assumed in its design, based on the data reported in the literature. According to Goldberg et al. (1981), the proportion of persons receiving 1 to 5 visits, 6 to 15 visits, and more than 15 visits was about the same. As the primary driver of total costs, this uniform distribution of visits per participant accounts for the uniformity of the final PMPM distributions.

Design and Input Values Used in the Model

Membership and Treated Prevalence

This model also assumed an MCO membership of 100,000. Based on U.S. Census Bureau (1990) data, the model assumed 32 percent of the population would be from birth to age 18 and 68 percent would be adults ages 19 to 65.

The model assumed any MCO would use "medical necessity" criteria when evaluating the need for brief psychotherapy, as was used in the study by Goldberg et al. (1981). Therefore, the model assumed that indicators of *treated prevalence* would best estimate the number of persons who would receive brief therapy.

For the child subgroup, the model assumed a *prevalence* rate of 9 to 12 percent

(in 1 percent increments in each scenario) based on median estimates from a meta-analysis of the epidemiological research reported by Friedman, Katz-Leavy, Manderscheid, and Sondheimer (1996). A study on *treated prevalence* of mental health problems among children and adolescents indicated that 23 percent of privately insured children with any mental health disorder (serious emotional disturbance [SED] or non-SED) received some outpatient therapy (Burns, 1991).

For the adult subgroup, the model assumed an outpatient *treated prevalence* rate of 14 to 15 percent (in 0.5 percent increments) based on an average treated prevalence rate for adults based on epidemiological research reported by Bourdon, Rae, Narrow, Manderscheid, and Regier (1994). That rate of treated prevalence is further reduced by 44 percent, a rate reported by Goldberg et al. (1981), of index patients with psychiatric diagnoses who received zero visits.

Volume of Service, Type of Provider, and Copayments

The child subgroup assumed a "triangular" distribution with an average of 2.75 visits per child (minimum = 1, most likely = 1.25, maximum = 6) to describe the frequency of therapy visits. Finney et al. (1991) reported a range of 1 to 6 visits and an average of 2.4 visits, but no measure of variability around this mean.

The model assumed each therapy session per child participant lasted 60 minutes, which includes the 50-minute sessions reported by Finney et al. (1991) and Goldberg et al. (1981) and 10 minutes for clinical record keeping. Based on the data reported by Goldberg et al. (1981), the model assumed a uniform distribution of eight visits per adult participant, each one requiring 50 minutes of therapist time and 10 minutes for record keeping.

The model assumed that the therapy was provided by a licensed mental health professional (psychologist or psychiatric social worker) with an annual salary of $50,000, a fringe-benefit cost of 29 percent, and a productivity rate of 70 percent, yielding an "effective cost per hour" of $44.30.

Because most insurance plans, including HMOs and behavioral health care "carve outs," have a mental health copayment requirement, the model assumed a copayment of $20, $15, $10, and $5, respectively, for the four scenarios from Least Expensive to Most Expensive. In other words, the copayment effectively reduces the "effective cost per hour" by $20 to $24.30 for the Least Expensive Scenario and by $5 to $39.30 for the Most Expensive Scenario. The model assumed 100 percent of all copayments were collected.

Other Expenses

Finney et al. (1991) reported that "behavioral treatment guidelines" (e.g., how to respond to bed wetting, the use of "time-outs") were given to the parents of the children in treatment. The model assumed a cost of $2 to $5 in $1 increments for the cost of reproduction and distribution of these guidelines.

Finney et al. (1991) also reported that "most families also received a number of planned telephone contacts after therapy was begun to ensure adequate implementation of recommended therapeutic techniques and to troubleshoot problems" (p. 452). Therefore, the model assumed 100 percent of the families would each receive two phone calls (i.e.,

using a triangular distribution with a minimum = 1, most likely = 2, and maximum = 3). The model assumed the phone calls took 5 minutes (SD = 2 minutes) and were made by the therapist.

The model assumed no supplies or phone call expenses for the adults.

The model also increased the total cost by applying a G&A overhead plus profit rate of 10, 11, 12, and 13 percent to the direct services cost in each of the four scenarios.

Model 4: Self-Care Health Education for Adults and Older Adults

This cost model was designed on the basis of an amalgamation of six publications—Kemper (1982); Vickery, Kalmer, Lowry, Constantine, Wright, and Loren (1983); Fries, Fries, Parcell, and Harrington (1992); Kemper, Lorig, and Mettler (1993); Leigh, Richardson, Beck, Kerr, Harrington, Parcell, and Fries (1992); and Vickery, Golaszewski, Wright, and Kalmer (1988)—and reviewed by Dorfman (2000) in references respectively numbered 29, 32, 40, 43, 51, and 52. Each study described a variety of interventions provided to adults or older adults. Five of the six studies were conducted within a managed care setting and one within the worksite.

Across the six studies, there was a wide range of activities that were provided to participants in order to promote positive health behaviors and self-care:

1. Workshops to train nurses to provide psychoeducational support to patients, including written materials, pamphlets, and booklets
2. Self-care guidelines, newsletters, books, and booklets for participants
3. Videotapes covering self-care
4. Access to telephone information service staffed by a nurse
5. Individualized health conferences with a nurse
6. Computer-based, serial, personalized health risk reports
7. Individualized recommendation letters and reports
8. One-on-one educational sessions with a physician
9. Access to a "self-care drop-in center" (Dorfman, 2000, p. 21)

The model was designed to incorporate all nine activities and estimate the PMPM costs of all nine combined. Therefore, the PMPM costs are overstated for any MCO that may wish to use only a subset of all activities.

PMPM Cost

Table A.5 summarizes the PMPM cost parameters that were generated in a simulation of Model 4. The average PMPM cost for the Least Expensive Scenario was $1.06. The average PMPM cost for the Most Expensive Scenario was $2.02. Across all four scenarios, the lower limit (5th percentile) was $0.99 and the upper limit (95th percentile) was $2.14, with 90 percent of the estimated 4,000 PMPM values across the four scenarios falling within this range of $1.15.

The results are presented graphically in Figure A.4. The distributions of PMPM values for each of the four scenarios of this model are clearly more separated than any of the other models. This large degree of separation is due to the wide range of assumed values for the input values of each scenario.

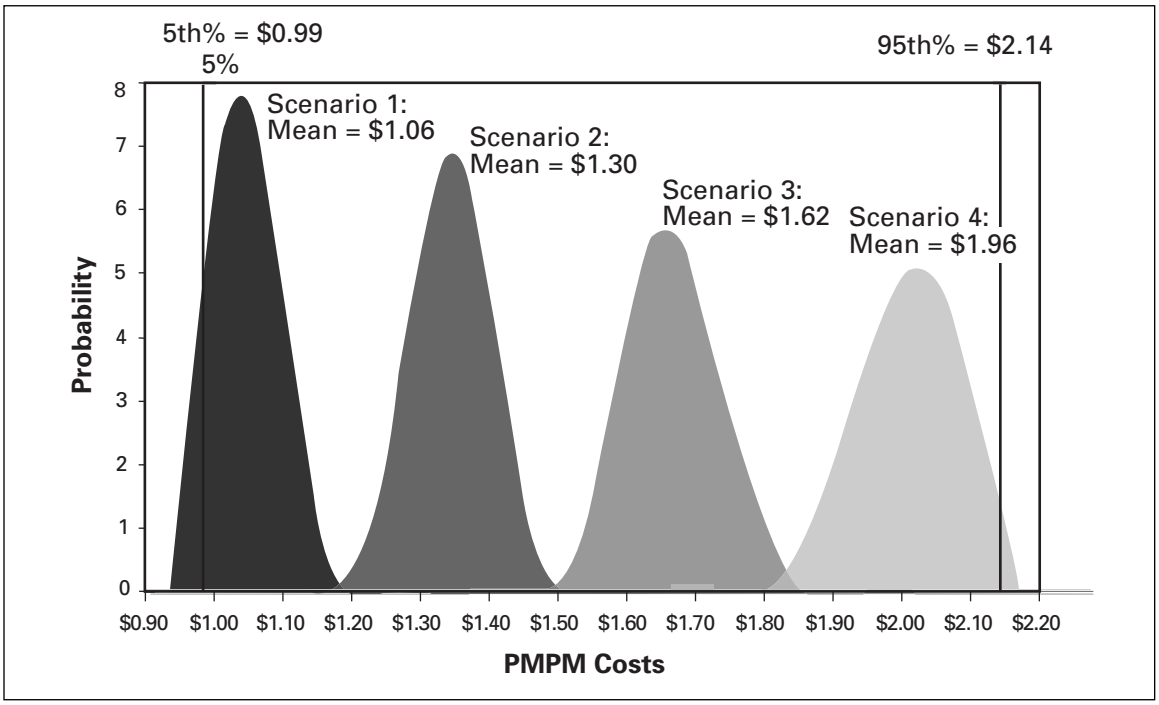
Design and Input Values Used in the Model

The model begins with an estimation of the number of adults and older adults who

Table A.5: Health promotion through self-care: Range of PMPM values under four scenarios

	Scenario 1 ***Least Expensive ($)***	***Scenario 2*** ***Intermediate Expenses ($)***	***Scenario 3*** ***Intermediate Expenses ($)***	***Scenario 4*** ***Most Expensive ($)***
Minimum	0.93	1.18	1.46	1.78
Mean	1.06	1.34	1.66	2.02
Median (50th Percentile)	1.06	1.34	1.66	2.02
Maximum	1.20	1.52	1.88	2.28
Standard Deviation	0.04	0.05	0.06	0.07
Variance	0.00	0.00	0.00	0.01
Mode	1.02	1.29	1.64	1.95
5th Percentile	0.99	0.99	0.99	0.99
95th Percentile	2.14	2.14	2.14	2.14
Difference Between 5th and 95th Percentile	1.15	1.15	1.15	1.15
All Scenarios				
5th Percentile	0.99			
95th Percentile	2.14			
Difference Between 5th and 95th Percentile	1.15			
Percent of Values Between 5th and 95th Percentile	90			

Figure A.4: Health promotion through self-care education: Distribution of PMPM costs under four scenarios



are members of an MCO with 100,000 members. Based on 1990 U.S. Census Bureau figures, these percentages were valued at 59 percent for adults and 11 percent for older adults. It then calls for an estimation of the percentage of each age group that is likely to agree to participate in a "Health Promotion Campaign" (i.e., a series of health promotion and self-care activities throughout the year). These estimates for adults ranged from 45 to 90 percent in increments of 15 percent for each scenario (Least Expensive to Most Expensive). For older adults the percentage started at 60 percent (Least Expensive Scenario) and went as high as 90 percent (Most Expensive Scenario) in increments of 10 percent.

Because some activities are costed out by household (e.g., a videotape mailed to a home), it is necessary to estimate the number of covered members per household for adults and older adult members. Based on data reported by Vickery et al. (1983), the ratio of older adult participants to households was set from 1.26 (Least Expensive) to 1.20 (Most Expensive) in increments of 0.02. For adults, this ratio ranged from 3 (Least Expensive) to 2.4 (Most Expensive) in increments of 0.20.

The rest of the model consisted of ten separate modules reflecting the various types of specific intervention activities that were described in the various studies reviewed by Dorfman (2000). Each module allowed for the cost estimation of written material as well as clerical and professional labor spent in conducting one-on-one activities or group activities. In each module, the model used a separate estimate for the level of participation by adults or older adults. For example, although 9,000 adults may agree to participate in the series of activities, only 25 per-

cent may actually show up to participate in a particular activity, such as educational workshops.

Staffing and Materials

Slightly different staff salaries, fringe-benefit rates (29 percent), and rates of productivity were assumed in Model 4 than were assumed in Models 1 through 3:

- Clerical at $20,000 in $500 increments and 80 percent productivity
- Nurses at $50,000 in $1,000 increments at 70 percent productivity
- Psychologists at $50,000 in $1,000 increments at 70 percent productivity
- Physicians at $100,000 in $2,000 increments and 70 percent productivity

Table A.6 summarizes the values assumed for each module in the model. The first column is a summary description of the activity. The second column is the percentage of total participants assumed to participate in each activity. The next four columns are the four values assumed for each successive scenario for the cost of purchasing or reproducing whatever supplies, booklets, or written material is required of each activity. The seventh column notes the type of professional staff member who carries out the activity. Columns 8 and 9 are the assumed mean and standard deviations of the assumed time required for each activity. The columns labeled "P" and "H" are indicators for whether the activity is costed out on the basis of individual participants (P) or households (H). The third-to-last and second-to-last columns reflect the total aggregate costs for adults and older adults, and the last column shows the PMPM costs for both age groups combined.

Model 5: Presurgical Education Intervention With Adults

This cost model was designed on the basis of three research publications—Devine and Cook (1983); Devine, O'Connor, Cook, Wenk, and Curtin (1988); and Egbert, Battit, Welch, and Bartlett (1964)—and reviewed by Dorfman (2000) in references respectively numbered 35, 36, and 38. One publication (Devine and Cook, 1983) was a meta-analysis of 49 other studies. This meta-analysis and the remaining two studies described a variety of component interventions provided to adults undergoing a wide range of inpatient surgical procedures:

- Nurse-conducted group workshops, which focus on the benefits of psychoeducational supports, including written materials and videos
- Presurgical and postsurgical visits by an anesthetist
- Skills or exercises training to promote postsurgical recovery
- Psychosocial support by a health care provider

PMPM Cost

Table A.7 summarizes the PMPM cost parameters that were generated in a simulation of Model 5. The average PMPM cost for the Least Expensive Scenario was $0.22. The average PMPM cost for the Most Expensive Scenario was $0.31. Across all four scenarios, the lower limit (5th percentile) was $0.16 and the upper limit (95th percentile) was $0.40, with 90 percent of the estimated 4,000 PMPM values across the four scenarios falling within this range of $0.24.

Table A.6: Assumed input values for variables in Model 4: Health promotion through self-care

	Activity	% Participation	Materials: Purchase or Reproduction Unit Cost Scenario 1 ($)	Scenario 2 ($)	Scenario 3 ($)	Scenario 4 ($)	Staff	Mean Minutes	Standard Deviation	Effective Cost/Hour	Sum for Adults	Sum for Older Adults	Total PMPM Costs
1	Group Education Workshops	4	1.00	$1.25	$1.50	$1.75	Nurse	90	15	$44.30	$12,958	$6,217	$0.02
2	Self-Care Guides per Participant	100	1.00	$2.00	$3.00	$4.00	Clerical	5	1	$15.50	$27,230	$13,065	$0.03
3	Videotapes per Household	100	3.00	$4.00	$5.00	$6.00	Clerical	5	1	$15.50	$16,997	$19,416	$0.03
4	Staffed Telephone Info Center (52/5/8) (Note 1)	100	0.00	$0.00	$0.00	$0.00	Nurse	124,800	12,480	$44.30	$62,267	$29,876	$0.08
5	Individual Health Evaluation and Planning Conference	100	0.25	$0.50	$0.75	$1.00	Nurse	45	5	$44.30	$200,324	$96,115	$0.25
6	Personalized Computerized Health Risk Reports	50	5.00	$6.00	$7.00	$8.00	Clerical	10	1	$15.50	$90,100	$43,230	$0.11
7	Individualized Recommendations and Letters Signed by MD	50	1.00	$1.25	$1.50	$1.75	Clerical, Nurse, and MD	10, 30, and 5	3, 5, and 1	$15.50, $44.30, and $86.60	$152,221	$73,035	$0.19
8	Individual Educational Sessions with MD	15	0.00	$0.00	$0.00	$0.00	MD	20	2	$88.60	$26,314	$12,625	$0.03
											Total Costs for All Eight Components	$881,989	$0.73

52/5/8 Access to Self-Care Drop-In Center	Square Footage	Monthly Lease ($)	Monthly Phone and Operating Costs ($)	Equipment	Consumable Supplies per Participant	Total Costs	PMPM Costs
	625	15.00	$7.00	$100,000	$5.00	$272,900	$0.23
					Total Costs for All Eight Components	$1,154,889	$0.96
Total for All Components					Margin for General and Administrative Expenses and Profit	10%	$0.25
					Total Costs with G&A and Profit	$1,270,377	$1.06

Note 1: Telephone Center Staffed 52 weeks, 5 days a week, and 8 hours a day

Table A.7: Presurgical education interventions with adults and older adults: Range of PMPM values under four scenarios

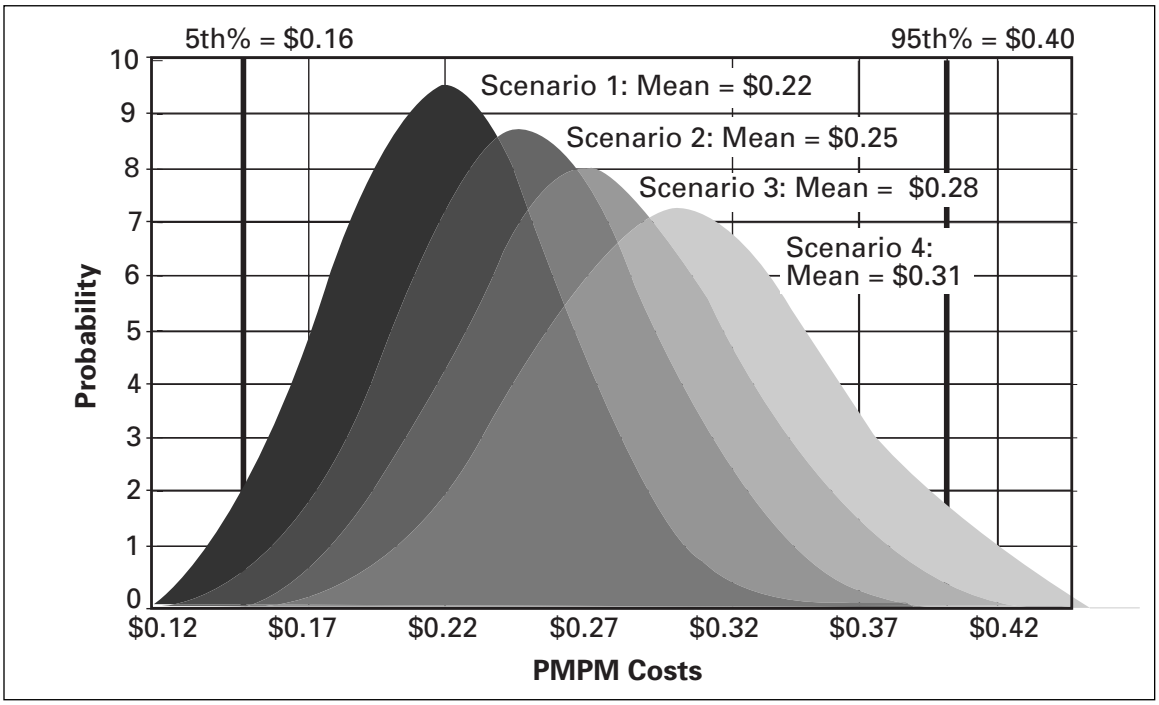
	Scenario 1 ***Least Expensive ($)***	***Scenario 2*** ***Intermediate Expenses ($)***	***Scenario 3*** ***Intermediate Expenses ($)***	***Scenario 4*** ***Most Expensive ($)***
Minimum	0.13	0.15	0.16	0.18
Mean	0.22	0.25	0.28	0.31
Median (50th Percentile)	0.22	0.25	0.28	0.31
Maximum	0.36	0.41	0.45	0.50
Standard Deviation	0.04	0.04	0.05	0.05
Variance	0.00	0.00	0.00	0.00
Mode	0.25	0.24	0.27	0.32
5th Percentile	0.16	0.16	0.16	0.16
95th Percentile	0.40	0.40	0.40	0.40
Difference Between 5th and 95th Percentile	0.24	0.24	0.24	0.24
All Scenarios				
5th Percentile	0.16			
95th Percentile	0.40			
Difference Between 5th and 95th Percentile	0.24			
Percent of Values Between 5th and 95th Percentile	90			

Design and Input Values Used in the Model

Membership and Participation

The model begins with an estimation of the number of adults who would undergo an inpatient operative procedure. The number of operative procedures carried out in inpatient settings within the entire United States was accessed in the most recent results (1996) reported by the National Hospital Discharge Survey (NHDS), and that number was adjusted down by 71 percent, for an estimate of only those procedures done on adult and elderly patients (ages 18 to 80), based on the U.S. Census Bureau figures for 1998 for persons in that age category. The 1996 inpatient surgical procedure rate was 154 per 1,000 members (NHDS) of the 1996 general population (U.S. Census Bureau, 1998). This value was reduced to 109 per 1,000 *adult and elderly* lives. This rate was reduced once again by the ratio of operative procedures in HMOs, as reported by the Group Health Association of America (1995), to the rate reported by the NHDS for the general population. HMO members

Figure A.5: Presurgical education interventions with adults and elderly: Distribution of PMPM values under four scenarios



in 1995 had about 36 percent fewer operative procedures than the general population. Therefore, the rate per 100,000 members in the hypothetical MCO was set at 70 per 1,000 adult and elderly lives (estimated at 71 percent of the 100,000).

The level of agreement to participate for the Least Expensive Scenario was set at 50 percent, increasing in 5 percent increments up to 65 percent for the Most Expensive Scenario.

Staffing and Materials

While the original research reports that an anesthetist made bedside visits to patients the night before the surgery, the model assumed that a nurse with specialty training in anesthesiology could carry out this task.

Table A.8 summarizes the assumed levels of participation for each component activity, the costs for the materials and supplies for each scenario, and the assumed time and effective cost per hour for the nurses, psychologists, nurse anesthesiologist, and health counselor.

As expected, the most expensive component would be the time spent pre- and postsurgery. The postsurgical component cost more than the presurgical component because it was assumed that most patients would receive two postsurgical visits before their discharge.

Model 6: Brief Counseling to Reduce Alcohol Use

This model was designed on the basis of four research publications—Bien, Miller, and Tonigan (1993); Fleming, Barry, Manwell, Johnson, and London (1997); World Health Organization (1996); and Fleming, Barry, Manwell, Adams, and Stauffacher (1999)—and reviewed by Dorfman (2000) in refer-

Table A.8: Assumed input values for participation, materials, supplies, and labor: Presurgical education intervention with adults and elderly

Activity	% of Patients Participating	Materials: Purchase or Reproduction Unit Cost Scenario 1 ($)	Scenario 2 ($)	Scenario 3 ($)	Scenario 4 ($)	Staff	Mean Minutes	Standard Deviation	Effective Cost/Hour	Total Costs	Total PMPM Costs
Train Nurses to Provide Psychoeducational Support	NA	5	6	7	8	Nurses and Psychologist	180	15	53.16	1,865	0.00
Individualized Presurgery Visit by Nurse Anesthetist	50	1	2	3	4	NAnesth	20	5	88.60	37,925	0.03
Individualized Postsurgery Visit by Anesthetist	50 and 2 visits	0	0	0	0	NAnesth	15	5	88.60	22,024	0.05
Train Nurses to Provide Pain Reduction Skills and Exercises to Patients	NA	5	6	7	8	Nurses and Psychologist	180	15	53.16	1,819	0.00
Psychosocial Support Provided by a Health Counselor	100	0	0	0	0	H Coun	50	5	35.44	146,732	0.12
										Total for All Components	$243,365
										PMPM for Direct Services	$0.20
										PMPM with G&A and Profit	$0.22

ences respectively numbered 33, 39, 50, and 53. As with all the other models, this model was designed to estimate PMPM costs for a managed care plan with 100,000 members that implements a screening and brief intervention to reduce excessive alcohol use by its adult members (ages 18 to 65) as well as its older members (age 66 and older), male and female.

PMPM Cost

Table A.9 summarizes the primary statistics generated for PMPM costs for each scenario. The average PMPM cost for the Least Expensive Scenario was only $0.36. The average PMPM cost for the Most Expensive Scenario was $0.85. Across all four scenarios, the lower limit (5th percentile) is $0.31 and the upper limit (95th percentile) is $0.93, with 90 percent of the estimated 4,000 PMPM values across the four scenarios falling within this range of $0.62.

If all the input variables were at their maximum possible values, there is a 90 percent probability that the PMPM cost would be $0.93, although it would probably be less.

Table A.9: Brief counseling to reduce alcohol abuse: Range of PMPM values under four scenarios

	Scenario 1 ***Least Expensive ($)***	***Scenario 2*** ***Intermediate Expenses ($)***	***Scenario 3*** ***Intermediate Expenses ($)***	***Scenario 4*** ***Most Expensive ($)***
Minimum	0.26	0.35	0.50	0.70
Mean	0.36	0.47	0.63	0.85
Median (50th Percentile)	0.36	0.47	0.62	0.82
Maximum	0.47	0.59	0.77	1.01
Standard Deviation	0.03	0.04	0.04	0.05
Variance	0.00	0.00	0.00	0.00
Mode	0.37	0.47	0.64	0.85
5th Percentile	0.31	0.41	0.57	0.77
95th Percentile	0.41	0.53	0.70	0.93
Difference Between 5th and 95th Percentile	0.10	0.12	0.13	0.15

All Scenarios

5th Percentile	0.31
95th Percentile	0.93
Difference Between 5th and 95th Percentile	0.62
Percent of Values Between 5th and 95th Percentile	90

Figure A.6 is a graphic representation of the distribution of average PMPM costs for each scenario. As with Model 1, as the average PMPM cost increases, so does the variability surrounding the average.

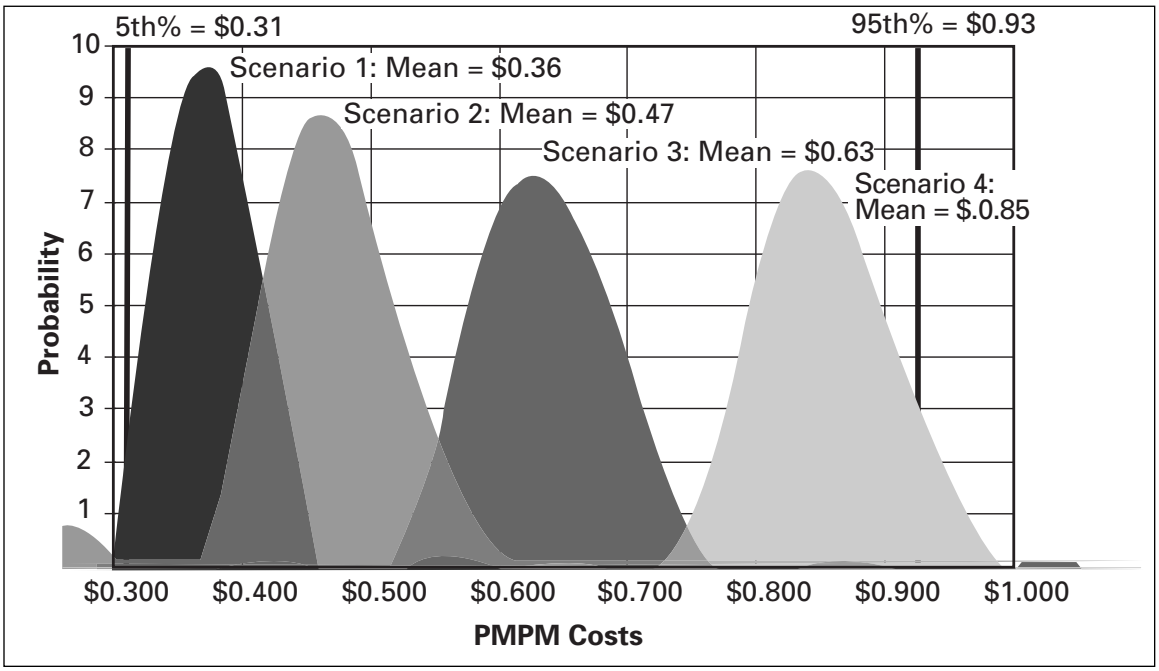
Design and Input Values Used in the Model

Screening for Alcohol Use

Based on U.S. Census Bureau information for 1998, the model assumed that male and female adults, including persons greater than age 65, represented a range of 70 to 73 percent (in increments of 1 percent for each scenario) of the 100,000 members. Based on the research reported by Fleming, Barry, Manwell, Johnson, and London (1997), and epidemiological household surveys of drug and alcohol use by the Office of Applied Studies, Substance Abuse and Mental Health Administration (1998), the model assumed 14 to 17 percent (in increments of 1 percent for each scenario) would screen positive for excessive alcohol use or dependency on a self-administered health screening instrument distributed by a receptionist. This percentage excludes female adults who were pregnant and all adults (ages 19 to 64) known to be drug or alcohol abusers or having a history of treatment for drug or alcohol abuse. The model assumed the average time for distribution and scoring of the self-administered health screening instrument by a receptionist was 5 minutes (SD = 1 minute). The model assumed that each health screening instrument would cost $0.75, $1, $1.50, and $2 in each scenario.

The model assumed 68 to 71 percent (in increments of 1 percent for each scenario) of those screening positive would agree to go through the initial 30-minute interview with a nurse to further screen participants and collect baseline behavior on health-related behaviors (e.g., smoking, exercise).

Figure A.6: Range of PMPM costs for brief counseling to reduce alcohol use



Based on data reported by Fleming et al. (1997), the model assumed 42 to 45 percent (in increments of 1 percent for each scenario) of those completing this interview would go on to start participation in the intervention. The model assumed 95 to 98 percent (in increments of 1 percent for each scenario) of the "Starters" would be "Completers."

Service Interventions

As described by Fleming et al. (1997), the model assumed participants would receive two brief counseling sessions with their primary care physician, each lasting 15 minutes (SD = 3 minutes). This time includes the few minutes required for the physician to enter brief documentation in the medical record.

Each participant was given a "workbook." The workbook used by the participant and the physician "contained feedback regarding current health behaviors, a review of the prevalence of problem drinking, a list of the adverse effects of alcohol, a worksheet on drinking cues, a drinking agreement in the form of a prescription, and drinking diary cards" (Dorfman, 2000, p. 61). The model assumed this workbook was provided to 100 percent of the participants. The model assumed the cost per workbook for each of the four scenarios was $5, $6, $7, and $8, respectively, from least to most.

The model assumed that 100 percent of participants received a followup phone call by a nurse following each of the two sessions with the physician (mean = 5 minutes, SD = 2 minutes).

The cost of these interventions by clerical staff, nurses, and physicians was determined by multiplying the cost of a productive staff hour (based on salary, fringe benefits, and nonproductive time) against hours spent to train, including travel time. The annual salaries of each category of staff were assumed as follows: clerical, $20,000 with $500 increments for each scenario and 80 percent productivity; nurses, $50,000 with $1,000 increments and 70 percent productivity; physicians, $100,000 with $2,000 increments and a 70 percent rate of productivity.

Fringe-benefit costs were assumed at 29 percent for all personnel. The model assumed there were no expenses associated with the need for additional supervisory or management staff because such an intervention could blend into the ongoing clinical operations of each physician's office.

Physician Recruitment and Staff Training

Based on ratios of participants to physicians reported by Fleming et al. (1997), the number of physicians that would *have to be invited* to participate was estimated. Assuming a rate of agreement to participate at 80 to 95 percent in 5 percent increments for each scenario, the number of physicians to invite and the number needed to participate in order to handle the number of expected participants could be calculated. Invitation costs were estimated at $35 to $50 in $5 increments. For each scenario, from Most Expensive to Least Expensive, the model assumed there would be 4, 3, 2, or 1 doctor per office site. That way, the number of office sites where personnel and physicians would need to be trained could be calculated.

The model assumed that all involved office personnel would require some training on the use of the protocol. For each office site, the model assumed a 20-minute (SD = 5 minutes) training for clerical personnel who distributed and scored the health screening instrument and a 60-minute (SD = 5 minutes) training session for the nurses who

would administer the interview and make the followup phone calls. The model assumed an *initial* training session of 60 minutes (SD = 10 minutes) for all agreeing physicians working in a single site. The model assumed two "booster" training sessions of 15 minutes each (SD = 10 minutes) for physicians.

The training costs were determined by multiplying the average salary and fringe-benefit costs of a "trainer" (salary, i.e., $40,000 in $1,000 increments for each scenario, with 70 percent productivity and 29 percent fringe-benefit costs) against time spent to train, including travel time. The model assumed there were no expenses associated with the need for additional supervisory or management staff because such an intervention could blend into ongoing office operations.

Because the original research by Fleming et al. (1997) reported a $300 payment to the physicians, the model assumed payments to each participating physician of $300, $500, $700, and $900 for each scenario. This payment would be made to compensate the physician for "lost patient revenue" related to the need for staff and physician to participate in the training.

As in Model 1, this model assumed some percentage should be added for G&A plus profit. A fairly generous amount of 10 percent increasing by 1 percent for each of the four scenarios from Least Expensive to Most Expensive was entered.

[Figure TK—DTP

Center for Mental
Health Services

DHHS Publication Number SMA 02-3617

Printed 2001

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