Final Research Report

The Economic Value of Respiratory and Cardiovascular Hospitalizations

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Prepared for:

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Prepared by:

San Diego State University
Mark A. Thayer, Ph.D.

Stratus Consulting
Lauraine G. Chestnut, M.A.
Jeffrey K. Lazo, Ph.D.

Kaiser Permanente
Stephen K. Van Den Eeden, Ph.D.

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Abstract

This study estimates the individual economic benefits of reducing respiratory and cardiovascular hospitalizations, events often associated with air pollution, using cost-of-illness and willingness-to-pay data. Willingness-to-pay was estimated directly from a survey of Kaiser Permanente patients. Supplemental respondent information pertaining to costs not reflected in the costs of medical services was also obtained from the survey respondents. This information set included the loss of time corresponding to work, recreation, and household production activities, as well as non-pecuniary losses such as pain, suffering, and inconvenience, among other losses. Data on direct medical expenditures were obtained from various sources. We provide improved cost-of-illness and willingness-to-pay information that allows government agencies concerned with air pollution to more accurately assess the benefits and costs of their actions.

Executive Summary

The California Air Resources Board (ARB) members have expressed concerns over the lack of information on the economic value of health benefits when evaluating current and proposed air pollution control programs. To assess the economic value of reducing air pollution related health effects, it requires both dose-response and monetary valuation information for health effects associated with air pollutants. Available dose-response information shows significant positive relationships between exposure to particulate matter and ozone and hospital admissions for respiratory and cardiovascular illnesses. Available monetary valuation estimates for these health effects include only the cost of illness for the medical treatment and value of patient's time spent in the hospital. This represents an incomplete accounting of the costs of hospitalization. The intent of this project was to develop more complete cost-of-illness and willingness-to-pay values for the types of hospitalization episodes that have been associated with air pollution exposure.

Our analysis of cost-of-illness and willingness-to-pay is based on a theoretical model of individual behavior. The primary implication of the model is that cost-of-illness measures will not capture the value of all the effects of illness and will therefore underestimate an individuals' willingness-to-pay to prevent a hospitalization event. In addition, previous cost-of-illness studies for hospitalizations have not accounted for all cost elements. Therefore, previous cost estimates are likely understated. We utilize detailed cost-of-illness information from Kaiser Permanente--Northern California Region (KP), and other sources, together with a survey of Kaiser Permanente patients who have been recently hospitalized, in order to test these propositions. That is, we surveyed Kaiser patients to estimate individual willingness-to-pay to prevent a hospitalization event and compared this estimate to a comprehensive cost-of-illness measure, one that includes many non-traditional cost elements related to time and productivity losses.

Previous cost-of-illness studies focused exclusively on medical costs and lost time while hospitalized, generally ignoring the recovery period. We specifically account for the recovery period and, in addition, we supplement the traditional cost categories by adding out-of-pocket expenses and activity losses (household production, recreation). We find that the hospitalization period is commonly much shorter than the recovery period. Thus, lost earnings are significantly increased when one accounts for the recovery period. In addition, we find that the out-of-pocket expenses are generally small, in comparison to medical costs and lost earnings. Of course, these results are for a well-insured group of patients. However, the activity losses are quite significant both in terms of time and associated monetary value. The willingness-to-pay estimates indicate that individuals value hospital prevention to a significant degree. Prevention of a 1-day hospitalization event is valued at approximately $1,600 and a 5-day hospitalization at about $2,100, after adjusting for possible scenario rejection bias in the survey responses. There is significant non-linearity in the estimates as preventing additional days in the hospital provides significantly smaller additional value.

Our best estimates of the total social costs associated with a hospitalization event range from a low of $4,800/hospital day for chronic respiratory illness (mostly asthma and COPD), to $5,000/day for acute respiratory illness (mostly pneumonia), to a high of $7,300/day for cardiovascular illness. Costs are higher for those under age 65 primarily because of larger losses in earnings due to a higher labor force participation rate. We arrive at these estimates using a pure cost-of-illness approach. Similar results would be obtained if individual willingness-to-pay estimates were combined with social cost-of-illness values incurred by others.

In general, the evidence is not inconsistent with our theoretical expectations. Our results suggest that a comprehensive cost-of-illness study that considers both hospitalization and recovery time and accounts for all aspects of loss provides a close approximation of willingness-to-pay. This implies that the activity losses, which can be valued using dollar estimates of wages, are the most significant missing element in previous cost-of-illness studies. Of course, these results may not hold for a different sample of patients, one that is less insured or is younger or has greater income. The estimates provided herein should be useful to the California Air Resources Board and other governmental agencies as they attempt to place an economic value on air pollution changes brought about by agency action.

Chapter 1

INTRODUCTION

1.1 BACKGROUND AND PURPOSE OF THE PROJECT

The California Air Resources Board (ARB) needs to be able to quantify the benefits of current and proposed air pollution control programs in California. Benefit estimation is a process that includes two independent steps. First, one needs an estimate of the dose-response relationship between air pollution and potential physical responses (e.g., health effects). For example, an epidemiology study design could be used to estimate the dose-response relationship relating air pollution to hospitalizations for respiratory and cardiovascular illness. This would produce a statistical association between air pollution and the health endpoint(s), which shows the increased risk from air pollution to the population but does not indicate the specific individuals affected by air pollution. Available dose-response information shows significant positive relationships between exposure to particulate matter and ozone and hospital admissions for respiratory and cardiovascular illnesses. The second step is to place a monetary value on these health outcomes, without attributing the health outcomes to specific individuals or assigning causality to air pollution. The research reported herein is concerned only with this second step, the monetary valuation of hospitalizations, regardless of the cause of these hospitalizations. This information, together with the dose-response information provides the basis for benefit estimation.

The intent of this project was to develop comprehensive cost-of-illness (COI) estimates and willingness-to-pay (WTP) values for the types of hospitalization episodes that have been associated with air pollution exposure. This was done by compiling detailed COI information from Kaiser Permanente--Northern California Region (hereafter referred to as Kaiser Permanente) and other sources, and with a survey of Kaiser Permanente patients who have been recently hospitalized. It should be noted that we examine all respiratory and cardiovascular hospitalizations regardless of the cause of these illnesses; that is, we do not explicitly limit our analysis to the subset of respiratory and cardiovascular hospitalizations associated with air pollution. This is not possible because the association is based on a statistical analysis and does not identify individual admissions caused by air pollution exposure.

This study represents a new contribution to the literature because no previous studies have included a survey of patients who have been hospitalized for respiratory or cardiovascular illness to obtain information for COI and WTP estimates. This allows compilation of COI information that was not previously available and is not included in available hospital usage databases. Previous benefits assessments for air pollution control have used monetary valuation estimates for hospitalizations that include only the hospital charges and value of patient's time spent in the hospital (e.g., U.S. EPA, 1999; 2000). It is expected that this understates the total value of preventing a hospitalization event, because it does not reflect (1) non-medical out-of-pocket expenses, (2) the time lost from work by family members, (3) the medical and value of time costs for the post hospitalization recovery period, and (4) the value of the reduced quality of life for the patient during the illness episode. One previous study (in Canada) estimated WTP for preventing days with respiratory or cardiovascular symptoms, including a range of activity restriction from none to being hospitalized (Johnson et al., 1998). This was a general population survey not limited to subjects who had recent experience with hospitalization.

1.2 STUDY PLAN

Total societal WTP to prevent hospitalizations was estimated using the following methodology. First, we estimated individual and societal COI, which consists of the value of lost productivity, medical expenditures, and other out-of-pocket costs. This was done using hospital admission data from Kaiser Permanente, from the existing COI literature, and from a survey of Kaiser Permanente patients who had been hospitalized within the past year. Second, we utilized the survey to obtain a monetary value on the individual WTP to prevent hospitalization. Standard contingent valuation techniques were employed in this section of the survey. Finally, we estimated total societal WTP as the sum of individual WTP and the difference between societal COI and individual COI. To execute our study plan we completed the following tasks, which are numbered below to be consistent with our original proposal to ARB.

Task 3. Cost-of-Illness for Hospitalizations

The study team obtained and analyzed the direct medical cost and earnings losses for hospitalizations due to illness episodes potentially related to air pollution. A key issue was to determine the extent to which these hospitalizations were related to chronic illnesses that may pose ongoing health implications for these patients and would need to be taken into account in the development of a survey instrument in Task 4.

This task was composed of two subtasks: (1) identifying the health endpoint to be analyzed; and (2) estimating individual COI for these health endpoints. The first subtask required a review of the epidemiological literature and a determination of the diagnoses that have been linked to air pollution. The second subtask was done with available national and California databases.

Task 4. Survey Instrument and Plan Development

A survey instrument was developed to obtain WTP estimates for preventing future hospitalizations, and to obtain information on direct and indirect costs and activity restriction associated with a previous hospitalization. This included information on the at-home recovery period following hospital discharge.

Individual interviews were conducted to assess the effectiveness of preliminary survey instrument drafts and to identify any difficulties respondents had in answering the questions posed. We had patients who had been hospitalized recently complete the draft questionnaire on their own as they would if they received it in the mail, and then followed up with an interview to see if there were any areas of the questionnaire that were difficult or confusing. We also assessed whether the questions captured the range of circumstances of the selected subjects, and were flexible enough to cover most patients' circumstances. The results were used to assess whether changes were needed before full survey implementation was undertaken. Outside expert reviews of draft instruments and study plan were also obtained.

Results guided revisions and further survey development to ensure that the final instrument was easily understood and obtained the desired information.

Task 5. Survey Instrument Pretest and Sample Selection

After a draft instrument was completed and tested in personal interviews, a pretest was conducted. This was done following the same procedures as those planned for the final survey: personal physician permission was obtained and then the questionnaire was mailed to the patient along with a cover letter.

Upon completion of the pretest we began sample selection activities. Sample selection was determined by such factors as patient utilization of Kaiser Permanente facilities, patient diagnosis, and age. The sample was selected to be representative of the distribution of discharge

diagnoses for the categories of hospitalization that have been statistically associated with air pollution exposure. The sample was stratified by age to ensure sufficient variation in age across the sample to allow generalization for different age groups.

Data available for Kaiser Permanente hospital admissions include medical record number, age, gender, race, admitting diagnosis, discharge diagnosis, up to 11 other diagnoses, primary procedure, up to 7 other procedures, and admit and discharge date. All diagnosis and procedures are categorized using ICD-9 codes. Additional factors that can be identified from this database include medical service, type of bed (e.g., ICU, step-down, standard), disposition, and admission source.

Task 6. Survey Implementation

The survey was implemented with a selected sample of Kaiser Permanente patients who had been hospitalized for cardiovascular or respiratory illness within the past year. The goals of the survey implementation were to obtain approximately 400 completed surveys.

Steps in the survey implementation included:

- Selecting approximately 1,000 patients from the Kaiser database that met the criteria;
- Contacting the patients' doctors by letter explaining the nature of the research and requesting permission to contact the patient as required by the Kaiser Permanente Institutional Review Board;
- Once the doctor's permission was given, the patients were sent the survey with a cover letter from Kaiser Permanente explaining the importance of the research and requesting their assistance by completing the survey and returning it; *and*
- Follow-up reminder postcards were sent to non-respondents after about 2 weeks, including offers to send a second questionnaire if the first had been lost.
- A second mailing was completed for all non-responders to the first mailing.

Responses to the survey were entered into a database for analysis. Entrees were keyed twice to ensure accurate coding. Relevant data from the Kaiser database was added to the survey database, but patient confidentiality was maintained by identifying patients with a subject number only in the study data set.

Task 7. Survey Data Analysis

After the data were entered and checked, the analysis of the data was conducted. The first step in the analysis process was to review responses, identify any areas of particular interest or concern, and, in some cases, conduct comparisons of responses for different survey or question versions. Response summaries (i.e., number of responses, means, standard deviations, and frequencies) were calculated for each question, and grouped by type of hospitalization the patient experienced.

WTP functions were estimated to examine relationships between WTP (or choice) responses and characteristics of the hospitalization episode and of the respondent to help explain the variability in responses. Many elements of reliability and validity assessment were considered simultaneously in the analysis. For example, sensitivity of WTP responses to differences in the length of the hospitalization was tested. Similarly, tests for sensitivity to elements in the questionnaire were also conducted as part of the analysis.

Our final test regarding the survey results was to make a detailed comparison of the WTP responses and COI data from the patients to the direct medical costs (COI) obtained from Kaiser Permanente and other sources.

Task 8. Draft and Final Reports

A final report will be submitted after comments on the draft report are reviewed and discussed and appropriate revisions are made. All data obtained in the project, including the survey database, will also be provided to ARB.

Chapter 2

THEORETICAL MODEL AND LITERATURE REVIEW

2.1 THEORETICAL MODEL OF WILLINGNESS TO PAY TO PREVENT ILLNESS

Consider the following theoretical framework, which follows closely the work of Harrington and Portney (1987), Freeman (1993), and Alberini and Krupnick (2000) for describing an individuals' willingness to pay (WTP) to avoid the negative health effects. An individual's utility is assumed to be a function of aggregate consumption (X), leisure (L) and sick days (D):

$$U = U(X, L, D; Zu), \tag{2.1}$$

where U is increasing in X and L, decreasing in D, and Z_u is a vector of individual characteristics that capture preferences for income, leisure, and health. The number of sick days (D) is dependent on (C), a cause of illness (e.g., pollution), averting activities (A), and a set of individual characteristics that capture individual predisposing factors and baseline health (Z_d). Thus,

$$D = D(C, A, Zd) \tag{2.2}$$

Note that C increases and A decreases D, the number of sick days.

In order to maximize utility the individual chooses the levels of X, L, and A, subject to the following budget constraint:

$$y + w[T - L - W(D(C, A))] = X + p_M \bullet M(D(C, A)) + p_A \bullet A. \tag{2.3}$$

In words, the individual allocates his/her time (T) between work, leisure (L), and lost work time (W), which depends on the number of sick days. In addition, the individual spends income (y) on aggregate consumption (price normalized to one), medical care (M), which in turn depends on the number of sick days, and averting activities. The prices of M and A are p_M and p_A, respectively.

This structure can be used to determine optimal choices of X, L, and A. For example, optimal averting behavior is determined by maximizing utility subject to the budget constraint. Therefore,

$$p_A = \frac{U_C}{\lambda} \bullet \frac{\delta D}{\delta A} - w\frac{\delta D}{\delta A} - p_M M' \frac{\delta D}{\delta A}, \tag{2.4}$$

or the marginal cost of averting behavior (price) equals the marginal benefit of averting behavior. The latter includes the dollar value of the marginal utility of avoiding illness (first term on the right hand side), plus the change in earnings due to changes in work hours (middle term on the right hand side), and changes in medical expenditures (final term on the right hand side).

An individual's WTP for a reduction in the cause of illness (C) is the amount that must be taken away from the individual's income while keeping his/her utility unchanged. Harrington

and Portney (1987) demonstrate that, for a small change in the cause of illness, individual WTP can be decomposed into:

$$WTP = w\frac{dW}{dC} + p_M\frac{dM}{dC} + p_A\frac{\delta A^*}{\delta C} - \frac{U_C}{\lambda}\bullet\frac{dD}{dC}, \qquad (2.5)$$

where A* is the demand function for A, and $\delta A^*/\delta C$ gives the optimal adjustment for A to a change in the cause of illness. Equation 2.5 indicates that WTP is comprised of the following four components, given a change in the cause of illness:

- the marginal lost earnings (first term of right hand side of Equation 2.5);
- the marginal medical expenditures (second term on right hand side);
- the marginal cost of averting activity (third term on right hand side); *and*
- the discomfort or disutility of illness (final term on right hand side of Equation 2.5), converted into dollars by dividing by the marginal utility of income (λ).

The implications of the theoretical model are as follows. First, maximum WTP for each individual reflects how much of other goods and services the individual is willing to give up in order to obtain a reduction or prevent an increase in adverse health effects. This gives a dollar measure of the change in well being that the individual expects to experience. Summing this measure of benefits across all affected individuals provides an estimate of the total benefits.

Second, cost of illness (COI), a common monetary measure used with respect to human health, is a measure of the direct financial impact of illness. COI estimates generally include only lost earnings and medical expenses (the first and second components of Equation 2.5). This is often what people are thinking of when they refer to health costs, so it is important to clarify the difference between WTP measures and COI measures. Table 2.1 illustrates the difference between COI measures and WTP measures. Moreover, as is apparent from Equation 2.5, COI will not capture all the value of the effects of illness and will therefore underestimate WTP.

Third, studies based on averting activities (third component of Equation 2.5) will also underestimate WTP. Thus, while important, averting expenditure studies such as those completed by Harrington and Portney (1987), Courant and Porter (1981), and Abdalla, Roach, and Epp (1992) do not provide a complete estimate of WTP.

To summarize, both COI and averting expenditure approaches neglect the value of discomfort caused by illness and therefore provide only a lower bound on the WTP to prevent or avoid illness. In general, WTP is 1.6 to 4 times larger than the sum of mitigating expenditures and income loss (see Rowe and Chestnut, 1985; Alberini and Krupnick, 2000).

The relationship between cost-of illness and WTP holds whether they are measured from an individual or a societal perspective as long as both are viewed from the same perspective. It is important to note, however, that an individual's WTP for a reduction in the cause of illness, as defined in Equation 2.5, will not be expected to reflect medical costs paid by insurance and lost income covered by paid sick leave. An individual may, however, take into account the impact to other family members in their own WTP. The differences between these perspectives are detailed in Table 2.1.

Table 2.1. Economic Impact of Adverse Health Effects

Impact Category	Impacts to the Affected Individual	Impacts to Others in Society
Medical Expenses	Costs directly paid by the individual for medical costs and related to obtaining medical treatment (time, expenses, etc.).	Costs paid by private or government insurance programs.
Income Loss	Lost wages, net of taxes and paid leave programs.	Paid leave and the value of lost productivity beyond wages. Also lost wages if a caregiver loses time from work.
Value of Lost Household Work Time	Impacts of loss in ability to do household and childcare chores, which may include additional expenses for services.	Value of time lost to household chores for caregiver.
Other impacts	Pain and discomfort. Impacts on leisure activities.	Distress to other family members and friends, and value of lost leisure activities for caregiver.

Individual and societal COI and individual and societal WTP are thus:

- Individual COI equals medical costs, income lost, and value of lost household work (rows 1, 2 and 3 in Table 2.1) incurred by the affected individual.
- Societal COI equals the total medical costs and employment and household work loss costs (rows 1, 2 and 3 in Table 2.1) incurred by the individual and by others in society (e.g., paid by private or government insurance).
- Individual WTP equals the willingness to pay of the individual to reduce or prevent adverse health impacts and includes the value of their out-of-pocket medical costs, work loss, and other adverse impacts such as averting expenditures and the value of discomfort associated with the illness (all rows in Table 2.1).
- Societal WTP equals the total willingness to pay of the individual and of all others in society to reduce or prevent the adverse health impacts and covers medical costs, work loss, and other adverse impacts (all rows in Table 2.1).

As these definitions and Table 2.1 illustrate, individual COI is only a portion of the individual's WTP, and societal COI is only a portion of total societal WTP. In short, COI measures understate the value of preventing adverse health effects because they omit the value of non-pecuniary impacts listed in Table 2.1.

A confusion in some health valuation literature is that total societal COI measures are used and compared to individual WTP measures. In these cases, the societal COI measure may exceed the individual WTP measure where costs paid by society are substantial. Ideally, we seek to have a total societal WTP measure that covers all impacts to all individuals. Therefore, in this study we have obtained estimates of individual COI and WTP measures, and a societal COI measure. Then, we added costs paid by others (societal COI minus individual COI) to the individual WTP to obtain a first approximation to total societal WTP. Working with Kaiser Permanente to obtain the appropriate COI data for the types of hospitalization that have been associated with air pollution exposures, and then following this with a survey of past hospitalization patients, has provided a unique opportunity to obtain detailed and comprehensive COI and WTP data, which has not been done in any previous study.

2.2 LITERATURE ON COST-OF ILLNESS

The COI approach, which has been described in detail by Rice (1966) and Hartunian, et al (1981), involves estimating direct medical expenditures and earnings losses associated with the health condition of interest. The origins of COI studies can be traced to the early 1600s (Fein, 1976). Rice (1966) provided the basic framework for modern COI studies. In this study, she provided detailed procedures for determining the relative burden of several diseases. Since then COI studies have proliferated. For example, more than 200 separate COI studies were completed over the twenty years after the publication of Rice's seminal work. Some of these were national in scope, others limited to a selected population or geographic area. Some of these dealt with a specific disease category, others were more general.

Either the range of health endpoints or the geographic area examined can categorize specific COI studies. For example, Cooper and Rice (1976), in a comprehensive study that examines a broad spectrum of disease categories across a large geographic area, updated the estimates in Rice (1966). Their work provides both a methodology for completing a large national study as well as providing specific dollar estimates for a range of disease categories. Chestnut, Mills, and Agras (2000) also completed a national COI study; however, they limit their analysis to a specific health endpoint (asthma). In a similar manner, Alberini and Krupnick (2000) calculate COI estimates of the damages from minor respiratory symptoms associated with air pollution for several Taiwanese cities.

COI estimates can be prevalence based or incidence based. The former estimates are the costs for all individuals who have a disease in a specified time period. In effect, prevalence based COI estimates are based on the *stock* of individuals who have a specific disease and are a measure of the full financial burden of a disease. They are useful for evaluating the financial benefits of policies aimed at improving the effectiveness of treatment or reducing the health effects of a disease. In contrast, incidence based COI estimates reflect the expected costs for the *flow* of cases of a specific disease and reflect the expected value of direct medical expenditures and lost earnings associated with a disease from the time of diagnosis until recovery or death. These estimates are useful for evaluating the financial benefits of policies aimed at reducing the incidence of new cases of disease.

In the COI portion of this study we are concerned with the costs associated with being hospitalized with cardiovascular or respiratory ailments of the type generally associated with air pollution. In addition, our geographic area of concern is California. Therefore, we provide incidence based COI estimates for a specific illness-related event, for a specific geographic region.

We are also concerned with both individual COI and societal COI in this study. Moreover, we have estimated both direct and indirect costs. Consider the individual COI. The direct costs to the individual include medical expenses paid by the individual. Indirect costs are lost earnings and the value of lost household services.

Several studies have estimated average direct medical expenses and earnings losses of hospitalization. For example, in an asthma cost study, Chestnut, Mills and Agras (2000) present a range of $2,000 to $5,500 (AHRQ, 2000) for the average medical cost of an asthma-related hospitalization. Recent U.S. EPA estimates (US EPA, 2000) based on medical costs and lost time associated with hospital admissions for respiratory and cardiovascular illnesses have an average cost range of about $7,000 to about $18,000 (in 1999 dollars) per case including medical costs for the hospitalization and the value of the patient's time lost while hospitalized. Time spent in the hospital was valued at the average national daily wage of $106 for each day spent in the hospital. Asthma hospitalizations had the lowest value at about $7,000 for all ages, COPD was about $12,000 for all ages and $15,000 for ages 65 and over, and cardiovascular hospitalizations were valued at $12,000 for all ages and $18,000 for ages 65 and over.

With regard to societal cost of illness we are unaware of any comprehensive studies that have done what this study has; that is, to use a survey instrument to obtain information on the costs imposed on other segments of the population. Specifically, we used the survey to estimate any caregiver time and associated earnings and/or leisure loss, the amount of medical expenses or direct earnings losses paid by medical insurance or paid leave programs, the magnitude of any other medical or non-medical costs, and the effect of co-morbidity.

In summary, the literature on the COI is quite extensive and provides the conceptual basis for our COI estimates. However, we also rely extensively on our survey instrument in order to more accurately determine the COI to the individual and to society.

2.3 LITERATURE ON WILLINGNESS TO PAY

Several studies have been conducted using stated preference approaches to estimate WTP to reduce or prevent the types of illnesses that have been associated with air pollution. Only one of these studies has specifically addressed hospitalizations (Johnson et al., 1998) and none has focused solely on hospitalizations.

WTP to Prevent Episodes of Mild to Severe Symptoms and Activity Restriction

Johnson et al. (1998; 2000) conducted a survey of about 400 residents of Hamilton, Ontario, regarding their preferences related to preventing future illness episodes. The illness episodes were defined to be those that have been associated with air pollution, but air pollution was not presented to the survey respondents as a factor in their chances of having a future illness episode. The survey used a choice question design in which symptoms, episode duration, activity restriction, and costs were bundled in various combinations and presented in pairs. Subjects then chose or rated the preferred bundle and subsequent statistical analysis estimated WTP based on subjects' choices.

Table 2.2 shows the attributes of illness episodes used in the study. Each episode was also associated with a cost ranging from $0 to $750. The payment vehicle was described to subjects as illness-related costs that are not covered by the government health care system or a company insurance plan. They were told to assume that any time missed from work would be covered by paid sick leave. Note that in Canada the government health care system covers everyone, and paid sick leave is common. Subjects were told:

> *Some of the costs that you pay are to reduce your discomfort, or the length of the illness. These might include vitamins, medicines, devices such as air filters or humidifiers, special foods and liquids, or other optional treatments. Other costs that you pay result from your illness, such as paying for childcare while you are sick or paying for transportation to the doctor. (p. B-7)*

The illnesses causing the episodes were not specified; although the subjects were given some background information on heart and lung diseases and the symptoms described common symptoms of such illnesses. An effort was made to distinguish between acute and chronic illnesses and to emphasize that if these episodes were related to a chronic illness that they referred only to the short period of worsened symptoms. Subjects were told:

> *As you read earlier, some lung and heart illnesses are "acute" and last only for a few days to a few weeks although they can recur later. Other conditions are "chronic" and affect you for the rest of your life. This survey is not asking you to consider the chronic condition itself, but only "attacks" of the chronic condition, when symptoms become worse for a period. (p. B-7)*

Table 2.2. Attributes and Attribute Levels used by Johnson et al. (1998)

Attribute	Level	Description
Symptom	Nose	Stuffy/runny nose and sore throat
	Eye	Eye irritation
	Flutter	Fluttering in chest and feeling light-headed
	Breath	Coughing, wheezing, shortness of breath
	Ache	Coughing or wheezing with fever, chills, or aching all over
	Swell	Shortness of breath, and swelling in ankles and feet
	Pain	Pain in chest or arm
Duration	1-day episode 5-day episode 10-day episode	
Daily Activity	NoLim	You can go to work, go to school, do housework, participate in social or recreational activities, and have no physical limitations.
	SomeLim	You can go to work, go to school, do housework, and participate in social or recreational activities, but you have some physical limitations (trouble bending, stooping, or doing vigorous activities) because of this health condition.
	NoSoc	You can go to work, go to school, do housework, but you have some physical limitations (trouble bending, stooping, or doing vigorous activities), and cannot participate in social or recreational activities because of this health condition.
	AtHome	You cannot leave your house, go to work, go to school, do housework, participate in social or recreational activities, and you have some physical limitation (trouble bending, stooping, or doing vigorous activities) because of this health condition, but you can care for yourself.
	NeedHelp	You cannot leave your house, go to work, go to school, do housework, participate in social or recreational activities, and you need help caring for yourself (feeding, bathing, dressing, toilet) because of this health condition.
	InHosp	You are in hospital and need help caring for yourself (feeding, bathing, dressing, toilet).

The WTP results obtained for the three more severe levels of activity restriction are shown in Table 2.3. The range of values for each length of episode is for the different symptoms. Some symptoms were consistently considered worse than others, but the length of the episode and the level of activity restriction were the bigger determinants of the WTP values. A significant aspect of these results is that they do not increase in proportion to the length of the episode. The severity of these episodes is significant and the WTP amounts have a potentially significant impact on the household

Table 2.3. Mean WTP Results from Johnson et al. (1998) for More Severe Episodes (1997 Canadian Dollars)

Number of Days	Level of Activity Restriction		
	At Home, but able to self care	At Home, need help with self care	In Hospital
1	$160 to $230	$285 to $365	$430 to $535
5	$435 to $620	$565 to $760	$705 to $910
10	$590 to $840	$720 to $980	$855 to $1115

The authors note that these WTP values are in addition to insurance paid medical costs and paid sick leave, and should be added to the latter for a benefits assessment. This is because

insurance paid medical costs and paid sick leave are costs to society, but they are not expected to be reflected in an individual's WTP value when they are not borne by the individual.

Two additional studies estimated WTP to prevent days with respiratory symptoms that were either minor and involved no activity restriction, or were severe and involved some activity restriction. Neither of these studies included symptoms severe enough to require a work loss day or a hospitalization. Loehman et al. (1979) conducted a relatively early contingent valuation effort conducted by mail with the general adult public. WTP values were obtained for avoiding minor and severe respiratory symptom days. One day, seven days, and ninety days per year were considered. Severe symptoms were defined as causing some restriction in activity; minor symptoms did not restrict activity. Symptoms included shortness of breath, coughing/sneezing, and head congestion/throat irritation. Tolley et al. (1986) and Berger et al. (1987) conducted a contingent valuation study using in-person interviews. The symptoms were defined in more detail than in the Loehman et al. study, and WTP values for more different kinds of symptoms were obtained. WTP was asked for minor and severe symptoms and for single or multiple days. The sample was general population adults.

Rowe et al. (1984) and Rowe and Chestnut (1986) conducted a study with a panel of asthmatics in Southern California recruited from a UCLA panel study on the effects of ozone on daily asthma symptoms in previously diagnoses asthmatics. The economic component examined COI and WTP for a worsening of asthma symptoms on a given day for subjects who already had diagnosed asthma. Each subject defined what they would consider a "bad asthma day" for themselves, and valued changes in the frequency of such days. These included days with some activity restriction due to asthma for some patients, but this was not specified.

Chestnut et al. (1996) examined the relationship between willingness to pay for changes in the symptoms associated with coronary heart disease, especially angina, and expenditures made by the individual to mitigate or reduce these symptoms. The results indicate considerable consistency between actual expenditures made to avoid angina and responses subjects gave to contingent valuation questions concerning what they would be willing to pay to avoid a hypothetical increase in angina symptoms.

Table 2.4 gives a summary of the WTP results for avoiding symptom days from these studies. Although these days include some with partial activity restriction, they do not, on average, represent days when a patient must stay at home or be hospitalized. Still, the WTP values range from about one-fourth to more than half of the average daily wage in the United States.

Table 2.4. Summary of WTP Results for Symptom Days

Symptom	WTP to Prevent a Future Symptom Day (1997 dollars)	Study Population	Study
Respiratory symptom	$15 to $25	General population adults	Loehman *et al.* (1979) Tolley *et al.* (1986)
Asthma exacerbation	$42	Symptom diary subjects (adults) with diagnosed asthma	Rowe *et al.* (1984)
Angina episode	$66	Symptom diary subjects (adult men) with diagnosed ischemic heart disease	Chestnut *et al.* (1996)
Minor restricted activity day due to respiratory symptoms	$50	General population adults	Loehman *et al.* (1979) Tolley *et al.* (1986)

Chapter 3

SURVEY DEVELOPMENT AND IMPLEMENTATION

3.1 SURVEY POPULATION AND HEALTH ENDPOINTS

The survey population is one that has direct experience with the health endpoint of interest, which is an advantage when it comes to willingness-to-pay (WTP) questions and essential for gathering individual cost-of-illness (COI) information concerning time and activity losses to the patients and their families.

The health endpoint is the illness episode that causes a person to be hospitalized. This may be the result of either a serious acute illness or an aggravation of a chronic illness. Both have been linked to air pollution exposures, but the link is to the hospitalization episode, not necessarily to the underlying chronic illness.

Post Hospitalization Kaiser Patients

The survey is designed to collect information from adult patients who have been hospitalized within the past year with a primary diagnosis of respiratory or cardiovascular illness. Patients were sampled by diagnosis in proportion to the frequencies of the various diagnoses in each diagnosis category that has been linked to air pollution, adjusted for the relative risks of air pollution.

Diagnosis Categories and Age Distributions

Table 3.1 shows the distribution of diagnoses for hospitalizations in the categories of acute and chronic respiratory illnesses that have been linked to air pollution in epidemiology studies. Table 3.2 shows the distribution of diagnoses for hospitalizations in the categories of circulatory illnesses that have been linked to air pollution in epidemiology studies. These are national figures from the 1999 National Hospital Discharge Survey. The annual number of hospital admissions and the average length of stay are shown for three age groups: (1) children under age 18; (2) adults ages 18 to 64; and (3) adults age 65 and older. These data give an idea of the specific types of hospitalization illness events that have been linked to air pollution.

For acute respiratory illness, the most common illness is pneumonia. For chronic respiratory illness it is a combination of asthma and chronic obstructive pulmonary disease (COPD), which includes chronic bronchitis and emphysema. Asthma is most common for those under age 65. For those aged 65 and over, COPD is the most common. Epidemiology studies concerning respiratory hospital admissions have looked at various diagnosis categories. Van Den Eeden et al. (1999) used the acute and chronic respiratory groups shown in Table 3.1. Other air pollution epidemiology studies have used all respiratory (ICD9 460-519) and/or pneumonia/flu (ICD9 480-487), asthma (ICD9 493), and COPD (ICD9 490-492, 494-496) individually and for various age groups (e.g., Moolgavkar, 2000; Samet et al., 2000; Sheppard et al., 1999).

The circulatory illnesses are divided between cardiovascular, which are various types of heart disease and illness, and cerebrovascular, which include stroke and various ailments of the arteries and veins. Epidemiology studies have used various combinations of circulatory diagnoses. Most commonly used is cardiovascular (ICD9 390-429), which has been linked to air pollution in several studies. Some studies have looked separately at cerebrovascular (ICD9 430-459), and have found the pollution effect is not as statistically strong for this category when considered alone (e.g., Moolgavkar, 2000). The epidemiology study based on Kaiser Permanente data for southern California (Van Den Eeden et al., 1999) used a combination of selected

diagnoses from both cardiovascular and cerebrovascular categories. These included all the cardiovascular subcategories listed in Table 3.2 (ischemic heart disease, heart failure, other heart disease, which dominate ICD9 390-429) and selected ailments of arteries and veins, but excluded the largest cerebrovascular subcategory, which is stroke.

Table 3.1. Respiratory Hospital Admissions in the United States, 1999

Diagnosis Category (ICD9)			Age under 18	Age 18-65	Age 65 and over	All ages
All Respiratory (460-519)		Admissions	759.2	1,098.3	1,831.7	3,689.2
		Length of stay	3.1	5.1	6.6	5.4
Acute Respiratory						
Pneumonia/flu	K	Admissions	220.7	366.4	827.9	1,415.0
(480-487)	O	Length of stay	3.9	5.8	6.6	6.0
Other acute respiratory		Admissions	329.2	301.3	446.9	1,077.4
infection (460-466, 472-478)	K	Length of stay	3.1	5.9	8.2	6.0
Chronic Respiratory						
Asthma	K	Admissions	202.3	203.2	72.6	478.1
(493)	O	Length of stay	2.4	3.4	5.0	3.2
COPD	K	Admissions	6.9	224.4	483.4	714.7
(490-492, 494-496)	O	Length of stay	4.4	4.4	5.4	5.1

Note: Source is 1999 National Hospital Discharge Survey. Admissions are in 1,000s; length of stay is in days. "K" means used in Van Den Eeden et al. (1999) epidemiology study using Kaiser Permanente data for southern California. "O" means used in other air pollution epidemiology studies.

Table 3.2. Circulatory Hospital Admissions in the United States, 1999

Diagnosis Category (ICD9)			Age under 18	Age 18-65	Age 65 and over	All ages
All Circulatory (390-459)		Admissions	30.7	2,208.0	4,105.2	6,343.9
		Length of stay	5.9	4.3	5.2	4.9
Cardiovascular **(390-429)**		**Admissions**	**21.7**	**1,731.3**	**3,028.8**	**4,781.9**
		Length of stay	**6.0**	**3.9**	**5.0**	**4.6**
Ischemic heart disease		Admissions	3.0	951.8	1,307.2	2,262.0
(410-414)	K	Length of stay	3.7	3.7	4.9	4.4
Heart failure		Admissions	1.9	205.8	767.0	974.8
(428)	K	Length of stay	8.3	5.2	5.5	5.5
Other heart disease (415-417,		Admissions	12.4	349.6	697.0	1,059.0
420-427, 429, 440, 451-453)	K	Length of stay	6.4	4.1	4.6	4.5
Cerebrovascular **(430-459)**		**Admissions**	**9.0**	**476.6**	**1,076.4**	**1,562.0**
		Length of stay	**5.4**	**5.5**	**5.7**	**5.7**
Stroke		Admissions	2.7	254.6	703.7	961.0
(430-438)		Length of stay	8.0	5.5	5.4	5.4
Arteries, veins and other		Admissions	1.2	130.8	182.7	314.6
(440-459)	K	Length of stay	5.2	4.8	5.6	5.3

Note: Source is 1999 National Hospital Discharge Survey. Admissions are in 1,000s; length of stay is in days. "K" means used in Van Den Eeden et al. (1999) epidemiology study using Kaiser Permanente data for southern California. "O" means used in other air pollution epidemiology studies.

Although circulatory hospital admissions are nearly twice as frequent as respiratory hospital admissions, the results of epidemiology studies show that PM-related admissions are

nearly equally divided between respiratory and circulatory, and ozone-related admissions are all within the respiratory category. Therefore, the sampling for this study reflected the proportions of air pollution related diagnoses rather than the total proportions. The sampling for this study is further discussed in Section 3.5.

3.2 SURVEY INSTRUMENT OUTLINE AND PRELIMINARY REVISIONS

The survey instrument was first revised based on two outside reviews (which are attached as an appendix) and on comments from the Kaiser Permanente Internal Review Board. The instrument was then tested during in-person interviews with several Kaiser Permanente patients who had been hospitalized for respiratory or cardiovascular illness recently. This testing identified a few areas of confusion and suggested several revisions to improve the clarity of the survey. The results of this testing of the instrument and the revisions made in response are summarized below.

Response to Comments from Outside Reviewers

There were several specific wording changes or question refinements suggested by the reviewers. In general, we incorporated all the suggested revisions. We also dropped the questions about post hospitalization earnings and limited the questions about post hospitalization activity levels. We decided to focus on the lost earnings during the hospitalization and at-home recovery period based on pre-hospitalization earnings and not try to attribute any long-term earnings losses to the illness episode in the interest of making the questionnaire easier and shorter. The out-of-pocket cost questions are still rather burdensome.

Significant comments are summarized and discussed below, in no particular order.

1. It's not clear in the choice questions whether 0 days means no illness event, or just no hospitalization.

Based on the epidemiology studies we have no knowledge of whether there is an illness event in the absence of a hospitalization. However, other types of studies consider other types of health effects, so the relevant valuation question here is for an illness event that includes a hospitalization relative to no illness event. We re-defined 0 days to mean no illness event and added these words to the choice questions.

2. There is some ambiguity in the questions about how recovery is defined. In some cases the questions are about return to pre-hospitalization activity levels and health status, and others are about numbers of days confined to home.

For purposes of monetary valuation we decided to focus on the more narrow definition of recovery, which is the number of days confined to home, and refer to this as "at-home recovery" throughout the questionnaire. We retained questions about whether the subject has returned to pre-hospitalization activity levels to gain a more complete picture of the whole recovery period. In many cases the subject may be dealing with an ongoing and progressing chronic condition. It is important that we define the hospitalization episode more narrowly rather than more broadly for the valuation questions, because we want to measure the value of preventing the episode only, not the ongoing chronic illness. However, we do want to get additional background about how the hospitalization event relates to the subject's overall health.

3. It is not clear over what time period the chance of a new hospitalization exists and over what time period the payment/cost (in the choice questions) would be made.

We added wording that clarifies that both the health risk and the cost would occur over the next year. We want the risk and the cost to be contemporaneous. A one-year time frame is consistent with typical benefits applications in terms of health risk.

4. The mechanism by which payment would be made and hospitalization prevented or shortened is too vague.

The reviewer acknowledged that there are tradeoffs between specificity and vagueness. We decided to remain vague about the payment mechanism to avoid problems of rejection if examples don't apply to the subject's specific type of illness or if the programs are things usually paid for by insurance.

5. What information supports the selection of levels for the attributes?

There are three attributes in the choice questions: (1) length of hospital stay; (2) length of at-home recovery; and (3) cost prevent or shorten the illness event. We selected ranges of numbers of days and costs based on limited available information. Table 3.3 shows the attribute levels selected for evaluation in the pretest.

A previous study (Johnson et al., 1998; 2000) covered similar health outcomes, but included days with symptoms and some activity restriction, as well as days in hospital. They used 1, 5, and 10-day episodes and dollar amounts ranging from $50 to $750. The ranges of WTP results they obtained for 1, 5, or 10 days in the hospital, at home needing help with care, or at home able to care for self were shown in Table 2-3. The ranges of results are for different respiratory or cardiovascular symptoms such as coughing and shortness of breath or chest pain. These give an idea of what might be a reasonable range of results to expect. However, we are covering a combination of days in hospital and days at home (up to 20 days combined), so we expect the dollar values will be higher in some cases.

Table 3.3. Attribute Levels Selected for Pretest

Days in Hospital	Days of at-Home Recovery	Costs
0 (no illness episode)	0	$50
1	1	$100
2	2	$200
5	5	$400
10	10	$600
		$800
		$1,000
		$1,500
		$2,000
		$3,000
		$4,000

General Results of the Interviews

We conducted four one-hour in-person interviews with Kaiser Permanente patients who had been hospitalized in the past couple of months. Each patient completed the questionnaire on their own in the presence of the interviewer, while reading it aloud and saying any comments or questions aloud as they answered the questions. The interviewer then went back and discussed the questionnaire with the patient asking additional questions to clarify any confusions or difficulties the subject may have had with the questions.

The patients represented a range of experience. Two were men and two were women. Two were under 65 and two were over 65. Two had no significant chronic illness, one was disabled with arthritis, and one was disabled with congestive heart failure. Two had short hospital stays (1 or 2 days) and two had stays of about a week. Three of the hospitalizations

were for respiratory illness (asthma, pneumonia, and respiratory virus) and the other was cardiovascular (irregular heart beat).

It took all the subjects between 25 and 30 minutes to complete the questionnaire. This is longer than it would be expected to take reading to themselves, since reading aloud is slower for most people. Overall, the patients understood the questions and were able to answer them. A few points of confusion arose that were addressed by redesigning some of the questions. These are discussed below. Some confusion arose because specific instructions with each question, such as "check one answer" or "fill in the number of times" were missing. Instructions were therefore added to each question.

Revisions to "Introduction"

The introduction gives a brief explanation of the purpose of the survey. The first question is to remind the patient about their recent hospitalization and confirm that we are discussing the same event as what the patient remembers. The date of hospital admission from Kaiser's records is inserted into each patient's questionnaire.

In response to a reviewer suggestion, we introduce the term "illness event" in the introduction and use the same phrase throughout the questionnaire to refer to the entire event including the initial symptoms, the admission to the hospital (usually through the emergency room), and the at-home recovery time.

We had changed the wording in the introductory paragraph to "heart or lung disease" rather than "cardiovascular and respiratory illness," but we found that this confused one person who had had a respiratory infection that caused a severe constriction in her throat, but did not think of this as a lung disease. We therefore revised again to say, "cardiovascular (heart) or respiratory (lung, breathing, ear, nose or throat)" to cover all the diagnosis categories we included.

The original Question 2 seemed redundant with asking patients to verify/correct the information presented on their most recent unscheduled or emergency hospitalization, so it was dropped. The explanation that the survey is about unscheduled or emergency hospitalizations that had been in the original Question 2 was added to Question 1.

Revisions to the "Medical History" Section

This section obtains some background information on the subject's general health history. Most important here is to get some information on whether the subject has an ongoing chronic condition that interferes with their day-to-day activities and whether the most recent hospitalization was related to an ongoing chronic condition.

The questions (previously Question 3 and 4) on previous hospitalizations seemed to be confusing, and a couple people put a check mark or a "yes" rather than filling in the number of times. We decided to simplify this question to just ask if they had had any other unscheduled or emergency hospitalizations in the past 5 years, and if so, how many (now Questions 2 and 3). This is sufficient to distinguish patients with repeated hospitalization experience from those for whom this was a one-time event.

Boxes were drawn to help guide patients through the questions on chronic condition and activity restriction (now Questions 4, 5, and 6). The level of activity restriction is now measured using a scale, rather than a serious of yes/no questions. Subjects tended to skip over the latter and just mark "yes" at their level of restriction.

Revisions to the "About Your Most Recent Hospitalization" Section

This section of the survey obtains COI information for the hospitalization that is not available from other sources. The information covers both the time in the hospital and the recovery time at home that is associated with the illness event that caused the hospitalization. In response to reviewer comments we revised the definition of at-home recovery time to include only the time during which the patient is essential confined to home and unable to do most normal activities. We use this same definition of at-home recovery time throughout the survey. Although it is possible that this does not reflect the entire amount of time it takes for a patient to fully return to previous activity levels, we are attempting to capture the impacts of an illness event, not the ongoing impacts of a chronic illness. We are therefore defining the at-home recovery time as the time during which activities remain extremely limited.

These questions are divided into three sections: out-of-pocket expenses, time lost from paid employment, and time lost from household chores and activities. A final question in this section asks how bothersome each type of impact was. This helps remind the patients about all the ways they were affected by the illness event, which is helpful before we begin the WTP section. It also provides some information about the relative importance of the monetary versus non-monetary impacts of the illness event.

Revisions to the "Out-of-Pocket Expenses" section. Only a few changes were made in this section. Instructions were added to each questions to "write 0 if none" to reduce the ambiguity of blanks.

Revisions to the "Time Lost from Paid Employment" section. A disabled category was added to the employment question, and skip instructions were made more prominent. The pay and work hours questions were clarified regarding the time period. One subject had written monthly hours although the question asked for weekly hours. The answer slot is now labeled "hours per week."

Revisions to the "Time Lost from Household Chores and Activities" section. Question 17 was changed to asking for "typical hours per day" rather than per week for regular household chores and activities, because this seemed to be the more natural way to think about it for the subjects.

Wording was changed to refer to the "illness event" rather than while you were hospitalized and recovering at home. One subject had specifically excluded her anxiety while at home and while arriving at the emergency room because of the latter wording. We really want their assessment of the illness event as a whole, and this wording was introduced on the first page, so it should not be confusing. In addition, we added "emergency room" to the title of the first column to make clear that this is to be included. We added a "does not apply" response option.

Revisions to the "About Potential Future Hospitalizations" Section

This section introduces the concept of potential future hospitalizations and possibilities of preventing them or reducing their length. The idea of potential higher costs in exchange for prevention or reduction of hospitalization is introduced. It is purposefully vague because more specificity often raises more questions. Objection to this tradeoff concept sometimes comes from those who expect that any costs should be covered by health insurance. This is evaluated using follow-up questions toward the end of the survey.

We added a statement (in what is now Question 24) to introduce the idea that a worst-case illness event would be a hospital stay of 10 days and an at-home recovery time of 10 days. This introduces the "no cost" scenario used in the subsequent choice questions and gives additional context to the question.

For the potential hardship question (now Question 25) we added more dollar amounts. This better introduces the range of potential costs to prevent or shorten the illness event that are used in the subsequent choice questions.

Revisions to the "Choosing Between Alternatives" Section

This section presents the choice questions that are used to estimate WTP to prevent or shorten future hospitalizations. Included in the choice options are hospitalizations and at-home recoveries of various lengths. Also, included are possibilities of no illness event at all. The process for the selection of the final choice set design is presented in Section 3.4 along with the statistical analysis plan. There are 10 versions of the 6 choice questions, which were randomly assigned to each patient in the sample.

Several of the subjects were somewhat confused by the first choice question, thinking that they were to choose their preference at each row, rather than between Alternative A and Alternative B, each as a package. This confusion did not continue past the first choice question for any of the subjects. We tried to eliminate this initial confusion by changing the format of the choices so that each alternative is enclosed in a separate box. Also, some of the explanatory text pointing out the differences between the alternatives in the first choice was moved to "bubbles" along side the choices, with arrows pointing to the specific content of the choices.

A direct WTP question was added (now Question 32), which follows the 6 choice questions. This is helpful in interpreting the choice results. We also added a follow-up question (now Question 33) with several statements for subjects to evaluate whether they agree or disagree. This helps in evaluation of the valuation responses and choice selections.

3.3 PRETEST RESULTS

We conducted two tests of the draft survey instrument. First, we conducted four one-hour in-person interviews with Kaiser Permanente patients who had been hospitalized in the past couple of months. The second test of the survey instrument consisted of a pretest sent to fifty recently hospitalized patients. The pretest was designed to test all aspects of the survey procedure, which include survey preparation, the sampling process, identification of the potential respondents, survey handling and mailing, and survey processing. The objective was to identify potential problem areas and then to address these issues prior to full survey implementation.

The first step in the pretest was to contact the participants' Kaiser physician by letter explaining the nature of the research and requesting permission to contact the patient and request their participation in the study. Once the physician gave approval, the patients were sent the survey with a cover letter from Kaiser Permanente explaining the importance of the research and requesting their assistance by completing the survey and returning it. The pretest survey was sent to fifty individuals. Follow-up phone calls were made to several of these individuals to explore reasons for non-submittal of the survey.

We received 15 completed surveys. One was not eligible because the diagnosis for the hospitalization was lupus, which is not in the study. The remaining 14 surveys illustrated a wide variety of diagnoses, as shown in Table 3.4. Follow-up phone calls with nonrespondents suggested that the primary issue was with the length and complexity of the questionnaire. The choice questions seemed especially daunting to some. We decided that there is little that can be done to make the questionnaire substantially shorter or easier without compromising the information we want to obtain. Our strategy was therefore to boost the total number of mailed surveys, and to assess the potential response bias by comparing available information on nonrespondents to the respondent group, such as diagnosis and age of patient.

Table 3.4. Primary Diagnosis Categories for Pretest Respondents

Primary Diagnosis	Number
Pneumonia	4
Lung cancer surgery	1
Chronic obstructive pulmonary disease	2
Asthma	1
Congestive heart failure	2
Heart attack	3
Arrhythmia	1

For the most part, the survey instrument worked quite well in that the respondents who completed it had little trouble filling in the required information. Of course, our primary concern is with the valuation related questions so we focus on these in the discussion below.

In the first choice question in all versions, the dollar cost is the same in both alternatives. In eleven out of the fourteen cases, the respondents chose the shorter hospital stay and longer at-home recovery in the first choice question. This indicates that the value of avoiding a day in the hospital is greater than the value of avoiding a day of at-home recovery. This is as expected and suggests that patients were understanding the tradeoff question and answering reasonably. In response to the pattern of answers, we revised the survey instrument to increase the number of at-home days in some choices to make some of the alternatives with the longer at-home recovery times less appealing. The choice questions provide the most useful information when responses are well distributed between the two alternatives in each choice.

Comparisons of the choice responses and the dollar amounts respondents offered in the open-ended WTP question for preventing a 5-day hospital/5-day at-home illness event also provide an indication of whether respondents were generally understanding the choice questions and whether their responses were internally consistent. Table 3.5 compares the number of times (out of five possible) the respondent chose the lower cost alternative in the 5 choice questions where costs vary, with the open-ended WTP responses. Respondents were spread across the range of potential times for choosing the lower cost alternatives from zero to five times. Those who chose the lower cost alternative either four or five times were also more likely to provide a zero WTP or a lower WTP in response to the open-ended question.

Table 3.5. Selection of Lower Cost Alternative compared to Open-Ended WTP Response

Number of times lower cost was selected out of 5 times possible	5	4	3	2	1	0
Number of respondents	4	4	0	1	3	2
Open-ended WTP responses: grouped together for 4-5 lower cost selections and 0-2 lower cost selections	refused $0 $0 $0 $500 $1,000 $1,200 $2,000			$0 $600 $1,000 $2,000 $2,000 $25,000		

Each respondent got one choice in which one of the alternatives was "no illness event." Responses to these are summarized in Table 3.6, along with the dollar amount offered to each respondent. Those who selected the "no illness event" alternative should be willing to pay about

half that amount or more for prevention of a 5-day hospital/5-day at-home event as included in the direct WTP question, because the baseline illness event in the choice questions is a 10-day hospital/10-day at-home event. This expectation is upheld, as shown in Table 3.6. All but one of the open-ended WTP responses for those who selected the "no illness event" alternative were greater than or equal to one-half of the dollar amount they indicated they would be willing to pay by choosing the "no illness event" alternative. For all of those respondents who selected the lower cost alternative rather than the "no illness event" alternative, the open-ended WTP responses were less than the dollar amount that they did not choose. This shows broad consistency between the choice responses and the open-ended WTP responses, and provides an indication that the respondents understood the choice questions.

Table 3.6. Responses to "No Illness Event" Choices

Dollar amount in the "no illness event" choice	Number of respondents who chose to pay for "no illness event"	Open-ended WTP values for those who chose to pay	Number of respondents who chose lower cost alternative	Open-ended WTP values for those who chose lower cost alternative
$1,000	1	$1,000	1	Refused
$1,500	0		1	$1,200
$2,000	3	$2,000	4	$0
		$2,000		$0
		$1,000		$500
				$600
$3,000	2	$25,000	1	$2,000
		$0		
$4,000	0		1	$0

One of the concerns with the valuation portion of the questionnaire is that patients may object to the idea of paying their own money to reduce chances of a future illness event, because they expect that their health insurance (i.e., Kaiser) should pay for any preventative health care. This might result in more respondents stating a zero WTP in response to the open-ended question, and more respondents always selecting the lower cost alternative, even though they do actually have a positive value for reducing or preventing a hospitalization episode. In the pretest, there were four out of the 14 respondents who wrote a zero in response to the open-ended WTP question. This suggests we might get about one-quarter of the respondents saying $0. This is a relatively high proportion high given the severity of the event and that most respondents say it is important to prevent or reduce the length of these events (Q25). The follow-up questions are intended to help in an evaluation of whether these responses are true zero values or are protests or rejections of the question premises. Two of the four zero WTP respondents also chose the lower cost alternative in every choice question and said that they strongly agreed with the statement that they could not afford to pay any more for health care regardless of the benefit. We interpret these as true zero WTP values. The other two are more suspect. One of them somewhat agreed with the statement that they would be willing to pay more for health care if it prevented or shortened a future illness event and the other one somewhat agreed with the statement that they didn't believe there were any preventative health care options that could prevent or shorten a future illness event. Both of these respondents also selected one or more higher dollar choice alternatives. These open-ended WTP responses are likely protest responses.

Overall, the range of dollar values used in the choice questions looked consistent with what respondents wrote in the open-ended responses. With the exception of one person who wrote $25,000, all the values are between $500 and $2000.

3.4 FINAL SURVEY REVISIONS AND CHOICE QUESTION DESIGN

Choice Question Design

Each choice question consists of 2 alternatives, each having 3 attributes: days in hospital, days of at-home recovery, and cost. Each survey contains 6 choice questions, and 10 versions of the choice section of the survey were created. Random combinations of alternatives were generated to create the 10 versions of choice questions with the following constraints:

- Trivial choices were excluded. All the pairs of alternatives involve a tradeoff of days versus cost. For example, there are no pairs in which one alternative has both fewer days of illness and lower costs because presumably all respondents would prefer that alternative and little information would be obtained from the question.
- Every version includes at least one pair with a zero cost and maximum days of illness alternative, which is 10 days in the hospital and 10 days of at-home recovery.
- Every version includes at least one pair with a "no illness event" alternative. Costs for these are $800, $1,500, or $3,000.
- If zero hospital days is one of the attributes, days of at-home recovery are also zero, and this is labeled a "no illness event"
- To maintain plausibility for the respondents, some general consistency of costs compared to days is maintained within each version, so that if the same number of days is repeated, the cost is also the same, and fewer days come with higher cost, etc.
- Differences in costs compared to days are introduced in different versions so that for the choice sets as a whole across all versions, costs and days are correlated at less than 0.6. Very high correlations among attributes make it difficult to statistically identify values for individual attributes.

The 10 versions of the choice questions selected for the final survey are shown in Table 3.7. The pretest results were evaluated to see if any adjustments were needed. The final choice questions versions were revised slighted from the pretest versions to include more simple tradeoffs and fewer complex tradeoffs in which every attribute is different in the two alternatives. More choices were included with (1) dollars held constant and (2) days at home held constant. We also added a few more choices where one of the alternatives is "no illness event", and a few more choices where one of the alternatives is the maximum 10-day hospital/10-day at-home event.

Table 3.7. Final Choice Question Versions

Version	Question	A			B		
		Hospital days	At-home days	Costs	Hospital days	At-home days	Costs
1	26	2	0	400	1	2	400
	27	0	0	1500	10	10	0
	28	1	0	800	10	10	0
	29	0	0	1500	1	0	800
	30	1	1	600	1	5	200
	31	2	5	200	10	1	200
2	26	1	10	200	5	5	200
	27	10	1	200	10	10	0
	28	0	0	3000	1	0	1500
	29	0	0	3000	10	10	0
	30	5	2	400	2	10	400
	31	5	0	600	2	0	800
3	26	2	0	400	1	10	400
	27	2	10	100	5	10	50
	28	5	10	50	2	0	400
	29	1	0	800	1	2	600
	30	1	5	400	0	0	1500
	31	5	10	50	10	10	0
4	26	1	5	600	2	0	600
	27	2	5	400	1	10	400
	28	1	0	800	2	0	600
	29	10	10	0	1	5	600
	30	5	0	200	5	10	50
	31	0	0	1500	1	10	400
5	26	2	1	800	1	5	800
	27	1	10	400	10	10	0
	28	1	10	400	0	0	3000
	29	5	1	400	10	1	100
	30	2	0	1500	2	1	800
	31	10	10	0	0	0	3000
6	26	1	5	400	5	0	400
	27	10	10	0	2	10	100
	28	10	0	200	10	1	100
	29	10	0	200	0	0	800
	30	2	1	400	5	5	50
	31	5	0	400	2	5	400
7	26	5	1	400	2	10	400
	27	10	2	50	5	2	200
	28	2	2	800	2	1	1500
	29	2	1	1500	10	10	0
	30	10	1	100	5	0	800
	31	10	0	200	0	0	3000

Table 3.7 (continued)

Version	Question	A			B		
		Hospital days	At-home days	Costs	Hospital days	At-home days	Costs
8	26	2	10	200	10	1	200
	27	10	10	0	10	5	50
	28	2	2	400	5	5	100
	29	5	0	400	1	5	400
	30	0	0	800	1	5	400
	31	10	5	50	0	0	800
9	26	1	10	200	5	0	200
	27	2	2	200	2	0	400
	28	10	5	50	1	0	800
	29	10	10	0	0	0	1500
	30	10	10	0	1	2	400
	31	1	10	200	2	10	100
10	26	5	2	200	2	10	200
	27	0	0	3000	10	10	0
	28	10	5	50	1	5	400
	29	5	1	400	10	10	0
	30	5	5	100	1	5	400
	31	5	1	100	5	5	50

We also developed some variations in the open-ended WTP question to allow for some separate analyses of the open-ended WTP responses. Table 3.8 shows the versions of the open-ended questions incorporated into the final 10 versions of the questionnaire.

Table 3.8. Ten Versions of the Open-Ended WTP Question

Version	Hospital Days	At-Home Days
1	10	1
2	5	10
3	10	10
4	2	2
5	5	1
6	5	2
7	5	5
8	1	10
9	2	5
10	1	0

The final questionnaire is included in the appendix. This shows version 1 of the choice questions. All 10 of the versions are the same except for the content of the choice questions and the open-ended WTP question. Changes to the questionnaire after the pretest were minor. We looked for opportunities to remove any extra words, and added a few clarifications. Specifically,

in questions Q4 and Q7 and in the introductions to Q24 and Q26, we added reference back to the hospitalization event listed in Q1 to make clear that we are referring to the same event or the same type of illness. We changed the formatting on Q12 to Q15, enclosing these in a box to make clear that these are only to be answered by those who were employed before their hospitalization. We dropped old Q21 on distance to hospital to reduce the number of questions; this is a relatively minor cost that does not vary much across respondents. We added $150 to Q25 on level of hardship. We added one more statement in Q33 to assess potential embedding of additional benefits in their responses. The statement is: "I was thinking that the new approaches would give me other benefits in addition to preventing hospitalization and this affected my answers."

Logit Model Analysis of Choice Question Responses

The purpose of this part of the analysis is to estimate the parameters of a conditional indirect utility function for reduced hospitalization episodes using the choice question responses. The choice data consist of the answers to 6 choice questions for each respondent. For each choice question the respondents indicated their preference between a pair of health alternatives. This process was repeated $J = 6$ times, where the length of the illness events and the costs to prevent or shorten the illness events are varied over the J pairs.

This section presents an econometric model for estimating willingness to pay (WTP) for preventing or shortening illness events that include a hospitalization. First, the conceptual model for derivation of WTP for reduced days in the hospital or at-home recovery is presented. Second, a binary logit model for estimation with the choice data is presented.

The utility an individual i gets from the hospitalization reduction program is assumed to be:

$$U_i = \beta_Y (Y_i - Cost) + \beta_{Hosp} Hosp + \beta_{Home} Home \tag{3.1}$$

where Y_i is individual i's income, *Cost* is the cost of the hospitalization reduction program, *Hosp* is the length of the in-hospital stay, and *Home* is the length of the at-home (post-hospital) stay. In this case β_{Hosp} and β_{Home} are expected to have negative values reflecting that more days of either are expected to reduce utility. With this model there are no nonlinearities, meaning that the marginal value of an attribute is constant across all levels of that attribute. Introducing non-linearities is simply a matter of changing the functional form (e.g. squaring the *Hosp* or *Home* term).

The parameter β_y represents the marginal utility of income, which is constant in this formulation and expected to be positive. Letting k (k=1,2) indicate the choice alternative, the difference in utility between any two choice alternatives is

$$U_i^1 - U_i^2 = \beta_Y (Cost^1 - Cost^2) + \beta_{Hosp} (Hosp^1 - Hosp^2) + \beta_{Home} (Home^1 - Home^2) \tag{3.2}$$

In this formulation, income drops out of the analysis and thus an individual's choice is independent of his or her income. Given that the cost levels offered in the survey may represent a significant portion of an individual's income (especially for those on fixed incomes) we may also consider model specifications where the marginal utility of income is a function of income (non-constant).

The other parameters represent the marginal utilities for the hospitalization reduction program attributes. Because improvements in utility are indicated by decreases in the measures of *Hosp* and *Home*, it is expected that the signs of the parameters are negative.

Calculation of marginal WTP for hospitalization reduction is achieved by dividing the marginal utility of a day in the hospital by the marginal utility of income.

$$WTP_{Hosp} = \beta_{Hosp} / \beta_Y$$

WTP can be modeled as a function of individual attributes by introducing interaction terms with *Hosp* and *Home*. The next section presents the development for the general binary choice model.

Basic Model of Binary Choice

This section presents the econometric model developed for the choice data. Expanding on the model described above, let utility for the various hospitalization episode alternatives be given by:

$$U_{ij}^{k_{ij}} = \beta_i \, x_{ij}^{k_{ij}} + \varepsilon_{ij}^{k_{ij}}, i = 1,...,n, j=1,...J, k_{ij} = 1,2 \qquad (3.3)$$

where $U_{ij}^{k_{ij}}$ is the utility of alternative k_{ij} chosen by individual i during occasion j. The $L \times 1$ vector x_{ij} contains the observed characteristics of the alternatives (days in the hospital, days of at-home recovery, and cost, possibly interacted with characteristics of the individual) and hence the elements of the unknown $L \times 1$ vector β can be interpreted as marginal utilities. In the choice model, individual i's utility from alternative j, U_{ij} is assumed to have two components, a deterministic component, V_{ij}, and a random component, ε_{ij}:

$$U_{ij} = V_{ij} + \varepsilon_{ij}.$$

The deterministic component is assumed to be a function of three variables, days in the hospital (*Hosp*), days at home recovering (*Home*), and the out-of-pocket costs to the individual associated with this event. The random component, ε_{ij}, is assumed to be Type I extreme-value distributed. This assumption generates a discrete-choice logit model. The random terms are assumed to be independently distributed across respondents and their A-B alternatives.[1] Given the logit formulation, the likelihood function is the standard joint probability computed as the product of probabilities associated with the observed choices. For example, in an A-B choice question, the probability A is chosen over B, P(A) is:

$$P(U_{A_{ij}} > U_{B_{ij}}) = \frac{e^{V_{A_{ij}}}}{e^{V_{A_{ij}}} + e^{V_{B_{ij}}}},$$

and the probability B is chosen is 1 - P(A).

In some of the models described below we look at the impact on the marginal utility of a day in the hospital of socio-demographic characteristics of the respondent and of his or her responses on "scenario" questions – questions designed to explore individuals reactions to the survey instrument including potential scenario rejection and comprehension. The basic modeling approach is the same except now we interact the number of days in the hospital with additional explanatory variables:

1. Accounting for any correlation across choice questions for a given individual would improve efficiency and may decrease the standard errors of the parameter and WTP estimates (although the consistency property is maintained without addressing correlation); this more complex error structure is not explored here but would be an area of potential future exploration.

$$U_i = \beta_Y(Y_i - Cost) + (\beta_{Hosp} + \beta_{Socio-demos} + \beta_{Scenario})Hosp \quad \text{where}$$

$$\beta_{Socio-demos} = \beta_{Educ}Educ + \beta_{Gender}Gender + \beta_{Age}Age \quad \text{and}$$

$$\beta_{Scenario} = +\beta_{InsShPay}InsShPay + \beta_{CldAns}CldAns$$

Using this approach we can explore individual heterogeneity in values for reducing illness related hospitalizations. We can also attempt to control for the effects of scenario rejection and respondent comprehension in deriving willingness-to-pay estimates.

3.5 FINAL SAMPLING PLAN AND IMPLEMENTATION

The study team implemented the survey instrument with a selected sample of Kaiser Permanente patients who have been hospitalized for cardiovascular or respiratory illness within the past year. The goal of the survey implementation was to obtain approximately 400 completed surveys. The sample was selected to be representative of the distribution of patient gender and discharge diagnoses for the categories of hospitalization that have been statistically associated with air pollution exposure, but stratified by age. Given the expected response rate, approximately 1,130 patients were selected to receive the questionnaire.

Original estimates were that we would obtain about a 50% response rate because the mailing would come from Kaiser Permanente and patients are generally willing to cooperate with surveys from their own health care organization. The original target of 1,000 surveys to be mailed was thought to be sufficient to ensure about 400 completed responses. However, the response rate to the pretest was only about 30%. Communication with nonrespondents indicated that reasons they did not return the questionnaire were primarily its length and complexity. Our judgment was that it would not be feasible to substantially shorten or simplify the questionnaire and still obtain the desired information, so some changes were made to try to increase the number of responses. First, the sample was increased to 1,130. Second, plans were made to make additional follow-up contacts, however, the extent of this was limited by budget constraints. The hope was to achieve a 35% response rate and still obtain about 400 completed responses.

The diagnosis categories are: (1) cardiovascular, (2) acute respiratory, and (3) chronic respiratory. Table 3.9 shows a summary of the Northern California Kaiser Permanente hospital admissions in 2000 in these categories for adults aged 20 year and older. Cardiovascular admissions are much more frequent than respiratory admissions. Cardiovascular admissions and most respiratory admissions (except for asthma) are much more frequent in patients over age 60.

Table 3.9. Hospital Admissions in Northern California Kaiser Permanente, 2000

Diagnosis Category	ICD9 Codes	Annual Number of Adult Admissions	Most Frequent Diagnoses
Cardiovascular	410-417, 420-429, 440, 451-453	Ages 20 to 59 1369 Ages 60+ 4468 Total ages 20+ 5837	Ischemic Heart Disease 48% Dysrhythmias 17% Heart Failure 22%
Acute Respiratory	460-466, 480-487	Ages 20 to 59 334 Ages 60+ 1139 Total Ages 20+ 1473	Pneumonia 91%
Chronic respiratory	490-496	Ages 20 to 59 336 Ages 60 + 849 Total Ages 20+ 1185	Asthma 23% Chronic Bronchitis 71%

Table 3.10 shows selected PM_{10} results from the earlier epidemiology study in Southern California. Although cardiovascular admissions are much more frequent than respiratory ones, the PM_{10} effect is stronger for respiratory admissions. Therefore, PM_{10}-related cardiovascular admissions are about equal to PM_{10}-related respiratory admissions.

Table 3.10. Pm_{10}-Related Hospital Admissions

Diagnosis Category	Percentage of Annual Admissions in May-Sept	Percentage Change in Admissions per 10 $\mu g/m^3$ PM_{10}[a]	Number of Admissions associated with PM_{10} in May-Sept
Cardiovascular	41%	4.5%	108
Acute respiratory	35%	5.7%	45
Chronic respiratory	30%	10.8%	43

a. Based on Van Den Eeden et al. (1999) from Table 11-26.

To get sufficient data to draw generalizable conclusions about the different patient groups, we stratified the sample as shown in Table 3.11. The Kaiser Permanente data (see Table 3.9) show more than 300 patients in each of these groups for the year 2000. Thus, it was feasible go back no further than the beginning of 2002 to get sufficient numbers for the study sample. This is preferable because recall is better if the hospitalization is more recent.

Table 3.11. Targeted Number of Patients to be Selected for Sample

Age Group (at time of hospitalization)	Cardiovascular ICD9: 410-417, 420-429, 440, 451-453	Acute Respiratory ICD9: 460-466, 480-487	Chronic Respiratory ICD9: 490-496
18 to 64	188	188	188
65 and older	188	188	188

Steps in the sample selection and survey implementation included:

- Selecting 1,130 patients from the Kaiser database that met the criteria for the sample.
- Contacting the patients' doctors by letter explaining the nature of the research and requesting permission to contact the patient and request their participation in the study as required by the Kaiser Permanente Institutional Review Board.
- Once the doctor's permission was given, the patients were sent the survey with a cover letter from Kaiser Permanente explaining the importance of the research and requesting their assistance by completing the survey and returning it.
- Follow-up reminder postcards were sent to non-respondents after about 1 week, including offers to send a second questionnaire if the first had been lost.
- A second mailing to all non-responders to the first mailing.

Responses to the survey were entered into a database for analysis. Entrees were keyed twice to ensure accurate coding. Relevant data from the Kaiser patient database were included in the study data set, but patient confidentiality was maintained by identifying patients with only a subject number in the study data set.

Chapter 4

SURVEY IMPLEMENTATION AND GENERAL RESULTS

4.1 SURVEY RESPONSE

Response Rates

A total of 1,129 surveys were mailed to Kaiser Permanente patients who had been hospitalized for respiratory or cardiovascular illness. The sample was stratified to be fairly evenly divided between those 65 and over and those under 65, and among the three major illness categories: acute respiratory, chronic respiratory, and cardiovascular.

A total of 441 of the final surveys were returned and entered into the database, and 13 of the pretest responses were added to this group.[2] Upon review of all available responses, we found several with extensive gaps. The final analysis was limited to respondents who completed at least 75% of the questions, excluding the branched question and the optional questions, such as comments. This resulted in exclusion of 57 returned questionnaires. The final number of responses used for the analysis was therefore 397. This implies an overall response rate of about 35%.

Table 4.1 shows the response rates by age and by diagnosis category. The response rate was higher for the group age 65 and over for all three diagnosis categories. The response rates were generally similar across the diagnosis groups, although slightly higher for cardiovascular, when averaged across the age groups.

Table 4.1. Response Rate by Sampling Group

Type of Illness	Under Age 65	Age 65 and Over
Acute Respiratory	32%	37%
Chronic Respiratory	27%	42%
Cardiovascular	27%	47%

We also looked at the response rates to individual questions in the survey. Non-response rates were 5% or lower for about 70% of the questions. Those with higher non-response rates are listed in Table 4.2. These generally involved more challenging recall questions or financial aspects and non-response rates were between 5% and 10% for all but three questions. The three questions with higher than 10% non-response were Q10, out-of-pocket expenses for non-medical services (21% non-response), Q26, the first choice question (24% non-response), and Q32, the open-ended WTP question (13% non-response). Given that the other choice questions were skipped by 5% of respondents or less, the high non-response rate for Q26 is surprising. The formatting of question may have lead some respondents to believe that it was just an example and not intended for them to answer. The high non-response rate for the open-ended WTP question illustrates some issues with this question. These are discussed further in Chapter 6.

2. Two pretest responses were excluded because they responded about hospitalizations that were for causes other than those included in this study.

Table 4.2. Questions with Higher than 5% Non-Response Rates

Q8, number of days of at-home recovery
Q9, out-of-pocket medical expenses
Q10, out-of-pocket expenses for services (non-medical)
Q17, daily hours for household chores
Q18, number of days unable to do most household chores
Q20, number of days unable to do most physically strenuous recreation
Q26, first choice question
Q28, third choice question
Q30, fifth choice question
Q32, sixth choice question
Q32, open-ended WTP question
Q33b, agreement with statement about being able to answer the questions
Q33f, agreement with statement about expecting other health benefits
Q37, household income

Conclusions Regarding Survey Implementation

During the pretest, the main reason patients gave for not completing the survey was that they found it long and hard to understand. The valuation section was most often mentioned as the difficult part of the survey. During initial planning phases of the study, we anticipated a 50% response rate based on Kaiser Permanente's experience with previous surveys, but we obtained only about 30% response to the pretest. Efforts to increase the response rate in the final survey implementation succeeded in obtaining a 35% response rate of usable responses. The first mailing obtained a 25% response. A second mailing of the questionnaire to initial non-respondents increased the response rate to 35%. It appears that with this target sample, which may have more health problems than the average person, and the length and complexity of the questionnaire, alternative survey implementation procedures may be needed to substantially improve the response rate. Any of these would substantially increase the cost per completion. Short of doing the survey in person, which is very expensive, it may have been possible to obtain more completions if answers were taken over the phone from those who did not respond to the second mailing. This is also more expensive than a simple mail survey approach, but cheaper than in-person interviews. In addition, the response rate might have been improved using more direct contact with potential respondents (e.g., telephone follow-up) rather than a post-card reminder.

Potential differences between the respondents and the full sample are examined in the following sections of this chapter. The primary concern is that respondents may be systematically different from non-respondents causing bias if the results from the respondents are assumed to apply for the whole sample. If there is no bias, the response rate is not a concern. However, it is difficult to determine with certainty whether such bias exists because limited information is available for the non-respondents.

4.2 Overview of Respondents

Characteristics of Respondents

Table 4.3 shows a summary of basic socioeconomic characteristics of the respondents. As the sample was intentionally stratified by age, we see that the average age is higher and the

percentage with one or more children under 18 at home is lower than the averages for the U.S. population.

Table 4.3. Characteristics of Respondents

	Mean	Median	S.D.	Min	Max
Age in years	65	68	13	18	94
2001 household income	$43,000	$35,000	$33,000	$5,000	$165,000
Percentage high school graduates	90%				
Percentage female	53%				
Percentage with children at home	13%				
Percentage White or Caucasian	80%				

About 47% of the respondents reported that they had had only one illness event resulting in hospitalization in the past 5 years. The other 53% of respondents reported an average of 3 hospitalizations in the past 5 years. About 54% of respondents reported that they have an ongoing illness that interferes to some extent with life's activities such as work, household or leisure activities. About 78% of these respondents said that their recent hospitalization was related to this ongoing illness. Thus, about 42% of the sample had been hospitalized for reasons related to an ongoing illness that interferes to some extent with life's activities. The levels of activity restriction reported by those who have an ongoing illness are shown in Table 4.4.

Table 4.4. Levels of Activity Restriction for those with an Ongoing Illness

Level of Restriction	Definition	Number of Respondents (% of those with an ongoing illness)
Slightly Restricted	Able to work and do most household chores, but occasionally unable to do vigorous physical activity.	33 (15%)
Somewhat Restricted	Able to work and do most household chores, but unable to do most vigorous physical activity.	61 (27%)
Moderately Restricted	Able to work part time or do some household chores, and able to do all self care activities.	47 (21%)
Very Restricted	Unable to work or do most household chores, but able to do basic self care such as bathing and eating.	61 (27%)
Extremely Restricted	Mostly confined to home and need help caring for self.	22 (10%)

Characteristics Of Hospitalization Events

Tables 4.5 and 4.6 summarize the responses to questions 21 and 22 regarding the severity of pain and discomfort and of anxiety and distress during the hospitalization and the at-home recovery period. The majority rated the pain and discomfort and the anxiety and distress as severe to very severe during the time in the hospital. The majority rated these both as mild to moderate during the at-home recovery time.

Table 4.5. Self Assessed Severity of Pain and Discomfort (Q21)

	None (0)	Mild (1)	Moderate (2)	Severe (3)	Very severe (4)	Mean
In the emergency room and hospital	22 (5.6%)	45 (11.4%)	100 (25.3%)	144 (36.5%)	84 (21.3%)	2.55
During your at home recovery	66 (17.1%)	113 (29.4%)	141 (36.6%)	57 (14.8%)	8 (2.1%)	1.51

Table 4.6. Self Assessed Severity of Anxiety and Distress (Q22)

	None (0)	Mild (1)	Moderate (2)	Severe (3)	Very severe (4)	Mean
In the emergency room and hospital	10 (2.5%)	37 (9.4%)	117 (29.8%)	131 (33.3%)	98 (24.5%)	2.66
During your at home recovery	47 (12.4%)	97 (25.7%)	156 (41.3%)	58 (15.3%)	20 (5.3%)	1.67

Table 4.7 shows the breakdown of the respondents and the full Kaiser sample by diagnosis and by age group. For the most part, the respondents are similar to the full sample in terms of diagnoses, but there are a few exceptions. In the full sample, 94% of those hospitalized for acute respiratory disease had pneumonia or flu. In the respondent group under age 65 this is about 85%. In the full sample, about 65% of chronic respiratory admissions for those under age 65 are for asthma. In the respondent group, about 47% of admissions for chronic respiratory disease are for asthma. For cardiovascular illnesses the respondent group looks pretty similar to the full sample. Overall, the most significant difference between the respondent group and the full sample is the under representation of asthma in the under 65 group.

Table 4.7. Hospital Admissions by Diagnosis for Respondents and Sample

Diagnosis		Respondents		Kaiser Sample	
		18-64	65 & over	18-64	65 & over
Acute Respiratory Disease	***Admissions***	***62***	***62***	***195***	***168***
Pneumonia & flu (480-487)	Admissions	53	57	184	158
	% of acute respiratory	85%	92%	94%	94%
Other acute respiratory infection (460-466)	Admissions	9	5	11	10
	% of acute respiratory	15%	8%	6%	6%
Chronic Respiratory Disease	***Admissions***	***57***	***77***	***214***	***182***
Asthma (493)	Admissions	27	11	140	40
	% of chronic respiratory	47%	14%	65%	22%
COPD, not asthma (490-492, 494-496)	Admissions	30	66	74	142
	% of chronic respiratory	53%	86%	35%	78%
Cardiovascular	***Admissions***	***53***	***83***	***194***	***176***
Ischemic heart disease (410-414)	Admissions	32	41	116	90
	% of cardiovascular	60%	49%	60%	51%
Heart failure (428)	Admissions	3	10	24	23
	% of cardiovascular	6%	12%	12%	13%
Other heart disease (415-417, 420-427, 429, 440, 451-453)	Admissions	18	32	54	63
	% of cardiovascular	34%	39%	28%	36%

Table 4.8 shows the average length of hospital stay for the respondents and for the same diagnosis groups in the 1998/1999 OSHPD data for unplanned admissions to non-HMO hospitals in California, by age group. Although there are some differences, these are not systematic. In other words, the lengths of stay for respondents are not consistently higher or lower than for California as a whole. For the two respiratory diagnoses categories, the respondents under age 65 have somewhat longer average length of stay and those over age 65 have somewhat shorter average length of stay. For the cardiovascular category the average length of stay is very similar for those under 65 and somewhat higher in the respondent group for those over age 65.

The differences between the survey respondents and the California sample seem fairly random and based on length of stay it appears that the respondent group does not have significantly greater or lesser level of severity for their hospitalizations.

Table 4.8. Average Length of Hospital Stay (Days) by Diagnosis for Survey Respondents and California

Diagnosis	Respondents		California 1998/1999 Hospital Survey	
	18-64	65 and over	18-64	65 and over
Acute Respiratory Disease	7.3	5.2	5.6	6.2
Chronic Respiratory Disease	4.7	4.9	4.1	5.1
Cardiovascular	4.5	6.9	4.2	4.8

Table 4.9 shows the average number of days respondents report being unable to do most of their normal household chores after their discharge from the hospital. These differ significantly by age group for chronic respiratory and cardiovascular diagnoses, with those over 65 reporting significantly more days of activity restriction. Also, those hospitalized for acute respiratory illness (which is primarily pneumonia) report similar periods of activity restriction in both age groups.

The last column in Table 4.9 shows the percentages by diagnosis group who reported that they have an ongoing illness that restricts their day-to-day activities to some extent and that their hospitalization was related to this illness. These percentages range from 33% to 54% and are significant even in the acute respiratory illness group.

Table 4.9. Average Numbers of Days Unable to do Most Household Chores after Hospital Discharge.

Diagnosis Category for Hospitalization	Average number of days unable to do most household chores after hospital discharge (Q18)		Percent reporting that this hospitalization was related to ongoing illness with activity restriction (Q4)
	Ages 18 to 64	Ages 65 and over	
Acute Respiratory	31.6 (n=57)	27.3 (n=57)	33%
Chronic Respiratory	8.9 (n=50)	39.2 (n=72)	54%
Cardiovascular	16.0 (n=50)	24.0 (n=77)	45%

Table 4.10 gives a summary of the open-ended comments offered by respondents at the end of the questionnaire where they were given the opportunity to add any comments they might have. About a third of the respondents wrote a comment. The percentages shown are based on the full number of respondents, so for example, 2.3% of all respondents offered a comment along the lines that they tried their best to answer the questions. The most common comments that might be considered negative regarding the survey were that it was too long, too hard, too confusing, or too vague (3.5%) and that they are already doing everything they can to improve

health (2.0%). Saying that they could not afford to pay anything more for improved health was also fairly common (3.3%).

Table 4.10. Summary of Open-Ended Comments

Comment	N	%
Positive about the Survey		
12 I tried my best to answer quest.	9	2.3%
13 Answered based on assumptions	3	0.8%
Negative about the Survey		
21 Survey too long, too hard, too confusing, too general, too vague	14	3.5%
22 Questions too personal, invasive	2	0.5%
23 Can't answer; didn't understand; results won't be accurate	5	1.3%
24 Can't see what good this survey will do	5	1.3%
Possible Rejections		
31 Kaiser/Insurance/Medicare/ government should pay	3	0.8%
32 Don't believe there are ways to reduce risk of future hospitalization	1	0.3%
33 Concern about negative side effects of treatment	3	0.8%
34 Don't trust Kaiser, doctors, insurance, government	1	0.3%
35 Need more information on what the treatment/test is; too vague	1	0.3%
General Clarifications - Negative		
52 Can't afford to pay, fixed income, etc	13	3.3%
55 Diet and lifestyle are more important	1	0.3%
56 Already doing everything I can to improve health	8	2.0%
57 Family/friends were affected by my hospitalization	2	0.5%
60 Negative comment about Kaiser (complaint about service, facilities, staff, cost, etc.)	34	8.6%
General Clarifications - Positive		
71 Positive comment about Kaiser (happy with doctor, service, hospital facility, staff, etc.)	22	5.5%
72 Reducing future hospitalization is important	3	0.8%
73 Would pay a lot/all I could afford to reduce time in hospital	1	0.3%
74 Would like competent medical care at reasonable cost	3	0.8%
Comments about Illness, Hospitalizations		
83 I have chronic heart disease	1	0.3%
84 I have cancer	2	0.5%
85 I have some other chronic disease	5	1.3%
86 My event was minor/Did not require overnight hospitalization	2	0.7%
88 I have had extensive hospitalizations in the past	2	0.7%
89 I had multiple hospitalizations during this particular time	3	0.8%

4.3 CONCLUSIONS REGARDING REPRESENTATIVENESS OF THE SURVEY

The focus of this study is the California population who are hospitalized for respiratory or cardiovascular illnesses within the selected diagnosis categories. This population is not the same

as the general population; those hospitalized are more likely to be over 65 and more likely to have a chronic illness than the general population. For example, nearly two-thirds of those hospitalized in these diagnosis categories are age 65 and older, but only about 12% of the population is in this age group. We have very little data beyond age to evaluate how this population with hospitalization events differs from the general population.

Our sample includes only individuals who have been hospitalized so it is drawn from the appropriate population, but it is limited to Kaiser Permanente members. There are two ways in which the survey respondents may differ from the target population. The first is if Kaiser members are systematically different from other hospitalized patients. The second is if there is some systematic difference between respondents and non-respondents to the survey. Regarding the first question we have little information except that we expect that the very poor are likely to be underrepresented in the Kaiser membership.

Regarding the second question we have some limited information. We are able to compare age and diagnosis of the respondents to the age and diagnosis of the full sample who were sent the survey. Two differences are apparent. We obtained a lower response rate for those under age 65, but we had purposefully over-sampled this group so the age group is slightly over-represented in the respondent group. We report all results by age group, so this is not problematic for interpretation of the results. The other difference is that asthma diagnoses appear to be somewhat under-represented for all ages compared to the sample.

We also have some information with which to compare the respondent group to all non-HMO hospitalizations in California and to the general population. This gives an idea if the respondent group appears to be typical. Hospital lengths of stay are comparable for the respondent group and for the non-HMO hospitalizations, with no systematic directional differences across the diagnosis and age groups. For the Kaiser sample as a whole, lengths of stay are generally lower than for all non-HMO hospitalizations, but the respondent group has somewhat longer lengths of stay making them closer to the non-HMO hospitalizations. The median household income for the respondent group is $35,000, which is lower than the California statewide median of $47,500, but is consistent with a much higher proportion of retired individuals (60% age 65 and over versus 12% for the state as a whole). Respondents are more likely to be high school graduates than the general adult population in California (90% versus about 80%). Respondents are also more likely to be white (80% versus 60% for California as a whole). These differences may reflect Kaiser membership as a whole, which is expected to exclude the very poor.

Overall, the respondent group appears to be reasonably representative of the hospitalized population. However, our ability to assess this accurately is limited by having only limited information about the target population.

Chapter 5

THE COST-OF-ILLNESS FOR HOSPITALIZATIONS --- MEASUREMENT

5.1 INTRODUCTION

The objective of this research project is to derive accurate estimates of both COI and WTP for preventing respiratory and cardiovascular hospitalization events. COI estimates are obtained using a combination of available data sources and, where necessary to fill data gaps, a survey of patients. WTP is obtained exclusively from the survey of patients.

Consider the cost-of-illness measure. As indicated in Chapter 2, the COI measure focuses on medical expenditures and the value of lost earnings and/or activities (e.g., housework or leisure). Medical expenditures are defined as the cost of treatment while in the hospital or in recuperation. Lost earnings are defined as the amount of time lost working times the foregone wage rate. Likewise, the value of lost household work or leisure is defined as the value of these activities times the amount lost (time or activities). Wherever possible, available data sources are used to construct COI estimates. The survey results are used to supplement where data are not readily available. In Table 5.1 we indicate which cost categories have data available and which cost categories require survey information. Note also that the survey is used to verify the accuracy of the available data.

As is illustrated in Table 5.1 we can directly estimate medical expenses, lost earnings while in the hospital, and portions of lost household work and leisure using available data. The survey results provide supplemental data to estimate additional lost earnings and lost household and leisure time. In addition, the survey results are used to verify the cost categories that are estimated from available data.

5.2 THE COST-OF-ILLNESS FOR HOSPITALIZATIONS

In this section we provide information pertinent to the various elements of COI. Specifically, we combine independent estimates of medical expenses, the expected source of payment, the time spent in the hospital, the foregone wage rate, and values for lost household work and leisure with survey data on work, household, and leisure time lost to create a complete COI estimate of a hospitalization event.

Table 5.1. COI Data Elements

Cost Category		Data Available	Survey Data Required	Survey Verification
Medical Expenses	Hospital Expenses	X		X
	Source of Payment	X		X
Lost Earnings	Time in Hospital	X		X
	Lost Work Time not in Hospital		X	
	Foregone Wage Rate	X		X
Lost Household Work	Value of Lost Household Work	X		X
	Lost Household Work Time		X	
Lost Leisure	Value of Lost Leisure	X		X
	Lost Leisure Time		X	

Medical Expenses During Hospitalization

As indicated in Table 5.1 medical expenses during hospitalization are derived from available data sources. Specifically, our estimates are based on medical expenses data for the selected ICD-9 codes that we obtained from the Office of Statewide Health Planning and Development (OSHPD). This data set pertains to all hospital admissions in California for the period 1998 – 1999 and contains several important variables, including the total charges for the hospital stay, the expected source of payment, the length of the hospital stay, and a variety of socioeconomic variables such as age and ethnicity. Summary statistics for many of these variables are presented in Table 5.2. The respiratory and cardiovascular diagnosis categories shown in Table 5.2 are those selected for inclusion in this study because previous epidemiology studies (Van Den Eeden et al., 1999) have found that a share of these are associated with air pollution exposures.

Table 5.2. Summary Statistics for Hospitalizations, 1998-1999

Hospitalization Category	Number of Admissions	Average Total Charges ($)	Length of Stay (Days)	Cost per Day ($)	Average Age of Admitted	Self-Pay (%)	Not Planned (%)
All Admissions	6,417,969	17,466	4.83	3,616	44	3.4	63
All Respiratory and Cardiovascular	1,052,549	24,947	5.07	4,921	63	2.3	85
All Acute Respiratory[a]	271,873	19,850	5.86	3,387	53	2.6	91
Pneumonia[e]	221,554	22,114	6.46	3,423	60	2.3	90
All Chronic Respiratory[b]	161,088	15,407	4.76	3,236	54	2.9	91
Asthma[c]	67,487	10,956	3.28	3,340	33	4.7	95
Non-Asthma COPD[d]	93,601	18,616	5.83	3,192	69	3.0	88
All Cardiovascular[f]	619,588	29,664	4.80	6,180	69	2.0	80
Ischemic Heart Disease[g]	299,835	36,086	4.34	8,315	67	2.0	78
Heart Failure[h]	140,965	19,833	5.42	3,660	73	1.7	91
Other Cardiovascular[i]	178,788	26,645	5.08	5,245	68	1.9	76

[a]ICD – 9 Codes 460-466, 480-487
[b]ICD – 9 Codes 490-496
[c]ICD – 9 Code 493
[d]ICD – 9 Codes 490-492, 494-496
[e]ICD – 9 Codes 480-486
[f]ICD – 9 Codes 410-417, 420-429, 440, 451-453
[g]ICD – 9 Codes 410-414
[h]ICD – 9 Code 428
[i]ICD – 9 Codes 415-417, 420-427, 429, 440, 451-453

As is illustrated in Table 5.2, there were in excess of 6.4 million admissions in California in the 1998 – 1999 period for which there is billing information; that is, the data set does not include admissions to Health Maintenance Organizations (HMOs) and other facilities that do not directly charge their patients. For example, all Kaiser Foundation Hospitals are exempted from reporting total charges because they do not charge specifically for an inpatient stay (we consider data from Kaiser below). Rather, they receive a constant monthly payment from each member, whether or not that member is hospitalized. Table 5.2 shows that for all diagnoses the average hospital admission resulted in average charges in excess of $17,000 and an average stay of 4.83 days. The average admission was of a person 44 years old, was unplanned (i.e., not a scheduled procedure - 63%), and was most likely not paid for by the admitted individual (alternatives include Medicare, Medi-Cal, private insurance coverage, workers compensation, etc.).

Respiratory and cardiovascular hospital admissions included in this study represent approximately 16.4 percent of all admissions. These admissions generally result in a hospital

stay of 5.07 days with associated average total charges equal to $24,947 or approximately $4,920/day. The average age of these respiratory/cardiovascular patients is 63 years old.

These total charges appear considerably higher than what the U.S. EPA has used in recent analyses for national average hospitalization costs (U.S. EPA, 2000), so we investigated why the California numbers might differ. The Agency for Healthcare Research and Quality reports similar data nationwide and by individual states through the Healthcare Cost and Utilization Project (www.ahrq.gov/data/hcup). This is the source of U.S. EPA's national average hospitalization costs, which are also based on hospital charges. When we compared the national averages to the California averages by diagnosis group and by age group, we found comparable lengths of stay but higher charges in California. The differences in charges were by a factor of about 1.6 to 1.7 and were fairly proportional across all diagnosis groups considered in this study.

As indicated in Table 5.2, about 80% of acute respiratory admissions are for pneumonia and involve a longer average stay and higher average cost, relative to chronic respiratory hospitalizations. Chronic respiratory admissions are about 40% for asthma and about 60% for non-asthma chronic obstructive pulmonary disease (COPD), which includes chronic bronchitis and emphysema. Chronic respiratory admissions are similar to the overall average admission in terms of length of stay and charges. Both categories of respiratory admissions are more likely to be unplanned compared to the overall. Asthma admissions reflect a younger population, on average. Acute respiratory and non-asthma COPD reflect an older population, on average. Finally, cardiovascular related admissions generally cost significantly more, affect an older population, and are less likely to be unplanned than respiratory related hospital admissions.

For this project the most important values are the total charges, the expected source of payment, and the length of stay (see Table 5.1). Total charges is a direct estimate of the medical expenses incurred as a result of the hospitalization. The expected source of payment helps determine the importance of insurance and the likelihood that social damages exceed individual COI. The length of stay value is important for determining lost earnings since days spent in the hospital are days spent not working.

The following trends emerge from an inspection of Table 5.2. First, average charges for respiratory and cardiovascular hospitalizations range from $10,955 (asthma) to $36,086 (ischemic heart disease). It should be noted that Kaiser Permanente data show significantly smaller costs values, as illustrated in Table 5.3.[3] As is shown, the cost/day values in Table 5.3 are approximately one-half of the corresponding values in Table 5.2. This is because Kaiser reports actual costs, whereas total charges reflect overhead, profit, and risk sharing for accounts that do not pay completely. The finding that total charges exceed actual costs is standard in the COI literature. The average length of stay is also one to two days shorter for all diagnosis categories for the Kaiser hospitalizations.

Table 5.3. Summary Statistics for Kaiser Hospitalizations

Hospitalization Category	Number of Admissions	Average Total Costs ($)	Length of Stay (Days)	Cost per Day ($)
All Respiratory and Cardiovascular	1,555	$ 5,772.70	3.41	$ 2,216.60
All Acute Respiratory	451	$ 6,289.90	4.24	$ 1,772.30
All Chronic Respiratory	542	$ 4,380.00	3.28	$ 1,613.70
All Cardiovascular	562	$ 6,701.60	2.85	$ 3,154.50

[3] Data from a sample of Kaiser Permanente patients for the period 2001-02.

Second, insurance is extremely important since a very small percentage of admissions are paid for by the individual admitted (self-pay ranges from 1.7% to 4.7%). Finally, the average stay ranges from 3.28 (asthma) to 6.46 days (pneumonia). On a cost-per-day basis respiratory admissions are much less expensive, on average, than cardiovascular admissions. Ischemic heart disease inflicts the greatest monetary damage at $8,315/day.

An alternative method for analyzing the medical expense data is to try to determine which factors contribute to total charges (TC). This is accomplished by estimating the following empirical model, which includes variables pertaining to the hospitalization event (length of stay, the type of admission --- scheduled or unscheduled, the disposition of the patient) and the individual hospitalized (age, sex, ethnicity).

$$TC = \alpha + \beta_1 LOS + \beta_2 Type + \beta_3 Disposition + \beta_4 Payment + \beta_5 Sex + \beta_6 Age + \beta_7 Ethnicity + \beta_8 Year \quad (5.1)$$

where

LOS = Length of Stay in Days

Type = Type of Event (Unscheduled or unplanned = 1, All other events = 0)

Disposition = Consequent Arrangement for Ending Event (Three dummy variables: Acute, Long-term Care, or Other)

Payment = Type of Organization that is to pay the bill (Selfpay = 1, all others = 0)

Sex = Sex of Patient (Male = 1, Female = 0)

Ethnicity = Race and Ethnicity of Patient (White = 1, all others = 0)

Year = Year in which the Admission Occurred (98, 99)

Note that α and the β_i are estimated parameters. The results of this exercise, using ordinary least squares estimation, are shown in Table 5.4.

Several aspects of the estimated equations are worth noting. First, the independent variable set contains a range of hospitalization events and individual variables. Second, the independent variables are generally significantly different from zero at usual significance levels and have the expected relationship to total charges. In general, the longer hospital events result in significantly greater total charges. Each additional day in the hospital, holding other variables constant, increases total charges by $1700 (Non-asthma COPD) to $4600 (Ischemic Heart Disease). This pattern is identical to that established in Table 5.2; however, the values are smaller since we are controlling for other explanatory factors. In addition, older male patients generally incur lower total charges. Ethnicity is either insignificant (the case of asthma) or has a mixed relationship to total charges (it seems whites have relatively more severe cardiovascular disease but milder (less costly) chronic respiratory ailments. Unscheduled respiratory events have higher associated charges whereas the opposite holds for cardiovascular related hospitalizations. Finally, those who self-pay generally have lower charges relative to patients covered by public or private insurance and there was significant inflation over the 2-year period.

Table 5.4. Estimated Coefficients and t-Statistics (Dependent Variable = Total Hospital Charges)

Independent Variable	All Acute Respiratory	All Chronic Respiratory	Asthma	Non-Asthma COPD	All Cardio-vascular	Ischemic Heart Disease	Heart Failures	Other Cardio-vascular
Age	16.15 (7.11)	42.86 (19.08)	-12.89 (-6.34)	-68.73 (-10.9)	-230.69 (-61.41)	-251.35 (-38.79)	-202.1 (-31.6)	-111.36 (-19.68)
Sex	1244.77 (9.85)	356.33 (3.19)	401.47 (3.88)	465.52 (2.70)	6005.02 (56.74)	5888.85 (35.79)	1442.6 (8.57)	4061.2 (22.08)
Ethnicity	400.17 (2.92)	-270.24 (-2.26)	62.35 (0.62)	-1079.7 (-5.45)	2945.15 (25.11)	3873.31 (21.62)	314.69 (1.72)	1419.01 (6.67)
Length of Stay	3111.06 (593.25)	1904.16 (261.04)	3680.80 (279.85)	1703.11 (185.94)	3469.21 (475.27)	4655.92 (351.73)	2418.3 (238.8)	3431.61 (291.46)
Type of Admission	13584 (67.61)	6707.29 (33.63)	6262.03 (26.77)	6520.04 (24.0)	-5893.43 (-44.77)	-6424.1 (-33.42)	11098 (37.29)	-6064.01 (-28.32)
Disposition Acute	3205.8 (9.25)	-1947.6 (-5.20)	3969.09 (10.20)	-3346.5 (-6.27)	-8698.6 (-44.99)	-13390 (-54.47)	-3460 (-8.39)	-5741.1 (-12.24)
Disposition Long-term	599.09 (3.44)	4443.17 (22.57)	937.54 (2.76)	4985.13 (19.95)	1591.81 (8.38)	4077.88 (11.06)	3901.7 (15.63)	2092.1 (6.93)
Payment	-3825.45 (-9.43)	-1410.9 (-4.33)	334.96 (1.46)	-3261.4 (-4.86)	-8240.5 (-21.88)	-8734.8 (-15.97)	-6854 (-10.5)	-7065.2 (-10.38)
Year	1789.5 (14.23)	1322.48 (12.07)	913.96 (9.39)	1673.51 (9.83)	3042.53 (29.41)	3739.20 (23.79)	2422.69 (14.61)	2554.6 (14.04)
Constant	-185978 (-15.01)	-132696 (-12.29)	-97006 (-10.11)	-157156 (-9.37)	-270678 (-26.55)	-335245 (-21.65)	-228346 (-13.97)	-233176 (-11.99)
R-square	.49	0.32	0.55	0.28	0.29	0.32	0.30	0.34
Number of Observations	384,455	161,199	67,539	93,660	619,588	300,013	141,040	178,788

Table 5.5 provides a summary analysis of medical expense data obtained from the OSHPD for three diagnosis groups (all acute respiratory, all chronic respiratory, and all cardiovascular), for two age groups (adults younger than 65, older than 65). There are three important aspects to consider when examining Table 5.5. First, we only consider unplanned hospitalizations; that is, the subset of hospitalizations in Table 5.2 that were scheduled or planned is omitted from further analysis. Second, we are primarily concerned with adults (age greater than 18 years old) and only present information for children for comparison purposes. Third, we present survey data in Table 5.5 for verification purposes.

Table 5.5. Medical Expenses during Unplanned Hospitalizations

Hospitalization Category		OSHPD Data				Survey		
		Number of Cases	Average Age	Length of Stay	Total Charges $	Number of Cases	Age	Length of Stay
Acute Respiratory	(>65)	123,248	80.0	6.24	22,616	62	76.1	5.22
	(18 – 64)	57,861	48.0	5.55	22,587	61	50.2	7.30
	(<18)	65,426	2.0	3.49	11,326	NA	NA	NA
Chronic Respiratory	(>65)	64,082	76.6	5.12	17,952	77	73.9	4.86
	(18 - 64)	56,303	48.3	4.09	14,843	57	52.2	4.72
	(<18)	26,541	5.4	2.42	7,993	NA	NA	NA
Cardiovascular	(>65)	321,616	77.9	4.78	26,932	83	74.8	6.88
	(18 - 64)	175,158	53.2	4.17	28,319	52	57.7	4.59
	(<18)	1,755	7.1	8.00	50,325	NA	NA	NA

As is illustrated younger adult patients in all categories spend significantly less time in the hospital for a given diagnosis. This generally translates in lower overall charges, with the exception being cardiovascular events. The total charges information is used below in our subsequent calculations of COI. It should also be noted that the trends in the survey data are similar to the OSHPD data for the variables selected (age, length of stay). Note that the survey purposely over sampled ages 18 to 64 to obtain sufficient responses for the analysis for this age group, and approximately equal numbers were selected from each of the three diagnosis categories. For adult acute respiratory and cardiovascular admissions, the OSHPD data show about two-thirds are patients aged 65 and over. For chronic respiratory admissions, the adults are split more evenly between the two age groups. The survey sample was split evenly between the age groups for all diagnosis categories. Because the response rate was somewhat higher in the older age group, about 60% of the survey respondents are age 65 and over.

Other Medical Expenses During and Post-Hospitalization

The direct costs of hospitalization are measured by the total charges variable in Table 5.5. There are other medical expenses that the patient incurs both while hospitalized and during the recuperative period. For example, there may be expenses for doctors, prescription drugs, specialized equipment and other miscellaneous items, and some of these expenses may not be covered by insurance. At this time we have no independent estimate of these costs and must therefore rely exclusively on the survey results. This is somewhat problematic since our survey includes only Kaiser Permanente patients, who only need to pay a small amount of co-payments and are not directly responsible for all costs of service. In addition, the survey data reflect only out-of-pocket expenses paid by the respondents and do not include costs covered by Kaiser. Our estimates of these categories therefore probably understate the costs in these categories for non-HMO patients.

The average out-of-pocket costs for doctors' fees, prescriptions, equipment, and other medical services, for both in-hospital and during recuperation are listed in Table 5.6. Three trends emerge from the data presented in the table. First, older patients, those over 65, have higher costs, irrespective of the disease category. Second, patients admitted to the hospital with chronic respiratory disease have the highest incidence of out-of-pocket costs. Third, the values in the table are generally small, relative to hospital charges (see Table 5.5). Of course, these cost categories might be much more significant for non-HMO patients. This proposition cannot be tested with the available survey data.

In addition to the out-of-pocket expenses during the hospitalization and recuperation periods, there are the costs of follow-up visits to doctors and corresponding procedures. Using Kaiser data we calculated the direct cost of follow-up medical care for the six-month period following the hospitalization event. These cost estimates are presented in the final row of Table 5.6. Note that these costs are approximately equal for all diagnosis/age groups. As in the case of medical costs these values represent actual Kaiser Permanente costs rather than hospital/doctor's office charges. The out-of-pocket share of these follow-up costs is only about $20 as Kaiser patients have only a small co-pay for office visits.

Table 5.6. Out-of-Pocket Medical Expenses ($/Hospitalization)

Cost Category	All	Respiratory				Cardiovascular	
		Acute		Chronic			
		(<65)	(>65)	(<65)	(>65)	<65	>65
In-Hospital Fees	58.41	27.56	122.74	39.79	54.64	56.11	59.71
In-Hospital Doctor Fees	5.73	1.57	24.18	3.14	5.00	0.29	3.18
In-Hospital Prescriptions	30.49	9.00	17.10	61.61	47.15	27.25	25.01
In-Hospital Equipment	2.21	0	6.70	0	6.20	0	0.76
In-Hospital Other Fees	10.38	24.18	6.25	6.92	5.82	17.71	3.47
At-Home Doctor Fees	19.75	31.96	5.00	5.71	37.77	4.07	14.90
At-Home Prescriptions	76.28	73.02	65.56	43.68	146.02	37.00	60.98
At-Home Equipment	22.43	2.22	14.85	27.86	52.52	6.92	22.17
At-Home Other Fees	79.37	65.67	0	15.69	162.54	5.38	141.861
Total	*305.05*	*235.18*	*262.38*	*204.40*	*517.66*	*154.73*	*332.04*
Follow-up Doctor's Visits (Kaiser costs)		1222.30	1055.60	1087.70	1005.90	1233.90	1069.80

Lost Earnings

Hospitalization also causes a loss in earnings, which are the product of time missed from paid employment and the foregone wage rate. Consider first the time element. In the survey all respondents were asked their employment status and those employed full-time, part-time, or self-employed were asked the number of days they missed from work during the hospitalization and during the recovery period. Every respondent, regardless of employment status, was asked how many days family and friends missed from work as a result of the patient's hospitalization and recovery period. Table 5.7 presents a summary of the responses to these questions. As is illustrated, time lost from work during at-home recovery periods exceeds time lost from work during the in-hospital time by an approximate five to one ratio. Overall, about 65% of the respondents ages 18 to 64 are employed and work an average of about 40 hours per week, and about 5% of those age 65 and over are employed and work an average of about 25 hours per week. These labor force participation rates are somewhat lower than for the general population in these age groups. We use the survey data on labor force participation for this analysis because it may be more representative of the population that is hospitalized who may have higher than average rates of chronic illness and therefore lower labor force participation.

With regard to the foregone wage rate we utilize estimates from Bureau of Labor Statistics for both the nation and the Pacific Census Division. These are presented in Table 5.8. These values reflect first quarter, 2001 estimates in current dollars for men and women, sixteen years and older, and for private industry versus government service. For verification purposes these values can be compared to the survey results. For the sub-sample of patients who specified that their employment status was either employed full-time, employed part-time, or self-

employed we calculated an average annual pay of $42,448, which converts to an average wage of $21.14/hour ($169.12/day) for the traditional 2080-hour work year.[4] This is significantly higher than the Bureau of Labor Statistics estimate and is likely related to the average age of the survey respondents relative to the Pacific Census Division population. It is also feasible that Kaiser patients have higher incomes than the general population, so we use the California average wage rate for this analysis.

The average employed person has lost earnings equal to the product of the average work days lost to illness (about 30 days on average) multiplied by the average daily wage ($129.3). It should also be noted that this value reflects social cost since the individual is often compensated for some of the in-hospital and at-home recovery time through sick leave provisions in the standard labor agreement. For example, the survey results indicate that, for the average individual, sick pay leave covers approximately one-half of time lost from work while hospitalized, and 17.5 percent of the time lost from work during the at-home recovery days. In addition, respondents report an average of about 3 days lost from work by family and friends because of the respondent's hospitalization and recovery.

Table 5.7 Average Number of Days Lost from Paid Employment

Hospitalization Category		Patient days lost from work for patients who are employed		Family/friends days lost from work for all patients	
		In Hospital	At-Home Recovery	In Hospital	At-Home Recovery
Acute Respiratory	Age 18 to 64	7.0 n = 35	40.3 n = 36	1.9 n = 56	1.4 n = 57
	Age 65 & over	2.4 n = 5	13.5 n = 4	0.8 n = 54	2.5 n = 49
Chronic Respiratory	Age 18 to 64	3.7 n = 33	21.4 n = 33	1.6 n = 54	1.9 n = 52
	Age 65 & over	3.7 n = 3	34.7 n = 3	1.0 n = 69	2.2 n = 64
Cardiovascular	Age 18 to 64	5.1 n = 36	21.2 n = 36	1.9 n = 51	2.7 n = 50
	Age 65 & over	1.3 n = 6	37.0 n = 6	0.7 n = 77	0.9 n = 73

Table 5.8. Estimates of Daily Wage Rates, First Quarter 2001 ($)

	National Daily Wage Rate (Median)	Pacific Census Division Daily Wage Rate (Mean)
Men	$133.00	
Women	$101.60	
Total	*$118.40*	
Private Industry		$122.45
State and Local Government		$150.95
Total		*$129.30*

[4] Respondents answered questions regarding hours worked and wage/salary levels differently, some providing weekly, monthly, or yearly values. In order to insure comparability these disparate values were converted into their annual equivalents.

Table 5.9. In-Hospital and At-Home Recovery Periods (Days)

Category	All	Respiratory				Cardiovascular	
		Acute		Chronic			
		(<65)	(>65)	(<65)	(>65)	<65	>65
In-Hospital (OSHPD data)	5.05	5.55	6.24	4.09	5.12	4.17	4.78
At-Home (survey data)	34.06	34.32	34.03	32.63	43.83	20.02	34.65
Total	*39.11*	*39.87*	*40.27*	*36.72*	*48.95*	*24.19*	*39.43*

Lost Household Production

Similar to lost earnings, lost household production is the product of time or services lost multiplied by the value of these services. Since we have no independent assessment of household time lost due to illness we utilize the survey instrument to determine the relevant time and/or services lost. Table 5.9 shows the average length of stay in the hospital (based on the OSHPD data) and the average at-home recovery time during which patients were unable to do most normal activities, as reported in the survey responses. Older patients, diagnosed with chronic respiratory disease, have the longest at-home recovery periods. In general, younger patients have the shorter recovery times, except for the acute respiratory category.

The survey also asked respondents how much time they normally spend per day doing all kinds of household chores and productive activities. On average, respondents indicated that they spent approximately 6.48 hours/day completing such tasks as childcare (0.76 hours/day), elder care (0.61 hours/day), house cleaning and maintenance (1.82 hours/day), yard work (0.98 hours/day), cooking (1.38 hours/day), and other chores (0.93 hours/day). In addition, respondents indicated that they were unable to perform these chores for an average of 25.67 days following their hospital experience. These figures combine to provide an estimate of approximately 166 hours of lost household production during the post-hospitalization period for each hospitalization event. The average hospitalization would also cause an additional 33 hours of lost household production (5.05 days times 6.48 hours/day), bringing the total to 199 lost hours per hospitalization.

With regard to the value of this lost time, there exist two possible methods to determine the value of the time or services lost: (1) the opportunity cost method; and (2) the replacement cost method. The first of these methods values lost household work at the wage rate of the individual who loses the services. The rationale is that in order for the individual to spend time doing household work rather than working at a paid activity then the household work must be worth at least what the individual could earn at the paid activity. For example, if the individual is willing to sacrifice hours of employment at $20/hour to engage in housework then the opportunity cost of the housework must be at least $20/hour. Thus, the hourly wage rate becomes the value of the household work.

The primary difficulty with the opportunity cost approach is that it ignores the possibility that a third party could perform the household tasks for less than the foregone wage rate. The replacement cost approach attempts to value household services according to the cost of hiring an individual (either a generalist or a specialist) who offers these services in a market. In general, the replacement cost method is recommended for use in court cases involving personal injury (see Fast and Munro, 1994).

Our estimates of the value per hour of lost household production are derived as follows. First, the Canadian courts have consistently ruled that the value of lost household services is the range of 10 – 12 dollars Canadian ($6.92 – $8.66 US). Second, the occupational wage estimates for California (current dollars) are $8.34 for housekeeping cleaners and maids and $9.34 for cooks. For our purposes we selected a value of lost household services of $9.00/hour.

Combining the lost time estimate with the value of lost household services yields an average loss in household production of approximately $1,791 (199 hours at $9.00/hour) per hospitalization. Survey respondents also indicate that they have an average out-of-pocket expense for household production activities equal to approximately $52 per hospitalization.[5]

Lost Leisure Time

Lost leisure opportunities are the product of time or services lost times the value of these services. As in the case of lost household production we have no independent assessment of lost leisure time or services due to illness. Thus, we utilize the survey instrument to determine the relevant time and/or services lost. Survey respondents indicate that they generally spend an average of 2.12 hours per day in physically active recreation. In addition, they indicate an inability to do these activities for an average of 31.3 days after leaving the hospital. In addition, the average hospital stay is 5.05 days.

With regard to the value of the lost leisure services there has been considerable discussion in the literature focused on both the correct theoretical measure and its empirical counterpart. From a theoretical perspective, it was originally believed that the opportunity cost of an hour of leisure was equal to the money wage rate earned by the individual. However, Johnson (1966) demonstrated that the "value of leisure ... time will be less than the money wage rate." This result occurs because individuals like leisure more than working, have a fixed wage rate, cannot adjust hours of work, or some combination of these factors.

Given this theoretical result, the next problem is to determine the appropriate discount from the money wage rate to accurately assess the value of lost leisure opportunities. There have been many studies of the value of time spent not working, although most have been concentrated on determining the value of travel time for planning for urban transportation systems. In this context the consensus is that people value travel time in the region of 20 – 60% of their gross wage rate (Bruzelis, 1979; Small, 1992). Consequently, we use 50% of the gross wage rate for evaluating lost leisure time.

Combining the lost time estimate with the value of lost recreation services yields an average loss of approximately $622 - $814 per hospitalization.

5.3 SUMMARY: THE COST-OF-ILLNESS FOR HOSPITALIZATIONS

In Table 5.10 we summarize our cost-of-illness estimates for the typical patient for each of our sub-groups as defined by diagnosis and age. The total costs cover time in the hospital and at-home recovery. The totals are also shown per hospital day in the bottom row to allow scaling of the costs to readily available hospital length of stay data. Hospital charges represent about 75% of total costs for both respiratory categories and about 85% of total costs for the cardiovascular categories. Kaiser's hospital costs for comparable lengths of stay are about $10,000 lower for every category. We have reason to expect that the hospital charges somewhat overstate actual costs and the Kaiser estimates understate actual costs, so true costs are somewhere in between.

Several aspects of the totals are worth noting. First, the total costs range from a low of approximately $4,400/day (acute respiratory for patients older than 65) to $8,100/day (cardiovascular patients younger than 65). Second, lost earnings and lost recreation, which are

[5]This value is added to the total cost of hospitalization despite some concern regarding double counting or overlap with lost household production. Since the survey question referred to tasks normally done by the individual, this could imply that these out-of-pocket expenses are included in lost production. These costs are quite small relative to lost household production so any error is likely insignificant.

affected by the wage rate, are calculated using the of the Pacific Census Region estimate ($129.30/day). Third, the out-of-pocket charge category is an underestimate due to lack of data from non-HMO patients. Fourth, lost earnings are adjusted for the labor force participation rate of the survey (by age/diagnosis group) and for hours/day generally worked.

Of course, the figures in Table 5.10 represent losses to society and hence are indicative of social cost-of-illness rather that individual cost-of-illness. And as is evident the total costs are dominated by cost categories (hospital charges, lost earnings) that are not generally paid by the individual patient. In the vast majority of cases the individual pays only a small fraction of these cost categories due to insurance and sick pay. Further, if the individual does not work (e.g., retired) then the lost earnings are not experienced. This is generally the case for older patients. Thus, for an insured, non-working individual the cost-of-illness would include only out-of-pocket medical charges, lost household production, miscellaneous services expenses, and lost recreation. For a young adult (<65 years old) patient hospitalized for an acute respiratory episode, for example, the average total costs incurred directly by that patient would be $3,742 or approximately $680/day in the hospital. This figure represents approximately ten percent of the total social cost-of-illness.

Table 5.10. Summary Estimates of Cost-of-Illness for Hospitalizations ($)

Cost Category	Respiratory				Cardiovascular	
	Acute		Chronic			
	(<65)	(>65)	(<65)	(>65)	<65	>65
Total Hospital Charges[a]	22,587	22,616	14,843	17,952	28,318	26,932
Out-of-Pocket Medical Expenses[b]	235.18	262.38	204.40	517.66	154.73	332.04
Lost Earnings for Patients[c]	3,092.6	390.5	2,753.4	158.2	2,220.4	191.2
Lost Earnings for Family/Friends[d]	426.7	426.7	452.6	413.8	594.8	206.9
Lost Household Production[e]	2,669.43	2,084.61	835.91	2,551.68	885.71	1,528.23
Out-of-Pocket Services Expenses[f]	237.55	226.74	82.61	224.52	16.8	85.20
Post-Hospitalization Doctors' Visits	1222.3	1055.6	1087.7	1005.9	1233.9	1069.8
Lost Recreation Value[g]	599.47	599.66	298.52	924.71	504.96	702.21
Total Costs	*31,071.8*	*27,659.9*	*20,557.7*	*23,747.2*	*33,929.0*	*31,046.1*
Length of Stay	*5.55*	*6.24*	*4.09*	*5.12*	*4.17*	*4.78*
Cost/Day	*5,598.5*	*4,432.7*	*5,026.3*	*4,638.1*	*8,136.5*	*6,495.0*

[a]Derived from OSHPD Data

[b]Survey data, includes costs for out-of-pocket hospital fees, doctor's fees, prescription medicines, medical equipment, home nursing care and other, during the time in the hospital and at-home recovery.

[c]Calculated as lost hours of work due to hospitalization and recovery (survey data) and the CA average wage rate, adjusted for labor force participation (survey data).

[d]Calculated as lost days from work for family and friends (survey data) and the CA average wage rate.

[e]Survey data, out-of-pocket expenses necessitated by inability to do childcare, elder care, house cleaning and maintenance, yard work and gardening, shopping, cooking, and other, during the time in the hospital and at-home recovery.

[f]Survey data, includes costs for out-of-pocket child or elder care, housecleaning and maintenance, yard work and gardening, meal preparation, and other.

[g]Survey data, includes losses due to inability to participate in recreation activities.

Chapter 6

WILLINGNESS TO PAY: SURVEY RESULTS

6.1 RESPONSE TO WTP INTRODUCTION

The final sections of the questionnaire focused on the value to respondents of preventing a potential future hospitalization event. In Question 23 respondents were asked to rate how bothersome various aspects of their previous hospitalization had been for them and their families. For each potential impact they were also given the option to say that it did not apply to them. Table 6.1 gives a summary of the responses. The highest rated impacts were physical pain and discomfort and emotional distress and anxiety. Next highest were lost time from recreational and household activities. Last were the out-of-pocket expenses and lost time from work. About 43% of respondents said that out-of-pocket expenses were not at all bothersome and 14% said they did not apply to them. About half of those for whom lost work time was relevant said that this impact was not at all bothersome. Thus, the financial impact of hospitalization for the patients seems to be a small concern relative to the other impacts. However, this is a group of patients with good health insurance coverage for hospitalization expenses so these findings should be interpreted in that context.

Table 6.1. Impacts of Hospitalization (Q23)

Impacts to You and Your Family	Not at all bothersome (1)	A little bothersome (2)	Moderately bothersome (3)	Very bothersome (4)	Extremely bothersome (5)	Mean	N.A.
Out-of-pocket expenses	165 (43%)	71 (18%)	48 (12%)	36 (9%)	11 (3%)	1.96	54 (14%)
Lost time from paid work or school	113 (29%)	30 (8%)	35 (9%)	22 (6%)	29 (7%)	2.23	159 (41%)
Lost time from household chores and activities	85 (21%)	105 (27%)	100 (26%)	42 (11%)	20 (5%)	2.47	42 (11%)
Lost ability for physically active recreation activities	60 (15%)	101 (26%)	102 (26%)	52 (13%)	44 (11%)	2.77	32 (8%)
Physical pain and discomfort	57 (15%)	93 (24%)	92 (24%)	83 (21%)	49 (13%)	2.93	14 (4%)
Emotional distress and anxiety	34 (9%)	88 (23%)	76 (19%)	97 (25%)	81 (21%)	3.27	14 (4%)

Question 24 introduced the idea of reducing or preventing a potential future 10-day hospitalization. Responses about the importance of preventing or reducing future illness events that would require hospitalization are summarized in Table 6.2. A large majority (94%) said that it would be very or extremely important to prevent this, and significant majorities (about 65%) said it would be very or extremely important to shorten the hospital stay and the at-home recovery time.

Table 6.2. If you were facing a hospital stay of 10 days and an at-home recovery of 10 days, how important to you, if at all, would it be to: (Q24)

	Not at all important (1)	A little important (2)	Moderately important (3)	Very important (4)	Extremely important (5)	Mean
Prevent this illness event from happening	3 1%	5 1%	20 5%	133 34%	232 60%	4.49
If you are hospitalized again, reduce the length of hospital stay by one-half	34 9%	39 10%	73 19%	121 31%	120 31%	3.66
If you are hospitalized again, reduce the at-home recovery time by one-half	28 7%	35 9%	69 18%	127 33%	126 33%	3.75

The next question introduced various levels of cost for reducing or preventing hospitalization. The purpose was to introduce the concept that respondents might incur costs themselves and to provide a way to help evaluate the realism of subsequent responses to WTP questions. This "hardship" question also serves to focus respondents on their budget constraints by asking them to think about how difficult it would be to pay various dollar amounts. As expected, levels of hardship increased with the dollar amount. At $50 about 81% of respondents said there would be no hardship or just a small hardship. At $1,000 about 54% of respondents said the hardship would be great, and at $3,000 about 77% of respondents said the hardship would be great.

Table 6.3. How much hardship would it cause if you had to pay more each year? (Q25)

	$50	$150[a]	$500[a]	$1000	$3000
No hardship	64%	38%	13%	7%	4%
Small hardship	17%	23%	13%	6%	3%
Some hardship	8%	18%	21%	11%	5%
Moderate hardship	6%	9%	22%	23%	11%
Great hardship	5%	11%	30%	54%	77%

[a] Thirteen respondents who completed the pre-test survey were not asked this dollar amount

After the series of WTP questions, respondents were asked the extent to which they agreed or disagreed with a list of statements. These questions were asked to help ascertain the degree to which the respondents accepted or not the premises of the WTP questions, and were comfortable with their answers. Table 6.4 summarizes the responses. Most striking is that a vast majority (86%) of respondent said they agreed either somewhat or strongly that their health insurance should pay for any program to reduce their chances of future hospitalizations. This raises some questions about the extent to which respondents accepted the premises of the WTP questions that they would have to pay from their own pocket. On the other hand 49% said they somewhat or strongly agreed that they were able to accurately answer the questions as if they would have to pay from their own pockets. There was also fairly strong agreement (64%) with the statement that they could not afford to pay more for health care regardless of the benefit.

Table 6.4. Responses to Valuation Follow-Up Questions (Q33)

	Strongly disagree (0)	Somewhat disagree (1)	Neither agree nor disagree (2)	Somewhat agree (3)	Strongly agree (4)	Mean
A. I think my health insurance should pay for any new approaches that might reduce future illness events.	4 1%	13 3%	38 10%	85 22%	254 64%	3.44
B. My answers accurately reflect what I would prefer if I did have to pay out-of-pocket.	30 8%	17 5%	135 38%	74 21%	100 28%	2.50
C. I am willing to spend more on health care if it prevents or shortens a future illness event.	53 14%	45 12%	69 18%	135 35%	85 22%	2.39
D. I don't believe there are any new approaches that would prevent or shorten a future illness event.	90 23%	71 18%	84 22%	62 16%	78 20%	1.92
E. I can't afford to pay anything more than I currently pay for health care no matter what the benefit.	26 7%	66 17%	45 11%	84 21%	172 43%	2.78
F. I was thinking that the new approaches would give me other benefits in addition to preventing hospitalization and this affected my answers.	27 7%	21 6%	132 36%	94 26%	91 25%	2.51

6.2 OPEN-ENDED WTP RESPONSES AND FOLLOW-UP QUESTIONS

Question 32 asked an open-ended WTP to avoid a future illness episode that would require hospitalization. The number of hospital days and at-home recovery days varied according to the version of the survey. Each respondent was asked to assume that the cause of the illness would be the same as their previous hospitalization.

Sometimes respondents refuse to answer direct WTP questions. Others say they would be willing to pay nothing, but they are really objecting to the premises of the question rather than stating a true zero value for the good or service in question. About 13% of the respondents did not give an answer to the open-ended WTP question. This is a fairly high non-response rate, suggesting some respondents may have had concerns about the premises of the question. The strongest concern seems to be that their insurance should pay for any new health program. On the whole, respondents said that they thought it was important to reduce the chances of a future hospitalization, so the high non-response rate more likely reflects problems with the payment mechanism rather than low value for the good.

About 33% of respondents wrote $0 as the amount they would be willing to pay. This is also surprisingly high given the percentages of respondents who said is was very or extremely important to prevent future hospitalization and is more evidence of concerns with the payment mechanism. We evaluated the $0 WTP responses to determine if any should be interpreted as protest responses rather than true $0 value for the good. First, if the respondent strongly agreed with the statement that they could not afford to pay any more for health care regardless of the benefit, we kept their $0 response as reasonable. Of the remaining $0 responses, we interpreted them as protests if they agreed with the statement that their insurance should pay and if they had said it was very or extremely important to them to reduce chances of future hospitalization. These were dropped from the analysis of the open-ended WTP on the assumption that the $0 WTP response was a protest answer. The numbers of respondents not included in the open-ended WTP analysis, and each of the reasons they are not included, are listed in Table 6.5. In the end we have about 18% excluded, 28% $0 WTP retained in the analysis, and 54% WTP responses greater than $0.

Table 6.5. Open-Ended WTP Response Evaluation

Category	Retained for Analysis	Dropped from Analysis
No response		53
$0 WTP	113	17
Highest WTP ($1,000,000)		1

Table 6.6 gives a summary of the open-ended WTP responses. The mean value overall is $770. This is for preventing an illness event with various lengths of stay in the hospital (ranging from 1 to 10 days) and various lengths of at-home recovery (ranging from 0 to 10 days). Sorted by the number of hospital days, the mean WTP responses range from about $400 to about $950. The mean WTP per hospital day is about $260. The mean WTP values do not increase in proportion to the number of hospital days prevented, but the sample sizes are quite small when respondents are subdivided. This issue is further explored in the statistical analysis of the open-ended responses presented in the next section.

Table 6.6. Willingness to Pay Out of Own Pocket to Prevent this Illness Event (Q32)

	N	Mean	Median	Std Dev	Min	Max
Total WTP	326	$770	$200	$2,389	$0	$25,000
WTP:						
1 hospital day	67	$590	$200	$1,015	$0	$5,000
2 hospital days	68	$412	$75	$1,248	$0	$10,000
5 hospital days	128	$965	$350	$2,797	$0	$25,000
10 hospital days	63	$952	$200	$3,374	$0	$25,000
WTP per day of hospitalization	326	$259	$50	$678	$0	$5,000

Table 6.7 shows various groupings of respondents according the how they answered the WTP questions and gives the averages of some selected attitude responses for each group. The importance of preventing the illness event was rated high across all the groups, and slightly higher for those who did not answer the open-ended WTP question or were judged to have provided a protest $0 response. Agreement that insurance should pay was highest among the $0 WTP protesters but was also high in the valid $0 group and in the group that always chose the lowest cost option in the choice question. Agreement with being willing to pay to reduce illness was highest for those who always chose the shortest hospital stay (highest cost option) in the choice questions.

Table 6.7. Attitudes toward Payment by WTP Group

WTP group	N	Q24a Importance of preventing illness (1 to 5 scale)	Q33a Agreement that insurance should pay (0 to 4 scale)	Q33c Agreement that willing to spend more to reduce illness (0 to 4 scale)	Q33e Agreement that can't afford to pay more (0 to 4 scale)
Refused	52	4.6	3.3	2.8	2.5
Dropped as protests [a]	18	4.7	3.9	1.9	2.3
Valid zero bid	113	4.4	3.6	1.8	3.6
Non-zero WTP	213	4.5	3.4	2.7	2.4
Always chose lowest cost	155	4.4	3.7	1.9	3.3
Always chose fewest days in hospital	25	4.6	2.9	3.3	1.5

a Protest-zeros (17), and 1 bid of $1,000,000 were dropped

6.3 STATISTICAL ANALYSIS OF OPEN-ENDED WTP RESPONSES

Table 6.8 shows the summary statistics for the independent variables used in the analysis of the open-ended WTP answers and in the choice question answers presented in the next section.

Table 6.8. Summary Statistics for Analysis Variables

Variable	Mean	Std. Dev.	Min.	Max.	N
Education (years of education)	14.2	2.75	10	20	397
Female (male = 0; female = 1)	0.51	0.50	0	1	397
Age (years)	65.3	13.2	18	94	397
Don't believe program (0 = completely disagree, 4 = completely agree)	1.91	1.45	0	4	385
Insurance should pay (0 = completely disagree, 4 = completely agree)	3.45	0.87	0	4	394
Could answer (0 = completely disagree, 4 = completely agree)	2.55	1.19	0	4	356
Hospitalization associated with a chronic illness with activity restriction (yes = 1)	0.44	0.50	0	1	397
Household income (2001)(1,000 dollars)	$43.7	$34.3	$5.0	$165.0	370

Note: For the statistical analysis missing values of explanatory variable were replaced. Missing agreement/disagreement variables were given a value of 2 to make them neutral to the statements. Missing household income(there were 27 missing) was estimated based on education, employment status, and number of adults in the household.

Table 6.9 shows the ordinary least squares (OLS) regression results for the open-ended WTP responses. The simple model with just the number of hospital days and the number of at-home days shows low explanatory power. Model 2 incorporates the number of hospital days as four dummy variables, which allows the value per day to vary with the number of days in the hospital. Models 3 and 4 add several socioeconomic and survey effect variables, and explanatory power of the models is increased. Several specifications for age including linear, nonlinear, and dummy variable for age 65 and over were considered. None were statistically significant. Other

potential explanatory variables that were considered and found to be not significant were the ratings for pain and discomfort and for anxiety and distress.

Table 6.9. OLS Regressions on WTP (standard error in parentheses)

	Model 1: Simple model with hospital days continuous	Model 2: Simple model with hospital days categorical	Model 3: Full with hospital days continuous	Model 4: Full with hospital days categorical
Number of Observations	326	326	326	326
Adjusted R-Squared	0.09	0.09	0.16	0.15
Intercept	na [a]	na [a]	-1120.18 (942.70)	-1091.90 (957.04)
Hospital days	105.05 *** (31.50)		68.28* (39.51)	
1 hospital day (dummy)		591.04** (291.82)		
2 hospital days (dummy)		412.21 (289.67)		77.83 (384.71)
5 hospital days (dummy)		965.31*** (211.13)		491.23 (335.79)
10 hospital days (dummy)		951.86*** (300.94)		576.56 (395.27)
At-home recovery days	41.12 (29.23)			
Hospitalization due to chronic illness			479.79* (250.45)	473.23* (251.83)
Household income ('000s)			19.05*** (4.07)	19.14*** (4.08)
Female			-213.80 (248.25)	-199.85 (250.51)
Education			105.95** (50.47)	102.50** (50.76)
Insurance should pay			-248.86* (146.03)	-251.03* (146.57)
Don't believe program			-176.82* (89.89)	-178.90** (90.25)
Could answer			143.40 (108.02)	148.06 (108.39)

*, **, and *** indicate significance at 10%, 5%, and 1% respectively

Note: for the simple models no intercept is estimated on the assumption that WTP avoiding illness episode is zero when there is no illness episode.

Household income, level of schooling completed, and whether the hospitalization was related to an ongoing illness that causes day-to-day activity restriction were all statistically significant. Agreement with not believing a program could prevent future hospitalization (i.e., skepticism about the hypothetical good) was also significant.

Models 1 and 2 differ in how the number of hospital days is treated. Model 1 is a simple linear specification and shows a statistically significant coefficient that implies an average WTP per hospital day of about $105. Several nonlinear specifications were explored because it is expected that there may be a premium for preventing any episode at all and then some additional but smaller value for preventing additional days. We did not find strong statistical significance

with these alternatives. Model 2 shows results for simple dummy variables for 1-day, 2-day, 5-day, and 10-day hospitalizations. All the coefficients are statistically significant except for the 2-day hospitalization. The magnitudes of the 1-day and 2-day coefficients are similar, implying that preventing a 1 to 2 day hospitalization has a value of about $500. The coefficients for the 5-day and 10-day hospitalizations are substantially higher but similar to each other. The 5-day coefficient implies a value per day of about $200 and the 10-day coefficient implies a value of about $100 per day for preventing these hospitalizations.

In all of the models tested the number of days of at-home recovery was not statistically significant, and the size of the coefficient was very small. The variable was dropped from the final full models. This result implies that respondents were focused on the number of days in the hospital and paid little attention to the associated number of days of at-home recovery. This may simply reflect their preferences and indicate that what matters to them is the length of stay in the hospital. As we know from the responses to the previous questions about their hospitalization experience, the average at-home recovery period is somewhat longer than the average hospitalization. Respondents may be treating this as a package event rather than two separable variables. This should not be interpreted as meaning that at-home recovery days have no utility loss.

Table 6.10 shows regression results for number of days the patient was unable to do most household chores, which is one way to measure the length of at-home recovery. These are based on the respondents' experiences with their previous hospitalization. We look at this because it may be that respondents consider this a package rather than two separate variables. The results show a statistically significant intercept of about 15 days, which could be interpreted as the average at-home recovery for a one-day hospitalization. Each additional day in the hospital is associated with an additional 0.5 day of at-home recovery, although this coefficient is not statistically significant. Respondents who report that they have not yet returned to their pre-hospitalization level of activity (13% of respondents) are associated with an average of about 77 more days of at-home recovery. The average number of days respondents were unable to do most of their usual activities after their discharge from the hospital was 17 days for those who had returned to most normal activities at the time of the survey, and was 93 days for those who had not. This suggests a wide variation in the number of days for recovery at home, and that the numbers used in the WTP questions may have been unrealistically low for many respondents.

Table 6.10. Regression Results for Number of Days Unable to do Household Chores

	Coefficient (standard error)
Intercept	15.08*** (3.71)
Number of days in the hospital	0.53 (0.35)
Not yet returned to previous activities	76.7883*** (9.51)
number of observations: 335	
adjusted R^2: 0.17	
F = 35.47	

Table 6.11 shows the results of analyzing the open-ended WTP questions using a Tobit model with specifications of explanatory variables similar to those used in the OLS models. A Tobit model was also used to analyze the WTP data because they were left-censored at zero (about 30% of the WTP responses are zero). Tobit regressions account for the censoring at zero of the WTP values, improving the model's ability to produce unbiased estimates (Kmenta, 1986). Thus, the Tobit model accounts for the fairly high percentages of $0 responses included in the dependent variable. The Tobit model estimates the likelihood a respondent gives $0 response as well as the effect of independent variables on the magnitude of the nonzero responses.

Table 6.11. Tobit Regressions on WTP (standard error in parentheses)

	Model 5: Simple model with hospital days continuous	Model 6: Full model with hospital days continuous	Model 7: Full model with hospital days categorical	Model 8: Full model weighted for "could answer" hospital days continuous
Number of observations	326	326	326	326
Log-likelihood	-2092.86	-2053.11	-2052.46	-2070.05
Intercept chi square	2.55			
Pr>ChiSq-Intercept	0.110			
Weight				CLDANSW_ADJ
Intercept		-2816.50**	-2728.17**	-2879.46**
		(1250.20)	(1265.90)	(1379.59)
Hospital days	21.76	118.20**		121.93**
	(43.67)	(53.47)		(56.63)
2 hospital days (dummy)			48.77	
			(530.97)	
5 hospital days (dummy)			797.72*	
			(454.90)	
10 hospital days (dummy)			975.56*	
			(534.10)	
At-home recovery days	-12.29			
	(40.35)			
Hospitalization due to chronic illness		613.69*	605.83*	674.41*
		(339.68)	(339.41)	(363.07)
Household income ('000s)		24.71***	24.83***	25.33***
		(5.35)	(5.35)	(5.61)
Female		-312.29	-305.71	-265.59
		(334.39)	(336.90)	(359.26)
Education		185.83***	180.19***	210.56***
		(67.00)	(67.09)	(72.56)
Insurance should pay		-373.45**	-373.96**	-418.62**
		(193.38)	(193.49)	(205.52)
Don't believe program		-385.21***	-388.51***	-441.27***
		(121.63)	(121.84)	(130.19)
Could answer		155.73	162.43	87.35
		(151.71)	(151.55)	(183.74)
Scale	3090.59	2727.14	2720.91	2926.81
	(153.48)	(134.05)	(133.72)	(144.15)

*, **, and *** indicate significance at 10%, 5%, and 1% respectively

The full model with a continuous hospital days variable (Model 6) shows a significant result for the number of hospital days, with an average value per day of about $118. The full model with categorical hospital days variables (Model 7) produced larger and more statistically significant coefficients for the 5-day and the 10-day variables than in the comparable OLS model. The coefficients imply that preventing a 5-day hospitalization is valued at about $800 more than preventing a 1-day hospitalization, and preventing a 10-day is valued about $1,000 more than preventing a 1-day. These imply average values per day of $200 and $100, respectively, for the additional days prevented. Days at home remain not significant in all the Tobit models and were dropped from the final models. The socioeconomic and survey instrument variables show generally similar results as in the OLS models, but with somewhat larger coefficients and greater statistical significance. The weighted model (Model 8) adjusts for the answers to the "could answer" variable to account for the fact that some respondents struggle

more with the premises of the question than others. The results of this model suggest a slightly higher average WTP per day of $122.

Table 6.12 lists mean WTP values per day in the hospital implied by the OLS model results for various numbers of hospital days under various assumptions. The OLS model allows a straightforward calculation of mean WTP for a 1-day hospitalization by using mean values for all variables and setting the 2-day, 5-day and 10-day dummy variables to zero. The result is a mean value of about $591 for preventing a 1-day hospitalization. For two days in the hospital, the average WTP value for preventing the hospitalization is about $206 per day. For five days and ten days it is $193 and $95, respectively. The result for preventing a 1-day hospitalization when all the socioeconomic and survey response variables are set at their mean values is $457. The Tobit model does not provide a simple way to determine the mean value for a 1-day hospitalization, but average implied values averaged across all days are about $200 per day. Thus, for a 5-day hospitalization both models imply about the same WTP value per day at about $200 per day, or about $1,000 for the episode. If we start with the base value of about $500 for preventing a 1-day hospitalization and add the result from the Tobit model for the additional value of preventing a 5-day hospitalization, we get a total value for preventing a 5-day hospitalization of about $1,300.

Table 6.12. Average WTP Results per Hospital Episode based on Open-Ended Responses

	Mean OLS results (Model 2)		Mean OLS results (Model 4)	Mean OLS results (Model 4) adjusted for scenario rejection	
	Per episode	Per Hospital Day		Moderate adjustment	Maximum adjustment
1 hospital day	$591	$591	$457	$1,308	$1,886
2 hospital days	$412	$206	$535	$1,386	$1,964
5 hospital days	$965	$193	$948	$1,800	$2,378
10 hospital days	$952	$95	$1,034	$1,885	$2,463

The last three independent variables in the open-ended WTP models reflect attitudes related to the premises of the hypothetical valuation questions and the results suggest that there is substantial downward bias in the WTP responses. Agreement with the statement that insurance should pay (Q33a) and agreement with the statement of not believing a program could prevent future hospitalization (Q33d) both have substantial negative coefficients, both of which are larger and more statistically significant in the Tobit model results. Agreement with these statements reflects some amount of rejection of the premises of the WTP scenario. Agreement with the statement that the respondent could answer the questions as if they had to pay for the program themselves (Q33b) was associated with higher WTP responses. The net effect of these three scenario rejection/acceptance variables at the mean values for the sample is to lower mean WTP values by about $800 based on the OLS results and by about $1,600 based on the Tobit results.

The coefficients on these three variables allow us to make some adjustments to see what mean WTP values would be if there was less scenario rejection. The results are show in Table 6.12 based on the OLS Model 4 results using mean values for all the other variables but adjusting the values for the three scenario variables. The moderate adjustment sets the insurance and the don't believe variables to a value of 1, which means somewhat disagree with the rejection statements, and sets the value for could answer to 3, which means somewhat agree with the could answer statement. At these values the WTP estimate for a 5-day hospital stay is about $1,800. If we use the Tobit Model 7 results for the incremental value of 5-day and 10-day hospitalizations over a 1-day hospitalization, with the moderate adjustment for scenario rejections, we obtain mean WTP values of around $2,100 for preventing a 5-day hospitalization and $2,700 for preventing a 10-day hospitalization. If we set the two payment vehicle rejection variables to zero,

which means strong disagreement, and set the could answer variable to 4, which means strong agreement, the mean WTP value for a 1 to 2-day hospitalization increases to about $1,900.

6.4 Statistical Analysis of Choice Responses

Table 6.13 shows the results of the choice models estimated as described in Chapter 3 using a logistic specification. In the simplest model that includes only the choice attributes, all the variables are statistically significant. The coefficients on the number of days in the hospital and on program costs are of the expected signs and imply an average WTP value per hospital day of about $49. The sign on the coefficient for the number of days at home is the wrong sign, suggesting a preference for more days of at home recovery rather than less. It may be that respondents focused only on the number of days in the hospital and on the costs, as indicated by the results of the open-ended WTP questions. When the number of days at home is dropped from the model, the average WTP value per day remains about $44.

Table 6.13. Choice Model Results (standard error in parentheses)

	Model 1	Model 2	Model 3
Mean Log Likelihood	-0.633250	-0.638791	-0.621240
Number of Observations	2189	2189	2189
Hospital days	-35.10 ***	-42.39 ***	-0.54
	(11.25)	(11.13)	(7.65)
At-home days	48.28 ***		
	(9.87)		
Program cost	0.72 ***	0.96 ***	1.00 ***
	(0.09)	(0.08)	(0.08)
Education x Hosp			-14.89 ***
			(2.23)
Female x Hosp			-8.37
			(17.90)
Chronic x Hosp			14.34
			(17.97)
Don't believe the program x Hosp			32.68 ***
			(6.40)
Insurance should pay x Hosp			34.35 ***
			(9.21)
Could answer x Hosp			-5.71
			(7.47)
Mean estimated WTP for avoiding one hospital day	$49.05	$44.02	$43.15 [a]
95% WTP Confidence Interval	$20.90	$22.98	$22.93
	$74.03	$62.09	$60.96

[a] Estimated using the mean values for the socio-demographic and scenario reaction variables.
*, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

Socioeconomic variables and survey response variables are added by interacting them with the number of hospital days in Model 3. The variables that were strongest at explaining the open-ended WTP responses, education and scenario rejection, are also statistically significant in the choice model. Having the hospitalization related to a chronic illness was not statistically significant in the choice model. Household income is not included in the choice model. To do so requires an adjustment to the marginal utility of money, which could be considered in future efforts. This may have caused the stronger result for education, which is correlated with income in the sample.

The mean WTP values per day based on the choice models and the mean values of the explanatory variables are low compared to the results of the open-ended WTP analysis. There

may have been considerable protest responses to the choice questions, but these were not identified and excluded as was done with the open-ended WTP analysis. For example all of the respondents who refused to answer the open-ended WTP question were included in the choice question analysis. Also, as noted earlier, about 40% of respondents always chose the option with the lowest cost. When the survey rejection variables are set equal to zero, mean WTP values per day in the hospital based on the Model 3 results increase to about $200.

6.5 WTP CONCLUSIONS

There seems to be significant downward bias in the WTP responses because many respondents believe that their insurance should pay for any program to prevent or reduce future hospitalizations, and they were reluctant to imply that they were willing to pay from their own pockets. However, they expressed strong preferences regarding the importance of preventing or reducing future hospitalizations.

Several aspects of the WTP responses are consistent with expectations. The values show a statistically significant association with the number of days in the hospital. There appears to be a substantial premium to prevent any episode, but the value increases with the number of days, especially for the 5-day and 10-day hospitalizations. Household income shows a strong relationship with WTP values, with an elasticity of WTP with respect to income of about 1.0. If the hospitalization is associated with a chronic illness that is severe enough to be causing restrictions in the patient's day-to-day activities, this is associated with higher WTP to prevent the hospitalization episode. The level of education is also associated positively with WTP. We found no relationship between age and WTP.

We have more confidence in the WTP estimates based on the open-ended WTP question than on the choice questions because some of those respondents who objected most strongly to the hypothetical payment mechanism were identified and excluded, and because it is possible to adjust quantitatively for the effects of scenario rejection on the mean WTP values. The mean WTP values for the sample to prevent a 1 to 2 day hospitalization were about $500. For a 5-day hospitalization, the mean WTP value was about $1,000. Making the moderate adjustment for the estimated effect of objections to the payment mechanism increases the WTP for a 1 to 2 day hospitalization to about $1,300, and increases the mean WTP value for preventing a 5-day episode to about $1,800. Using the results that adjust for the high share of $0 WTP responses (Tobit Model 7) and the moderate adjustment for scenario rejection puts the mean WTP for preventing a 5-day hospitalization at about $2,100.

The effect of attitudes regarding the valuation scenario on the WTP estimates is clearly substantial, suggesting that the results should be viewed with some caution. This is problematic for this type of estimation approach because payment mechanisms other than health care programs are not as realistic or not as effective at keeping the respondent focused on values for their own health outcomes. The use of choice questions rather than direct WTP questions does not appear to alleviate this problem at all. Some approach is needed to identify and statistically adjust for those who may be answering the choice questions in ways that do not reflect their actual preferences for the good, but rather reflecting reactions to the payment mechanism or other aspect of the valuation scenario.

Finally, the range of values for the WTP estimates suggest that income constraints are a significant factor for many respondents relative to their strength of preferences regarding prevention of hospitalization episodes. About half of respondents said that paying $1,000 to prevent a hospitalization would impose a "great" hardship. This suggests that it may be preferable to define the good in a probabilistic way rather than in terms of prevention with absolute certainty. For example, WTP could be based on reducing chances of a future hospitalization by 10%. This would make the questions more realistic in terms of public policy choices, but such an approach also presents challenges for respondents.

Chapter 7

SUMMARY AND CONCLUDING REMARKS

7.1 SUMMARY

The intent of this project was to develop more complete cost-of-illness (COI) and willingness-to-pay (WTP) values for preventing respiratory and cardiovascular hospitalizations, the types of hospitalization episodes that have been associated with air pollution exposure. This was done by compiling detailed COI information from Kaiser Permanente and other sources, and with a survey of Kaiser Permanente patients who have been recently hospitalized.

Total societal WTP to prevent hospitalizations was estimated using the following methodology. First, we estimated individual and societal COI, which consists of the value of lost productivity, medical expenditures, and other out-of-pocket costs. This was done using data from Kaiser Permanente, from the existing COI literature, and from a survey of Kaiser Permanente patients who had been hospitalized within the past year. As summarized in Table 7.1 our estimates of total societal COI range from range from $4,400 to $8,100 per hospital day, depending on the diagnosis category.[6] Note that we have used the average length of stay for all non-HMO hospitals in California in these calculations. In addition, the lost earnings and imputed activity losses are relevant to the hospital stay; that is, we first calculate the lost earnings and activity losses for the entire hospitalization and recovery period then divide by the average length of stay in the hospital. These social COI values are dominated by direct medical costs while in the hospital, which account for about 75% to 85% of total COI. It should also be noted that recovery times are generally 5 – 7 times longer than the corresponding hospital time. Finally, these values, while representing our best COI estimates, could be somewhat overstated because the medical costs are based on hospital charges and actual payments are usually somewhat discounted from the original charges or understated since out-of-pocket expenses are for Kaiser Permanente patients only and we ignore any costs prior to the hospitalization episode (i.e., precursor costs).

Table 7.1. Summary Estimates of Total Social Cost/Hospital Day ($)

	Respiratory				Cardiovascular	
	Acute		Chronic			
	(<65)	(>65)	(<65)	(>65)	<65	>65
Medical Costs (hospital charges)	4,070	3,624	3,629	3,506	6,791	5,634
Out-of-Pocket Medical Expenses	42	42	50	101	37	69
Lost Earnings (patient and family)	634	131	784	112	675	83
Lost Household Production	481	334	204	498	212	320
Out-of-Pocket Services Expenses	42	36	20	44	4	18
Post-Hospitalization Medical Costs	220	169	266	196	296	224
Lost Recreation Value	108	96	73	181	121	147
Total Daily Costs	*5,599*	*4,432*	*5,027*	*4,638*	*8,137*	*6,495*
Length of Stay	*5.55*	*6.24*	*4.09*	*5.12*	*4.17*	*4.78*

[6] We present only point estimates. Each category specific value is the mean of a sample, which has an associated standard deviation. A theoretically correct confidence interval for the sum of the mean values would require an analysis of the joint variation across all cost categories. This is beyond the scope of this project.

As illustrated in Table 7.2, individual COI estimates are much smaller than social COI since most individuals have both health insurance and sick leave --- generally, less than three percent of hospitalizations are paid for by the patient. The individual COI estimates in Table 7.2 assume an insured individual with sick leave. Thus, for a typical 5-day stay in the hospital, the associated value of lost time for activities and out-of-pocket expenses are about $2,700 for the period of time in the hospital and the recovery time. The predominant portion of this total is the imputed value of lost household productivity and recreation activity. Out-of-pocket costs are generally quite small, implying that insurance coverage is quite extensive. These are based on out-of-pocket expenses reported by Kaiser patients. Out-of-pocket medical costs are likely to be somewhat higher for non-HMO patients, although most insurance programs cover a large share of hospitalization costs. The household productivity and recreation activity losses are quite significant both in terms of time and associated monetary value. To determine the total society cost of a hospitalization, these costs to the patient should be added to the medical costs covered by insurance and income losses covered by paid sick leave.

Table 7.2. Summary Estimates of Individual Cost/Day for Hospitalizations ($)

	Respiratory				Cardiovascular	
	Acute		Chronic			
	(<65)	(>65)	(<65)	(>65)	<65	>65
Out-of-Pocket Medical Expenses	42	42	50	101	37	69
Lost Household Production	481	334	204	498	212	320
Out-of-Pocket Services Expenses	42	36	20	44	4	18
Lost Recreation Value	108	96	73	181	121	147
Total Individual Costs per Hospital Day	*673*	*508*	*347*	*824*	*374*	*554*
Total Individual Costs per 5-day Hospitalization	*3,365*	*2,540*	*1,735*	*4,120*	*1,870*	*2,770*

Second, we utilized the survey to obtain a monetary value on the individual WTP to prevent hospitalization. Standard stated preference techniques were employed. After the data were entered and checked, the analysis of the data was conducted. The first step in the analysis process was to review responses, identify any areas of particular interest or concern, and, in some cases, conduct comparisons of responses for different survey or question versions. Response summaries (i.e., number of responses, means, standard deviations, and frequencies) were calculated for each question, and grouped by type of hospitalization the patient experienced.

The willingness-to-pay estimates indicate that individuals value hospital prevention to a significant degree. WTP functions were estimated to examine relationships between WTP (or choice) responses and characteristics of the hospitalization episode and of the respondent to help explain the variability in responses. Many elements of reliability and validity assessment were considered simultaneously in the analysis. For example, sensitivity of WTP responses to differences in the length of the hospitalization was tested. Similarly, tests for sensitivity to elements in the questionnaire were also conducted as part of the analysis. The prevention of a one-day hospitalization event is valued at approximately $1,600 after adjusting for possible scenario rejection bias in the survey. There is significant non-linearity in the estimates as additional days provide significantly smaller additional value. The best estimate of the average WTP value to prevent a typical 5-day stay in the hospital is about $2,100. We found that this value did not vary significantly with the type of illness that would cause the hospitalization, among those considered in this study. Note that our WTP estimates are quite close to the individual COI values in Table 7.2.

7.2 IMPLICATIONS FOR POLICY ANALYSIS

The results of this study indicate that previous COI estimates used in assessments of the benefits of air pollution control programs have understated the value of reducing respiratory and cardiovascular hospitalizations. Table 7.3 shows the estimates that would be obtained using the previous COI estimation method, which includes only hospital charges and time in the hospital valued for everyone at the average wage rate. These are shown in the first two rows based on the average length of stay in non-HMO hospitals in California and based on California hospital charges and wage rates. The sum of these is shown in the third row.

Comparing the estimates obtained in this study (shown in the first row—from Table 5.10) to those obtained using the previous method we find that the previous method understated the COI values by several thousand dollars. This is primarily the result of not accounting for the post hospitalization recovery period when there are additional medical costs and time lost from work and other productive and recreational activities.

Table 7.3. Comparison with Previous COI Estimation Methods

	Acute Respiratory		Chronic Respiratory		Cardiovascular	
	18 to 64	65 and over	18 to 64	65 and over	18 to 64	65 and over
Hospital Charges (1998/1999 dollars)	$22,587	$22,616	$14,843	$17,952	$28,319	$26,932
Hospital Time (2001 wages)	$711	$807	$529	$662	$539	$618
Previous COI Approach	$23,298	$23,423	$15,372	$18,614	$28,858	$27,550
Complete COI (this study)	$31,072	$27,660	$20,558	$23,474	$33,929	$31,046
Difference	$7,774	$4,237	$5,186	$5,133	$5,071	$4,114
(% of previous)	33%	18%	34%	28%	18%	15%

This analysis has shown that a large share of the costs of an illness event that includes a hospitalization are not borne directly by the individual, because medical care and work loss are typically covered by health insurance and paid sick leave. It is therefore reasonable that an individual's WTP value for preventing a future hospitalization may be more consistent with the magnitude of those costs borne by the individual rather than with total costs. If the WTP estimates from this study are used to value prevention of hospitalizations, they should replace the value of lost household production, the value of lost recreation time, and the out-of-pocket expenses. Thus, the WTP estimates should be added to all medical costs covered by insurance and to lost earnings of the patient covered by paid sick leave and to all lost earnings to family members and friends. This would put the total value within a few hundred dollars of the total COI estimates shown in the fourth row of Table 7.3

7.3 CONCLUDING REMARKS

In general, the evidence pertaining to cost-of-illness and willingness-to-pay is not inconsistent with our theoretical expectations. Our results suggest that for a typical 5-day hospitalization, a comprehensive cost-of-illness study that considers both hospitalization and recovery time and accounts for all aspects of loss provides a close approximation of willingness-to-pay. This implies that the activity losses, which can be valued using dollar estimates of wages, are the most significant missing element in previous cost-of-illness studies and that the pain and suffering may not contribute significant additional amounts to utility losses once the value of activity losses have been accounted for. Of course, these results may not hold for a different sample of patients, one that is less insured or is younger or has greater income.

In addition, the results indicate a high degree of rejection of the payment vehicle specifically and the survey in general. In essence, it is difficult to get survey respondents to answer a lengthy mail survey and to realistically consider alternative payment schemes for health care programs when they expect that these should be paid for by their health insurance. These problems are best exemplified by the relatively low response rate and the scenario rejection bias.

In spite of the significant limitations and qualifications that must be recognized when using the quantitative results, the study provides new information on the value of preventing or reducing hospitalization that have been associated with air pollutant exposures. The estimates provided herein will enhance the California Air Resources Board's ability to accurately evaluate proposed air pollution control programs.

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Appendix A
Survey Instrument

INTRODUCTION

This survey concerns the impacts on patients and their families from a hospitalization for cardiovascular (heart) or respiratory (lung, breathing, ear, nose, or throat) disease or illness, such as you recently had. Your responses will help public health officials better understand how this illness event affected you and to evaluate potential ways to reduce the frequency and severity of these types of illness events.

Kaiser Permanente is supporting this research by sending this survey to its patients who were hospitalized within the past year. Your responses to this survey will be kept strictly confidential. An identification number is on the survey only so that your name can be checked off the list when the completed survey is received.

Please answer each question as best you can. We greatly appreciate your help.

Illnesses Covered by this Survey

Cardiovascular	**Respiratory**
Heart attack	Asthma
Ischemic heart disease	Chronic obstructive pulmonary disease (COPD)
Heart failure	Chronic bronchitis
Arrhythmia	Emphysema
Other heart disease or illness	Pneumonia
	Influenza
	Other respiratory illness or infection

Q1 This survey concerns unscheduled or emergency hospitalizations for cardiovascular or respiratory illness events. It does not concern hospitalizations that are scheduled in advance for surgery, tests, or other procedures.

Records show you had an unscheduled or emergency hospitalization (overnight or longer) for a cardiovascular or respiratory illness within the past year. Please review this information and correct any errors. (*See list of illnesses covered in the survey in the above box.*)

	Correction, if needed
a. Date of admission: _____	_____
b. Length of hospital stay: _____ days	_____ days
c. Illness that caused hospitalization: _____	_____

Q2 Have you had any other emergency or unscheduled hospital stays (overnight or longer) in the past 5 years? (*Check √ one answer*)

☐ No → *skip to* ***Question 4***

☐ Yes →

Q3 How many additional times have you had emergency or unscheduled hospitalizations in the last 5 years?

(*please fill in number of times*) _____

Q4 Before your recent hospitalization (listed in Question 1) for respiratory or cardiovascular illness, did you have any ongoing illness or condition that interfered with life's activities such as work, household chores, or leisure and recreational activities? (*Check √ one answer*)

☐ No → *skip to* ***Question 7***

☐ Yes →

Q5 Was your recent hospitalization related to this ongoing illness or condition? (*Check √ one answer*)

☐ No

☐ Yes

Q6 How much were your activities restricted by this ongoing illness or condition before your hospitalization? (*Check √ one answer*)

☐ extremely restricted:	mostly confined to home and need help caring for self
☐ very restricted:	unable to work or do most household chores, but able to do basic self care such as bathing and eating
☐ moderately restricted:	able to work part time or do some household chores, and able to do all self care activities
☐ somewhat restricted:	able to work and do most household chores, but unable to do most vigorous physical activity
☐ slightly restricted:	able to work and do most household chores, but occasionally unable to do vigorous physical activity

Q7 Has your level of activity mostly returned to what it was before your recent hospitalization (listed in Question 1)? (*Check √ one answer*)

☐ No, I still cannot do many of the activities I did before my recent hospitalization.

☐ Yes, I am able to do most of the activities I did before my recent hospitalization.

ABOUT YOUR MOST RECENT HOSPITALIZATION

The next questions concern the impacts on you and your family during the illness event for which you were recently hospitalized. These questions cover your time in the emergency room, hospital, and the at-home recovery time after you left the hospital.

Q8 By at-home recovery time, we mean the number of days after you left the hospital that you were unable to do most of your normal activities and were essentially confined to home. How long was your at-home recovery time after you left the hospital?
(Check √ one answer and fill in number of days)

☐ My at-home recovery time was _____ days after leaving the hospital.

☐ My at-home recovery time so far has been _____ days, but it is still continuing.

OUT-OF-POCKET EXPENSES

Q9 How much were your total out-of-pocket expenses for medical care while you were in the hospital (including the emergency room), and during your at-home recovery? Please include all expenses (including deductibles and copays) that were not covered by Kaiser Permanente or other private or government insurance (including Medicare). Please estimate as best you can, and feel free to check any documents you have. The categories are listed to help you remember. If it is easier, you can just give your total out-of-pocket medical care expenses. (*Please fill in dollar amount or write 0 if none*)

	In Hospital	At-Home Recovery
a. Hospital fees	$_____	
b. Doctors fees	$_____	$_____
c. Prescription medicines	$_____	$_____
d. Medical equipment	$_____	$_____
e. Home nursing care	$_____	$_____
f. Other (*specify*):_____	$_____	$_____
g. Total out-of-pocket medical expenses	$_____	$_____

Q10 How much were your total out-of-pocket expenses for other services, such as childcare, housecleaning, prepared meals, etc., that you and your family needed because of your hospitalization and at-home recovery? (*Please fill in dollar amount or write 0 if none*)

	In Hospital	At-Home Recovery
a. Childcare or care for elderly or disabled family member	$_____	$_____
b. Housecleaning and maintenance	$_____	$_____
c. Yardwork and gardening	$_____	$_____
d. Prepared meals, cooking, shopping	$_____	$_____
e. Other (*specify*): _____	$_____	$_____

TIME LOST FROM PAID EMPLOYMENT

Q11 What was your employment status before you were hospitalized? (*Check √ one answer*)

- ☐ Retired
- ☐ Unemployed
- ☐ Homemaker
- ☐ Disabled, unable to work
- ☐ Student

→ Skip to ***Question 16***

- ☐ Employed full time
- ☐ Employed part time
- ☐ Self employed

→ Continue with ***Question 12***

Q12 If you were employed before you were hospitalized, what was your pay (before taxes)? (*Fill in one amount—whatever is easiest for you*)

Approximate pay before taxes $_____ per week

$_____ per month

$_____ per year

Q13 Before you were hospitalized, how many hours did you work each week, on average? (*Fill in average hours per week*)

Average hours worked per week: _____ hours per week

Q14 How many days did you miss from work while you were in the hospital and at home during your recovery? (*Fill in number of days missed, write 0 if none*)

	In Hospital	At-Home Recovery
Work days missed	_____ days	_____ days

Q15 How many of these days were covered by paid sick leave? (*Fill in number of days missed, write 0 if none*)

	In Hospital	At-Home Recovery
Missed days covered by paid sick leave	_____ days	_____ days

Q16 How many total days did family members or friends miss from their paid employment to help while you were in the hospital or at home during your recovery? Please estimate the total number of days missed from work for all family and friends. For example, if your spouse missed 2 days and your friend missed 1 day, the answer would be 3. (*Fill in number of days, write 0 if none*)

	In Hospital	At-Home Recovery
Total work days missed by family/friends	_____ days	_____ days

TIME LOST FROM HOUSEHOLD CHORES AND ACTIVITIES

Q17 How many hours per day, on average, did you spend on household chores and activities before you were hospitalized? (*Fill in number of hours, write 0 if none*)

	Typical hours per day
Childcare	_____ hours per day
Caring for elderly or disabled family member	_____ hours per day
Housecleaning and maintenance.....	_____ hours per day
Yardwork and gardening.....	_____ hours per day
Grocery shopping and cooking.....	_____ hours per day
Other (please specify):_____	_____ hours per day

Q18 For how many days after you left the hospital were you unable to do most of your usual household chores and activities? (*Fill in number of days*)

_____ days I was unable to do most household chores and activities

Q19 How many hours per day did you usually spend on physically active recreational activities, such as walking or shopping, before you were hospitalized? (*Fill in number of hours*)

_____ hours per day I usually spent on physically active activities

Q20 For how many days after you left the hospital were you unable to do most of your usual physically active recreational activities? (*Fill in number of days*)

_____ days I was unable to do most physically active recreational activities

Q21 How would you describe the pain and discomfort you experienced with this illness event? (*Check √ one answer for each period*)

In Emergency Room and Hospital	**At-Home Recovery**
☐ Very severe	☐ Very severe
☐ Severe	☐ Severe
☐ Moderate	☐ Moderate
☐ Mild	☐ Mild
☐ None	☐ None

Q22 How would you describe the emotional distress and anxiety for yourself and your family during this illness event? (*Check √ one answer for each period*)

In Emergency Room and Hospital	At-Home Recovery
☐ Very severe	☐ Very severe
☐ Severe	☐ Severe
☐ Moderate	☐ Moderate
☐ Mild	☐ Mild
☐ None	☐ None

Q23 Listed below are some of the impacts on you and your family that may have occurred with your recent hospitalization and recovery. Please mark how bothersome each of these impacts was to you. (*Check √ one answer for each impact*)

Impacts to you and your family	Not at all bothersome	A little bothersome	Moderately bothersome	Very bothersome	Extremely bothersome	Does not apply
Out-of-pocket expenses for medical care and other services	☐	☐	☐	☐	☐	☐
Lost time from paid work or school	☐	☐	☐	☐	☐	☐
Lost time from household chores and activities	☐	☐	☐	☐	☐	☐
Lost ability for physically active recreational activities	☐	☐	☐	☐	☐	☐
Physical pain and discomfort	☐	☐	☐	☐	☐	☐
Emotional distress and anxiety	☐	☐	☐	☐	☐	☐

ABOUT POTENTIAL FUTURE HOSPITALIZATIONS

The remaining questions ask you to consider the possibility that within the next year you would have another illness event that requires hospitalization, caused by the same kind of illness that caused your recent hospitalization (as indicated in Question 1). Your answers will help us evaluate new approaches that may become available to prevent or reduce these events.

Q24 New approaches to reduce illness events that require hospitalization might include medical and physical treatments, reduced exposure to environmental stresses, preventative health care programs, and other actions. If, without new approaches, you faced a hospital stay of 10 days and an at-home recovery of 10 days, how important to you, if at all, would it be to: *(Check √ one answer for each statement)*

	Not at all important	A little important	Moderately important	Very important	Extremely important
Prevent this illness event from happening	☐	☐	☐	☐	☐
If you are hospitalized again, reduce the length of hospital stay by one-half	☐	☐	☐	☐	☐
If you are hospitalized again, reduce the at-home recovery time by one-half	☐	☐	☐	☐	☐

Q25 The costs for some possible approaches to reduce illness events that require hospitalization may not be covered by private or public insurance. Suppose you were facing the possibility of another illness event that would require hospitalization within the next year. If an approach could prevent this illness event or reduce your length of hospitalization and recovery, but there was an out-of-pocket cost to you, how much financial hardship would it be for you and your family to have to pay the following amounts over the next year? *(Check √ one answer for each dollar amount)*

	No hardship	A small hardship	Some hardship	A moderate hardship	A great hardship
$50	☐	☐	☐	☐	☐
$150	☐	☐	☐	☐	☐
$500	☐	☐	☐	☐	☐
$1,000	☐	☐	☐	☐	☐
$3,000	☐	☐	☐	☐	☐

CHOOSING BETWEEN ALTERNATIVES

The next questions ask you to consider alternatives concerning a potential future illness event that would require hospitalization, caused by the same kind of illness that caused your recent hospitalization (as indicated in Question 1).

- In each question there are two alternatives: A and B.
- For each question, tell us if you would prefer the circumstances in Alternative A or Alternative B.
- Even if you dislike both alternatives, please tell us which one of the two you would prefer if these are your only two choices.
- In some cases, one alternative is no illness event at all and an associated cost to you for preventative efforts.
- Please assume that the costs to you could be paid over a period of one year.

Q26 Would you prefer Alternative A or Alternative B if faced with a future illness event?
(Check √ A or B)

	Alternative A	**Alternative B**	Differences between A and B
Days in hospital	2 days	1 day	A means more days in the hospital
Days of at-home recovery	0 days	2 days	B means more days at home
Additional cost to you	$400	$400	A and B mean the same cost to you
Which do you prefer? *(Check √ A or B)*	A ☐	B ☐	

Q27 Would you prefer Alternative A or Alternative B if faced with a future illness event?
(Check √ A or B)

	Alternative A	**Alternative B**
Days in hospital	0 days (no illness event)	10 days
Days of at-home recovery	0 days (no illness event)	10 days
Additional cost to you	$1,500	$0
Which do you prefer? *(Check √ A or B)*	A ☐	B ☐

Q28 Would you prefer Alternative A or Alternative B if faced with a future illness event? (*Check √ A or B*)

	Alternative A	**Alternative B**
Days in hospital	1 day	10 days
Days of at-home recovery	0 days	10 days
Additional cost to you	$800	$0
Which do you prefer? (*Check √ A or B*)	A ☐	B ☐

Q29 Would you prefer Alternative A or Alternative B if faced with a future illness event? (*Check √ A or B*)

	Alternative A	**Alternative B**
Days in hospital	0 days (no illness event)	1 day
Days of at-home recovery	0 days (no illness event)	0 days
Additional cost to you	$1,500	$800
Which do you prefer? (*Check √ A or B*)	A ☐	B ☐

Q30 Would you prefer Alternative A or Alternative B if faced with a future illness event? (*Check √ A or B*)

	Alternative A	**Alternative B**
Days in hospital	1 day	1 day
Days of at-home recovery	1 day	5 days
Additional cost to you	$600	$200
Which do you prefer? (*Check √ A or B*)	A ☐	B ☐

Q31 Would you prefer Alternative A or Alternative B if faced with a future illness event? (*Check √ A or B*)

	Alternative A	**Alternative B**
Days in hospital	2 days	10 days
Days of at-home recovery	5 days	1 day
Additional cost to you	$200	$200
Which do you prefer? (*Check √ A or B*)	A ☐	B ☐

Q32 Now suppose that you knew that you were facing an illness event in the next year, similar to your recent illness event, that would require 10 days in the hospital and 1 day of at-home recovery. What is the most you would be willing to pay out of your own pocket to prevent this illness event? Please assume that the payment could be spread out over a year. *(Please fill in dollar amount or write $0 if none)*

$ _____

Q33 The following are statements some people tell us about their answers to the questions about choosing between alternatives to prevent or shorten a future illness event. From strongly agree to strongly disagree, how do you feel about these statements? *(Check √ one answer for each statement)*

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I think my health insurance should pay for any new approaches that might reduce future illness events.	☐	☐	☐	☐	☐
My answers accurately reflect what I would prefer if I did have to pay out-of-pocket.	☐	☐	☐	☐	☐
I am willing to spend more on health care if it prevents or shortens a future illness event.	☐	☐	☐	☐	☐
I don't believe there are any new approaches that would prevent or shorten a future illness event.	☐	☐	☐	☐	☐
I can't afford to pay anything more than I currently pay for health care no matter what the benefit.	☐	☐	☐	☐	☐
I was thinking that the new approaches would give me other benefits in addition to preventing hospitalization and this affected my answers.	☐	☐	☐	☐	☐

ABOUT YOU AND YOUR HOUSEHOLD

Q34 Including yourself, how many people in your household are in each age group below? *(Please enter a 0 if no one in that age category)*

_____ less than 18

_____ 18 to 64

_____ 65 or older

Q35 What is the highest level of schooling you have completed? (*Check √ one answer)*

- ☐ Did not complete high school
- ☐ High school diploma or equivalent
- ☐ Some college, two year college degree (AS), or technical school
- ☐ Four year college graduate (BA, BS)
- ☐ Some graduate work but did not receive a graduate degree
- ☐ Graduate degree (MA, MS, MBA, PhD, JD, MD, etc.)

Q36 Which of the following categories best describes your racial or ethnic background? (*Check √ all that apply)*

- ☐ White or Caucasian
- ☐ Black or African American
- ☐ Hispanic or Mexican American
- ☐ Asian or Pacific Islander
- ☐ Native American Indian

Q37 What was your household income (before taxes) in 2001? (*Check √ one answer)*

- ☐ less than $10,000
- ☐ $10,000 to $19,999
- ☐ $20,000 to $29,999
- ☐ $30,000 to $39,999
- ☐ $40,000 to $49,999
- ☐ $50,000 to $59,999
- ☐ $60,000 to $69,999
- ☐ $70,000 to $79,999
- ☐ $80,000 to $89,000
- ☐ $90,000 to $99,000
- ☐ $100,000 to $119,000
- ☐ $120,000 to $139,000
- ☐ $140,000 to $159,000
- ☐ $160,000 or more

Q38 Is there anything we have overlooked? Please use this space for any additional comments you would like to make.

Appendix B
Survey Reviews

Review of Draft Survey (October 24 Version),

"Your Recent Hospitalization: How Were You Affected?"

by Mark Dickie

The project aims to generate WTP estimates and more comprehensive COI estimates for air pollution-related respiratory and cardiovascular illnesses episodes leading to hospitalization. This is certainly a worthwhile objective. After reviewing "Technical Memorandum Three" and the draft survey, I think that in general the research design is appropriate for achieving the objective. But there are several issues that may warrant further consideration.

General Issues

1. The commodity being valued needs to be clarified, both for respondents and in terms of interpreting results. According to the memorandum (p.2), the health endpoint to be valued is the illness episode that causes hospitalization. This is somewhat different from valuing the hospitalization, and from valuing an illness episode like the one that caused the hospitalization – because one might experience a similar episode without being hospitalized. For respondents, this distinction comes up in the choice scenarios, where some of the alternatives have zero days of hospitalization and home recovery. If I were responding, I would not be sure whether this meant that I had no illness episode at all, or that I had an episode but it was not severe enough to warrant hospitalization. Am I not ill at all, not ill enough to see a physician, or ill enough to see a physician but not get admitted? For interpreting results, this distinction bears on the kinds of events your results will generalize to. Of course the illness events leading to hospitalization are not representative of the illness events experienced. I'm sure you have thought about this aspect of it but when it comes time to defend your results you will need to set it out more clearly.

2. There is also the question of the representativeness of the respondents. You will need to say something about Kaiser members relative to California residents generally, and about your respondents vs. those selected who did not respond or whose physicians did not grant access. On the latter point, your results would be more defensible if you have some information on the non-respondents that you could use for a test of sample-selection bias. Will you be able to use any information about their hospitalizations, or demographics from the Kaiser database, or some information based on their addresses?

3. Why not include parents of hospitalized children? Based on Tables 1 and 2 in the memorandum, this may not matter for cardiovascular events, but children (under age 18) experience a sizeable fraction of the respiratory hospitalizations.

4. Apart from the issues above I think the general plan of surveying people with recent experience with hospitalization, valuing avoidance of events like those they experienced, and sampling in proportion to air pollution-related episodes is good.

5. Clearly the choice experiment needs to be designed and pre-tested carefully. There are many issues here. You have three attributes, with several levels of each, indicating that you expect significant non-linearities in the preference relations. (If preferences are linear, then knowing values for 10 days and 0 days tells you everything in between. If preferences are quadratic, then 0,5,10 days would do it. Having six levels of days allows for lots of non-linearity.) You apparently want to estimate marginal and total values for length of hospitalization, and length of confinement to home. Perhaps you plan to use other information about the hospitalization or about the respondent to account for possible variation in these values. While values per day may be exactly what you want, it is worth considering whether this matches how people perceive and value the commodity. The levels of the attributes presented in the example seem reasonable, but there needs to be some basis for how they are chosen. For example, were these numbers of days chosen because they are typical of hospitalizations of the type considered here? The choice of levels of cost also is important. Pre-tests are usually too small to offer much guidance. Is there prior research that could be used? Can you structure the sampling so as to check responses part way through and adjust the prices if necessary? Also, some of the costs are substantial enough that you may need to specify how they would be paid. Would a person have to write a check for $4000 today? Once the levels of attributes are chosen, there remains the issue of assembling alternatives, pairing them, assigning them to respondents, and choosing how many choices to present to each respondent in what order. The example presents six, which is certainly not out of line with the literature but is a bit too much for my taste. It seems that there is a lot to do here, and this is critical to the success of the WTP estimation part of the project.

6. In general the payment vehicle and the program that will reduce illness seem a little vague for my taste. I understand the tradeoff here as you describe it in the memorandum, and particularly in view of the variety of illnesses considered here, it would be difficult to be very specific. But, this will be an issue in interpreting your results, because some people favor more concrete descriptions while others prefer the more general approach you take. In my opinion a little more specificity is warranted, or some examples. If I'm the respondent I want to have in mind some actual item that I'm paying for that will accomplish the reduction in duration. As I was going through the choices presented, I began to think of the higher cost option as reflecting a better treatment that I would receive in the hospital that would shorten my hospitalization or home recovery. But then I came to an alternative with no hospitalization and that didn't work anymore. So I have to invent something else to proceed.

7. The definition of "recovery time" needs some clarification. One question is how long it took to return to prior levels of activity. Another question, if prior levels of activity have not yet been regained, is whether this will ever occur. This may be what you mean by having "stabilized" in Q8. I think the issue of recovery time is both complex and important to the study, so that you don't want to mix these up – I think you want to sort out between those who have not yet returned to prior activity and those who will not ever return to prior activity. Maybe you want to have a skip where you ask only those who have not regained prior activity whether they have stabilized, or whether they expect to get back, or whether their doctor said they would. Then you can use your subsequent activity questions to determine whether any permanent activity limits are severe. In any

event, the issue of defining recovery time consistently comes up in Q8, Q17, Q19 and again in the choice scenarios where the attribute is "time confined to home" rather than recovery time as defined previously in the survey.

8. In general I think you have a good approach to accounting for the activity limits and work loss, and to measuring household impacts rather than exclusively individual impacts. This will usefully complement standard COI estimates.

9. When you get ready to send this out I think you will want to pay more attention to formatting and to visually setting out the skip patterns, and so on.

Specific Survey Items

10. The memo indicates that you will sample those with hospitalizations in the past year, but the introduction to the survey says six months.

11. In Q3 and Q4 it may be worth underlining "Including" and "other", respectively, for emphasis.

12. In Q8 you seem to be trying to ask two questions in one, recovery vs. stabilization. See item 7 above.

13. In Q10, I think the Q16 list is better. I would make the two lists more similar in any event. For example you might have hired out yard work or maintenance in Q10.

14. In Q12, why specifically ask hourly pay? Why not let them give it to you however they like, and then ask the questions you need to get the hourly equivalent?

15. In Q14, I would consider asking the question the other way around, how many days of pay you lost. Or somehow account for the possibility that some people will not have a formal sick leave pay plan but may have been paid anyway if the duration was short.

16. Regarding Q21 and Q22: there is physical pain or discomfort, as well as emotional distress, anxiety and the like. It is quite possible to have little physical pain but enormous anxiety about death, future episodes, inability to care for one's family, or other potential problems arising from illness. Emotional distress may be just as important as physical pain in explaining variation in WTP or accounting for its divergence from COI. You need to ask about it.

17. In Q34 you may want additional prompting to get total household income from all sources.

18. The economic and demographic information collected seems a little thin. I assume you are getting some information – like age and gender -- from the Kaiser records.

Review of California Air Resources Board
OZONE AND PARTICULATE MATTER STUDY
SURVEY AND METHODOLOGY

Charles W. Leonard, Ph.D.

INTRODUCTION

When deciding to allocate funds for public project A versus project B, elected officials and funding agencies look for a rational basis on which to make a judgment. Simple to cite as a decision tool, and simple to explain to the taxpayers, the cost-benefit analysis makes intuitive sense.

Unfortunately, in the policy analysis community, the cost-benefit analysis is the object of much skepticism. What is the "benefit" of a saved life? Of averted suffering? Of the educated child who contributes to the well-being of society versus the uneducated child who grows up to be a drain on societal resources?

Fortunately, the present survey and methodology seem limited and defensible in scope and modest in methodological claims. Averted hospitalizations and associated costs attributable to improved air quality, and cost savings and preserved off-time associated with improved medical treatments are relatively easily measured, and philosophically and methodologically defensible.

As the authors note, their methodology and survey instrument will likely produce conservative cost measurements. Similarly, events that lead to diminished quality of life are things that cannot be easily quantified, and the authors do not pretend to try.

One piece of the puzzle that future studies might address—should time, inclination, and resources permit—would be to try to estimate quality-of-life impacts among members of the population who do not seek hospitalization for respiratory and other problems caused by air pollution.

PART I. TECHNICAL MEMORANDUM THREE

1.1.1 Section A: Introduction

No comments

Section B: Background and Purpose

No comments

1.1.2 Section C: Survey Population and Health Endpoints

No comments

1.1.3 Section D: Survey Instrument

See comments on survey instrument in Part II following.

1.1.4 Section E: Survey Implementation Plan

I agree with the plan's approach to try early versions of the instrument on focus groups and affected individuals, even before a somewhat more-formal pretest.

In order to standardize the approach of numerous researchers who may be conducting the focus groups or one-on-one interviews, I suggest a focus group discussion guide or interview schedule. This does not need to be complicated or difficult, but merely to give all interviewers a set of standardized questions, observations, and invitiations for comment. As I'll suggest below, this is different for a health-effects survey than for an attitude survey (the type with which I'm more familiar), but nevertheless it reduces the chance of interviewers introducing error or bias.

Sampling Strategy:

The researchers seem to be describing a quota sample, in which respondents are selected so that the sample is in accordance with the percentage of the total population in such areas as sex, geography, income-level, et cetera. In theory a random sample of the population of hospitalized individuals (produced most simply by a skip-count through the sampling frame) will produce a sample that is representative along these important dimensions. The researchers know this better than I; I might merely have suggested that I'd take a random sample first, then adjust it as necessary to produce a sample that represents the population on the more important dimensions.

Survey Implementation

The researchers might acknowledge the logistical headaches in contacting physicians and obtaining their permission to contact their patients. I'd like to see a sentence on how they plan to get their pleas noticed in physicians' mail and how they plan to follow up. Further, will different sorts of physicians produce different rates of cooperation, and will this have an appreciable impact—geographic, socioeconomic, or otherwise—on the composition of the sample?

COMMENTS ON THE MAIL SURVEY METHODOLOGY

In the business of surveying attitudes—whether to answer public policy, electoral, or market-driven questions—the mail survey presents some serious, sometimes insurmountable problems. Specifically, the mail survey removes from the researcher the ability to rely on sampling theory. That is, the researcher may no longer be able to extrapolate, within a certain margin for error, from her sample of the population to the population at large.

The sample in a mail survey is no longer random (or rather, removes from the researcher the ability to operate on the assumption of randomness) because it is the respondent who decides whether to include himself or herself in the sample. Generalizing from a sample to a population depends upon the assumption of randomness, and this is gone from mail surveys, Web-based surveys, and, for that matter, suggestion-box surveys.

The issue at the heart of the mail survey's weakness is simple: the attitudes, intentions, or predispositions of those who choose to respond may be different in some fundamental way from those who do not.

Put another way, if a random list of mailing addresses produced pairs of next-door neighbors, and only one of each pair of neighbors responded, we would have a hard time claiming that what we got was generalizable from the sample to the whole: what was it about the voters or consumers from whom we didn't hear that made them different from their cooperative neighbors?

Forgive the circuitous reasoning. What rescues the present survey from many of these methodological pitfalls is that the hypothetical pairs of next-door neighbors breathe the same air! Never mind if previously hospitalized neighbor A does not respond; previously hospitalized neighbor B has the same particulate matter and ozone in her air as does A.

While in the preference-pair questions on treatment time versus cost, the researchers will have to overcome some of these problems, it seems to this reviewer that in terms of time and money saved, a mail survey with appropriate follow-up is to be preferred over phone surveys or other data collection methodologies.

PART II. SURVEY INSTRUMENT

The researchers are to be congratulated for making a complex subject accessible to the general population of hospital patients. I hope consideration of the following comments proves helpful in simplifying the instrument:

Introduction:

Replace ". . . understand the impact of these illness events" with "understand how such illnesses affected you . . ."

Last sentence:

Replace "checked off the list . . ." with "checked off **a** list . . ." Sorry to sound Orwellian, but "the list" might sound ominous to enough respondents to skew the results.

Q3: Are you worried about the specificity of "the same or similar illness"? We are talking about a lay audience whose idea of similarity may be different from that of a health professional.

Q6: If "or similar" is OK in Q3, you might want to include it here (or delete it in 3).

Intro to "About Your Most Recent Hospitalization": typo: "hospitalized" not "hospitalization."

Q9: This and subsequent questions may discourage respondents from continuing. It seems daunting (reminds one of doing one's income taxes!) to get figures for which the researchers are asking. Think about such reassuring language as "just your best estimate" (if accuracy is less important than response rate) or instructions such as "you may want to briefly consult your check register" if a more accurate response is more important.

Q 12: I encourage the researchers here to think (again) about whether "hourly" is the intuitive way in which most respondents will think of their earnings. (I hope college professors don't!) Is weekly, monthly, or yearly wage easier to calculate, leading to less "bail-out"?

Q 15: I assume that here you are interested in missed person-days. Again, don't assume on the part of respondents familiarity with the project. A participant might be forgiven for saying "three days" if her family of seven were around her for three days, while her next-door neighbor might say "three days" if her husband and son were performing similar bedside duties.

Q 16: Reconsider the time frame here? If I do my lawn and garden once a week, do you want me to do the per-day-average math on that? I submit it might be easier for the respondent to do the math (and therefore, as before, help response rates) to ask for average hours per week. If the hours/day are important, you can calculate from the week.

Q 22: "Least" and "most" suggest a ranking, even though your instructions say, in effect, it's OK not to treat them as a ranking. Why not use a Likert scale that is perhaps more familiar to respondents, and certainly more familiar to reviewers? How about a scale similar to that used in Q 21 preceding—adding more categories or not, to aid in analysis. (or a ten-point scale from minimally to maximally bothersome)?

Q 23: Now, in this case, you probably *do* want a ranking, rather than get a "5-5-5" response set that will provide less meaningful variance.

Q 25: I can't think of a way to state these alternatives any more clearly than they have been here.

Summary

The instrument and the methodology as they stand should yield useful and reliable information for policy makers. None of the concerns I've raised seem to me to be serious enough to impact the quality of data received. I hope my suggestions make data collection and interpretation even easier and more straightforward.