

REPORT ON ENVIRONMENTAL HEALTH ECONOMICS SURVEY

Health Risk Assessment Unit
Minnesota Department of Health

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This report, as well as more information on the economics project, is available on the Minnesota Department of Health website (www.health.state.mn.us). Go to <http://www.health.state.mn.us/divs/eh/children/data.html> to locate the report and supporting information.

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Executive Summary

The Minnesota Department of Health met with environmental economic advisors and collaborators, convened focus groups of Minnesota citizens, and designed and administered a survey to one thousand Minnesota residents in a two-year effort to learn the advantages and disadvantages of using economics in environmental health decision-making. Specifically, the MDH explored the use of economics in gauging public concerns about protecting children from environmental threats. The department learned the basics of environmental health economics and the limitations in methods of generating monetary values for reduction of health risks. The department found that the application of economic data is controversial (particularly when applied to decisions about children), but may offer useful information and explanation to support decisions that are made about public health protections.

The major work undertaken was to survey one thousand Minnesota residents about their willingness to increase protection from environmental causes of cancer to the public (adults compared to children) or their families (themselves compared to their children). The survey results indicated that adults were more willing to spend money to reduce risks to all children than to reduce risks to all adults. Similarly adults were more willing to spend money to reduce risks to their children than to themselves.

The department will use this experience to critique willingness-to-pay data that are used by the federal government to evaluate and support risk assessment decision-making such as the risk reduction benefits of setting air and water pollutant regulations. The work will be considered and cited in department rulemaking for water and air contaminants.

*conducted a number of surveys that simply ask people how they would trade income and health or income and visibility. Valuing health is obviously controversial because each person may place a different value on health. The problem facing society with pollution control is that we must make decisions that are not specific to each person but rather apply to us all. It is therefore not surprising that there is such controversy about picking a single value for health. This controversy clearly underlies much of the tension that is readily evident in every public debate about pollution control.*³

MDH staff recognize that assigning a value to health is a society-wide valuation. The risk assessment work performed within the department must reflect this societal value. The MDH has used non-economic measures of protection in rules and guidance that relate directly to environmental issues of contamination. For example, in risk assessment conducted by the MDH, these measures of protection take the form of a portion of the population that is considered and encompassed in a health-based standard for an environmental hazard. MDH rules for air and water contaminants incorporate what MDH has identified as appropriate levels of protection such as using a cancer risk level of concern associated with an increased risk of one in 100,000 over a 70-year lifetime. Sensitive portions of the populations are considered when the MDH selects and extrapolates from a dose of concern that was safe for 90 or 95 percent of a group of animals tested in the laboratory. In addition, highly exposed portions of the population are considered. For example, the exposure of concern for adults is typically calculated using drinking water intakes that encompass 85 percent or more of adults. When exposures occur that exceed rules or other products of risk assessment (for example, when the assessed cancer risk to a population exceeds 1 in 100,000) public health interventions may be recommended by the MDH.

Assumptions (such as those described above) of population-level exposures that trigger public health action are used widely by states and the federal government. They are measures that have also been tested in the legal system from special interests that seek more or less restrictions on release of pollutants. However, they are societal rather than scientific values, and the extent to which they have been subjected to public referendum in Minnesota is debatable.⁴ MDH staff have been asked to evaluate these values as rules on water and air contaminants undergo development or revision. Most recently, such requests have been specific to the value that society places on protecting children. Public comment suggests that children should be afforded a greater level of protection than adults. For example, early in the groundwater contaminant rule revision process, and in the earlier development of the air contaminant rule, one request was to use a one in a million (1 in 1,000,000) risk level in rules in order to provide more protection to children.⁵

³ Environmental Economics and Human Health. Robert Mendelsohn. Environmental Health Perspectives Volume 110, Number 3, March 2002 <http://ehp.niehs.nih.gov/docs/2002/110-3/editorial.html>

⁴ Some apparent public health "values" are based on science, for example, the proportion or segments of the population who must be vaccinated in order to reduce the risk of an epidemic.

⁵ Public comments on the Health Risk Values for air rule (P. Maccabee, September 12, 2001), Limits for Groundwater Rule. Public comments on the revision of the Health Risk Limits for groundwater rule (P. Maccabee, October 31, 2001, <http://www.health.state.mn.us/divs/eh/groundwater/hrlgw/mtg103001.htm>)

Introduction and Background

The Health Risk Assessment Unit of the Minnesota Department of Health (MDH) identified a need to understand economic tools for measuring risks and benefits, and in particular, tools for measuring the public's perception of acceptable risks to children compared to risks to adults. Staff have recognized a growing reliance on these tools at the federal level, along with the fact that economic techniques for measuring the potential risks and benefits of proposed environmental programs have drawn a great deal of criticism from some sectors.¹

The basic premise of managing environmental exposures on a cost-benefit basis is to somehow balance the value or demonstrated benefits of protecting health (ensuring humans and the environment are not exposed to harmful amounts of chemicals) with the costs of achieving that health benefit (preventing or reducing exposures). According to this economic model, when the value of the health benefits exceeds the cost of, for example, prevention or abatement, the appropriate management is to reduce or abate pollution. Also according to this economic theory, the optimal pollution management plan would keep the societal costs from exposures to pollutants as small as possible. According to this model, there is no economic net benefit in reducing pollution levels below the point at which health is adversely affected.

The techniques for conducting cost-benefit analyses are economic tools that risk managers, risk assessors, toxicologists, and environmental scientists are not trained to use or even evaluate. And yet, risk managers and others must understand these tools as these tools are used more frequently, and even mandated, at the federal level; in particular through the Office of Management and Budget.²

A crucial step in cost-benefit analysis is to place a value on health. Economists develop dollar values to represent illness and death. How this is done is difficult, varies with the issue under study, and the results are difficult to apply widely. One researcher has succinctly described the way that economists place a value on health:

Economists have contributed to the debate about values by examining a number of choices that people have made between money and health. For example, some people accept higher wages as compensation for more risky jobs. By examining how much more these people must be paid, economists have been able to value small changes in mortality or morbidity rates. Economists have also looked at how much more homes are worth in cleaner environments. These studies reveal that clean air increases housing value. Finally, economists have

¹ Priceless: On Knowing the Price of Everything and the Value of Nothing. Frank Ackerman, Lisa Heinzerling. The New Press. 2004;

² Cost-Benefit Analysis and Regulatory Reform: An Assessment of the Science and the Art Raymond J. Kopp, Alan J. Krupnick, and Michael Toman Discussion Paper 97-19 January 1997 Resources for the Future http://www.rff.org/~kopp/working_papers/qe97-19.pdf; Government Analysis of the Benefits and Costs of Regulation. Robert W. Hahn Journal of Economic Perspectives-Volume 12, Number 4-Fall 1998- Pages 201-210 <http://www.aei-brookings.org/admin/authorpdfs/page.php?id=414>

The MDH has been very interested in determining whether economic tools for making decisions about risks could help the department in evaluating the current and proposed risk assessment assumptions that serve as measures of protection for Minnesotans. In particular, the MDH was interested if Minnesotans believe that it is appropriate to have different environmental health protection values for children compared to adults.

The Legislative Commission on Minnesota Resources (LCMR) published (in February 2002) a request for proposals to address children's environmental health issues. The MDH partnered with environmental health economists within the state and at the U.S. Environmental Protection Agency (EPA) National Center for Environmental Economics (NCEE) to consider a proposal to study the issues of economic valuation of children's risks from environmental hazards. Initially, the MDH proposal described the need for state scientists and policy makers to become more knowledgeable about how economic tools might be used for decision-making. As the proposal developed further, the NCEE scientists offered to coach the MDH staff on environmental health economics so that the MDH could use the state funding to actually generate environmental health economics data on child and adult valuation. The MDH submitted a proposal to the LCMR⁶ to conduct a survey on Minnesotan's willingness-to-pay to reduce potentially harmful exposures to environmental hazards. The MDH received legislative funding (\$95,000 for work in 2003-2005) for this project through the competitive LCMR approval process.

Planning the Survey

The MDH consulted with environmental and health economists starting in 2001 in order to develop the proposal. A large number of individuals were consulted, including staff of state agencies, economists from multiple state universities and colleges, and staff of federal agencies. Starting in September 2003, regular conference calls with a select number of collaborators were started. These collaborators included EPA staff (Drs. Nathalie Simon and Chris Dockins), academics (Drs. Patrick Welle of Bemidji State University, Rebecca Judge of St. Olaf College, and Andy Klemer of University of Minnesota, Duluth), and a state economist (Robert McCarron, Minnesota Pollution Control Agency). In addition, a limited number of meetings were also held in person and open to other interested parties. The collaborators advised the MDH on how willingness-to-pay surveys are structured (a scenario describing a risk reduction choice followed by questions), discussed likely scenarios that would allow plausible and clear differences between protections for children compared to adults, and discussed the merits of different ways of administering surveys. These discussions culminated in the MDH developing a request for proposals for a contractor to administer a willingness-to-pay survey.

The MDH faced many difficult decisions in planning the survey, many of which involved some level of controversy amongst the collaborators and interested parties. These

⁶ LCMR 2003 Project Abstracts, Subd. 12 - Children's Environmental Education 12(b) Economic-based Analysis of Children's Environmental Health Risks.
<http://www.commissions.leg.state.mn.us/lcmr/abstracts/03abs.htm#chi>

difficult decisions included the survey type (willingness-to-pay versus contingency valuation), a focus on cancer and the descriptions of cancer in the scenario (fatal rather than treatable), descriptions of when a cancer would occur (early or late in life), and whether the survey would address private (personal) or public (population-wide) decisions about reducing risks. These issues are described below.

In the process of planning the survey MDH staff learned that willingness-to-pay surveys, and how the EPA uses them is controversial. In particular, some of the advisors to the MDH were highly critical of the estimated value of a statistical life used by EPA, which would be the likely end product of any EPA analysis of a willingness-to-pay survey conducted by the MDH. The MDH was much more interested in the quantitative difference between adult and child valuation, but recognized that EPA collaborators would be most interested in the overall statistic that represents the dollar value placed on reducing the risk of dying.

The MDH learned that the willingness-to-pay survey reduces the complexities of health questions into an arguably overly simplistic calculation of the amount someone is willing to pay to reduce the probability of dying. Risk assessment for most chemicals is based on determining an exposure that is below a threshold for harm. However, according to the way in which cancer risk is determined from human and animal studies, the risk of dying from cancer directly translates into a mathematical probability. The MDH found that it was necessary to limit the survey to questions about carcinogens, as probabilities of dying are not developed for exposures to other types of environmental pollutants. The risk used in the scenario must be very simply stated as the probability (e.g., 5 in 1000) of developing a fatal cancer as a result of exposure to a carcinogen. The primary objective for the MDH was therefore to craft a scenario and educational material for the survey participant so that small differences in risk (5 in 1000 compared to 2 in 1000) were meaningful to individuals. The MDH was concerned that the risk values that were ultimately used in the surveys is actually substantially higher than the risks used in regulation (e.g., 1 in 100,000 and 1 in 1,000,000). In addition, the MDH was concerned that the public's perception of the value of reducing the risk from cancer includes their concerns over having a treatable cancer as well as dying from cancer. The nuances of treatments and how people feel about treatment, or are financially impacted by treatments, was not part of the scenario for the survey. Some of the collaborators strongly urged the MDH to consider a more complex "contingency valuation", which could include more considerations. The MDH decided that there was insufficient technical assistance from collaborators to design and analyze the more complex survey, but the MDH understands that there are many excellent reasons to use a alternative types of survey.

The MDH was concerned that the context in which the MDH needed to apply any information developed on differences between adult and child valuation would be substantially different than the simple question of whether adults wish to protect children more than adults. Risk incurred due to exposures at different life stages is an emerging and changing concept in risk assessment, and the MDH wished to create a scenario that mimicked how these values are actually used. Therefore, rather than a scenario

that contrasted death during childhood versus old age (which is what some of the economists assumed would be the contrast), the MDH worked with collaborators to create a scenario that used long-term risk (deaths would occur 20 or more years after exposures), but focused on whether those risks resulted from exposures early or late in life. This scenario exactly mimics the laboratory findings that, for some carcinogens, early life exposures may lead to disproportionately higher cancer rates later in life compared to exposures that begin during adult years. This subtlety was not supported by all of the collaborators, and was difficult to explain to some interest groups who were following the development of the project. The MDH felt that simply contrasting mortality in childhood (from cancer) to mortality in adults would not match the decision-making challenges faced by the department.

Another controversy during the planning was whether the survey could measure both willingness-to-pay to reduce personal risks (or risks to one's children) and willingness-to-pay to reduce risks to the general public. The MDH learned that standard economic valuation practices focus on personal choices and personal financial resources. The standard approach is to use a study in which a person's actual purchases are used to indicate payment to reduce risks (revealed preference) or a survey that asks about the amount that a person would spend to reduce a personal risk (stated preference). The MDH learned that a person's willingness to impose an increased cost on the public (e.g., increased taxes, increased prices) in order to reduce risks to everyone is difficult to interpret economically because economists cannot easily separate out the extent to which a person believes a benefit for everyone also applies to himself or herself. Despite this complication, the MDH agreed with some collaborators that a survey that asked Minnesotans about reducing population-wide risks would better inform the department about the values that had been expressed concerning the MDH public health mission as well as the way that these values are incorporated into the department's rules.

Designing the Survey

The design of the survey underwent much iteration with the review and encouragement of collaborators, particularly those of the EPA staff, who had examples of the educational pieces to incorporate into the survey. The survey used a basic scenario of increased costs for foods that had been tested for carcinogens. The MDH tested the survey with staff and staff contacts early in its development, and worked closely with the EPA on focus group testing for later iterations of the survey. The EPA arranged the focus group testing as technical assistance to the MDH. The EPA collaborators used their contractors to hold focus groups in the metro area, Bemidji, Duluth, Mankato, and Rochester. MDH staff, EPA staff, and other collaborators and interest groups attended these focus groups as observers. The contractor recruited focus group participants at random from the surrounding community. The focus group testing was extremely helpful in discarding scenarios, testing ideas on public payment methods, and testing the plausibility of various scenarios for the survey. The results of the focus groups were

shared with other environmental health economists in a federal workshop on children's environmental health economics.⁷

During the testing phase of designing the survey the MDH further developed the scenario to test the plausibility of two mechanisms of reducing risks. One was the "Public" scenario in which the survey participant was asked about a willingness-to-pay for increased food costs for ensuring that foods low in contaminants were available to everyone (e.g., grocery stores, schools, restaurants). The other scenario was the "Private" scenario in which the survey participant was asked about his or her willingness-to-pay an increased cost for foods (in stores and restaurants) that were labeled as low in contaminants (the analogy is a higher price for organically-grown foods). The MDH also tested the plausibility of two scenarios for the timing of when the exposure to contaminants should be reduced. In one scenario, the contaminants of concern were described as having an effect of initiating the disease of cancer so that prevention was only effective if it took place in childhood ("Child" survey). In the other scenario, the contaminants were described as having an effect of promoting the disease of cancer so that cancers would be prevented from developing only if exposures were reduced later in life ("Adult" survey). The first contrast would allow the MDH to compare willingness-to-pay for private versus public good. The second contrast would allow the MDH to compare willingness-to-pay for reduced risks to children (albeit grown children) versus reduced risks to adults.

The EPA collaborators explained how the data analysis is conducted for these surveys and advised the MDH on the pricing structure for the survey. The EPA explained that in order to analyze the results, the survey would need to include a price that the participant would accept or reject. Depending on the participant's answer, he or she would be offered a second price (higher or lower). The intent was to find a price range that the participant was willing to pay. However, the MDH also learned that the dollar amounts used in surveys are also calculated from some intended range of outcomes. For example, a researcher may want to test the hypothesis that the participant is willing to pay the mathematical equivalent of 2 million dollars to prevent death from cancer (value of a statistical life or "VSL"). The researcher will be able to calculate a 2 million dollar VSL if the survey participant is willing to pay \$2,000 for a 1 in 1000 risk reduction (or \$200 for a 1 in 10,000 risk reduction, etc.). The researcher needs to select a value that seems plausible according to the scenario used (e.g., the prices for a bike helmet, air purifier, or special foods must be plausible). The MDH found, therefore, that the pricing for a scenario is somewhat constrained. The scenario and pricing must be closely linked (for example, to end up with a high enough dollar amount, the scenario would specify multiple years of payment), and ultimately the pricing may need to be selected through trial and error and participants' rejection of different prices.

⁷ "Valuing Environmental Health Risk Reductions to Children", a workshop sponsored by the U.S. Environmental Protection Agency's National Center For Environmental Economics (NCEE), National Center For Environmental Research (NCER), and Office Of Children's Health Protection; and the University of Central Florida, October 20-21, 2003, Washington Plaza Hotel, Washington, DC [http://yosemite.epa.gov/ee/epa/eeermfile.nsf/vwAN/EE-0475-05.pdf/\\$File/EE-0475-05.pdf](http://yosemite.epa.gov/ee/epa/eeermfile.nsf/vwAN/EE-0475-05.pdf/$File/EE-0475-05.pdf)

The resulting design of child and adult and public and private scenarios made the survey very complicated to administer. Each eligible participant was randomly assigned to one of the four surveys and was randomly assigned a risk reduction of 2 or 5 in 1,000. In addition, the initial price offered was also randomly selected, and the follow-up price was based on the previous answer. The MDH and collaborators debated the best way of administering the survey—by telephone, in person, or by computer (either in person or remotely through an internet application). The final decision was to not specify a single method of administration but to require potential contractors to propose a survey based on their experience and capabilities.

Administering the Survey

The MDH followed state requirements for soliciting and evaluating bids to conduct the survey. The contract was awarded to the University of Kansas Survey Research Center (SRC). The MDH determined that the dollar amount awarded through the LCMR recommendations was insufficient to conduct the survey and secured additional program money from the MDH. The total contract amount was \$115,000.

The SRC proposed an internet-based survey as the most efficient and economical way of recruiting participants statewide, conveying complex graphs and diagrams, and administering four versions of a survey in a random manner. In addition, prices for willingness-to-pay could be programmed such that the initial offer was random and the succeeding offer was based on the first response of the participant. Participants would be contacted by telephone using a random list of telephone numbers. Participants who agreed to take the survey would be told it was computer based. Those who could not take the survey on a home computer would be told where to find a public access computer in their community. The participant would receive \$25 when she or he completed the survey.

The MDH went through the MDH Institutional Review Board for approval to conduct a survey with human subjects. A detailed description of data privacy and permissions to use the data were included in the recruitment process.

The SRC created a website for the survey and converted the survey prepared by the MDH and collaborators to a password protected web-based survey. The SRC created both Spanish and English language versions of the survey. The EPA assisted the MDH with testing the final versions of the computer-based version of the survey by conducting "protocol interviews" with randomly selected Minnesotans from Minneapolis and St. Paul. Individuals came to a testing facility to take the survey on a computer and then discuss their responses and thoughts about the survey with an interviewer. Final changes to the survey were made as a result of this testing. The MDH recruited additional individuals to test the survey on home computers using different web browsers in order to detect and correct any problems.

Once final versions of the survey were tested, the SRC staffed the survey—recruiting participants, providing technical support for those encountering difficulties taking the

survey, providing interim data on recruitment and altering recruitment strategies to ensure the demographics of the participants matched statewide demographics. The MDH supported the work of the SRC by providing demographic data and analyses. The MDH also supported recruitment of survey participants by mailing follow-up letters to households that agreed to take the survey but did not promptly complete the survey. In addition, MDH staff answered questions from participants who had questions, concerns, or difficulties in completing the survey and for various reasons preferred to speak to someone in the MDH.

The SRC prepared a report of the results of recruitment, participation rates, and demographics, and submitted the raw data (that is, answers to the survey questions) to the MDH for analysis. The MDH received no information on the names or addresses of who took the survey, but did receive a geographic code for each person in order to assess, if necessary, the geographic distribution of participants.

The survey was administered from March 2005 through August 2005. From 7 to 13 percent of those called (the value was calculated separately for each version of the survey) agreed to discuss the survey with a recruiter, and of those, from 17 to 30 percent agreed to take the survey on line. More than half of the people recruited completed the on line survey (64 to 68 percent). The overall response rate, from potential telephone respondent to completed survey, was 5 to 9 percent. The SRC goal was to complete 250 of each of the four versions of the survey. The actual numbers of surveys completed was 259 (Child-Public), 242 (Child-Private), 255 (Adult-Public), and 260 (Adult-Private) for a total of 1016 surveys. Not all who completed the survey provided answers for every question and the data still need to be examined for how many individuals completed the entire survey. The SRC had the most difficulty recruiting participants for the Child-Private survey as eligible families had to have a child under the age of 14 living in the home at the time of recruitment.

The SRC compared the final demographics of the participants to Minnesota demographics. Survey participants matched Minnesotans in the proportion who were low income and living outside of metropolitan areas. But there were significantly higher proportions of women, older individuals, and larger families amongst participants. Two of the four surveys had significantly fewer than expected Hispanic and nonwhite participants as well. A greater effort to recruit a more representative sample would have required more time and money for recruitment and follow-up of recruited participants to ensure completion of the survey. The SRC provided statistical weighting for analysts to use in the data analysis, if necessary.

Survey Results

The results of the survey are being analyzed at this time by EPA staff in close consultation with MDH staff. Some of the specific questions that first needed to be answered were whether or not participants understood the complex questions on the meaning of a small risk reduction (2 in 1000 or 5 in 1000); understood the time difference between taking preventive action (i.e., reducing exposure today) and seeing

a benefit (reduced cancer mortality in twenty years); and whether a participant's doubts and concerns about the scenario influenced their willingness-to-pay.

A set of questions was included in the survey that allowed for internally "testing" whether or not a participant answered questions about willingness-to-pay in a logical manner and interpreted risk numbers as expected. An issue that concerns the MDH is that a person's interpretation of risk, and their reaction to reducing risk, may not be logical and yet could still be a valid personal response. There does not seem to be any easy way of determining the intent behind a person's response to risk reduction without more survey questions, in person interviews, or other personal feedback that is difficult to include in a computer-based survey. The MDH did receive some feedback from individuals who took the survey and later called the MDH. These individuals wanted to discuss their concerns about environmental risks and many described frustration with the survey (for example, more than one person said that there were no questions to allow them to make their concerns explicit). MDH staff were grateful for this individual response and the MDH values the concerns of these individuals. While staff could not quantify this frustration or alter the survey (or its results) to reflect the issues brought up by callers, staff believe it is important to document the concern of some participants that the survey failed to capture their beliefs that environmental contaminants from human activity should not be in foods and that government should be acting to reduce contamination for everyone (so that purchasing choices at the grocery stores, for example, would not be necessary).

A set of questions was included in the survey that allowed participants to state whether or not they found the scenario believable and whether or not their doubts about the scenario influenced their support for the program as described. Between 40 and 50 percent of respondents had doubts that the program would work as described, and about half of those who doubted, also said that the doubts influenced their support of the program (which researchers interpret as an influence on willingness-to-pay dollar amounts). It is not clear the quantitative extent to which these doubts affected the dollar amounts that respondents said that they were willing to pay to reduce exposures.

Researchers expect an economically logical response of willingness-to-pay a greater amount for a greater risk reduction. The initial analysis has not shown a clear and logical relationship of increased willingness-to-pay for either a greater risk reduction or a more immediate health benefit. This may be because the sample size was too small in comparison with a large amount of person-to-person variability in answers. The failure to see a distribution of responses by dollar amount may mean that the dollar amounts chosen (a difference of 2 to 60 dollars per month in grocery bills) were simply clustered too closely. Much larger amounts would certainly have resulted in people saying no, that they were not willing to pay such amounts. Those who were not willing to pay any amount may not have believed that the money would result in any health benefit; they may have believed that there was no health risk to begin with; or those individuals may have believed that it was important to respond as unwilling to pay because they were opposed to the concept of paying to reduce exposures (as indicated by some of the phone calls made to the MDH).

Since this survey payment structure was very closely patterned on a successful survey recently conducted with EPA collaboration⁸, the researchers anticipated results that would show a distribution that lent itself to a specific analysis. The EPA scientists are examining the data very closely to understand if the participants' answers to questions of knowledge or doubts explain the difference between the responses in this study and the expected distribution of responses based on other studies with which they are familiar.

In the meantime, the MDH is interested in some very basic results of the survey. One question is how many individuals agreed that they would pay some dollar amount to reduce exposure, and how might that willingness be different from survey to survey. Table 1 shows the numbers of individuals in each of the four surveys who were willing to pay to reduce exposures when first presented with a risk reduction scenario, a dollar amount to accept or reject, and a lower dollar amount if the first offer was rejected. After participants were asked if they were willing to pay one price, and then a lower price if they refused the first "offer", they were presented with a second scenario. In the second scenario they were asked about a willingness-to-pay for a risk reduction that was more immediate or more distant (participants were randomly assigned one of the two options) and new amounts were offered. Table 1 shows the willingness-to-pay response for those individuals who initially said no to each of the first offers and were given a new set of prices and conditions to consider.

Table 1. Number of individuals willing to pay some dollar amount to decrease exposure to carcinogens in foods (responses from both scenarios).

	Total yes* from first scenario	"No" changed to Yes on 2 nd scenario**	Total individuals answering yes	Total individuals answering question	Percentage willing to pay
Child Private	188	22	210	242	87%
Adult Private	192	21	213	260	82%
Child Public	177	27	204	259	79%
Adult Public	168	22	190	255	75%
Total	725	92	817	1016	80%

* If the participant initially said "no" or "don't know" when asked if he or she was willing to pay a specific amount (for example, \$20 per month increase in grocery costs), the participant was asked the question again but with a lower amount. This column shows the number who said yes to the first scenario initially or when the dollar amount was lowered.

**Total of participants that said "no" to both the first and second offer from the first scenario, but said yes to the first or second offer in the second scenario. The second scenario changed the time over which the cancer reduction would occur (for example, from 45 years from now to 35 years from now).

⁸ Alberini, A., Cropper, M., Krupnick, A., and Simon, N. Does the value of a statistical life vary with age and health status? Evidence from the United States and Canada. *Journal of Environmental Economics and Management*, 48(1):769-792, 2004. <http://www.rff.org/rff/Documents/RFF-DP-02-19.pdf>

It appears to the MDH that adults who were asked about reducing their children's exposures or their personal exposures were more willing to pay for that reduction than adults who were asked about reducing exposures for the general public. The largest number of adults willing to pay to reduce exposures were those who were asked about reducing exposures to their own children. The number of adults willing to pay to reduce exposures to benefit all children was larger than the number of adults who were willing to pay to reduce exposures to all adults in the population. The MDH had expected to find that people would be more willing to pay to improve health of their own or other children, whether or not those benefits accrued during childhood.

The MDH was interested in the sensitivity that individuals exhibited to the prices for the risk reductions. The response (yes—to accept the dollar amount, or no—to reject payment) to the first offer of the first scenario was examined. Of the 1016 individuals who answered the first willingness to pay question, 634 said yes, and 382 said no or don't know to the first price offered. Participants who answered no or don't know were offered a second price, upon which 91 participants changed their answer to a yes when a lower price was offered (for a total of 725 yes answers, shown in column 1 of Table 1). Table 2 shows the price options offered to these 91 individuals and the number of individuals who changed their answer from a no to a yes at each of the price options.

Table 2. Numbers of individuals who rejected a dollar amount on initial offer and accepted the second offer in the first scenario (total number of participants in the survey who were offered the initial price is shown in parenthesis).

	\$12 to \$6*	\$20 to \$14	\$25 to \$16	\$30 to \$22	Total individuals
Child Private	7 (75**)	3 (49)	3 (60)	4 (58)	17 (242)
Adult Private	7 (62)	8 (66)	7 (55)	7 (77)	29 (260)
Child Public	18 (64)	4 (69)	4 (62)	3 (64)	29 (259)
Adult Public	6 (56)	3 (74)	5 (71)	2 (54)	16 (255)
Total	38 (257)	18 (258)	19 (248)	16 (253)	91 (1016)

* The first dollar amount was rejected and the second was accepted, both offers were part of the first scenario only.

** The number in parenthesis is the total number of participants in that survey who were offered the initial price.

In each of the surveys, the initial offered price was randomly assigned, but approximately the same number of participants were offered the same initial amounts in each version of the survey. A participant was not aware of the range of prices that could be offered. The change in willingness-to-pay suggests that the reluctance to pay may have been a matter of price. More individuals were willing to pay a dollar increase of \$6 per month in grocery costs than any other amount that was offered. These data suggest that \$6 per month could be a minimal expense. Similarly, the fewest number of people were willing to pay the reduced offer (\$22) on the highest initial payment suggested. By the end of the second scenario, a person unwilling to pay may have been offered a price as low as a \$2 per month increase in grocery costs while a person consistently