THE RELATIONSHIP BETWEEN RISK MANAGEMENT INTERVENORS AND THE COMMUNITY*

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ABSTRACT

The management of toxicologic risk at the community level is a very complex process. It is generally construed as a centrally-directed activity void of interaction. Our observations in communities facing health risks as a result of chemical contamination of groundwater indicate that there is considerable interaction between centralized risk managers and community members. This paper introduces a systematic framework which can be used to describe the risk management process. We have found that the risk management process is iterative, interactive and layered in time, and that the pools of participants overlap. There also is feedback on two levels. We have disaggregated the process into individual decision units, each of which is then broken down into a series of four stages: identification of the decision question, emergence of interested parties, attempts to influence the decision outcome, and reaching the decision outcome. This framework for analyzing the risk management process helps to identify important events that otherwise may go unnoticed.

KEY WORDS: Groundwater, risk management, risk analysis, decision making, toxic chemicals, chemical contaminants, community

INTRODUCTION

Successful risk management should not only satisfactorily deal with the specific risk that precipitated the response, but also provide a learning experience through which the community (and perhaps the outside

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* This paper was presented as part of a series of five related papers entitled "Enhancing Risk Management by Focusing on the Local Level." Funding for this research was provided by the Jesse Smith Noyes Foundation and the National Science Foundation Ethics and Values in Science and Technology Program (RII-8409912). All view expressed in this paper are those of the authors and do not necessarily reflect the views of the Jesse Smith Noyes Foundation or the National Science Foundation.

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intervenor) develops response patterns or skills that will be helpful in preventing the occurrence of another similar risk in the future or result in an appropriate, productive response should a similar risk be unavoidable. Our observations indicate that, at least in the case of chemically contaminated groundwater used as drinking water, risk management is often less than entirely successful.

While people might disagree about what constitutes a "satisfactory" resolution of the risk situation, some outcomes can easily be classified as unsatisfactory. In one of our study communities, a reliable and inexpensive source of drinking water that was estimated to pose a cancer risk of one additional case per million persons exposed over a lifetime was closed and replaced with an unreliable, more expensive source that was estimated to pose a cancer risk one or two orders of magnitude higher. All parties agreed that this outcome was unsatisfactory.

Unsatisfactory risk management outcomes occur in part because both local participants and intervenors tend to view risk management as a centralized decision making operation. Centralized risk managers tend to view their activities as something that is applied to the community within which the risk occurs; they are the practitioners of risk management and the community is the recipient.[1] Local participants, likewise, often perceive risk management as something that is done to them and their community.

Our experience indicates that in reality the risk management process is an interactive process, one to which both intervenors and local participants provide inputs. We divide the participants in risk management into two groups: local participants and intervenors. Local participants are those actors who are recognized by members of their communities as "one of us." This does not mean that all community members agree about the resolution of the issues facing them, but rather than there is usually some consensus as to whether or not any given individual is an insider or an outsider. Examples of local participants are mayors, department of public works employees, town council members, and active local residents. Intervenors are the "outsiders." Examples include representatives of the federal Environmental Protection Agency or U.S. Geological Survey, and state health or environmental agencies. We suggest that if all participants, both local and non-local, recognized the interactive nature of the risk management process, the resulting perspective would be more conductive to successful risk management.

METHODS

This paper is one outcome of a larger research project designed to study the perception and management of toxicologic risk at the community level. Data were gathered in six non-metropolitan communities in upstate

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[1]For examples of the perspectives on risk management commonly presented in the literature, see Calabrese (1978), Crandall and Lave (1981), Fischoff, et al. (1979), Keeney (1983), Okrent (1980), and Starr and Whipple (1980). See Berry and Stoeckle (1985) for a discussion of decentralization in the case of drinking water regulation.

New York.[2] All six communities had become involved in a risk management process as a result of contamination by trichloroethylene and/or tetrachloroethylene of groundwater serving as the source for public (and sometimes private) drinking water supplies.

These local risk management situations were followed through time. For each community, a chronology of past events was reconstructed and ongoing events were observed. Local, state and federal level participants in the risk management process were interviewed to obtain their perspectives. Local newspaper accounts of the events surrounding the risk management process were analyzed, and we attended public meetings relevant to the risk situation. Technical (engineering) reports and other documentation (such as written records of communication between participants or notes taken by participants at meetings) were also reviewed when available.

All examples given in this paper are taken from our observations of communities engaged in the management of public health risks posed by chemically contaminated groundwater.[3]

The management of toxicologic risks at the community level varies from community to community and from one situation to another, but regularities can be identified. The conceptual framework presented in figure 1 has proved useful as a means of describing the interactive nature of risk management.

THE INPUTS

We emphasize the importance of considering the impact of broader social and political forces and technical capabilities on the process of managing risks at the community level. The risk management process is very much embedded within the context of the community as a whole (Fitchen, et al., forthcoming). It also occurs within a legal and regulatory framework that varies according to substantive issue area and governmental level. Laws, policies and actors at the local, state and federal levels affect the management of risks posed by contaminated drinking water. Groundwater quality is managed through different laws and

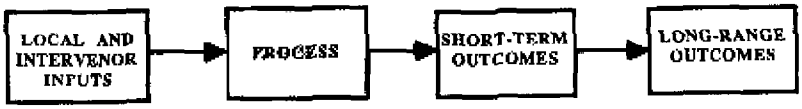

figure 1

Risk Management

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[2]The authors wish to express their gratitude to Janet M. Fitchen, who participated in the investigation of the communities and has provided intellectual support throughout the process of preparing this paper.

[3]We appreciate the participation of the many individuals who cooperated with our research efforts. We protect the anonimity of our study communities out of respect for ongoing risk management efforts.

policies which were invoked in some of our study communities. Also, the risk management processes in some of these communities were affected by state and federal "superfund" activities. Thus, risk management in these communities is effected by actors from all three levels of government.[4] Because all six study communities face similar risk situations and are in the same state, variation of the inputs into the risk management process was minimized.

THE PROCESS

The risk management process is initiated by the recognition that a risk exists. In the communities in this study, this recognition occurred in one of two ways. Either someone with a specific suspicion about the existence of contaminants in the groundwater decided to sample the drinking water supply, or a sample was taken from a randomly identified supply (as when the U.S. Environmental Protection Agency (U.S. EPA) did a survey of water quality).

Numerous decisions are made in the process of managing a health risk in a community. We have found that looking at each individual decision separately allows us to develop an accurate description of the activities comprising the management of the risk. Thus, we break down the risk management process into individual decision units and focus on each separately. All of these units taken together make up the risk management process.

The risk management process has five important characteristics. (1) It is an iterative process. That is, each successive decision unit brings the process as a whole somewhat closer to the final outcome. (2) The risk management process is also interactive. The interactive nature of the process is so important that our framework focuses not on information gathering and processing, but rather on the interaction itself.[5] (3) The participant population overlaps. There is one pool of participants for the process as a whole, and different subsets of this pool participate in each decision unit. (4) The risk management process is also layered in time. By this we mean that at any given time, many decisions are being made The passage of time is important because the larger social context within which the whole process is embedded changes with time (Fitchen, et al , forthcoming). (5) Finally, there is feedback in the risk management process on two levels. Within a given decision unit, some activities will affect others. Also, each unit may affect local and intervenor inputs into other concurrent and future decision units.

For each decision unit, we have identified four stages: the identification of the decision question, the emergence of interested parties, attempts to influence the decision outcome, and reaching the decision outcome (see Figure 2). It is helpful to separate these stages conceptually, but in reality they are not necessarily distinct. In particular, the emergence of interested parties and attempts to affect the decision outcome commonly are very closely linked.

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[4]See Fessenden-Raden, et al. (1986) for elaboration of our definition of inputs into the risk management process.

[5]The decision literature often treats information gathering and processing. See, for example, Anderson (1983), Archer (198), Hill, et al. (1978), and Mintzberg, et al (1976).

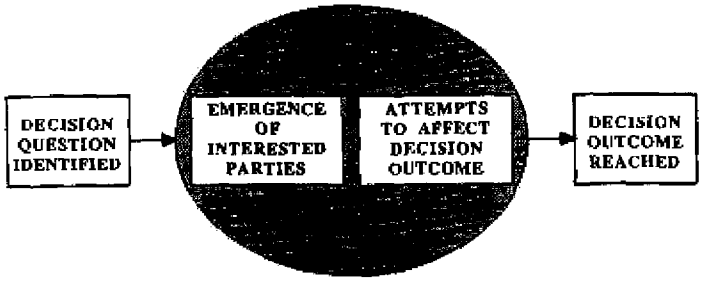

Figure 2

The Process

Identification of Decision Question

The first stage in each unit of the risk management process is the identification of the decision question. That is, one or more participants recognizes that there is some specific question to be addressed. Examples of decision questions include: "Should we issue a boil water notice?" "Should we close well number seven?" or "Which treatment option will we choose?"

Emergence of Interested Parties

Once the decision question has been identified, parties who are interested in the outcome of the decision emerge. Different interested parties have different preferences as to what the decision outcome should be, and so take different sides.

The power relationships involved in decision making at the community level have been studied by Gamson (Gamson, 1968). Some of his concepts help to clarify the interactions both within and across decision units.

Gamson (1968) suggests that for any single decision question, there is some individual or group that has the ability to make a binding decision. He calls that group the "authorities" for that given decision question. All other participants for the decision unit Gamson calls "partisans." (Authority as used here in no way implies expertise.) There may be a different group of authorities for each different decision question. For instance, representatives of the U.S. EPA or the New York State Department of Environmental Conservation are the authorities for decision questions involving the use of Superfund monies.

It is not always clear which group is the authority for a given decision unit. When lines of authority are unclear, the participant who first identified the decision question is often assumed to be the binding decision maker. In New York, this sort of role confusion is common in decision units involving the closing of public supply wells. Since there is no state (or federal) law governing the presence of most organic chemicals in the drinking water, the final decision about closing a public supply well is technically in the domain of local participants. But many local participants are not aware of their authority in this decision unit. The state Department of Health is often the source of the

suggestion to close a well (the decision question), and so is often assumed to be the authority.

The other participants who are interested in the decision outcome Gamson (1968) calls "partisans." Because different people may prefer different outcomes for any given decision question, there may be many different partisan groups. But, there is only one group of authorities for each decision question. For instance, if the mayor were the authority for the decision question of whether to close contaminated wells, partisan groups might be the local department of public works and county health department preferring that the wells remain open, and the state health department preferring that the wells be closed.

Individuals' preferred decision outcomes are not static but may change over time. While some participants tend to share preferences across different decision units, it is not uncommon for participants who align together in one decision unit to oppose each other in another.

Individuals' preferences for decision outcomes seem to be affected by four factors: (1) relevant information and knowledge possessed by the participant, (2) the participant's concerns about broader issues, (3) the participant's affiliations with other participants, and (4) distrust of other participants. This is a preliminary categorization; the four are not entirely distinct from one another, and certainly not independent.

Information and knowledge about the risk situation and about the potential ramifications of a given set of decision outcomes affects individuals' preferences of outcomes (Hughes and Bisogni, 1986). Different individuals have different amounts of knowledge and interpret that knowledge didferently, and so informed, intelligent participants may, on the basis of knowledge alone, prefer different decision outcomes.

Also, different participants often focus on different broader concerns. We have found that risk managers generally expect that participants will focus mn the health risk. But our research indicates that many other concerns may take precedence over the health risk in people's minds. For instance, some participants have a broader concern about the economic risk to the community, others about the issue of adequate water supply, still others about bureaucratic stumbling blocks, and so on.[6] While it is not uncommon for different participants to have different broader concerns, we have found that participants often fail to recognize this absence of consensus. This lack of awareness is often a stumbling block in the risk management process because decision outcomes that seem ideal to participants with one set of over-riding concerns seem inappropriate to participants with different broader concerns. Discord results.

Individuals' affiliations with other participants may also affect their preferences, as when some organization expresses a preference and its members then feel compelled to concur.

Finally, distrust of other participants affects people's preferences. Participants tend to take sides against others whom they distrust. The effect of distrust on the risk management process is particularly noticeable when the activities in other concurrent and previous decision units have caused local participants to distrust

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[6]Pitchen (1986) described ten factors in the community context that affect broader concerns.

intervenors. In such situations, local participants may almost automatically join together in opposition to the intervenor's preferred outcome, to the detriment of all involved.

Attempts to Affect the Decision Outcome

The third stage in each decision unit is attempts to affect the decision outcome. This is the stage at which the various partisan groups try to get the authorities to reach the decision outcome they favor. Gamson (1968) uses the term "influence" for partisans' attempts to sway authorities. In the study community where the local department of public works and the county health department formed one partisan group active in the decision unit for the question, "Should we close the well?" and the state health department was another, both attempted to influence the authority (the mayor). Representatives of the state health department, preferring that the well be closed, threatened that if the mayor did not close the well, they would tell the local media that the mayor was ignoring a public health risk. The clear implication was that the mayor might not be re-elected if his constituents felt he was not protecting them. The local department of public works and county health department wanted the well to remain open, and attempted to influence the mayor by explaining their reasons to him.

Gamson (1968) suggests that influence attempts can be broken down into three categories or three "means of influence." These are constraint, inducement, and persuasion. The state health department's attempt to affect the mayor's decision about closing the well by threatening him is an example of a constraint. The local department of public works' and county health department's attempt to educate the mayor was a form of persuasion.

In response to partisans' influence attempts, authorities attempt to maintain "social control" (Gamson, 1968). That is, authorities try to maintain their freedom to reach their own preferred outcome despite partisans' influence attempts. In the case of the mayor deciding whether to close the well, it is not clear that any attempts were made to control the partisans. In another community, the U.S. EPA has attempted to control local partisans' ability to affect numerous Superfund-related decisions by reaching decision outcomes without telling other potential participants that such a decision was being considered.

Gamson (1968) identifies three "means of social control": insulation, sanction, and persuasion. When the Environmental Protection Agency makes decisions in isolation, it is using insulation.

It is helpful to borrow these six concepts (three means of influence and three means of social control) for application to the risk management process. The choice of means of influence and control illuminates certain aspects of the relationship between different participants. First, the choice reflects participants' perceptions of current and past relationships. For instance, the use of persuasion usually indicates feelings of mutual respect (Gamson, 1968). Sensitive participants can recognize relationships that need improvement if they pay attention to choice of means. Choice of means of influence and control in one decision unit also affects the relationships between the same participants in other concurrent and future decision units.

Decision Outcome Reached

The fourth stage in the decision unit is that a final decision outcome is reached by the authorities. Decision outcomes and the

activities that precede them may have several effects. It may become evident during the resolution of one decision question that another decision question must be addressed. Also, the decision outcome may result in some intermediate risk management outcome, such as the closing of a well or the initiation of a new study. The decision outcome itself is distinct from its implementation.

OUTCOMES

We identify two categories of risk management outcomes. The first, short-term risk management outcomes, are the direct result of the process described above. Activities like issuing a boil water notice, performing a hydrogeologic study, or providing carbon filtration are examples of short-term risk management outcomes. The sum of the effects of all of the short-term outcomes in a given community is the long-range outcome. This outcome, which includes resolution of the risk situation and any relevant learning that may occur within the community, can seldom (if ever) be assessed in a time-frame that is meaningful to the intervenors.[7]

CONCLUSION

We have found that the risk management process is very complex -- much more so than most people realize. Disaggregating the process in a systematic way, as we do using the four stage decision unit, helps to unravel some of its complexities.

As we continue to gather and analyze data, we will expand this perspective on the risk management process. We hope, for instance, to identify associations between means of influence and control used in one decision unit and choice of preferred outcome by the same participants in other concurrent and future decision units. The analysis we have completed thus far will guide our continued efforts.

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CITIZENS' KNOWLEDGE, BELIEFS AND ACTIONS REGARDING CHEMICAL CONTAMINATION OF DRINKING WATER*

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ABSTRACT

To obtain background information for the development of educational materials, we studied a sample of water supply customers in a non-metropolitan area in New York State. We examined knowledge, beliefs and actions related to chemical contamination of groundwater used as a source of drinking water. Respondents knew many of the key concepts related to water and health to which new information about the chemical contamination of groundwater could be linked. Respondents were less familiar with the terms, groundwater and parts per million. Few misconceptions were observed. Respondents who knew more about water and health tended to have more positive beliefs about seeking information about drinking water quality, be more interested in information, and report reading or learning about drinking water quality more frequently.

KEY WORDS: Risk management, groundwater contamination, drinking water quality, education, environmental toxicology, public perceptions

INTRODUCTION

Individual citizens can influence the management of risks from chemical contamination of groundwater used as a source of drinking water through their actions. One of the ways to enhance the management of such risks is to educate citizens about groundwater and its protection. Before embarking upon educational programs, however, the characteristics of potential audiences must be understood. What an audience already knows about a topic as well as their beliefs and actions will influence how they respond to educational messages and whom they will believe (Gillespie and Yarbrough, 1984).

We studied citizens' knowledge related to chemical contamination of groundwater used as a source of drinking water as background for the development of educational materials. We used Novak's theory of education as a framework for studying citizens' knowledge (Novak, 1977; Novak and Gowin, 1984). According to this theory, new knowledge is acquired meaningfully only when it is related to concepts that the learner already has. Thus, one focus of our study was to identify the concepts that citizens had about water and the health effects of contaminants to which new information might be related.

We also studied how frequently citizens had read or heard information about drinking water quality and their beliefs about seeking information on this topic. To investigate the relationships of individual's beliefs to action we were guided by the theory of reasoned action (Ajzen and Fishbein, 1980). According to this theory an important determinant of a person's actions are his/her beliefs about outcomes of the action. A person is more likely to engage in an activity if s/he has a positive attitude about it. The positive attitude will tend to occur if the person thinks that a desirable outcome is likely to result from the action. In our study we explored how citizens' knowledge about water and health effects of contaminants was related to their beliefs about reading or hearing about drinking water quality and to the frequency with which they took these actions. We hypothesized that citizens with greater knowledge about water and the health effects of contaminants would believe that reading or hearing information about drinking water quality would have beneficial outcomes for them and report more involvement in seeking information.

Method

The citizens in our study were the customers of a water supply system in Elmira, New York. A well supplying the water system had been closed in 1980 because of contamination by trichloroethylene, an industrial solvent. In 1984 several private wells were found to be contaminated with the chemical. We sent a mail questionnaire to a systematic random sample of 1100 (6.5%) of the water customers in February 1985. We used Dillman's (1978) method for mail surveys and received 610 (55%) responses.

In developing the measures for knowledge, beliefs and actions we first conducted in-depth interview with a different sample of the water system customers. Among the 26 people interviewed, we discovered some knowledge of simple toxicological concepts, but confusion about groundwater. These people reported seeking information about drinking water to various degrees. Based on the responses to the interviews we designed a mail questionnaire to probe the same topics: knowledge about water, knowledge about the health effects of contaminants and seeking information.

Knowledge about water and and knowledge about health effects of contaminants were measured using a series of true and false statements with the response choices: true, false and don't know. The knowledge instrument measured the extent to which respondents' belief about water and health were in agreement with the latest professional tenets.

To study whether or not respondents' knowledge of water and knowledge of the health effects of contaminants were related to their beliefs about seeking information and frequency of seeking information, we developed scales to measure these variables. Scales were created by summing over the related knowledge items. For each item a correct response was scored as +1, a don't know response as 0, and an incorrect response as -1.

To assess respondents' beliefs about seeking information we asked how likely it was that each of six outcomes would happen as a result of seeking information and how desirable each outcome was. A score of +1 was assigned when an outcome was rated as "likely," -1 for a rating of "unlikely" and 0 for a rating of "neither." Likewise each desirability rating was assigned +1 if the respondent said "desirable," -1 for undesirable and 0 if the respondent said "neither."

The products of the likelihood and desirability ratings were calculated for each outcome. A positive product indicated that the

respondent thought that the action was beneficial with respect to that outcome; a negative product indicated that the action was not beneficial with respect to the outcome; a product near or equal to zero indicated that the respondent felt neutral with respect to the outcome. For example, a potential outcome of "reading or hearing about drinking water quality" was "teaches me new ways to protect water quality." If the product of these two ratings was -4, the respondent considered this outcome either desirable and likely or undesirable and unlikely. Both types of responses suggested that the result of the action would be beneficial, assuming that the respondent wants to avoid something undesirable as well as bring about desirable things.

The products of the desirability and likelihood ratings for all listed outcomes for reading or hearing about information listed were added together. If the sum was positive, the respondent believed that the action would be beneficial with respect to the listed outcomes; if negative, not beneficial; and if zero, neutral. To the extent that the listed outcomes were representative of those the respondent considered relevant when deciding whether or not to read or hear information, the sum of the products mentioned above indicated whether or not the respondent believed the outcomes of this action to be beneficial on the whole.

We also asked respondents to rate how interested they were in information about drinking water quality using one of four response choices, "not at all," "a little," "fairly interested," and "very interested."

To measure the extent to which respondents sought information about drinking water quality, we asked how frequently in the last year respondents had read about drinking water quality in newspapers or magazines, heard about drinking water on radio or television or talked about it. Based on respondents' answers to these questions, each respondent was assigned a score for seeking information about drinking water quality

We examined the relationships among respondents' scores for knowledge of water, knowledge of health effects of contaminants, beliefs about reading or hearing about information about drinking water quality, self-rated interest in information and self-reported frequency of seeking information about drinking water quality. Depending on the characteristics of the data we examined the relationships using either chi square analysis or Spearman's rank correlation.

RESULTS AND DISCUSSION

Knowledge. Only about one-third of the respondents were aware that industrial chemicals had led to the closing of a water supply system well. This level of awareness seemed low especially because newspaper articles had been written about the 1980 closing. However, articles had not appeared until two years after the closing. Another possible explanation for the low awareness was that the system had several other wells in addition to a surface water supply so that the closing of one well was not a major problem. About 70% of the respondents were aware that some private wells had been contaminated by industrial chemicals. Reports of contamination of several private wells in this community had generated considerable publicity the summer before the survey was conducted. In the year before the survey ten articles had been published in local papers about private wells compared to six articles about public wells.

When asked about water under the ground, 70% or more respondents knew that such water moved; could be contaminated; and was replenished by rain, snow, lakes, and streams and water that people use. Less than 25% knew the correct definition of "groundwater," which is all water below the water table.

About 70% of the respondents knew what the term "concentration" meant and knew that the term "parts per million" was a measure of concentration. Only 45% correctly identified the definition of parts per million, however. Some respondents indicated misconceptions for these terms.

In terms of concepts related to effects of contaminants on health, most respondents indicated few misconceptions. About 90% of the respondents knew that chemical contaminants or pollutants could get into people's bodies and could correctly identify routes of exposure. Seventy percent or more knew that exposures to chemical contaminants could affect one's behavior, nervous system, chances of getting cancer, or chances of having a child with birth defects. Only 12% associated exposure to chemical contaminants with the chances of getting diabetes, and association for which the authors know of no research evidence. Seventy-five percent of respondents correctly identified the definition of the term, "a one in a hundred thousand chance of happening in a lifetime."

The results of the knowledge questions indicate that in general the respondents had many of the key concepts related to water and health to which new information about groundwater or associated health risks could be related. The lack of misconceptions for some of the key concepts may make the task of educating easier than if many misconceptions were present. Novak claimed that changing misconceptions is very difficult (Novak and Gowin, 1984).

The area for which respondents indicated the least amount of knowledge was related to technical terms including "groundwater" and "parts per million." These findings indicate that intervenors should be sure to define these terms when communicating with citizens.

Beliefs about Seeking Information. Ninety-one percent of respondents believed that reading or hearing about the quality of drinking water was likely to keep them informed about an important issue; 94% viewed this outcome as desirable. Eighty percent believed that the activity was likely to teach them new ways to protect water quality, and 90% rated this outcome as desirable. Only 31% believed that reading or hearing about drinking water was likely to result in something that they enjoyed, but 93% rated doing something I enjoy as desirable. Only 22% thought that the activity was likely to result in doing their work better, but 92% rated this outcome as desirable. Sixty-six percent believed it was unlikely that reading or hearing about drinking water would take time away from other things, but 54% rated this outcome as desirable. Seventy-one percent thought it was unlikely that reading or hearing about drinking water quality does not help them or their family and 65% rated doing something that does not help me or my family as undesirable.

Thus, in terms of both likelihood and desirability many respondents viewed reading or hearing information about drinking water quality as beneficial with respect to outcomes related to keeping informed about an important issue, helping themselves or their family, and learning new ways to protect water quality. Outcomes related to enjoyment or work performance were viewed as less beneficial.

Respondents rated their interest in information about drinking water quality in the following way. Thirty-four percent indicated "very interested," 42% "fairly interested," 18% "a little" and 6% "not at all." Reading or hearing about drinking water quality. Seventy-four percent of respondents reported that they had read about drinking water quality in newspapers or magazines. Of these, 55% reported reading about drinking water quality more than four times in the last year. Sixty-nine percent of respondents had heard about drinking water quality on the radio or television with 53% of these reporting that they had heard such information more than four times in the last year. Of the 62% who had discussed the quality of drinking water with someone, 56% had discussed it four or more times in the last year.

Relationships Among Knowledge and Beliefs. Respondents with high scores for knowledge of water tended to have high scores for self-reported interest in information about drinking water quality (chi square significant, $p = 0.0001$). However, respondents' scores for knowledge of health effects of contaminants were not related to scores for self-reported interest in information about drinking water quality.

A relationship between knowledge about health effects of contaminants and beliefs about the outcome of reading or hearing about drinking water quality was observed, however. Respondents with lower scores for knowledge of health effects were less likely to believe that the outcomes of reading or hearing about drinking water quality were beneficial (chi square significant, $p = .006$). No relationship between knowledge of water and beliefs was observed.

Respondents' scores for beliefs about the outcomes of reading or hearing about drinking water quality were significantly related to their self-rated interest in information about drinking water. Respondents with more positive views about the outcomes of reading or hearing information about drinking water tended to report more interest than other respondents (chi square significant, $p = .0001$).

Relationships of Knowledge, Beliefs and Actions. Scores on the knowledge scales were related to respondents' self-reported frequency of information-seeking. For both knowledge of water and knowledge of health effects, higher scores were associated with higher frequencies of reading or hearing information about drinking water quality (chi square significant, $p = .0001$).

Self-rated interest in information about drinking water quality was also positively associated with the frequency with which respondents reported reading or hearing about drinking water quality (Spearman's rho = 0.41, $p = .0001$).

Respondents who had more positive beliefs about the outcomes listed for reading or hearing about drinking water quality tended to report reading or hearing about drinking water quality more often (chi square significant, $p = .0005$).

These results provide some support for the hypotheses that individuals who are more knowledgeable about a topic will be more interested in seeking information on drinking water and report more involvement in this behavior. These associations, however, are not necessarily causal. A high level of knowledge could result from interest in a topic and information seeking behavior. The findings suggest, however, that if people acquire some information about water quality, this

information may interest them in further information. Furthermore, if they become interested in the information they may believe that seeking information will be beneficial and actually seek information more often than before. More research is needed, however, to support these conclusions.

The study suggests that citizens may be receptive to educational messages about drinking water quality because many citizens have the key concepts related to water and health effects and that once they gain some knowledge they will seek more. The challenge to educators is to present the information in a way that will motivate citizens to learn. Citizens may perceive benefits of information as relating to keeping them informed of important community issues, helping their family and resource protection. Other benefits that we did not explore may also be perceived.

This study has provided initial insight into some characteristics of audiences that must be considered when developing educational messages about drinking water quality. Further work must be conducted to develop effective strategies for communicating with citizens about this important issue.

NOTES

* This paper was presented as one of five papers in an integrated series entitled, "Enhancing Risk Management by Focusing on the Local Level." Funding for this project was provided by the Ford Foundation and the Jessie Smith Noyes Foundation. The opinions expressed in the paper represent those of the authors and not necessarily those of the Foundations.

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