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Introduction

To accomplish public health objectives, American society increasingly relies on programs that inform people how to detect and reduce health risks. This form of risk management can be used as a complement to, or instead of, traditional regulation. Especially for relatively new information programs related to environmental risks, there has been little examination of how well target groups follow guidance, what critical factors influence compliance rates, how well resulting compliance accomplishes risk reduction goals and the cost-effectiveness of risk reduction. Lack of evaluation makes it difficult to determine which risk communication methods are most effective,

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suggest improvements in specific programs or determine the most appropriate role for risk communication vis-a-vis regulation. This paper summarizes the findings of a study designed as one step toward filling the gap. It examines the effectiveness of risk communication materials, information dissemination and assistance efforts and selected regulatory design strategies.

We examined three different risk management programs for public schools that the U.S. Environmental Protection Agency (EPA) initiated in response to Congress mandates. EPA regulations require specific actions to manage potential health risks from asbestos-containing materials in public schools. EPA also has guidelines that recommend specific actions to test for and remedy potential health risks from lead in drinking water and from radon gas in public schools.

Effective risk communication is particularly important for schools, because children have many years of potential exposure and often are more susceptible to a given dose. Evaluating risk management programs in schools can offer insights on how to improve these programs and how to develop effective programs for managing other environmental risks in schools. Such evaluations could also help when developing information programs for managing various risks in other settings.

EPA has developed and distributed printed materials to aid school administrators in understanding these three environmental risks and the steps necessary to test for and remedy situations that could pose health problems. (See U.S. EPA items cited in notes 11, 14, 15 and 16.) Across the three programs, EPA has undertaken varying approaches to information distribution and varying levels of supplementary workshops, training sessions and technical assistance. However, primary responsibility for implementing these risk programs has been turned over to the states.

Pretesting, or formative evaluation, increasingly is used to assess the strengths and weaknesses of materials before full production and distribution.[1] However, even very effective materials will have little

[1] Elaine Bratic Arkin, *Evaluation for Risk Communicators,* in EVALUATION AND EFFECTIVE RISK COMMUNICATION WORKSHOP PROCEEDINGS, at 11 (Ann Fisher, Maria Pavlova & Vincent Covello eds. EPA-600-9-90-054 1991).

impact if they do not reach those with the responsibility and authority to test for environmental risks and mitigate them if found, or if those responsible are not motivated to act. Process evaluation tracks the implementation of a risk information program, so adjustments can be made in distributing materials and scheduling activities.[2] Outcome and impact evaluation provide feedback on results, such as changes in awareness, attitudes, behavior and (ultimately) health status. This study includes components related mostly to process and outcome evaluation.

Several studies have evaluated risk communication materials with respect to awareness, attitudes and testing or mitigation responses.[3] However, fewer have considered the relative importance of the process for disseminating risk information[4]. Achieving risk management goals could depend as much on the coordination and management of information dissemination as on the risk information materials themselves. Despite research evidence and practical experience indicating a possible correlation, there have been few coordinated evaluations of both risk communication materials and how they were distributed.[5] We found no reports on schools responding to risk information programs in terms of effectiveness of the materials, program implementation and regulatory design.

This paper describes the results of a research effort to evaluate the effectiveness of EPA's asbestos, lead in drinking water and radon risk

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2 *Id.*

3 F. Reed Johnson & Ann Fisher, *Conventional Wisdom on Risk Communication and Evidence from a Field Experiment,* 9 RISK ANAL. 209 (1989); V. Kerry Smith, William H. Desvousges, F. Reed Johnson & Ann Fisher, *Can Public Information Programs Affect Risk Perceptions?* 9 J. POL. ANAL. & MGMT. 41 (1990); DONNA SYNSTELIEN, THE INSIDE STORY: A GUIDE TO INDOOR AIR QUALITY — HOW WELL IS IT WORKING?. (EPA 230-01-90-073 1990); NEIL D. WEINSTEIN, PETER M. SANDMAN & NANCY E. ROBERTS, COMMUNICATING EFFECTIVELY ABOUT RISK MAGNITUDES, (EPA-230-08-89-064 1989); and RICHARD J. BORD ET AL., ACHIEVING CONSISTENCY BETWEEN SUBJECTIVE AND OBJECTIVE RISKS (EPA-230-11-89-071 1989).

4 Tamara R. Lave & Lester B. Lave, *Public Perception of the Risk of Floods: Implications for Communication,* 11 RISK ANAL. 255 (1991); and Robert S. Adler & R. David Pittle, *Cajolery or Command: Are Education Campaigns an Adequate Substitute for Regulation?* 1 YALE J. REGULATION 159 (1984).

5 U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, MAKING HEALTH COMMUNICATION PROGRAMS WORK, (NIH 89-1493 1989); Michael J. REGAN & WILLIAM H. DESVOUSGES, COMMUNICATING ENVIRONMENTAL RISKS: A GUIDE TO PRACTICAL EVALUATIONS (EPA-230-01-91-001 1990).

management programs for schools, focusing on the risk communication materials, information dissemination and assistance methods and whether action was required or voluntary. Effectiveness is measured in terms of school district response to the programs.

This evaluation addressed, to some extent, the following questions.

• *Effectiveness of EPA Materials*

1. Is EPA's message clear, informative and complete?
2. Do the EPA materials lead to actions?

• *Effectiveness of Information Distribution and Assistance Approach*

3. Are school districts aware of the EPA regulations and guidelines?
4. What percent of school districts received the materials, and from where?
5. Do different distribution methods matter?
6. How is the effectiveness of federal risk information programs affected by variations in state characteristics such as political climate, funding, public and media pressure and agency efforts?

• *Effectiveness of Program Design*

7. Are the programs leading to required or recommended actions?
8. How important are regulations versus recommendations?
9. What impact does issuing "interim" versus "final" guidance have upon program response?

The EPA Programs

Brief summaries of these programs provide a basis for discussing results and conclusions about the risk communication, management and regulatory strategies employed. Detailed program information can be found in Chapman et al.[6]

• *Asbestos.* Exposure to asbestos can cause a fatal lung disease called asbestosis. Recent research indicates that asbestos also can cause cancer. In 1982, the Asbestos in Schools rule went into effect and required schools to inspect for friable asbestos-containing materials, analyze samples and make notification of results.[7] Four years later, the

6 RUTH H. CHAPMAN, LAURAINE G. CHESTNUT & ROBERT D. ROWE, AN EVALUATION OF THREE EPA PUBLIC SCHOOL RISK COMMUNICATION PROGRAMS: ASBESTOS, LEAD IN DRINKING WATER AND RADON (EPA 1990).

Asbestos Hazard Emergency Response Act of 1986 (AHERA)[8] became law, with regulations following in 1987.[9] This law expands the requirements of its predecessor to include non-friable asbestos, require each school district to develop an asbestos management plan with implementation to begin no later than July of 1989, and require states to develop accreditation plans for training, examination and other requirements for asbestos personnel in the state. The act also includes fines for failure to comply. Three grant programs have been available to help schools. During this process, a number of states have passed regulations equalling or more stringent than the EPA regulations.[10]

EPA prepared three publications for schools and sent them directly to all public and private K-12 school districts in the U.S.[11] These documents did not include a model format for the asbestos management plan, but EPA did provide a model accreditation plan.

• *Lead in Drinking Water.* Lead is highly toxic, particularly to children. The Lead Contamination Control Act of 1988[12] required EPA to provide guidance to states and localities on testing for and remedying high levels of lead in a school's drinking water. Testing and correction is voluntary, with the exception that the law requires testing, recall, repair and/or replacement of water coolers with lead-lined storage tanks or with parts containing lead. EPA published a list of these water coolers in 1989 and revised the list early in 1990.[13] Starting in April 1989, EPA regional offices sent state agencies a camera-ready copy and

7 *See* H. R. REP. NO. 97-791, 99th Cong., 2d Sess. 15, *reprinted in* 1986 U.S.C.C.A.N. 5004, 5005–6 (discussing early EPA efforts to deal with asbestos).

8 Pub. L No. 99-518, 100 Stat. 2970 (1986) (amending 15 and 20 U.S.C.).

9 *See, e.g.,* 40 C.F.R. §§ 763.80–763.119 (1992).

10 E.g., Illinois, New York, Tennessee and Texas are more stringent than EPA regulations, *see supra* note 6, at 4–5.

11 EPA, OFFICE OF PESTICIDES AND TOXIC SUBSTANCES (EPA-OPTS), ASBESTOS-IN-SCHOOLS: A GUIDE TO NEW FEDERAL REQUIREMENTS FOR LOCAL EDUCATION AGENCIES (1988); EPA-OPTS, THE ABCS OF ASBESTOS IN SCHOOLS (1989); EPA-OPTS, 100 COMMONLY ASKED QUESTIONS ABOUT THE NEW AHERA ASBESTOS-IN-SCHOOLS RULE (1988). *See also,* EPA News Release, April 28 (1993) (announcing awards of "$76.2 million in FY 1993 funds to public and non-profit private schools for asbestos abatement projects.")

12 Pub. L. No. 110–572, 102 Stat. 2884 (1986) (amending 42 U.S.C.).

13 *See* 42 U.S.C. § 300j-23 (1991).

a limited number of bound copies of the manual, "Lead in School's Drinking Water."[14] In contrast to the asbestos information distribution program, it was up to state agencies to purchase or photocopy enough manuals for dissemination to their schools. EPA also sent a flyer to all 42,000 public school districts in the U.S. announcing availability of the manual, with a form for purchasing the manual, labeled interim, from the Government Printing Office (GPO).

EPA conducted five regional training seminars for state personnel about lead in schools' drinking water. Those attending were encouraged to conduct similar seminars for school district personnel in their own states. States are mandated to assist schools in testing for and remedying high lead levels, but Congress did not appropriate funds for this and there are no sanctions for noncompliance.

• *Radon Gas.* Research shows that radon gas can cause lung cancer and that children may be at a greater risk from exposure than adults. In 1989, EPA released the results of a study of 130 schools in sixteen states around the country and found 19% of the 3,000 rooms tested had radon levels above a recommended maximum level of 4 pico curies per liter (pCi/l) and 3% of rooms exceeded 20 pCi/l. At the same time that EPA released the study results, the agency also released working interim recommendations that all schools should measure radon levels in selected environments. There is no mandate requiring this testing be done; it is only recommended. In 1989 EPA sent its booklet, "Radon Measurements in Schools — An Interim Report," to state radon offices and state education departments, along with a press kit.[15] "Radon Reduction Techniques in Schools" more recently was mailed to all 42,000 school districts.[16] Limited EPA grants were available to assist states with the radon program.

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[14] EPA, OFFICE OF WATER (EPA-OW), LEAD IN SCHOOLS' DRINKING WATER (1989); *see also,* EPA-OW, LEAD IN SCHOOL DRINKING WATER: A TRAINING AID (1989).

[15] EPA, OFFICE OF RADIATION PROGRAMS, RADON MEASUREMENTS IN SCHOOLS: AN INTERIM REPORT (1989).

[16] EPA, OFFICES OF RADIATION PROGRAMS & RESEARCH AND DEVELOPMENT, RADON REDUCTION TECHNIQUES IN SCHOOLS: INTERIM TECHNICAL GUIDANCE (1989). *See also,* EPA Guidance of Testing Radon in Schools Available, EPA News Release, Sept. 10, 1993.

Methods

To evaluate the three EPA public school risk management programs, nine case study states were selected to obtain diversity in terms of both geography and state government responses to EPA's delegation of responsibility: Colorado, Idaho, Illinois, New York, Ohio, Pennsylvania, South Carolina, Tennessee and Texas.

Two types of data were collected.

• *Qualitative data* was collected through semi-structured, open-ended telephone interviews with regional EPA and state agency personnel charged with program responsibility. Initial interviews helped identify actions, attitudes and circumstances within the state that might affect the success of the programs.[17] A second set of interviews at the end of the research clarified existing and new conditions within the state that could affect the interpretation of the mail survey responses (described next).

• *Quantitative data* was collected through a mail survey of school districts within each case study state. One set of schools responded to a questionnaire about lead in drinking water and radon. The other set responded to a questionnaire about asbestos-containing materials. The questionnaires asked about risk perceptions, public pressure, familiarity with the relevant materials, familiarity with regulations or guidance, the status of testing and remediation, and important factors motivating and impeding school district actions. Space was provided so that respondents could comment and make suggestions.

The analysis relies primarily on the mail surveys. EPA is one of the relatively few agencies willing to subject its risk communication programs to scrutiny. However, EPA's initiation of the evaluation suggests the potential for finding what the agency wanted to hear. Great care was taken to avoid the possibility that EPA's involvement might bias either respondents' answers or who chose to respond. This was accomplished by informing the sample only that the research was being conducted by RCG/Hagler, Bailly, Inc., for Research Triangle Institute. School districts were selected for the mail survey by a standard

[17] Such data supplemented other information for the designations of each state's programs shown in Table 3, discussed below.

probability-based random sampling procedure that assured a cross-section of districts according to the number of schools and students in a district, the level of affluence, the percentage of minorities and whether the district could be considered urban, suburban or rural.

The survey process followed a Dillman repeat mail approach,[18] with the first mailing in November 1989. The superintendent of each school district in the sample received an advance notification letter from the state school board association (except in New York and Pennsylvania, where notification was an article in a regular newsletter). Questionnaires were addressed and mailed to the superintendent by name, with a cover letter requesting that the superintendent complete it or have it completed by the most appropriate staff member. A reminder postcard was sent approximately ten days later. A second letter and questionnaire were sent to everyone who had not responded within four weeks. One-third of those who had not responded after two months were phoned. Some key data were collected during phone calls, and additional copies of the questionnaire were sent to those who did not recall receiving one. All phone respondents were encouraged to complete the mail questionnaire.

Results

Response Rates

Across the nine states, the mail survey response rates ranged from 53 to 77%. The average was 62% for each version, with 441 returns for the lead/radon questionnaire and 374 returns for the asbestos questionnaire.[19] Also, 126 telephone interviews were conducted with districts that did not complete the mail survey, for an overall response rate of 72%. The similarity of responses between the telephone survey of non-respondents and the mail survey suggests no significant response bias. Copies of the questionnaires and more details concerning the analysis are in Chapman, et al.[20]

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[18] DONALD A. DILLMAN, MAIL AND TELEPHONE SURVEYS: THE TOTAL DESIGN METHOD (1978).

[19] Because asbestos was added to the study relatively late, and because Idaho and South Carolina did not have enough school districts to provide two samples, these states only have a sample of districts responding to the lead/radon questionnaire.

Respondents' Characteristics and Relative Risk Perceptions

About 70% of the respondents were superintendents or assistant superintendents who often are responsible for actions related to environmental issues in the district. Most of the rest were individuals specifically charged with responding to the environmental risk programs. The respondents exhibited considerable familiarity with these issues in their districts, so we would expect informed responses. On the average, respondents had worked for 11 years in the district and 7 years in their current position.[22]

Two questions examined how respondents viewed the relative significance of the health risks in schools from asbestos, radon and lead in drinking water. The first question asked respondents to rate eight health risks to students with respect to concerns expressed in the past year by parents, students, faculty and staff. The second question elicited the respondents' own ratings of the eight health risks. Concerns about drugs, alcohol and tobacco substantially exceeded those for any of the environmental risks. As a result, one might expect some reluctance to expend scarce resources to address these environmental risks. Respondents rated asbestos as a greater concern than lead in drinking water or radon gas. (Third and fourth rows of Table 1, below.)

Similarly, respondents perceived that parents, students, faculty and staff are more concerned about asbestos than radon and lead in drinking water. Respondents thought other groups would have more concern about all of these risks at schools than they would themselves. This may reflect the fact that many of the schools already had undertaken corrective measures to reduce exposure to asbestos and to test for lead in drinking water and radon. A respondent would be aware of these actions while the other groups might not.

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20 *Supra* note 6.

22 One reviewer found it troubling that the people being asked whether EPA's assistance has been effective are the same people charged with local implementation of these risk management programs. The concern was that the respondents in a sense might be working for EPA because they must implement the programs. Note, however, that the lead and radon programs are largely voluntary, and there are several layers of authority between the school districts and EPA. Respondents can be expected to view their primary responsibility as being their local school district, rather than to a federal agency. The fact that some share of their work is to implement these programs makes them well qualified to judge EPA's assistance.

Table 1
Comparison Across the Programs[21]

		Asbestos	*Lead*	*Radon*
Age of program		8 yrs.	1 yr.	less than 1 yr.
Type of program		Mandatory	Guidance	Guidance
Concern by parents, staff, etc. (1=none ... 4=great)		2.2 (1.9-2.6)	1.8 (1.6-2.1)	1.7 (1.4-2.2)
Perceived health risk (1=none ... 5=great)		1.8 (1.5-2.1)	1.6 (1.4-1.9)	1.6 (1.3-1.9)
Familiarity with the regulations/guidelines (1=none ... 5=very)		4.2 (4.0-4.5)	3.1 (2.3-3.6)	2.6 (2.0-3.3)
Lead/Radon: Have tested for problem		NA	46% (23-70)	18% (6-37)
Asbestos: Have submitted plan		98% (96-100)	NA	NA
Need for retesting and/or remediation (as a % of those who have tested)		97%	43%	42%
Overall ease or difficulty of compliance (1=easy ... 5=difficult)		4.0 (3.8-4.6)	2.7 (2.4-3.4)	2.9 (2.5-3.4)
Reported use of any EPA materials		85% (78-92)	70% (54-92)	52% (40-66)
Reported use of any state materials		77% (57-88)	64% (42-89)	41% (25-61)
Recall receiving specific EPA materials		80% (71-86)	49% (22-78)	27% (12-54)
Rating of specific EPA materials as being: (1=not ... 5=very)	Clear	3.5	3.8	3.8
	Instructive	3.6	3.9	3.8
	Complete	3.7	3.9	3.8
EPA materials affect action? (% saying NO of those who recall specific materials)		28%	36%	37%

[21] Mean scores for full sample (range of state means in parentheses). Figures are as of January, 1990. For each estimate, the standard error of the mean was less than 0.1.

Effectiveness of EPA Materials[23]

Table 1 shows those who recalled receiving them rated the EPA materials for all three programs as generally clear, instructive and complete.[24] More detailed analysis for each program shows that the higher the rating, the more likely school districts were to report that their actions were influenced by the materials. The bottom row shows that large shares (63% to 72%) of those who recalled receiving the specific titles mentioned in the mail survey said that the materials did affect their actions regarding these risk management programs. Even higher shares reported using EPA materials in general (row 10 in Table 1). EPA and state materials were used most for dealing with asbestos and least for radon, for which there has been less testing and remediation. Also, the asbestos program is older and requires school district action.

Table 2, below, reinforces the usefulness of materials, in terms of respondents' judgments about whether these materials motivated or impeded action by their school district to respond to these risk management programs. EPA materials were seldom an impediment to action and were often a motivating factor through the provision of information about regulations and guidance, and testing procedures.

Comments on the EPA materials did suggest potential improvements. These included providing factual details such as the expected risk level in the area, the type of buildings at greatest risk, etc. Some respondents suggested a more detailed description of a preferred approach, especially model programs for states and school districts to follow. They also requested descriptions of alternative programs that would be acceptable for different situations. Finally, several respondents indicated skepticism about whether the risks are as serious as the EPA programs seem to indicate. This could explain why some districts have been slow to act.

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23 Questions 1-2 in the Introduction.

24 The ratings rely on the respondents' judgments about whether the materials fit each of these categories. An observer might claim that failure to take a required or recommended action would imply at least a lack of completeness. Unfortunately, such an observation could be confounded by political and financial constraints, by modest penalties for noncompliance, etc. The data do not permit the unravelling of such influences.

Table 2
Ratings for Motivating and Impeding Factors for Taking Action

	Mean Score*		
Factors	*Asbestos n=374*	*Lead n=436*	*Radon n=436*
MOTIVATING FACTORS			
State and Federal Requirements and Recommendations	4.4	3.9	3.3
State Technical Assistance	2.6	2.7	2.5
State Financial Assistance	2.0	2.3	2.3
U.S. EPA Materials and Technical Assistance	2.9	3.1	2.7
Public & Media Concern	2.7	2.8	2.8
IMPEDING FACTORS			
Inadequate District or State Funds	3.9	3.0	3.2
Inadequate EPA Information	2.4	2.5	2.8
Inadequate State Information	2.5	3.9	2.9
Inadequate Expertise and Staff	3.0	2.8	3.0

* Ranked from 1 = not important to 5 = very important. The standard error for each mean score was less than 0.1.

Effectiveness of Information Distribution and Assistance Programs

• *Distribution and Awareness.*[25] For the asbestos and radon programs, EPA mailed risk communication materials directly to all school districts. For the lead in drinking water program, EPA made materials available to state agencies and encouraged them to copy and distribute the materials. EPA also sent an announcement to all school districts indicating that the lead-in-water materials could be purchased from GPO. Direct mailings of risk communication materials are expensive, but Table 1 shows that, in combination with other factors, the asbestos mailings were relatively effective; 80% of the school districts recalled receiving EPA materials about asbestos. Table 1 shows that, by January 1990, 49% of the respondents recalled receiving the manual on lead in drinking water. However, only 13% (one of every four who recalled receiving it) of the school districts bought it from the GPO. State departments of education and health, or regional and federal

[25] Questions 3–5 in the Introduction.

EPA offices were much more common sources for obtaining the manual. This suggests direct mailings or enhanced distribution efforts through state and regional EPA offices are more effective than an announcement mailing. This is not unexpected, because each school district would have to take the extra step of processing paperwork to purchase the lead-in-water manual from GPO.

Perhaps because EPA's radon program for schools is so new, only 27% of respondents recalled receiving the EPA materials (see Table 1). It is also likely that more districts remembered receiving the materials about lead in drinking water because the regulatory component in the lead program (that deals with water coolers) involved several formal communications with school districts in 1989 and 1990. Nevertheless, the low percentage recalling the radon materials suggests that simply mailing the risk communication materials to schools, without some other form of follow through, may have limited impact.

The usefulness of the materials and the importance of materials distribution is highlighted by the respondents' self-reported familiarity with the regulations or guidelines. They reported being the most familiar with those for asbestos and least familiar with those for radon. This familiarity is highly correlated with their recall of having received the specific EPA materials and with reported use of both EPA and state materials, as shown in Table 1. All of these factors are correlated with the age of each program; familiarity increases the longer a program has been in place.[26]

• *Federal and State Assistance.*[27] For all three programs, state assistance was rated as less motivating than EPA materials and technical assistance. Yet, once the EPA materials and technical assistance are provided consistently to all states, the state environment becomes an important factor in terms of program response within a state.

The importance of the state role is highlighted by the strong tendency for local school districts to turn to state agencies for assistance

[26] This correlation cannot be separated from the regulatory component, or from the amount of information distributed, because the oldest program also is the one with the most requirements and the one for which EPA sent the most materials to school districts.

[27] Question 6 in the Introduction.

and information. Had the EPA materials not been available, more than 50% of respondents, for all three issues, said they would have turned to state agencies. Further, inadequate state information and assistance was often ranked as a significant impediment to taking action, particularly for the lead in drinking water program (Table 2). A further reflection of the state role is whether the state has its own regulations or guidelines for schools to manage these risks. Districts in states with requirements more stringent than the federal requirements rated their state recommendations as slightly more motivating than EPA's.

Table 3
Relative Level of Activity By State[28]

State	*Asbestos*	*Lead in Drinking Water*	*Radon*
Colorado	somewhat inactive	somewhat inactive	**very active**
Idaho	—	moderately active	somewhat inactive
Illinois	**very active**	moderately active	moderately active
New York	**very active**	moderately active	**inactive**
Ohio	somewhat inactive	somewhat inactive	somewhat inactive
Pennsylvania	somewhat inactive	somewhat inactive	moderately active
South Carolina	—	**very active**	**inactive**
Tennessee	moderately active	moderately active	moderately active
Texas	**very active**	moderately active	**inactive**

Table 3 summarizes the level of activity by the state for each program in each case study state, emphasizing those at the ends of the spectrum. This information was gathered prior to the mail survey. While state activity was not always ranked as the most important motivating or impeding factor, the overall level of action by school districts within a state is correlated to the level of state activity. For example, Idaho, New York, South Carolina, Tennessee and Texas have been more active in disseminating materials and training for the lead in drinking water

[28] Based upon regulatory, information, training, and technical assistance programs, plus other criteria.

program. These states have the lowest proportion of schools reporting no awareness of the EPA manual. This, combined with the poor response to the flyer announcing the lead in drinking water manual, suggests that the money spent on the flyer might have been more effective if used to support state agency efforts.

Not surprisingly, the percentage of districts having tested for lead in drinking water or for radon gas is higher for the states (in Table 3) that have more activity for each program. The highest levels of testing had occurred in states where EPA and other information was disseminated to all districts and training workshops for district personnel were conducted by the state. The exception to this pattern was Tennessee where in spite of fairly active state programs, very low percentages of the districts had conducted testing. This may be due to financial limitations as discussed below.

Even for the required asbestos program, state activities significantly affect what happens at the local level. For example, Pennsylvania had not yet developed its required accreditation plan (to specify training, examination and other requirements for asbestos personnel). Districts in Pennsylvania reported less familiarity with the regulations and were the most likely to rely on environmental consulting firms for information. Many districts had to start implementing their management plans (to meet the deadline in the Asbestos Hazard Emergency Response Act) before receiving their state's comments on the draft plans.

Another reflection of the importance of the state environment upon action is that school districts view inadequate district or state funds as one of the most serious impediments to action for all three programs (Table 2). Much of the variation in action across states is correlated with their financial situations. For example, Tennessee has a high proportion of students below the poverty line and a much lower share of districts that tested for lead and for radon than other states, in spite of fairly active state programs for both issues.

Comments by respondents suggested potential improvements in the information distribution and assistance procedures. Most importantly, they emphasized the need to distribute information to schools before announcing it to the public (as had occurred with the radon program) so

that schools would be ready to respond to the public, the need for more training workshops and public meetings and the need for financial support to implement the programs.

Effectiveness of Program Design

• *Actions.*[30] Overall, these three programs are resulting in actions to test and mitigate potential health hazards. For the asbestos program, Table 1 shows that 98% of the districts had submitted their required plan for managing asbestos-containing materials. Of those, 97% needed some abatement. Table 4 shows average asbestos expenditures (completed and planned) per student overall and by state. For comparison, it also shows the per-student annual expenditures on instructional materials for school districts in each state. On average, about 30% of these asbestos expenditures had been incurred when the questionnaires were completed (November-December 1989). One-time abatement expenditures are not strictly comparable to annual spending needs, but Table 4 illustrates why many states complain that the asbestos program diverts money from education. This is particularly important because inadequate state or district funding is reported as the most serious impediment to asbestos abatement.

Table 4
Completed and Planned Expenditures for the Asbestos Program

	Dollars per Student							
	All	*CO*	*IL*	*NY*	*OH*	*PA*	*TN*	*TX*
Total asbestos expenditures								
Mean *	406	268	920	878	315	265	189	55
Standard error	68	50	411	144	62	44	62	10
Annual instructional materials								
Mean	71	74	75	121	58	73	42	57
Standard error	2	4	4	5	3	4	2	3

* Table 3 shows that Texas has been very active in addressing asbestos in schools. The much lower abatement expenditure reflects that many rural Texas schools require no insulation.

Table 1 shows that school districts find it more difficult to comply with the asbestos regulations than with the guidance for lead in drinking

[29] Question 7 in the Introduction.

water or radon. Three factors probably contribute to this finding: (1) schools have much less discretion over what they can do about asbestos; (2) asbestos management usually is more costly than remedies for lead in drinking water or radon; and (3) changes in the asbestos program have meant that some initial remediation did not meet new requirements.

By far the largest proportion of districts used removal as the form of asbestos abatement. They preferred to "just get rid of it," even though EPA materials say that repair or sealing often achieves satisfactory risk reductions at much lower costs. Thus, many school districts have not been choosing cost-effective asbestos risk reduction. There is substantial controversy over how large the risk from asbestos-containing materials is, because the data come mostly from studies of workers exposed to very high levels. If the true risk in schools is much smaller than estimated, this would make expensive removal options even less cost effective.

Table 1 shows that 46% of school districts indicated they have tested for lead in drinking water, but only 18% have tested for radon. Another 30% of respondents said that they had plans to test for each potential problem in the next 12 months. More than 40% of those testing for radon or lead need to either verify the test result or mitigate. The radon testing figure seems quite low compared with those for asbestos and lead. However, another perspective is to consider the 1986 guidance issued by EPA that homes be tested for radon, a recommendation that was strengthened in 1988. Despite the longer life of the home testing information program, only about 5% of homes had been tested for radon when the school districts were surveyed.[30] This is only about 1/10th the rate of actual or planned testing at public schools under the voluntary guidance risk management program. Less information is available about the proportions of homes that have been inspected for asbestos or tested for lead in drinking water.

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[30] Ann Fisher, Gary H. McClelland & William D. Schulze, *Radon Risk Communication: The Effectiveness of an Integrated Media Campaign Versus Communicating When a House is Being Sold,* 41 J. AIR & WASTE MGMT. ASSOC. 1440 (1991).

These findings suggest that the asbestos program has been more effective than the other programs. However, it appears that school districts' actions often have been more costly than necessary.

• *Program Design.*[31] Perhaps the most important design element is whether the risk management program requires actions, or simply provides guidance. Table 2 shows that the state and federal requirements and recommendations were ranked as the greatest motivating factor for all three programs. It is not surprising that the use of materials, the rating of the regulations and recommendations and the level of action taken is higher for the required asbestos program as compared to the voluntary lead in drinking water and radon programs.

Program age and level of funding also matter. Most of these programs have not provided significant financial support to the states and schools for implementation, but the passage of time allows state agencies and schools to become familiar with the program and plan for it in their budgets. It simply takes time for these programs to mature.

Many issues are associated with starting a program and the degree of specificity of the program. The mail survey comments indicate that school districts seek a model program that is easy to follow. At the same time, the model program should include allowable options that might help them deal with their special circumstances and minimize expenses. In some cases, EPA has attempted to move forward in an expeditious manner on important programs through the provision of "interim" guidance and regulations. Many respondents indicated that changes in the asbestos regulations made it more difficult to comply and resulted in some past efforts having to be redone at considerable expense. This has created reluctance among school district and state agency personnel to move forward based on interim guidance on radon, lead in drinking water and other new EPA programs. If interim guidance is necessary to address a particularly important risk, EPA (and other regulatory bodies) should make it clear at the onset that a grandfather clause would assure acceptability of early response under any final regulations. Alternatively, interim rules could be issued as advance notice of proposed rules, with no expectation of action until final rules are issued.

31 Questions 8-9 in the Introduction.

Conclusions

Overall, EPA environmental risk communication and management programs are well received and result in positive actions by public schools. There appears to be genuine motivation among the schools to respond to public health risks within the schools. Program effectiveness increases over time, especially when the program includes regulations rather than just guidance. The response is strong even for the voluntary lead in drinking water and radon programs and much stronger than the public's response to guidance for having private homes tested for radon. The EPA materials and training are seen as beneficial, clear and informative and appear to help the local school districts understand the requirements and regulations, and select actions.

The response is stronger when EPA programs are complemented by very active state programs to distribute materials and provide training, assistance and financial support. Local school districts often first turn to their state agencies for technical assistance, rather than to the regional or federal EPA. Both respondent-reported results and the correlation between state activity and local school district activity show that the state "environment" accounts for much of the variability across the sample states. Thus, state agencies are a significant link between the federal EPA and local school districts. An important point of improvement in risk communication and management programs could come from working with key program personnel at the state level to improve the risk information distribution, training and financial support process.

The qualitative interviews revealed that some differences across states can be attributed to individuals in state legislatures and agencies responsible for the school environmental risk management programs. Working with multiple agencies and individuals in 50 states can be a formidable task, but more direct contact, use of regional EPA offices and model programs could break the task into manageable pieces.

This study illustrates the importance of evaluating the information dissemination process as well as evaluating risk communication materials, and it demonstrates that such a two-pronged evaluation is feasible, affordable and can provide feedback for improving information programs. While this study provides evidence on how well target

groups comply with regulations and guidance, it does not address the issue of how well compliance achieves risk reduction goals and the cost effectiveness of this risk reduction. To examine these issues would require estimating risk levels before and after any testing and remediation is completed. Similarly, calculating the cost effectiveness of risk reductions would require comparing the change in health risks with the amounts spent by EPA, states and schools to reduce these risks. These would be useful topics for future evaluation efforts.