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Assessing risk communication effectiveness: perspectives of agency practitioners

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Abstract

A study conducted by the Agency for Toxic Substances and Disease Registry (ATSDR), a US public health agency, evaluated ATSDR's risk communication process, specifically the roles and responsibilities, planning, implementation, and coordination of activities in response to illegal indoor spraying of methyl parathion, a hazardous pesticide, in Pascagoula, MS. Interviews of staff members involved in the intervention were conducted and an analysis revealed strengths and areas in need of improvement in the design and implementation of risk communication strategies. Key recommendations included developing a clear strategy for planning and conducting communication activities; determining staff roles and responsibilities for coordination; and developing clear and consistent health messages, a dissemination strategy, and training in the delivery and evaluation of messages, effects, and outcomes. © 2000 Published by Elsevier Science B.V.

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1. Introduction

With greater attention focused on a growing number of health problems, federal public health agencies have found the task of communicating health risks to be increasingly complex. Considerable research and anecdotal experience point to a lack of understanding between the sender of a health risk message (e.g. a federal agency) and

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the receiver (e.g. the public) (Agency for Toxic Substances and Disease Registry [ATSDR]/Association of State and Territorial Health Officials [ASTHO] [1–4]).

When confronted with a potential health hazard, a federal public health agency typically responds by examining the public health implications of the scientific evidence and then working within legal and economic constraints to provide its best assessment. That analysis, often presented in technical and uncertain terms, can be poorly received by a public that (ATSDR/ASTHO [1–4]) wants certainty, (Subcommittee on Risk Communication and Education [SRCE] [5]), has difficulty adjusting to change (Cole et al. [6]), and is particularly sensitive to risks that they perceive as being imposed (e.g. exposures to toxic substances).

A government agency must acknowledge and deal effectively with public perceptions of health risks to reduce the public's alarm about the risks and its potential hostility toward government agencies. Poor risk communication can lead to ineffective public health interventions. Often public concerns and an agency's assessment of health risk do not correlate, resulting in some public health concerns being inadequately addressed and others commanding a disproportionate amount of agency resources.

Any risk communication plan must be sound, with effective strategies, monitoring and evaluation to ensure the desired objectives are achieved. The planning requires expertise in various fields, such as program planning, evaluation, communications theory, and public health practice.

This report presents the results of an evaluation study conducted by ATSDR, a US public health agency, of its risk communication process. Specifically, ATSDR looked at the roles and responsibilities, planning, implementation, and coordination of activities necessary when responding to illegal indoor spraying of methyl parathion, a hazardous pesticide, in Pascagoula, MS. [1]

This study's purpose was to highlight the basic premises and approaches that guide the risk communication planning process and to help public health professionals better understand the basic communication principles.

Risk communication was defined as ''an interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the existence, nature, form, severity or acceptability of health risks'' (SRCE [5,7]).

2. Background

2.1. The public health threat: methyl parathion

Methyl parathion, a pesticide approved only for outdoor use, has become an important public health concern because of illegal, indoor use. Traditionally, methyl parathion — also known as ''cotton poison'' — has been sprayed in open fields to control insects. Recently, unlicensed exterminators and homeowners have illegally applied it indoors to kill roaches and other household insects.

[1] Though methyl parathion has a similar or lower toxicity than other commonly used pesticides, such as diazinone or warfarin, when sprayed indoors it can present a significant public health hazard.

When used indoors, exposure to methyl parathion can result in a range of signs and symptoms, depending on how great the exposure and the health status of the person exposed. Symptoms can range from subtle neurobehavioral disturbances to non-specific symptoms such as nausea; diarrhea; dizziness; confusion; blurred vision; excessive sweating, tearing or drooling; weakness or muscle twitching, and/or to acute cholinergic crisis with severe manifestations of the above symptoms. Direct experience in locations where indoor spraying has occurred indicates that most household members who were exposed are likely to be asymptomatic or have low-grade symptoms.

Methyl parathion is an organophosphorus (OP) insecticide of the phosphorathionate group. Indicators show that OP insecticides or their active metabolites elicit toxicity by inhibiting the nervous system acetylcholinesterase (AChE). Inhibition of AChE leads to accumulation of the neurotransmitter acetylcholine (ACh), leading to hyperactivity in cholinergic pathways, present in the central nervous and peripheral nervous systems, and in both automatic and somatic pathways, present in the peripheral nervous system. The resultant hypercholinergic activity leads to a variety of signs and symptoms, some of which (e.g. respiratory) can be life threatening if poisoning is at a sufficiently high level.

Methyl parathion requires metabolic activation to methyl paraoxon (MPO) to yield appreciable anticholinesterase activity; MPO could phosphorylate serine esterases other than AChE or serine proteases. Inhibition of these other enzymes, if they are noncritical enzymes, could be protective (they could have a scavenger function) or, conversely, could yield toxicities unrelated to AChE inhibition.

However, because much of the data are extrapolated from experiments on animals, not much is known about the sensitivity of human blood and liver and brain esterases to inhibition by MPO and the likelihood of MPO degradation by plasma and liver A-esterases. The biochemical protection available to humans is not known and therefore predictions of the disposition and internal dose of MPO cannot be made. Another critical data gap is how these enzymes develop in humans to help determine the vulnerability of the infant or child compared to the adult (see Section 2.4).

The earliest report on the indoor use of methyl parathion concerned incidences in Lorain, OH, in 1994 (Cole et al. [6]). Since then, indoor use of methyl parathion in Michigan, Alabama, Tennessee, Arkansas, Louisiana, Illinois, Mississippi and Texas has been reported. Thousands of families and homes have been affected. Because of the effects methyl parathion can have on human health, agencies are responding nationally to prevent and mitigate exposure to the substance.

Since November 1996, more than 2600 homes and 100 small businesses (including day care centers) on the Mississippi Gulf coast have been identified as possibly contaminated with methyl parathion. As of June 1998, a total of 1863 persons in the USA had been relocated from 478 homes until the methyl parathion could be cleaned up. Pascagoula is a significant site because it constitutes a large portion of the people affected nationally and serves as the foundation for the national response to illegal indoor spraying of methyl parathion.

2.2. The public health response: communication, information and education

ATSDR, the US Environmental Protection Agency (EPA), and state and local health and environmental agencies worked together at the community level to respond to the incidents. Their collective efforts included testing homes and businesses for methyl parathion; conducting biomedical tests to determine levels of methyl parathion exposure; providing health professionals and the public with information about preventing or properly responding to this problem; and, in cases of imminent public health threat, cleaning up methyl parathion from contaminated buildings. The agencies established and staffed a communications coordination center to provide information to the public.

Additional health promotion-related activities in Mississippi and other states included (1) educating local health professionals to increase knowledge about the diagnosis and treatment of persons who possibly have been exposed to methyl parathion and how to answer health-related questions and concerns; (2) assisting the community in dealing with the adverse psychological and social effects of exposure and relocation, including training social workers to help affected communities cope with concerns about methyl parathion exposure; (3) answering calls from area physicians and advising the local health department about how to test and interpret test results for methyl parathion; and (4) educating the community about how to prevent and reduce exposure to methyl parathion and how to control roaches and other insects more safely.

2.3. Factors influencing the public health response

Since November 1996, ATSDR periodically reassessed its role in responding to methyl parathion health concerns and identified the following three factors as the reasons the agency gradually moved from direct intervention to a consultative role: [2]

A change in the scientific knowledge,
knowledge of the response capabilities of agencies involved, and
development of an integrated public health response through the development of a long-term strategy.

2.4. Scientific knowledge

At an ATSDR Expert Panel convened in April 1997, three major data gaps were identified. These areas of particular interest include the choice of para-nitrophenol (PNP) as a biomarker for exposure to methyl parathion, the use of creatinine corrections for urinary para-nitrophenol results, data gaps in toxicology regarding dermal absorption and placental transfer to fetus, and data gaps regarding long-term adverse health effects of exposure on children.

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[2] Public health and regulatory agencies typically recommend that continuous human exposures to toxic substances not exceed a dose that is 10- to 100-fold lower than a dose at the no-observed-adverse-effect level (NOAEL) identified in study populations. The EPA has formalized this process by including when available chemical-specific values, called reference doses (RfD), in its toxicity database, which is used by regulatory programs. A subchronic RfD for methyl parathion has been established by EPA. While RfDs are generally considered to be screening levels and are not regulatory standards, they are often used to establish environmental cleanup levels.

2.4.1. P-nitrophenol (PNP)

Identification of the environmental degradation products of methyl parathion in indoor settings was needed. Panel members recommended that the agencies monitor surfaces for methyl parathion, PNP and paraoxon in representative samples of homes to determine the need for continued systematic sampling in all homes.

2.4.2. Infants and children

Methyl parathion is more toxic to infants and children because they have immature, low levels of xenobiotic metabolizing enzymes and decreased renal clearance. In addition, the brain continues to develop after birth and to form neural connections through adolescence. Younger children are likely to be the most susceptible, but the magnitude of risk at specific age groups is unknown.

2.4.3. Toxicology

Methyl parathion's physical and chemical properties, environmental fate, bioavailability from environmental media, and food chain bioaccumulation are areas in need of further investigation. Also, more information is needed on the dermal absorption of methyl parathion and placental transfer to the fetus.

These data gaps demand that greater focus be placed on the preparation of communication programs and materials in communities to help ensure the most complete and accurate risk information is being communicated.

2.5. Moving from direct intervention to consultative role

ATSDR began the public health intervention of methyl parathion misuse with a rapid field-action-oriented response to an imminent health hazard in the Pascagoula area. The components needed for the intervention were, at the time, viewed more as an emergency response activity than as a long-term public health intervention. As further identification of this illegal spraying became evident and inadequacies in scientific knowledge were identified, the public health agencies involved became aware of the need for a broader, more generalized public health intervention to handle this complex problem. Procedures, protocols, materials developed, and training provided in the initial response were designed to build capacity within state and local health departments to address concerns related to methyl parathion.

2.6. Development of a long-term strategy

The goal of the long-term strategy was to establish a process to address issues regarding the misuse of methyl parathion. A proactive strategy, developed in cooperation with ATSDR's partners, was based on a four-step framework. The elements of the framework are assessment, consultation, evaluation and assurance.

Assessment covers (1) surveillance of populations exposed to methyl parathion, (2) design of an epidemiologic study to follow up (surveillance) young children who were exposed to methyl parathion, and (3) identification of key toxicological gaps.

Consultation consists of (1) technical assistance to state and local health agencies, (2) guidance in public health practice by ascertaining the public health implications of complex exposure scenarios and the development and adaption of the response strategy, and (3) establishment of clinical referral networks for physician consultations and information resource.

Evaluation consists of the (1) development of a National Evaluation Model for Methyl Parathion to provide consistent evaluation across sites for feedback and program improvement and (2) application of quantitative and qualitative methods to assess the immediate, direct effect and the sustained or long-term cumulative effect on a person or group of persons as a result of public health actions. Changes in awareness, knowledge, attitudes and behaviors are measures of effect.

Assurance consists of (1) periodic reviews and updates based on current scientific information, (2) use of information obtained during the assessment to inform public health practice, (3) enhancement of local response capacity, and (4) establishment of a national health education plan to provide state and local health departments with the tools and guidance needed to establish community and health professional education action plans. It also provides guidance and information on safe and integrated pest management programs.

3. Methods

3.1. Conceptual framework

Except for the National Cancer Institute (NCI), National Institutes of Health (NIH), most federal public health agencies do not systematically apply agency-specific principles and standards in practicing effective risk communication. In 1989, NCI substantially contributed to the study and practice of public risk communications by developing a six-stage approach to communications planning; this approach is commonly known as the ‘‘health communication wheel’’ (NCI [8]). The major steps in the NCI wheel are designed for integrating assessments of audience needs and perceptions at critical points in program development and implementation. NCI later revised the wheel from six to four stages (NCI [8]).

In this case study, NCI’s four-stage communication wheel was used as a basis for data collection and analysis in evaluating ATSDR’s risk communication process in responding to methyl parathion misuse in Pascagoula. The four-stage wheel includes planning programs, developing messages and materials, conducting activities, and evaluating programs.

3.2. Data collection and analysis

A series of interviews were conducted to determine more precisely how the involved ATSDR staff members perceived the intervention process — specifically, roles and responsibilities, planning, implementation, and coordination. Documents resulting from the intervention (e.g. trip reports, site activity plans, memoranda, letters, meeting agendas and minutes, proposals, and progress reports) were also used to develop interview questions.

The 27 on-site, off-site, and interdivisional ATSDR staff who worked directly or indirectly on health-risk-communication-intervention-related projects in Pascagoula participated in the interview process.

A five-point Likert scale with choices ranging from strongly agree (5 points) to strongly disagree (1 point) was used to collect quantitative data. In addition, yes/no questions were asked of each respondent. Analysis of the interview data revealed varying perspectives on the content, implementation and expected outcomes of risk communication strategies.

4. Key findings

4.1. Perceptions of roles and responsibilities

When asked if ATSDR's public health purpose at the Pascagoula site was clear, approximately 70% of participants responded ''yes,'' identifying several important roles for ATSDR in responding to methyl parathion exposures (Table 1).

Other results suggested that participants were generally aware of their own roles and responsibilities in the response but were less certain about the roles and responsibilities of the other agencies involved (Table 2).

4.2. Risk communication approach

Planning is fundamental to effective risk communication and begins with defining the public health issue, identifying key target audiences, specifying goals and objectives, and developing multiple risk communication strategies. The following results reflect the participants' opinions about the planning and implementation phases of ATSDR's risk communication efforts in Pascagoula.

Table 1
The ATSDR's role as defined by participants

Role	Example	Percentage of participants
Assistance	To provide technical assistance to the state if needed	40
Education	To provide community and health professional education	30
Development	To develop a communication strategy, educational materials, and protocols	20
Leadership	To provide health leadership/expertise	20
Coordination	To help coordinate a multi-agency response. To coordinate urine testing for methyl parathion	20

Table 2
Participants' perceptions of roles and responsibilities

Understood	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Don't know (%)
Individual role	47	20	13	7	133	0
Individual responsibilities	47	13.3	27	7	7	0
Role of involved agencies	13.3	20	20	27	13	7
Responsibilities of involved agencies	7	33	20	27	7	7

4.2.1. Public health issue

Fifty-three percent of participants described the problem or public health issue as being ‘‘clearly defined.’’ The most frequently identified public health issues were illegal methyl parathion spraying in homes and businesses (63%) and the possible risk to human health associated with exposure to methyl parathion (38%).

4.2.2. Target audiences

Eighty-eight percent of participants agreed that the target audiences were clearly identified. The most frequently identified target audiences were residents (affected and not) (77%); health professionals, including physicians and nurses (46%); and the community at large (39%).

4.2.3. Goals and objectives

Participants were asked about the clarity of communication of goals and objectives at different time points during their involvement in the program, including the ‘‘beginning,’’ ‘‘middle,’’ ‘‘end,’’ or ‘‘never.’’ Responses indicated that goals and objectives were clearly communicated to 33% of participants in the beginning, 20% in the middle, and 7% at the end of the involvement. Thirty-three percent stated that the goals and objectives were never clearly defined, and 7% answered that they did not know. Overall, 40% agreed and 40% disagreed that the goals and objectives were clearly defined.

The most frequently given communication goals were ‘‘to prevent and mitigate exposure to methyl parathion’’ (27%) and ‘‘to communicate the health effects of methyl parathion (27%).’’ Forty-six percent agreed the goals were appropriate for the public health issue, and 40% agreed that the goals were appropriate for the target audience(s).

For the objectives established, 33% cited ‘‘education on the illegal indoor use of methyl parathion,’’ 20% cited the ‘‘prevention of further exposure,’’ 20% cited ‘‘communication of the public health implications,’’ 13% indicated ‘‘clear explanations of the different levels of exposure,’’ and 13% cited ‘‘development of an awareness among health professionals about methyl parathion.’’ Overall, 47% found the objectives to be clear and specific, 20% thought them to be attainable, 40% found them to be prioritized, and 20% found them to be measureable (Table 3).

4.2.4. External and internal communication strategies

The *external* communication strategies used and reported by participants and reflected in reports were fact sheets for community members and telephone staff (53%),

Table 3
Participants' views of the intervention objectives

	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	Don't know (%)
Clear	20.0	6.7	13.3	40.0	20.0	0
Specific	26.7	20.0	6.7	33.3	6.7	6.7
Attainable	6.7	13.3	33.3	6.7	20.0	20.0
Prioritized	6.7	33.3	6.7	33.3	20.0	0
Measurable	6.7	13.3	13.3	26.7	20.0	20.0

grand rounds presentations, briefings to hospital staff and education activities for local physicians (40%), establishment of a coordination center with agency staff (40%), small group community availability sessions and question and answer sessions (33%), press releases to media outlets (33%), door-to-door visits and face-to-face communication (27%), and development of expert panel reports to community members (7%). The most frequently reported *internal* communication strategies were daily conference calls (47%), informational and planning meetings (27%), and electronic mail (7%).

4.2.5. Challenges and barriers

During the response to the indoor spraying of methyl parathion, ATSDR worked to communicate to target audiences the health risk associated with the pesticide; however, there were barriers that affected ATSDR's ability to communicate effectively. The emergency communications response presented staff with several challenges: (1) limited awareness about the scope and magnitude of a quickly evolving public health threat, (2) no defined roles or responsibilities, (3) limited scientific data, and (4) no identified strategy for providing public education and outreach in a crisis or emergency situation.

5. Conclusions and recommendations

More than 40 federal, state and local agencies cooperated with the affected communities to (1) intervene early to stop current violators of pesticide regulations; (2) remove the population at risk from exposure; (3) implement a clinical protocol to test 6400 persons for exposure, which helped protect the health of those tested, helped direct the intervention efforts, and continues to drive risk management decisions; (4) identify key science data gaps; (5) reach agreement with the manufacturer of methyl parathion to modify the product and packaging to reduce the potential for its misuse; (6) form partnerships to more effectively use resources; and (7) improve response capabilities for similar problems on a national level.

As participants in the Pascagoula intervention, the interviewees identified the following three major recommendations to improve the effectiveness of risk communication practice.

(1) Conduct comprehensive, integrated, and systematic planning. Proper planning, even in an emergency situation, will save time, effort, and energy and will reduce stress

that can lead to staff fatigue and turnover. The purpose, public health issue, target audience(s), goals, objectives and strategies need to be clearly defined as soon as possible and understood by those participating in the intervention. Planning helps define project expectations and anticipate future barriers and ways to address them before they occur. Other key components that should be considered when developing a plan are message design, development and dissemination strategies, resources (e.g. people, money and materials) needed and available to implement the plan, an evaluation strategy, and an implementation time line.

In response to the need for a long-term strategy, ATSDR developed *Methyl Parathion Public Health Response: ATSDR Long-term Strategy*. This agency strategy document includes a history of the methyl parathion problem, ATSDR's response and role, data gaps in current scientific knowledge, and a plan for developing a long-term response strategy. The strategy can be adapted to other types of public health interventions and is based on the four-phase approach mentioned previously (see p. 122).

(2) Determine linkages and lead responsibilities. Although they seemed to understand what their individual roles were, ATSDR staff members understood less about the roles of other people, agencies and organizations working at the site. This lack of understanding led to duplication of effort and created the potential for confusion. As well, critical tasks and activities went undone when people assumed someone else was performing the task. A designated lead person implementing a developed plan will serve to prioritize, organize, inform, coordinate and monitor activities. This will help to reduce confusion over which task to perform, who is going to perform it, and what method of implementation and evaluation to use. A clear focal point should also created for information exchange among other group members.

(3) Develop clear and consistent health messages, a dissemination strategy, and training in the delivery of key messages. Health messages concerning methyl parathion are difficult to formulate because of insufficient scientific data. This problem is further compounded when multiple agencies have to coordinate and make decisions about what messages should be delivered, how they should be delivered, and by whom. To avoid these problems and communicate the message successfully, development of clear and consistent messages, a strategy for releasing information, and timely training are essential. Once a message is developed, participants must be trained on message content and direction as to who should deliver which message(s). Though the channels used to convey information may change, the message delivered must remain consistent.

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