RISK COMMUNICATION RELATED TO THE FOOD SECTOR

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ABSTRACT
The potential for stigmatization of food is enormous. Well-publicized outbreaks of foodborne pathogens, the furor over agricultural biotechnology and the recent outbreak of foot-and-mouth disease are but three examples of the interactions between science, policy and public perception. Current risk management research indicates that it is essential for risk managers to show that they are reducing, mitigating or minimizing a particular risk. Those responsible must be able to effectively communicate their efforts and must be able to prove they are actually reducing levels of risk.

The components for managing the stigma associated with any food safety issue involve the following factors:
- effective and rapid surveillance systems;
- effective communication about the nature of risk;
- a credible, open and responsive regulatory system;
- demonstrable efforts to reduce levels of uncertainty and risk; and,
- evidence that actions match words.

Appropriate risk management strategies, such as on-farm food safety programs and processing HACCP plans are essential to demonstrate to consumers and others in the farm-to-fork supply chain that producers and regulators are cognizant of their concerns about food safety.

Introduction

Risk communication, the science of understanding scientific and technological risk and how it is communicated within a socio-political structure, is a relatively new scientific endeavor. Starr's 1969 paper was the first attempt to offer a scientific basis for thresholds of risk which were accepted by the public. As public concerns regarding nuclear power gained prominence in the 1970s, investigators tried to establish general principles of public risk acceptability. This was usually based on mortality statistics and the de minimis risk principle, which argued that if a risk can be effectively lowered to less than one additional fatality per million citizens, the risk is effectively zero (U.S. National Research Council. 1989). Such a morbid approach was uniformly unsuccessful. In the 1980s, several groups developed models that incorporated the value systems of individuals, peer groups and societies into risk communication theory (Vlek and Stallen, 1981; Douglas, 1986;

Slovic, 1987). This generated broad agreement that risks are evaluated according to their perceived threat to familiar social relationships and practices, and not by numbers alone.
According to a U.S. National Research Council committee on risk perception and communication (1989), risk communication is defined as, "An interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, which express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management." In essence, risk communication must be treated as a reciprocal process- including the opinions of all stakeholders, not simply those who wish to sell their side of the story more effectively.
Soby et al. (1993), in a review of risk communication research and its applicability for managing food-related risks, developed the concept of the risk management cycle. In this model, public and other stakeholder concerns are actively sought at each stage of the management process- including risk assessment.
"Unless the risk assessment procedure involves an element of interactive public participation and mutual questioning the decisions and conclusions reached may be more likely to be challenged" (Simpson, 1994).
This integrative approach to risk analysis was recently endorsed in a report by the U.S. National Academy of Sciences' National Research Council Committee on Risk Characterization (1996), which urged risk assessors to expand risk characterization beyond the current practice of translating the results of a risk analysis into non-technical terms. The report reframes risk characterization from an activity that happens at the end of the risk assessment process, as many people understand it, to a continuous, back-and-forth dialogue between risk assessors and stakeholders that allows the problem to be formulated properly, and depends on an iterative, analytic-deliberative process.
Similarly, the U.S. Presidential/Congressional Commission on Risk Assessment and Risk Management (1997) developed an integrative framework to help all types of risk managers- government officials, private sector businesses, individual members of the public-make good risk management decisions. The framework has six stages (Fig. 1):
• define the problem and put it in context;
• analyze the risks associated with the problem in context;
• examine options for addressing the risks;
• make decisions about which options to implement;
• take actions to implement the decisions; and,
• conduct an evaluation of the action's results.

Of particular importance from a risk communication perspective is that the framework is conducted in collaboration with stakeholders and iterates stages in the process if new information changes the need for, or nature of, risk management. As Pollak (1996) has argued, due to the inadequacy of scientific knowledge and the lack of public trust in government and in experts, risk regulators should be concerned both with creating institutional arrangements likely to foster trust and mechanisms for providing concerned individuals with credible reassurance. With any risk communication exercise, it is imperative to understand the stakeholder audiences involved in any risk management action.
A body of knowledge has been created over the past decade which can assist in the understanding of public perceptions of microbial food safety risk, how the media translates this information, and how government, industry and other organizations can better relate risk information over a wide range of disciplines. The growth of interest in risk communication is driven by four motivations:
• a requirement for-or desire by-government to inform in the participatory democracies of Western politics, from informal consultation to legislated accountability (such as the U.S. Administrative

Procedures Act of 1946 and the Community Right to Know provisions of Title III of the Superfund Amendments and Reauthorization Act of 1986);
• desires to overcome opposition to decisions;
• a desire to share power between government and public groups; and,
• a desire to develop effective alternatives to direct regulatory control (U.S. National Research Council, 1989).

Underlying these motivations is a general recognition that decision-making in democratic societies is becoming more public and is increasingly driven by non-experts. Thus, the need for a paradigm or system, such as the risk communication framework, which acknowledges this transition. The ability to apply science-based solutions to food safety and other food-related challenges is intricately dependent on issues of public perception, the regulatory environment, fairness, accountability and, most importantly, trust. Proactive, industry and producer-led risk management efforts such as Environmental Farm Plans (EFP), pesticide training courses, and on-farm food safety systems must increasingly demonstrate to a skeptical public that risk is being reduced, that actions are matching words.

The Role of the Media in Risk Communication

The outbreak of bovine spongiform encephalopathy (BSE, or mad cow disease) in the U.K. and the well publicized 1993 outbreak of E.coli O157:H7, known as the Jack-in-the-Box outbreak, have dramatically changed the public discussion of food safety in North America.

The Jack-in-the-Box outbreak, which eventually killed four children and sickened over 700, had all the elements of a dramatic story which catapulted it to the top of the public agenda -- at least in the U.S. Children were involved; the risk was relatively unknown and unfamiliar; and a sense of outrage developed in response to the inadequacy of the government inspection system (for a full accounting, see Powell et al., 1997). E. coli O157:H7 became the focus of Congressional debates on regulatory reform, tragic tales from bereaved parents, and the subject of investigative journalism. More importantly, in the wake of Jack-in-the-Box, stories about microbial food safety began appearing more frequently and more prominently in American media.

During the same time period, there have been many public opinion surveys about biotechnology in general, and more specifically, agricultural biotechnology. Since public discussion of this issue began in the late 1980's and early 1990's, concerns about biotechnology have been driven by ethical and safety concerns. Interestingly, the relatively low levels of public support for a variety of gene transfers change dramatically when a gene transfer is tied to achieving a specific goal that is deemed worthy, such as increasing nutritional content in a food crop. The popular press has been instrumental in framing issues in a social context.

Public communication about issues of technological risk often involves messages from diverse individuals or communities that are translated and synthesized by media outlets and other members of the public. At each step, message providers, journalists and audience members are using their own value systems, constraints and the filters of experience and expectation to contexualize the information they receive. It is therefore incumbent on the provider of risk messages to determine how a specific target audience receives and perceives risk information. The role of the media in shaping public perceptions during technological controversies has been well-documented (Molitor, 1993). Yet the actual impact of media coverage on citizen decision with respect to a particular risk remains unclear.

Protess et al. (1987) found that when examining the impact of reporting on toxic waste controversies media disclosures had limited effects on the general pubic but were influential in changing the attitudes of policy makers. Dunwoody (1993) argues that while mass media tells people something about the risk present in a society, interpersonal channels are used to determine the level of risk to individuals. How much information these secondary sources originally receive from media stories has not yet been determined. Further research is on-going in this area (Atman, et al., 1994; Bostrom, et al., 1994; Frewer and Shepherd, 1994; McCallum, et al., 1991).

Communicating uncertainty is also the focus of more recent research. While it is often argued that a more thorough explanation of uncertainty surrounding a technological risk may enhance trust and citizen decision-making (Johnson, et al., 1992), Johnson and Slovic (1995) found that media accounts containing details relating to health effects and exposure pathways to a dangerous chemical had no apparent effect on risk perceptions. Research in health-related risk communication (Hornig, 1993) has shown that the presentation of risk statistics has little meaning to a public audience, and that attitudes about how science and technology are controlled are better predictors of risk levels than are the cost-benefit considerations, judgments about effects or concerns about how science and technology are used.

Risk Communication and Microbial Food Safety

When 1,000 Americans were asked, "What, if anything, do you feel are the greatest threats to the safety of the food you eat," as part of the annual survey conducted by the Washington-based Food Marketing Institute (1997), spoilage topped the list, as it has for the past four years. Other responses included freshness/expiration dates, bacterial/germs/E. coli, quality control/shipping/handling/storage, spoilage/lack of refrigeration, and pesticides/residues/etc. From 1996 to 1997, the perceived threat to food safety from spoilage, Escherichia coli and quality control increased by 20 per cent (Fig. 2).

Without effective risk communication in the event of a microbial outbreak, the potential for stigmatization of food is enormous. For example, in the spring and summer of 1996, some 1,465 people across North America were stricken with Cyclospora cayetanensis, a parasite initially linked to the consumption of California strawberries. However, the common vehicle was later thought to be Guatemalan raspberries (Hofmann, et al., 1996). Most citizens did not hear the correction, and the California Strawberry Commission estimates it lost $20 to $40 million in sales. Yet despite increased surveillance and risk management of Guatemalan raspberries, cyclospora emerged again in 1997, associated not only with consumption of fresh fruits but with mesclun lettuce in Florida and fresh basil in Washington, D.C. Sales of fresh herbs immediately dropped (Masters, 1997).

In the Odwalla juice company outbreak of E coli, the increased and more effective attention of the Seattle-King County Health Unit-the same one involved in the Jack-in-the-Box outbreak-toward E. coli O157:H7 resulted in rapid identification of the problem. The company exercised exemplary risk communication. Odwalla officials responded in a timely and compassionate fashion, co-operating with authorities after a link was first made on Oct. 30, 1996 between their juice and an illness which was eventually linked to 65 people in four U.S. states and B.C. Upon learning of a child's death, company chairman Greg Steltenpohl issued a statement which said, "On behalf of myself and the people at Odwalla, I want to say how deeply saddened and sorry we are to learn of the loss of this child. Our hearts go out to the family and our primary concern at this moment is to see that we are doing everything we can to help them" (Odwalla, 1996).

Yet despite the comforting words, the company failed to acknowledge the existence of risk, let alone efforts to reduce levels of risk. Steltenpohl told reporters at the time that the company did not routinely test for E. coli because industry experts had advised that the acid level in the apple juice was sufficient to kill the bug. Because they are unpasteurized, Odwalla's drinks are shipped in cold storage and have only a two-week shelf life. Odwalla was founded 16 years ago on the premise that fresh, natural fruit juices nourish the spirit. And the bank balance: in fiscal 1996, Odwalla sales jumped 65 per cent to $60 million (U.S.). Odwalla insisted the experts in this case were the U.S. Food and Drug Administration. The FDA isn't sure who was warned and when. However, researchers from the U.S. Centers for Disease Control and Prevention wrote in the May 5, 1993 Journal of the American Medical Association that a 1991 outbreak of E. coli O157:H7 which struck 23 people in Fall River, Mass.-and was well-publicized at the time-was caused by unpasteurized, unpreserved cider. The story received national media attention and noted that researchers had

found that E. coli could survive for 20 days in unpreserved, refrigerated cider. Further, the authors cited two previously reported outbreaks of illness associated with drinking apple cider.
In Dec. 1994, the Columbus Salami Co. of South San Francisco recalled 10,000 pounds of salami after health officials linked the product to at least 18 cases of E. coli O157:H7 in California and Washington. The bacterium was supposedly unable to survive the acidic environment of salami, and again the story received national coverage. In this case, the industry immediately pledged to test whether E. coli O157:H7 could survive the process used to make dry sausages like salami, which only involves meat curing, not cooking.
And earlier in Oct. 1996, fresh (unpasteurized) apple cider produced at the Notch Store and Cider Mill in Cheshire, Connecticut was linked to an outbreak of E. coli O157:H7 in at least seven people. For Odwalla to say it had no knowledge that E. coli O157:H7 could survive in an acid environment is simply unacceptable in a global food manufacturing and distribution system, especially one becoming increasingly vulnerable to outbreaks of foodborne illness.
Risk Communication and Agricultural Biotechnology
In his comprehensive history of biotechnology, Bud (1993) begins by asking, "What other single word is itself the subject of worldwide polling?" The reason for extensive polling was described by the U.K. Advisory Council on Science and Technology (1990): "The impact of biotechnology will be pervasive. Public perception, and governmental response will be of paramount importance in setting a regulatory framework and determining the rate and direction of the diffusion of the technology. The power of public feeling must not be underestimated; consumer resistance and fears for safety and pollution, for example, can seriously encumber commercial prospects."
Public perceptions of biotechnology have received extensive attention in recent years in most Western countries, including articles (Albrecht 1992), book chapters (Fleising 1991), conferences (Burke, 1993; Institute for Science in Society, 1993; MacDonald, 1993), a public perception bibliography series (Cabirac and Warmbrodt 1993), studies of social implications and public concerns about biotechnology (Lacy et al. 1991, Kemp 1992), and even entire books (Batra and Klassen 1987). There have been many several surveys of public perception of biotechnology (Hallman and Metcalfe, 1994; Hoban and Kendall, 1992; Miller, 1992; Hoban 1990; Berrier 1987; Russell et al., 1987; U.S. Office of Technology Assessment, 1987; Lasley and Bultena 1986). For a review, see Zechendorf (1994). One U.K. survey specifically related to public perceptions of food production and consumption has been completed and analyzed using the psychometric approach developed to understand public risk perceptions (Sparks and Shepherd, 1994; Sparks, et al., 1994). Kelley (1995) recently completed a survey of public perceptions of genetic engineering in Australia. Several such surveys have also been conducted in Canada (Powell and Griffiths, 1994; Optima Consultants, 1994), and other regular surveys are now including questions about biotechnology (Angus Reid Group, 1995; Canadian Council of Grocery Distributors, 1995; Einsiedel, 1997). Awareness of biotechnology in Canada has been consistent since public discussion of biotechnology began in the late 1980's and early 1990's. The 1997 Trends in Canada report (Market Facts of Canada, 1997) indicates that most respondents have some and/or little awareness of biotechnology. Only 9 percent admitted to having heard, read or seen much about biotechnology. Industry Canada focus group research also demonstrated that three quarters of participants had heard of biotechnology (Ekos Research Associates Inc., 1996). Research conducted by Optima Consultants in November 1994, showed that more than 50 percent of the respondents recognized applications of biotechnology (Optima Consultants, 1994). The applications respondents' were most familiar with were genetic testing for disease (84 percent), reflecting perhaps the publics support for using biotechnology to combat disease or the media attention received by this topic. On the other hand, acceptance of biotechnology by the public may not be related to awareness at all. Regardless of whether individuals were aware of biotechnology, respondents were able to make judgements about how useful or risky it was (Frewer et al., 1994; Frewer et al., 1995). Of the

variables studied, usefulness, riskiness and morality, it was found that moral acceptability of biotechnology was the strongest predictor of support for biotechnology.

The public's main concerns about biotechnology are primarily driven by ethical, value and safety concerns (Powell and Leiss, 1997; Optima Research Consultants, 1994; Sheehy, 1996; Einsiedel, 1997; Hagedorn and Allender-Hagedorn 1995). The popular press has been instrumental in framing issues in the social context. Research by Hagedorn and Allender-Hagedorn (1995) supports the idea that public perceptions can be formed only within the boundaries of information available to an individual. Thus, the popular press has addressed the public's ethical, value and safety concerns. Canadian surveys have discovered that although relatively few Canadians had heard or read much about biotechnology, opinions regarding specific biotechnology applications appeared quite strong. Kelley (1995) similarly concluded that Australian voters had firm opinions about biotechnology, and noted that in a democracy, voters routinely make decisions about policies about which they have no detailed academic understanding. Consumers will continue to make decisions about biotechnology, whether they are "better educated" or not.

Although those who said they were more aware about biotechnology thought biotechnology would offer more benefits, these same people also thought biotechnology would offer more danger. The notion that enhanced education would automatically increase acceptance of biotechnology is not borne out by these

results. An alternative suggestion is that those with more education may be better able to critically assess both risks and benefits of a new technology. Kelley (1995) recorded a similar observation and suggested that increases in knowledge lead some people to be more supportive of genetic engineering, but lead other people to be less supportive, and the two effects cancel each other out. Hagedorn and Allender-Hagedorn (1995) concluded the public has expressed a strong perception of being omitted from the process even though this same public has been the focus of many different biotechnology educational initiatives that call for including the public as a legitimate partner (Kemp, 1992), using the media to develop public awareness (McCabe and Fitzgerald, 1991), instituting nationwide public school programs (Miller 1992), and developing a special infrastructure to meet legitimate public concerns (Lacy et al, 1991). These initiatives have shown varying degrees of success and/or acceptance (Hopkin, 1993). The relatively low levels of public support for a variety of gene transfers change dramatically when a gene transfer is tied to achieving a specific goal that is deemed worthy, such as increasing nutritional content in a food crop.

Kelley (1995) obtained a similar result, arguing that most Australians approve of genetic engineering because they see it as serving goals that they value, not because they understand much about it. Such results can inform risk communication efforts; one interpretation is that risk messages regarding agricultural biotechnology must contain a rationale for engaging in such activity. While many respondents suggested medical or agricultural applications when asked about benefits from biotechnology, these same respondents were concerned about the lack of oversight or that the science was "out of control." Risk messages must therefore be designed to address this underlying concern. On a related matter, there was clearly a perception on the part of respondents that experts were not involving citizens in decision-making. Taken together, these results suggest there is a need for either clear messages stressing regulatory oversight and the nature of public consultation, or that current regulatory procedures are inadequate and need to be altered.

Stigmata, Trust, and Guidelines for Effective Risk Communication

The current state of risk management and communication research suggests that those responsible for food safety risk management must be seen to be reducing, mitigating or minimizing a particular risk. Those responsible must be able to effectively communicate their efforts and they must be able to prove they are actually reducing levels of risk. Otherwise, stigma is a powerful shortcut consumers may use to evaluate foodborne risks. Gregory, et al. (1995) have characterized criteria that can lead to the formation of stigmata:

- the source is a hazard;
- a standard of what is right and natural is violated or overturned;
- impacts are perceived to be inequitably distributed across groups;
- possible outcomes are unbounded (scientific uncertainty); and,
- management of the hazard is brought into question.

Certainly the outbreak of bovine spongiform encephalopathy (BSE, or mad cow disease) could be characterized as a stigmata using the evaluative criteria listed above. There have been dozens of other, well-publicized outbreaks since Jack-in-the-Box that contribute to a lack of trust in food safety regulators.

Despite the many examples of risk communication failures from which to learn, many politicians, company executives and academics still urge citizens to become better educated in scientific matters as a means to overcome public fear as a barrier to "progress." This strategy has been advocated by technology promoters in discussions of technological risk for the past 200 years. More recently, promoters of agricultural chemicals in the 1960s and nuclear energy in the 1970s have embraced the public education model. It has failed. Today, the notion of public education is the basis of dozens of communications strategies forwarded by government, industry and scientific societies, in the absence of any data suggesting that such educational efforts are successful.

What is known is that levels of perceived trust in technology promoters and regulators is a better predictor of consumer support. Several surveys in North America and the U.K. have found that perceptions of trust in government regulation (and industry), regarding either pesticides (Dittus and Hillers, 1993) or the products of agricultural biotechnology (Frewer, et al., 1994) is the strongest predictor for consumer support. People
either trust that pesticides and agricultural biotechnology are adequately regulated or they do not. Those with low trust have the highest concern about possible risks. Those with high trust perceive greater benefits from both products. van Ravenswaay (1995) concluded that trust in government and industry may be a more important influence on risk perception than the inherent safety or the danger of a particular agrichemical.

According to Covello (1992a; 1983), research in the psychological sciences has identified 47 known factors that influence the perception of risk; issues like control, benefit, and whether a risk is voluntarily assumed. The most important factor is trust. This can help explain why consumers are concerned about food safety issues that scientists deem trivial. The actual risk does not change, but the perception can; and in the domain of public policy, perception is reality (Covello, et al., 1988; U.S. National Research Council, 1989). People also judge risk according to their perception of its controlling agents: if these controlling agents have a track record of secrecy, or they dominate supposedly independent regulatory bodies and the public policy process, then people magnify the perceived risks (Hamstra, 1992; Covello, 1992b).

A caveat must be added to interpretations of questions relating to perceived trustworthiness. Based on responses of 150 individuals to mock newspaper stories varied to have different social actors state different risk messages, Frewer and Shepherd (1994) found that "stated trust in hypothetical information sources does not necessarily correspond with trust in the same sources in an actual or simulated context." When asked to rank the trust levels of various social actors, respondents generated listings similar to that obtained in this survey. But in the absence of real information-a context such as a newspaper story, or a personally compelling reason to seek out information-such rankings may be meaningless. Frewer and Shepherd conclude that "stated trust in risk information sources and actual reactions to information cannot be equated. The relationship between source and subsequent behavioral reactions may be determined by interactions between information source, hazard characteristics and receiver characteristics. Such interactions should not be investigated outside of a realistic context."

If trust is a better predictor of consumer support, then what factors influence perceptions of trust? Lynn Frewer and colleagues at the U.K. Ministry of Agriculture, Fisheries and Food's Institute of Food Research in Reading have conducted the most comprehensive work toward understanding food-related risk perception. In their most recent paper, Frewer et al. (1996) conducted two sets of in-depth interviews with about 45 people each, and then a larger quantitative survey to better understand the formation of trust. Overall, there were many findings of relevance to effectively communicating about food-related risks, including:

• the most important and frequently cited source of information about food-related information was the media, far ahead of any other source;
• while scientists and medical sources were rated as trusted but not distrusted (media were often trusted and distrusted), they were infrequently named as sources of food-related information;
• the single most important determinant of gain or loss of trust in a source is whether the information is subsequently proven right or wrong, and that the source is subsequently demonstrated to be unbiased;
• information about natural toxins, genetic engineering and pesticide residues was more distrusted than info about high fat diets, microwave ovens, etc.;
• medical sources are likely to be viewed as expert in medically-related areas, but to have little knowledge in technological risk assessment and therefore poor sources of information about technological hazards;
• trust is clearly multidimensional and cannot be predicted by single items or psychological constructs (i.e. surveys which ask respondents to rank social actors-doctors, farmers, environmentalists, government-in terms of levels of trustworthiness are somewhat meaningless in the absence of context)
• trust appears linked with perceptions of accuracy, knowledge and concern with public welfare;
• if government sources and risk regulators are seen to be proactive in their interactions with the media and other trusted sources-including discussions of risks-this may positively influence the way in which risk information is reported, as well as increasing trust in government regulation;
• admitting to uncertainty, or facilitating public understanding of science as a "process" could increase communicators trustworthiness; and,
• people seem to be adverse to ambiguous risks and trust is all the more likely to be important where there is a perception that accurate estimates of risk are not available, like genetically-engineered foods.

Powell and Leiss (1997) stress the need for a long-term institutional commitment to the gradual development and application of good risk communication practices, using the following guidelines.

Risk Communication is serious business-failures can be costly.

The financial cost of the BSE crisis in the U.K. is currently pegged at some $5 billion, a cost which could have been substantially reduced with more effective risk management and communication practices. Outbreaks of foodborne illness routinely cost industry millions of dollars.

Regulators are responsible for effective risk communication

Governments, and in particular those agencies of governments which have regulatory authority over a broad range of health and environmental risks, have-or are capable of acquiring (through enabling legislation) -- the legal authority to manage risks.

Industry is responsible for effective risk communication

It is now generally accepted that industry must take primary risk communication responsibility for product-related risks and workplace hazards, as well as for community awareness in the vicinity of facilities where hazardous materials and processes are employed. But with the rationalization of government services, industry is assuming more responsibility for the delivery of food inspection services (under government auditing) and therefore is assuming more of the risk communication responsibility.

If you are responsible, do it early and often.

Timeliness is everything in effective risk communication: overcoming entrenched perceptions that are broadly dispersed in the social environment is a thankless task with almost no chance of succeeding. Further, doing good risk communication early is of little benefit if it not also done often, as often and as long as is needed to prevent a risk issue from being put into play by other interested parties.

There is always more to a risk issue than what science says.

Public perceptions, values and opinion all enter into characterizations of risk.

Always put the science in a policy context.

Almost any type of risk issue can turn into a seemingly intractable risk controversy, and it is the nature of such controversies inevitably to give rise to demands on governments to "do something" about controlling or eliminating the risks in question. In other words, although the scientific description of the hazards and probabilistic risk assessments can be matters of widespread public interest, in the final analysis the competing choices among risk management options-banning or restricting a substance, say-make up the contents of letters and calls to politicians. This means that the contents of effective risk communication cannot be limited to the scientific description of hazards or the risk numbers. Rather, the science should be put into a policy (action) context, which in the early stages of an emerging risk controversy might take the form of forecasting a range of policy options-including the "do nothing" option-and of exploring their consequences in terms of implications for economic and social interests, international developments, and obligations for environmental protection (all in the context of the risk management cycle, mentioned earlier). Responsible agencies and industries ought to begin discussing the possible policy responses to emerging risk controversies as soon as they arise, and continue to do so throughout their life history.

"Educating the public" about science is no substitute for good risk communication practice.

Sanctimonious urgings for new programs designed to increase the public's awareness about the inner mysteries of scientific research are encountered frequently. What appears to sustain this mission is the curious belief that the citizenry's ignorance of scientific method can best explain the observed differences between the expert assessment of risk and the public perception of the same. This rhetorical strategy has been advocated by technology promoters in discussions of technological risk for the past 200 years. More recently, promoters of agricultural chemicals in the 1960s and nuclear energy in the 1970s have embraced the public education model. It has failed. Today, the notion of public education is the basis of dozens of communications strategies forwarded by government, industry and scientific societies, in the absence of any data suggesting that such educational efforts are successful.

Banish "No risk" messages

Ironically, although citizens and environmentalists are often taken to task by government and industry officials for advocating "zero risk" scenarios, pronouncements of the "there is no risk" variety are a favourite of government ministers and sometimes of industry voices as well. In fact, at least some business sectors-the chemical industry in particular-do this less and less, which is a sea-change from what used to be their standard public relations practice.

Risk messages should address directly the "contest of opinion" in society.

There is a curious reluctance, especially on the part of government risk managers, to avoid addressing directly the alternative representations of risk issues as they form and re-form in dialogue among interested parties in society. Quite simply, if government regulators and industry have the primary responsibility for effective risk communication, these officials cannot avoid confronting the issues as they are posed in the society.

Communicating well has benefits for good risk management.

Good risk communication practice should be regarded as of equal importance to the other key elements-risk assessment and the evaluation of risk control options-in the overall risk management process. In fact, good risk communication practice can be regarded as the causeway that links all

the organizational elements in a well-functioning risk management process, especially in the face of scientific uncertainty.

Risk analysis and food safety

Covello and Merkhofer (1994) define risk as a combination of something that is undesirable and uncertain. More specifically, "the possibility of an adverse outcome, and uncertainty over the occurrence, timing or magnitude of that adverse outcome." Risk analysis was first formalized by the U.S. National Academy of Sciences-through its U.S. National Research Council-in 1983, in a publication commonly referred to as, The Red Book. The 1983 NAS-NRC model explicitly distinguished between three stages of risk analysis: risk assessment, risk management and risk communication. Risk assessment, it was argued, is a scientific assessment of the true risk; risk management allowed for the incorporation of non-scientific factors to reach a policy decision; and risk communication involved the communication of a policy decision.

Hazard Analysis Critical Control Point (HACCP) & On-farm Food Safety Systems

Hazard Analysis Critical Control Point is a system of food safety control based on a systematic approach to the identification and assessment of hazards associated with food operations and the definition of means for their control. This approach focuses on prevention and control and is advocated for every stage in the food chain, from primary producers up to the final consumer. Producer-led risk management programs such as this one, are an appropriate risk management strategy that demonstrates producers are aware of consumer concerns about food safety.

It is widely recognized that the first application of HACCP to food safety was at the Pillsbury Company in the 1960s, when developing safe foods for the American space program. The HACCP system had to ensure "zero" defects during food handling by monitoring the whole preparation process. It had to identify and correct errors before they happened, rather than using the traditional method of test sampling the finished product to identify foods with high levels of contamination.

HACCP has gained recognition throughout the developed world, as the best safety assurance system developed to date. It has been recommended by the National Academy of Science (USA) and the World Health Organization's Codex Alimentarius committee, as well as the Food and Drug Administration (FDA) as an effective and workable approach to food safety, control, and can be incorporated into a total quality management program.

The main objective of Agriculture Canada's Food Safety Enhancement Program (FSEP) is to encourage the adoption of HACCP principles that may help to ensure the consistency of food safety programs across all agri-food commodity groups in Canada.

Besides its preventive nature, the HACCP system exercises control over the manufacturing process at critical stages which are known as "critical control points" (CCP), detecting or correcting defects which might impact on the safety and wholesomeness of the product before its packaging and distribution.

The application of the HACCP system consists of a logical sequence of twelve steps encompassing seven basic principles, which can be implemented in any food industry. However, as recognized by the U.S. Food and Drug Administration (FDA), true on-farm HACCP systems are unachievable for fresh produce because there are no critical control points such as pasteurization that can be applied. However, HACCP principles can guide development of on-farm food safety programs.

Conclusion

Slovic (1997) noted, "We live in a world in which information, acting in concert with the vagaries of human perception and cognition, has reduced our vulnerability to pandemics of disease at the cost of increasing our vulnerability to social and economic catastrophes of unprecedented scale. The challenge before us is to learn how to manage stigma and reduce the vulnerability of important

products, industries, and institutions to its effects, without suppressing the proper communication of risk information to the public."

In essence, risk messages must be designed to address underlying concerns, stressing regulatory oversight and the nature of public consultation, and whether regulatory procedures are adequate or need to be altered.

Producer-led risk management programs are an action, an appropriate risk management strategy, to demonstrate to consumers that producers are cognizant of their new found concerns about food safety, and to demonstrate that producers and others in the farm-to-fork continuum are working to reduce levels of risk. Because when the next outbreak or crisis of confidence comes-and microorganisms can adapt and evolve to any food production and distribution system that is created-producers need to demonstrate due diligence to minimize potential losses.

Surveys and media analysis have shown that level of perceived trust in promoters and regulators of technologies are the most accurate gauge of consumer support. Further, as Frewer and Shepherd (1994) concluded, "stated trust in risk information sources and actual reactions to information cannot be equated."

People who demonstrate low trust have the highest concern about possible risks regarding pesticides and the products of agricultural biotechnology. Those with high trust perceive greater benefits from both products. Therefore, instead of the inherent safety or danger of a particular food product or technology being the influencing factor of risk perception; trust in government and industry is more important.

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An annotated bibliography on Food Safety Risk Assessment, Management and Communication is available on the USDA/FDA Foodborne Illness Education Information web site at:
http://www.nal.usda.gov/fnic/foodborne/risk.htm

Figures
Fig. 1. U.S. Presidential/Congressional Commission on Risk Assessment and Risk Management risk management framework (1997).
Fig. 2. Perceived Threats to Food Safety (%); n=1,011 (Food Marketing Institute, 1997)