

# Challenges in Pesticide Risk Communication

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## Abbreviations

<b>DHHS</b>	Department of Health and Human Services
<b>EPA</b>	United States Environmental Protection Agency
<b>FAO</b>	United Nations Food and Agricultural Organization
<b>GHS</b>	Globally Harmonized System for the Classification and Labelling of Chemicals
<b>LD<sub>50</sub></b>	lethal dose to kill 50% of test animals
<b>OSHA</b>	Occupational Safety and Health Administration
<b>WHO</b>	World Health Organization.

## Introduction

Pesticides are toxic substances by design and are intentionally used for the control of various 'pests' (insects, weeds, diseases, etc. that are in competition with humans). The health risks associated with pesticide use are well highlighted in numerous research studies and range from acute symptoms of varying severity (e.g., headaches, vomiting, skin rashes, respiratory problems, eye irritations, seizures, coma, death) to various chronic effects (e.g., cancer, asthma, dermatitis, endocrine disruption, birth defects, neurological effects). As all pesticides are toxic and vary in degrees of toxicity, end users require knowledge of a particular pesticide's associated risks for risk decision making to protect themselves and the environment from harmful exposures and contamination. Simplistic enough in concept, communicating pesticide risks to diverse end users is challenging and contentious. The complexity of transmitting risk concepts is often underestimated, and more importantly, intended risk messages are often misinterpreted. This is particularly the case in developing countries where transnational pesticide companies and governments regulating pesticides are faced with transmitting risk information to semiliterate and illiterate populations. Thus effective pesticide risk communication is vital in the development and implementation of pesticide and environmental health policies, regulating pesticides, protecting human health, and preventing environmental contamination. Environmental health professionals play a key role in developing, evaluating, and implementing effective risk communication strategies relevant for the protection of various target audiences.

This article presents a brief general background on the field of risk communication before focusing specifically on the issues relating to communicating risks associated with pesticides. Although challenges may overlap, pesticide risk communication issues and differences between developed and developing countries are highlighted. This is particularly important in light of globalization and global usage of risk communication strategies. Although the challenges associated with transmitting risk information about pesticides is the focus of this article, the reader is left with recommendations for promoting effective environmental health risk communication generally as well as identifying areas for future work.

## Risk Communication

"No matter how accurate it is, risk information may be misperceived or rejected if those who give information are unaware of the complex, interactive nature of risk communication and the various factors affecting the reception of the risk message. Fessenden-Raden et al. (1987)"

Risk communication is the process through which people become informed about hazards with the intention of influencing behavioral changes. Understanding this process of transmitting or exchanging information about the likelihood and consequences of adverse events, in this case, from the exposure to pesticides, is crucial for managing risks in environmental health. Within the risk communication literature there are three schools of thought of how risk communication can control risk: (1) risk communication as public relations (i.e., educating the public), (2) risk communication as a business strategy (i.e., regulatory compliance, risk sharing, transferring liability to end users as is the case with product labels where the end user may have to pay a penalty/jail time for not using a product as directed on the label), and (3) risk communication as risk management (i.e., eliciting safety behaviors). Within each of these schools of thought, the objectives and goal of communicating risks vary, overlap, and sometimes even conflict with the other schools of thought. Thus, the term risk communication has different connotations and different outcomes for the various risk communication practitioners and participants. For example, the view that risk communication is a business strategy (2) would focus on the ultimate goal of

fostering corporate profits rather than the promotion of human health, which would be the primary focus in risk communication as a risk management strategy (3). All three strategies are used in communicating risks about pesticides to workers, end users, and the general public; however, the purpose of the strategy depends on who is communicating and what their underlying goal or purpose is in communicating pesticide risks. In this article, a brief overview of the field of risk communication is presented to contextualize the discussion of pesticide risk communication strategies used in developed and developing countries.

The field of risk communication developed as a result of several interrelated factors, including the legal and moral obligations placed on governments and industries to inform potentially exposed populations of environmental, technological, and health hazards, along with public policy difficulties resulting from social conflicts over risks (e.g., industry versus community rights in the citing of pesticide factories in poor communities and developing countries). Baruch Fischhoff, a psychologist and researcher in risk decision making, modeled an eight-stage chronology summarizing risk communication development over the past 20 years. In Fischhoff's model, each stage represents the main strategy that risk communication practitioners viewed as effective at the time. Thus, each stage transcends the limits of preceding strategies, building on what preceded that stage. These risk communication stages are as follows:

- Stage 1: Only need to get the numbers right.
- Stage 2: Only need to tell the target audience the numbers.
- Stage 3: Only need to explain what is meant by the numbers.
- Stage 4: Only need to illustrate that the target audience has accepted similar risks in the past.
- Stage 5: Only need to show the target audience that they are getting a good deal.
- Stage 6: Only need to treat the target audience nicely.
- Stage 7: Only need to make the target audience partners.
- Stage 8: All of the above.

Currently, in literature from developed countries, risk communication operates at stage 8, which sees risk communication as a two-way process based on a collaboration between the target audience and an agency (often government and industry) in developing the most appropriate communication strategy for the target audience. However, risk communication, and particularly pesticide risk communication, in developing countries such as South Africa appears to be stuck at Fischhoff's stages 1 and 2. That is, risk communication is viewed from the traditional authoritarian top-down (one-way)

**Table 1** Some characteristics of the two languages of risk communication

<i>'Expert' assessment of risk</i>	<i>'Lay/public' assessment of risk</i>
<ul style="list-style-type: none"> <li>● Scientific</li> <li>● Probabilistic</li> <li>● Acceptable risk</li> <li>● Changing knowledge</li> <li>● Comparative risk</li> <li>● Population averages</li> <li>● A death is a death</li> </ul>	<ul style="list-style-type: none"> <li>● Intuitive/personal experience/hearsay</li> <li>● Yes/no</li> <li>● Safety</li> <li>● Is it or isn't it?</li> <li>● Events</li> <li>● Personal consequences</li> <li>● It matters how people die</li> </ul>

Source: Leiss W and Powell D (2004) *Mad Cows and Mother's Milk: The Perils of Poor Risk Communication*, 2nd edn. Montreal: McGill-Queen's University Press.

assumption that the laity (e.g., general public, workers) do not understand or do not have access to technical scientific data and therefore only require the provision of risk information to have the appropriate risk reduction behaviors when exposed to risks.

To understand from what basis risks are communicated and from what basis they are perceived, it is important to have an understanding of the two languages of risk communication (Table 1). The level of risk literacy, that is the ability to weigh risk and benefits for decision making (often through interpreting statistics and probability) varies both within and between developed and developing countries. Developed countries generally expose the general public more to the technical language of risk through regular reporting of scientific studies in the media, which has the potential to increase risk literacy.

## Risk Communication Factors

When communicating risks, there are several factors that need to be considered, which influence both how the information is communicated and how it is received. These factors are the target audience, the messenger, the message itself, and the medium for transferring the message. These four factors are briefly discussed in the following text.

### Target Audience

Target audiences of a risk communication strategy are not homogenous, which is problematic when risk communication strategies are developed to cover a broad and general audience. Therefore, understanding the audience and their characteristics (e.g., social and cultural beliefs, language, economic status) is the most important principle for effective risk communication. Target audiences' characteristics, identified in the literature, that need to be

defined and taken into account when communicating risks include:

- The individual's or the group's values and frame of references/world views
- Previous experiences with the risk (e.g., previously poisoned by pesticides?)
- Previous experience with and attitudes toward the organization communicating the risk
- Literacy level
- Levels of formal education/training
- Current level of knowledge about the risk
- Health status of the individual and their family members
- Local conditions that might affect how information is received (e.g., socioeconomic status, political climate)

This list of characteristics can be used in the field of environmental health as a survey guideline for the type of information needed before considering and developing a risk communication strategy.

### **The Messenger**

Messenger characteristics also influence effective risk communication especially in relation to how the target audience trusts who is communicating the risk information (e.g., government official, pesticide industry representative, environmental health professional). Factors influencing a target audience's trust of a messenger include characteristics such as competence and expertise, objectivity, fairness, consistency, goodwill, commitment to a goal, fulfilling responsibilities, honesty, and openness. Environmental health specialists need to engage in critical evaluation of pesticide risk communication strategies with the prime goal of protecting human health and the environment.

### **The Message**

Generally, the goal of risk messages is to inform and influence the target audience either to produce an intended behavior to reduce risk exposures or to alter the target audiences' risk perceptions. Risk messages are either 'official' or 'unofficial' and are expressed through various methods. Official risk messages are statements that are communicated by the 'experts,' for example, scientists, government officials, and chemical companies' technical staff. Unofficial risk messages, however, are referred to as statements communicated by laypersons and the media. For most of the part, both official and unofficial risk messages are hard to create in ways that are accurate, comprehensible, and not misleading. These messages tend to make general statements rather than providing numerical information/statistics regarding the magnitude of the risk (e.g., 'harmful if inhaled' does not specify the quantity that can cause harm). Risk messages

also tend to be controversial as the hazards they depict are themselves controversial.

According to the National Academy of Sciences, risk messages should have the following qualities for effective risk communication to occur:

1. Emphasized information relevant to any practical actions that can be taken;
2. Used clear and plain language;
3. Reflected and respected target audiences and their concerns/worries; and
4. Focused on informing the target audience rather than using persuasion or influencing strategies.

### **The Medium**

Various mediums (tools, strategies, methods) are employed for communicating risks to diverse target audiences. For example, in developed countries, risk communicators rely on mediums such as community and public talks/meetings, the Internet, the media, labels on products, and signage in areas where risks may occur; whereas in developing countries, predominately the mediums used are labels and signage (**Figure 1**), with occasional use of the media.

Pesticide labels are one of pesticide companies' main risk communication mediums, which rely on technical data and scientific jargon to convey the message that pesticides are 'safe' as long as the label information is adhered to. In South Africa, for example, the government and pesticide industry assume that the pesticide label is a viable medium for communicating pesticide risks to all population groups, irrespective of the appropriateness of the medium's characteristics for these groups – that is, language of the written text, technical language proficiency, unexplained icons, and symbols. That is to say that if a case of pesticide use results in poisoning or environmental contamination, government and industry would presume that risk communication was sufficient because there was a label on the container.

What are the implications of risk communication for the field of environmental health? Risk communication in environmental health, generally, highlights the public's right-to-know about chemical and industrial hazards, and as presented here, the 'right-to-comprehend' risk information is neglected. Although within the field of environmental health substantial attention has focused on risk communication, existing models focus on communicating general risk messages to population groups and not on communicating specific exposure or risk data to individuals. As people who are exposed to pesticides are not homogeneous and exposure contexts have vast differences, risk information should ideally be contextual and individually relevant. However, no simple risk message would fit this requirement. The question is then what information should be communicated and how



**Figure 1** Billboard used for risk communication in Lusaka, Zambia.

exposure contexts should be addressed by these risk messages.

## Pesticide Risk Communication

Communicating the risks associated with various pesticides is of vital importance since many of these products are highly acutely toxic and cause long-term health effects. The risk communication platform for pesticide risks is based on scientific testing of each pesticide to determine potential risks to humans and the environment, as well as determining acceptable levels of risk. Toxicological and ecotoxicological data are then translated into risk assessments (the evaluation of potential adverse effects) by extrapolating these data (in most cases conducted on laboratory animals) to humans. The assumptions made in human extrapolations generally rely on a model of a healthy Caucasian male whose susceptibility may be very different to that of a person living in a different context. Although every country using pesticides should require that research and risk assessment data are produced within that country, realistically, most developing countries have neither the financial and human resources nor laboratory capacity to conduct these expensive tests. This results in most regulatory agencies in developing countries accepting, for registration purposes, the pesticide risk assessment data produced by the parent pesticide company, which is predominately based in a developed country and therefore the data are premised on risk assessments using different populations with different susceptibilities.

What is the implication of inappropriate risk assessment data for pesticide risk communication? In developing countries the human populations do not resemble healthy Caucasian males and many suffer from a range of health burdens (immune deficient diseases, malnutrition, etc.). Furthermore, climatic conditions are vastly different. Developing countries often experience hotter climatic conditions resulting in some pesticides breaking down into more toxic metabolites (e.g., organophosphates). This means that if populations in developing countries are able to understand the pesticide risk information being communicated, the information may well be inappropriate for protecting their health given their own health and the environmental context within which they are using the pesticide.

## Pesticide Risk Communication Strategies

Pesticide communication strategies are not uniform between developed and developing countries. The former rely on the media, public and community discussions/meetings, and pesticide labels. In developing countries, predominately the only risk communication tool to which the general public and workers have access to is the pesticide label. Whose responsibility is it for communicating pesticide risk information to exposed populations? Is it the pesticide industry, which has a vested interest in presenting information that indicates all pesticides are safe? Or is it the government who may receive industry financial support or, in the case of developing countries, who do not have the capacity to

conduct and implement effective risk communication? In the United States, the Department of Health and Human Services (DHHS) and the Environmental Protection Agency (EPA) share the broadest set of responsibilities for determining and communicating health risks to the public. The United States also has the legislated Hazard Communication Standard under the Occupational Safety and Health Administration (OSHA) for work-related risk communication. Agencies responsible for and professionals concerned with environmental health issues should more proactively be involved in the critical evaluation of pesticide risk communication strategies, especially in countries where no formal structures for evaluating risk or hazard communication exist.

### **Pesticide Labels as a Risk Communication Tool**

Pesticide manufacturers and regulatory agencies globally rely on pesticide labels to communicate general information, as well as environmental and toxicological risk assessment data to end users with the intention of soliciting specified safety behaviors. The label serves a dual function. That is, it provides use and risk assessment information for risk reduction and product efficacy, on the one hand, while on the other, it functions as a legally binding document. Namely, the end user is bound to use the pesticide as indicated on the label or be liable for penalties. Therefore, comprehension of the risk information is vital not only to protect human health and the environment, but also against liability charges. The results from toxicological and environmental risk assessments conducted on a particular pesticide will be expressed on the label as information, for example, on handling, storage, application methods, waiting periods before reentering into sprayed areas, disposal, and poisoning first aid. Pesticide labels are designed by the company producing the pesticide. The labels are designed to meet the standards set by the regulating body of the country and submitted to this body when a company first applies to register a pesticide.

Currently, pesticide labels are not standardized in how they present risk information and vary depending on which countries they are used in. In many developing countries, pesticide companies are required to produce labels that follow the United Nations Food and Agricultural Organization's (FAO) guidelines to labeling under the International Code of Conduct on the Distribution and Use of Pesticides. This entails the use of pictograms and color codes for transmitting hazard information, the precautionary measures required, as well as the toxicity of a pesticide. However, developed countries do not use these. To illustrate this point, two pesticide labels are presented for the same chemical (i.e., aldicarb) and produced by the same company (i.e., Bayer

CropScience). **Figure 2** illustrates the front page of a pesticide label used in the United States for the acutely toxic (WHO Class Ia) pesticide aldicarb (trade name is Temik). **Figure 3** illustrates the front label used on Temik products in South Africa. The American front label of Temik provides more detailed written risk information, particularly first aid information, than the South African label, which predominately presents protective equipment and warning advice information using symbols. Thus both labels present a different take on communicating the same acute toxic risks. What is also interesting to note is that both labels, in written text, put the responsibility of negative health and environmental effects back on the end user. That is, the American label states, "if you do not understand the label, find someone to explain it to you in detail" (what happens if the person cannot read?) and the South African label states, "do not misuse this product" (what constitutes misuse? What if the person cannot read?).

### **Interpreting and Communicating Pesticides Risk Assessment Data**

The right-to-know about pesticide risks does not necessarily equal the right-to-comprehend what these risks mean and how to prevent them. In risk communication, emphasis is often placed on the communication process, that is, understanding the target audience, designing messages either to alter risk perceptions or to influence behaviors, developing various strategies for the message transmission, and working on developing trust of the messengers. However, little emphasis and attention is placed on how risk messages are comprehended and whether these interpretations are actually increasing environmental health risks. In the case of pesticides, the concepts behind the risk information are complex and prone to misinterpretations. Research has shown that pictograms used on pesticide labels in developing countries to transmit risk assessment data to illiterate populations are not well understood and often lead to hazardous misinterpretations (**Figure 3**). A problem is that definitions of these pictograms are intuitively implied. That is, the meanings/scientific definitions for each pictogram (and for the other risk communication vehicles on the label – e.g., color, risk phrases) are not provided on the label. The assumption is that the pictogram is simplistic enough in design to be obviously understood. This, research has shown, is not the case.

### **Communicating the Concept of 'Toxicity' and Acute Effects**

In 1973, the World Health Organization of the United Nations (WHO) developed a classification system to

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IF SWALLOWED:	<ul style="list-style-type: none"> <li>• Immediately call a poison control center or doctor for treatment advice.</li> <li>• Do not induce vomiting unless told to do so by a poison control center or doctor.</li> <li>• Have person sip a glass of water if able to swallow.</li> <li>• Do not give anything by mouth to an unconscious person.</li> </ul>
IF IN EYES:	<ul style="list-style-type: none"> <li>• Hold eye open and rinse slowly and gently with water for 15–20 minutes.</li> <li>• Remove contact lenses, if present, after the first 5 minutes, then continue rinsing.</li> <li>• Call a poison control center or doctor for treatment advice.</li> </ul>
IF ON SKIN OR CLOTHING:	<ul style="list-style-type: none"> <li>• Take off contaminated clothing.</li> <li>• Rinse skin immediately with plenty of water for 15–20 minutes.</li> <li>• Call a poison control center or doctor for treatment advice.</li> </ul>
IF INHALED:	<ul style="list-style-type: none"> <li>• Move person to fresh air.</li> <li>• If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible.</li> <li>• Call a poison control center or doctor for further treatment advice.</li> </ul>
For MEDICAL Emergencies Call 24 Hours A Day 1-800-334-7577. Have the product container or label with you when calling a poison control center or doctor or going for treatment.	

Aldicarb is a N-methyl carbamate.

GENERAL

**Figure 2** Temik pesticide label used in the United States.

distinguish between the levels of hazards for each pesticide. This classification system is only in relation to acute risks to health and does not reflect potential chronic risks from exposure (see the section “Communicating the concept of ‘long-term,’ chronic health effects”). The WHO classification attempts to distinguish between the hazardous levels of each pesticide based on the toxicity of the compound (Table 2). What needs to be

remembered is that toxicity testing does not take into account the context the pesticide will be used in or the current health status of the humans that are exposed. Toxicological risk assessments are intended to deal with these interpretations.

More specifically, the WHO classification is based on the acute oral or dermal toxicity of a pesticide to rats, which is determined by the LD<sub>50</sub> in laboratory trials. The

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INSECTICIDE GROUP CODE 1A

Active ingredient:  
Aidicarb (carbamate) ..... 150g/kg

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NOTE:

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**Figure 3** Temik pesticide label used in South Africa.

LD<sub>50</sub> value is a statistical estimate of the number of milligrams of toxicant per kilogram of bodyweight required to kill 50% of a large population of test animals. Communicating pesticide health risks based on the LD<sub>50</sub> to a nonscientific target audience is not a simple feat and even more challenging where nonliterate audiences are concerned. Although the WHO does not specify the symbols or risk phrases to list on pesticide labels to show the level of toxicity, general recommendations are made, especially in relation to the most toxic pesticides (e.g., recommend skull and cross bones symbol for classes Ia and Ib). The WHO hazard classification system is currently being revised to incorporate a new system attempting to harmonize the classification and labeling of

chemicals globally (see the section “New initiative to harmonize chemical hazard classification and communication”).

Nevertheless, the FAO Code of Conduct recommends the use of color bands on pesticide labels to illustrate the active ingredient and the formulation’s acute toxicity based on the WHO’s hazard classification of pesticides (Figure 3 and Table 2). Table 2 presents the toxicity color codes used in South Africa. Although the FAO Guidelines on Good Labelling Practice for Pesticides specifies colors to use with each WHO hazard class, some countries interpret these colors differently (e.g., purple instead of red or orange instead of yellow). This is particularly problematic for countries such as Zambia who

**Table 2** WHO acute hazard classification for pesticides and South African color codes

WHO acute toxicity classes	Class Ia Class Ib	Class II	Class III	Class IV or U (unclassified)
Hazards of active ingredient	Extremely hazardous Highly hazardous	Moderately hazardous	Slightly hazardous	Less hazardous
South African FAO toxicity color codes				

import pesticides from South Africa and Zimbabwe, as each of these countries use different colors for the four hazard classes. Linking colors to toxicity is quite arbitrary, and current research has shown that end users rely on their social and cultural frame of reference to interpret what these colors means. These interpretations are often not as scientifically intended and may not afford protection from potential exposure risks in different cultural settings. The concept of 'toxicity' is not easy to explain to populations with limited or no scientific background. Using color to denote acute toxicity may therefore, in the absence of effectively communicating risk, serve more as a means to protect the industry from liability rather than effectively communicate the potential acute pesticide risks.

### New Initiative to Harmonize Chemical Hazard Classification and Communication

In 2002, the United Nations agreed on a voluntary international system for classifying and labeling all chemicals, including pesticides. The Globally Harmonized System for the Classification and Labelling of Chemicals (GHS) was meant to be globally implemented by 2008, but to date only a handful of countries have implemented this system. This system provides a framework for identifying and communicating chemical hazards with the intention of reducing human health risks, reducing environmental contamination and removing barriers to trade in chemicals. The GHS advocates the use of nine pictograms as risk communication vehicles for common and risky chemical hazards with the view to promoting global recognition of these (Figure 4). Preliminary research findings indicated a high confusion in understanding many of these pictograms, which resulted in high misinterpretations. The aim of the GHS is to promote continuity in chemical risk communication tools, particularly in light of continued globalization and trade in chemicals. The current FAO pictograms used on pesticide labels in developing countries will continue to be used in conjunction with the new GHS symbols when a GHS symbol is not available.

**Figure 4** GHS hazard pictograms.

### Communicating the Concept of 'Long-Term,' Chronic Health Effects

The GHS presents the first attempt to develop a hazard classification system for chronic effects associated with pesticide exposures. This system has also designed a risk communication pictogram to represent, without words, the concept of chronic hazard (Figure 4). The concept of an exposure causing an effect many years from now is difficult for nonscientific populations and especially poor populations worried about daily survival. This particular pictogram is prone to misinterpretations by its sheer design, which draws more attention to respiratory ailments, heart problems, and, in some countries, spiritual enlightenment.

### Comprehension Issues

Insufficient research and evaluation, before implementation, are currently assessing whether target audiences



actually understand the risk information being communicated as scientifically intended. Government officials, researchers, and other risk communicators need to ensure that Fischhoff's stage 8 promotes more participatory research and evaluation of risk communication strategies such as pictogram designs, phrasing of risk message, and finding other visual means for communicating risk, especially for developing country target audiences. For example, the GHS-proposed pictograms were not tested for comprehensibility before adoption of this new system. Nor was extensive research conducted with illiterate populations on the comprehension of the FAO pictograms when they were developed in 1980. Recent research has shown that farmers and farm workers in developing countries are predominately unable to interpret the FAO pesticide pictograms as scientifically intended. Some of the interpretations given for these pictograms were critical confusions, implying that interpretations could lead to even more hazardous exposures.

### **Pesticide Risk Perceptions**

Risk perception refers to people's beliefs, attitudes, judgments, and feelings toward risk, and incorporates the wider social and cultural values, as well as outlook, people adopt toward hazards. Perception is a significant concern for risk communication. Risk perception research has provided risk communication researchers with insights into the various issues in relation to people's attitudes, beliefs, and interpretations of risk. However, the trend in the risk communication literature focuses mostly on how to use risk communication mechanisms to control, manipulate, and change perceptions to achieve a desired precautionary behavior rather than using risk perceptions as a starting point for adapting various communication strategies to promote better understanding of the risk information. What is important to take into account is the role that risk perceptions play in interpretations of risk communication strategies and, more specifically, the perceptions of the symbols, pictograms, and color codes used as risk communication vehicles.

### **Can Pesticide Risk Communication Be Context Neutral?**

Pesticide toxicity data are produced in laboratory environments. It is in this context that risk information is produced. For example, what precautions pesticide users need to take (e.g., wear gloves, wear a respirator, harmful if swallowed) to prevent possible negative health effects. However, once a pesticide leaves a laboratory the context it is used in is no longer controlled and pristine. Thus the

question is, can risks identified in a laboratory be adequately identified and appropriately extrapolated to human use and exposure contexts? In many developing countries, protective equipment is not available, pesticide containers are reused (e.g., for food and water), and pesticides intended for agricultural uses are decanted and sold in unlabeled containers by street sellers in informal markets for domestic control of pests. Furthermore, current strategies do not present risk assessment information relevant (1) to protect children from exposure vulnerabilities (e.g., neurodevelopmental effects) or (2) to protect pregnant or lactating women farm workers from risks. (e.g., birth defects, transmission of residues from hand to breast to baby).

Thus provision of pesticide safety information cannot be context neutral. The challenge is how to produce more context-relevant risk information and, ultimately, an appropriate risk communication tool. Otherwise, the question arises as to the purpose of the safety information - i.e., to protect industry from liability or to protect the end user? One suggestion for laboratory-based research on pesticides is to include simulated contexts found in developing countries or amongst migrant farm labor populations in developed countries.

### **Challenges in and Recommendations for Effective Pesticide Risk Communication**

This article has illuminated some of the many challenges faced in communicating scientifically identified pesticide risks to diverse population groups. To make pesticide risk communication an effective endeavor, particularly for developing countries, many of these challenges will need to be addressed by environmental health professionals and students, policy makers, and others. Challenges to be addressed include:

- Pesticide risk communication strategies tend to be static, particularly in developing countries. Climate change challenges risk communication strategies to become less static and to provide information to protect from unforeseen risks due to climate change.
- Developing risk communication mechanisms in developed countries is currently more participatory and interactive for those who have access to the Internet. The challenge is to promote participatory and problem-solving risk communication strategies in developing countries where the means to participate are limited and not actively fostered.
- Current pesticide risk communication strategies (e.g., pictograms) are not gender specific or targeted for children. The challenge is to design relevant strategies.
- Addressing means of communicating risks to informal sector pesticide street sellers.

- An enormous challenge is for those involved in risk communication to promote the concept of the right-to-comprehend risk information (i.e., provision of mechanisms to understand risk information) rather than just the right-to-know (i.e., provision of or access to information only). For example, one way to foster comprehension of existing risk communication strategies would be to include pesticide pictograms and color codes in the curriculum of schoolchildren and incorporating risk communication into tertiary degree programs (e.g., in environmental health fields). New and progressive risk communication strategies are needed, which not only focus on communicating risks to semiliterate and illiterate populations (the right-to-know), but also aid in the understanding of this information as intended (the right-to-comprehend).

The challenge for the field of environmental health is to design, research, and implement innovative and appropriate strategies with the view to reducing pesticide health effects and environmental contamination.

See also: Children's Exposure to Environmental Agents, Food Safety and Risk Analysis, Organophosphate Insecticides: Neurodevelopmental Effects, Pesticide Exposure and Human Cancer, Pesticides: Human Health Effects, Risk Management in Environmental Health Decision.

## Further Reading

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Harvard School of Public Health, Center for Continuing Professional Education, USA. Risk communication training for health professionals and policy makers.