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Health and environment: communicating the risks

Abstract

Public administrations at all levels must often manage complex situations related to environmental determinants of health, often surrounded by controversy. Many factors contribute to a rapid escalation of those situations: increased sensitivity in the face of uncertain risks, uneven distribution of risks and benefits, and decreasing trust in authorities and entities involved in making decisions influencing public health. There is a need, in such circumstances, to assess the extent of possible health and environment impacts and to manage information, evidence and communication on possible risks, while understanding and taking into consideration the opinions, interests and values of the relevant stakeholders.

A workshop, jointly organized by the WHO European Office for Investment for Health and Development in Venice and the WHO European Centre for Environment and Health in Bonn, was held in Trento, Italy with the aim of sharing experiences in the management and communication of environmental risks.

This report builds on the presentations and discussions from the workshop and presents a series of key messages useful to regional and local authorities, as well as to risk managers in general.

Keywords: risk management, interdisciplinary communication, safety management, hazard management, vulnerable populations.

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Foreword

The challenges facing health agencies, in Europe and elsewhere, are becoming increasingly demanding. WHO is not exempt from such challenges: besides fulfilling its technical role of providing Member States with up-to-date, evidence-based advice, WHO often needs to engage with multiple stakeholders, the public and the media in discussing the nature of the scientific evidence, its strengths and weaknesses and, crucially, its policy implications. If it is to be meaningful, such dialogue must necessarily take into account the broader context, including the diverse opinions, interests and values held by different stakeholders. This type of work requires skill, time and energy and can occasionally be regarded as an additional burden. Yet when well-designed and conducted it is invariably very fruitful: dialogue ensures that technical work is well understood, that ownership of results is shared and that policy decisions are consistent with available evidence. Moreover, the acceptance and legitimacy of proposed policies and decisions are raised and ultimately the course of action can be steered in directions that promote health and well-being for all, including the vulnerable. In addition – and this is more recently gained awareness – open, two-way communication with relevant stakeholders provides an invaluable contribution to the scientific debate. By considering different perspectives and viewpoints, by collecting informal pieces of evidence and by comparing and contrasting preferences and needs, it is often possible to interpret scientific knowledge better, to formulate more realistic hypotheses and to identify more appropriate and feasible policy options and improve their implementation. In other words, engaging directly in open and evidence-informed dialogue on risks, benefits and policy response permits a realistic consideration of the context and improves the quality of the entire process, from risk assessment to risk management.

The present report results from the collaboration of various programmes of the WHO Regional Office for Europe, involving different types of expertise and technical skills, and builds on the invaluable contributions of experts from different fields. This reflects the fact that WHO is fully committed to addressing complex questions through a multidisciplinary approach, so often invoked in present-day public health debate. And good public health requires good communication, both when speaking and when listening. While this report is aimed at regional and local authorities, I trust it will also be useful to risk managers at large.

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Foreword

In September 2012, the 53 Member States of the WHO European Region unanimously adopted Health 2020, the new European policy framework for health and well-being. Health 2020 sets two complementary goals: improving the population's health and reducing health inequities.

These goals are ambitious. Multisectoral policies and actions solely at the national level will not suffice. They need to be mirrored at subnational levels of governance through approaches that are no longer fragmented and sectoral and that vertically integrate all the subnational institutional structures.

The Regional Office's Regions for Health Network provides long-term assistance to regional stakeholders operating in the subnational arena in implementing Health 2020. It is a technical network based on the exchange of knowledge and know-how on specific topics, all of them underpinned by the need to systematically tackle health inequities.

The incredible diversity of the regions that comprise the Network, in terms both of context and of institutional arrangements, is its biggest asset. Some regions may already have in place effective actions to counteract health inequities, whereas other may still be measuring them. Notwithstanding this, processes and conceptual frameworks in dealing with the issue are universal. Exchanging information on the enabling factors or on the obstacles incurred during the achievement of the same goal can be of mutual benefit. It also helps to optimize resources by avoiding using time and resources on something that has already been tried elsewhere.

Risk communication in environment and health is a topic that has no borders and that is of concern to the national stakeholder as well as to the local manager of a private enterprise or of a health agency. In some instances, the topic has catalysed global media attention among all groups of society, as in the case of the Chernobyl and Fukushima nuclear disasters. It is essential to capitalize on these and on other less dramatic events and to spread the lessons learnt.

We at WHO are pleased to present this report, which is the result of fruitful collaboration with the WHO European Centre for Environment and Health and the Autonomous Province of Trento. This is the first of a series of publications aiming at disseminating knowledge and know-how generated during Regions for Health Network events.

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Acknowledgments

This report is based on the outcome of the WHO workshop entitled "Environmental determinants: identification, management and communication of health risks" held in Trento, Italy on 16 April 2013. The workshop, which fell within the framework of the Regions for Health Network of the WHO Regional Office for Europe, was jointly organized by the Regional Offices WHO European Office for Investment for Health and Development in Venice and the WHO European Centre for Environment and Health in Bonn. This report builds on the presentations and discussions from the workshop. The following people contributed to the preparation and revision of the report:

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The WHO European Office for Investment for Health and Development would like to thank the Autonomous Province of Trento for the financial support provided for the workshop and this report.

Executive summary

A workshop entitled "Environmental determinants: identification, management and communication of health risks" was held in Trento, Italy on 16 April 2013. It focused on sharing regional experiences from Italy. As risk communication is central to WHO's work in environment and health, the workshop provided an opportunity to reflect on the current state of affairs, examining case examples from the environmental health domain. Risk communication is a challenging task because, depending on the target audience, some risks appear more alarming than others. Perception of risk varies according to target, gender, value system and the way in which the different risks are presented. Reactions to risks also depend on the different types of risk: they can be voluntary or involuntary, natural or man-made or possess other characteristics. To communicate risk in an effective way, it is important to understand the reasons behind these variations, perceptions and biases.

The Sandman formula states that risk perception is formed by two components: hazard and outrage. Hazard (the technical, scientific aspect) combines the probability of a certain event occurring with the severity of the outcome. Outrage (the subjective part) focuses on the situation as opposed to the extent of the risks, including the nature of the risk and the way it is managed. The main components of outrage factors are the involuntary nature of the issue, the artificial (industrial) nature of the risk, the use of cover-up or silence, attempts to engage message recipients to persuade them about the issue, the occurrence of accidents, double truths around the issue, conflicts of interest, contradictory types of behaviour and inequitable distribution of risk. It has been demonstrated that a clearer perception of the risk by the population leads to a higher effectiveness of the protective measures established by health institutions. Uncertainty also plays an important role in environmental risk assessment, management and communication. Uncertainty should be acknowledged as a central component in the management of environmental risks. It is important to consider and assess uncertainties in the risk assessment process, since not doing so leads to a distortion of study conclusions. Recognition of uncertainties allows for their further reduction in future studies and unmasking in previous cases. It can also help in the taking of political and regulatory decisions.

To illustrate this, a range of Italian experiences managing risk in contaminated sites were presented, along with the lessons learnt. Among these were: the importance of the explicit consideration of communication needs at the outset of studies; the use of qualitative approaches for collecting information from a target audience prior to formulating messages; the need to take into account the economic costs of undertaking risk communication activities; and perspectives from an environmental authority. Based on the presentations and discussion, the following key messages regarding risk communication in environment and health can be extracted.

The public is among the key stakeholders that should be involved in risk communication from the outset and can contribute to the assessment and management of risk. Involving the public as stakeholders helps establish effective communication and reciprocal exchange of information and is conducive to finding innovative solutions, thus moving away from one-way communication models.

Information needs to be appropriately framed to be understood by a lay audience. Communicating to a lay audience requires conveying specific and contextual information rather than fragments of evidence. Scientists should engage in communication and must acquire appropriate skills so as to be understood by a lay audience.

Essential elements for effective risk communication are information quality, transparency, the simplicity and coherence of the message, receptivity to public concerns and timing. In the face of ambiguity or inconclusive evidence, it is best to acknowledge and describe limitations and gaps in knowledge. "Over-assurance", one of the most common pitfalls of risk communication, should be avoided, as should alarming people about negligible risks.

Multisectoral and multi-stakeholder involvement are essential for communicating risk. Reliance on public health professionals alone to communicate risk no longer makes for a comprehensive approach; they should be just one category among several involved in communicating risk.

Communication approaches should be based on a clear methodology, be participatory and integrate sociological methods into traditional public health-oriented ones. While this can lead to additional cost and effort, it is necessary to manage controversy. The challenge remains to achieve impartiality and integrate scientific evidence, norms and public values.

Communication vehicles such as social media, when used correctly, promote a sharing aspect that creates a sense of active communication. There are a number of ways to use social media in a constructive way.

A sense of "outrage" can distort risk perception. Outrage plays an important role in the policy debate. Outrage is triggered by the situation, the type of risk and how it is being managed. Transparency, monitoring of health and determinants and access to the decision-making process help reduce the sense of outrage in a population facing risks.

Uncertainty should be acknowledged as a central component in the management of environmental risks. The extent and nature of the uncertainty surrounding any assessment or statement should always be described. The ability of the general public to comprehend uncertainty should not be underestimated.

Communication of risk should be embedded within scientific studies from the outset. When an investigation is undertaken, the affected population should receive information on investigation plans, intermediate findings and final results in a manner that is understandable to a lay audience.

Capacity-building is needed in the area of risk communication. Effective communication about hazards and prevention is nowadays a must for health agencies. The task is not a simple one and underestimation of the necessary skills and resources is a real risk. Individuals and institutions need knowledge on how to carry out correct and transparent communication within their means.

Rationale


Chernobyl © F. Zambon/WHO

Public administrations at all levels often find themselves having to manage complex situations related to environmental determinants of health. Many factors contribute to a rapid escalation of those situations: increased sensitivity in the face of uncertain risks, decreasing trust in authorities mandated to control such factors and allocation of responsibility for public health to outside authorities. This problem is very evident in cases of alarm or health concerns related to ascertained or suspected environmental risk factors, such as those from industrial or agricultural activity. Management of these problems, typically by local authorities, calls for a new set of skills and entails interventions of a diverse nature. There is a need to assess the extent of possible health and environment impacts and to manage information, evidence and communication on possible risks while keeping in mind the opinions, interests and values of the various stakeholders.

While the growing demand for participation in risk management policies on the part of citizens and interest groups provides an excellent opportunity for adopting sustainable and participatory policies, health authorities now have to face the challenge of acquiring additional skills in the management and communication of risks. For this reason, the dissemination and promotion of

valuable knowledge and best practices accumulated on this subject serves as a good starting point. Many countries have a vast reservoir of such knowledge as well as considerable experience from which lessons can be learnt. For many years, expert working groups in Italy and in other European countries have been conducting epidemiological and environmental analysis, making recommendations in the fields of research, land reclamation policy and environmental and health monitoring and assisting authorities to manage such situations.

To achieve a common understanding of these issues, a workshop was held to introduce the subject of management and communication of health risks from industrial and environmental risk factors, focusing on sharing regional experiences from Italy. The workshop was realized thanks to the support of the Province Autonomous of Trento. The Province is one of the founding partners of a think tank aiming to facilitate cooperation between countries and regions at European level in sharing knowledge and testing new tools and technologies for improving health, reducing health inequalities, consolidating human rights and creating the appropriate conditions for social and economic development. The recommendations from this workshop make a considerable contribution to knowledge exchange within the Regions for Health Network of the WHO Regional Office for Europe.

Section I. Concepts

Background

As risk communication is central to WHO's work in environment and health, this workshop provided an opportunity to reflect on the current state of affairs by examining examples of cases from the environmental health domain. Presentations and interventions included: an introduction to WHO policy and approach to working in environment and health; perspectives on environment and health risk communication; several Italian regional case studies highlighting lessons learnt and useful tools; guidance on how to deal with uncertainties in environment and health; and illustrative case studies sharing regional approaches to dealing with uncertainties and providing useful tools. The workshop and this report thus represent a joint effort of the WHO European Centre for Environment and Health, Bonn, Germany and the WHO European Office for Investment for Health and Development, Venice, Italy.

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In the WHO European Region, the ministerial conferences held every five years constitute the point of reference for work in environment and health. The most recent such conference was held in Parma, Italy in 2010. Commitments to work on four Regional Priority Goals (RPGs), made at the Fourth Ministerial Conference on Environment and Health in Budapest, Hungary in 2004, were confirmed and renewed in Parma. The RPGs cover the topics of water and sanitation (RPG 1), accidents and injuries (RPG 2), indoor and outdoor air pollution (RPG 3) and chemical, biological and physical environments (RPG 4).

Key priorities mentioned by governments and by international and nongovernmental organizations in the 2010 Parma Declaration on Environment and Health include:

- the health and environmental impacts of climate change and related policies;
- the health risks to children and other vulnerable groups posed by poor environmental, working and living conditions (especially a lack of water and sanitation);
- socioeconomic and gender inequalities in the human environment and health, amplified by the financial crisis;
- the burden of noncommunicable diseases, and particularly the extent to which it can be reduced through adequate policies in areas such as urban development, transport, food safety and nutrition and living and working environments;
- concerns raised by persistent endocrine-disrupting and bio-accumulating harmful chemicals and (nano)particles and by novel and emerging issues; and
- insufficient resources in parts of the WHO European Region.

WHO also considers the "health in all policies" approach[1] key to dealing with environmental risks, as it promotes cross-sectoral work. It also provides a powerful framework for primary prevention and considers not only proximal environmental risk factors (such as air pollution) in isolation but also policy-level "determinants of determinants" such as urban transport policies. It promotes intersectoral action, essential for work in environment and health, and considers the political and social context very important.

WHO is increasingly faced with having to provide Member States with advice on risk communication strategies – a challenge for WHO and other health agencies that goes beyond the more familiar assessment of risks and impacts. In fact, the boundaries between risk assessment, risk management and risk response and communication are difficult to draw and depend markedly on the nature of available evidence for the topics being addressed. As well as the "traditional" agent-based factors (such as water, asbestos, air and chemicals), WHO is often faced with sector-wide environment and health topics such as energy and waste policy, urban planning, climate change and emerging issues such as nanotechnology, with sparse underlying evidence.

It is important to recall that the preamble to the WHO Constitution describes health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". This strong, uncompromising definition is a clear statement of WHO's core value and has a compelling aspirational component. Its implementation, however, is difficult as this requires assessing complex health determinants involving multiple risk factors, embracing complexity and uncertainty, and considering confounding factors and interaction between hazards such as synergistic effects of chemicals, predisposition, vulnerability and socioeconomic status differentials.

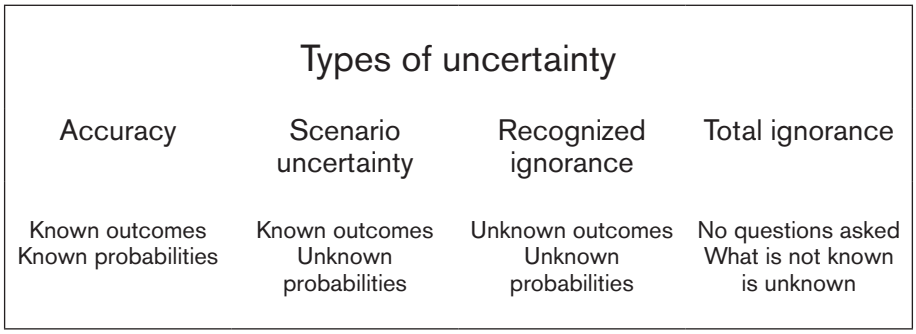
Prevalent models of risk assessment, however, estimate the strength of evidence, prevalence of exposures and magnitude of risks. This method is currently applied in many fields (such as air quality) as it is rigorous, structured and logical for many established determinants. It also provides a strong basis for utilitarian strategies in policy-making. Some limitations are the fact that: the entry point is the risk factor and not the policy option; risk factors are considered one at a time; there is partial coverage of only

1 http://www.euro.who.int/en/who-we-are/partners/observatory/studies/health-in-all-policies-prospects-and-potentials.

measurable, established health impacts; and it is reactive, focuses on damage limitation and uses a narrow model of health. Uncertainty in this framework is often underestimated, in that only the "known uncertainty" (for example, lack of accuracy in risk estimates for identified health outcomes) tends to be addressed while larger sources of uncertainty may lie elsewhere (see Fig. 1).

WHO retains the goal of supporting Member States in developing and adopting effective, evidence-based policies that make health the number one priority and that take account of equity and sustainability of action. Risk communication in the area of environment and health makes a contribution to this work.

Fig. 1. Types of uncertainty



Managing and communicating risk and uncertainty: theory and practice

Risk can be regarded as a social construct of modern society; many consider life is less risky than in the past because most people live longer and better. Despite this, there is some perception of living surrounded by high risks in everyday life. In the field of environmental health, while assessing risk is commonplace, skills for informing and communicating on risk are not yet very widespread among professionals.

An example of how important yet challenging risk communication is can be seen in the legal trial of six Italian seismologists and a government official who failed to provide adequate information on potential disasters arising from seismic activity in the city of Aquila before the earthquake that struck on 9

April 2009, causing over 300 deaths. During a press conference a few days prior to the earthquake, these experts downplayed the risk of a possible earthquake even though thousands of small shocks had occurred during the past several months. These people were charged and convicted not because they failed to foresee the earthquake but because they had unduly reassured the population about the risks. "Over-assurance" is one of the most common pitfalls of risk communication, as is the opposite – alarming people about fake risks.

Risk perception and the "outrage factor"

Risk communication is a challenging task because, depending on the target audience, some risks appear more alarming than others *(1)*.

Public reaction to risk often appears to be at odds with scientific estimates. Although risk may technically be defined as 'probability times severity of harm', the suggestion that a hazard poses an annual risk of death of 'one chance in x' may cause anything from near panic to virtual indifference.

Perception of risk varies according to the target, gender, value system and the way in which the different risks are presented. Reactions to risks depend also on the different type of risk: they can be voluntary or involuntary, natural or man-made or possess other characteristics. To communicate risk in an effective way, it is important to understand the reasons behind these variations, perceptions and biases (see Box 1):

> *The First Law (maybe the only law) of Risk Communication: outrage, not hazard, drives reputation. Even significant hazards are usually tolerated when outrage is low, and even insignificant hazards are usually rejected when outrage is high (2).*

According to the Sandman formula, the higher the sense of outrage the stronger the intensity with which people will perceive risk. As previously mentioned, a sense of outrage is most commonly triggered if risks are perceived *(3)*:

- to be involuntary (e.g. exposure to pollution) rather than voluntary (e.g. smoking);
- to be inequitably distributed (some benefit while others suffer the consequences);
- to be inescapable even if personal precautions are taken;

- to arise from unfamiliar or novel sources;
- to cause hidden and irreversible damage, such as becoming sick many years after exposure to a risk factor;
- to pose some particular danger to small children or pregnant women or more generally to future generations;
- to cause death (or illness) arousing particular dread;
- to damage identifiable rather than anonymous victims;
- to be poorly understood by science; or
- to be subject to contradictory statements from responsible sources (or, even worse, from the same source).

These factors can be interdependent and strengthen one another.

Box 1. The Sandman formula and definition of risk perception

R = H + O
R (perceived RISK) = H (measurable HAZARD) + O (OUTRAGE or sense of injustice)

Risk perception is the subjective judgement that people make about the characteristics and severity of a risk. It is formed by two components: **hazard and outrage**.

Hazard (the technical, scientific aspect) combines the probability of a certain event occurring with the severity of the outcome (e.g. an increase in the cancer rate, a catastrophic accident). **Outrage** (the subjective part) focuses on the situation as opposed to the extent of the risks. This category includes the nature of the risk and the way it is managed. The main components of outrage factors are the involuntary nature of the issue, the artificial (industrial) nature of the risk, the use of cover-up or silence, attempts to engage message recipients to persuade them about the issue, the occurrence of accidents, double truths around the issue, conflicts of interest, contradictory types of behaviour and inequitable distribution of risk.

Risk perception is most commonly used in referring to natural hazards and threats to the environment or health. It has been demonstrated that a clearer perception of the risk by the population leads to a higher effectiveness of the protective measures established by health institutions.

For the purposes of this report, when referring to risk perception, the reader should refer back to the definition in this box.

Source: Sandman (2).

The 12 principal components of outrage are shown in Table 1.

Table 1. The 12 principal components of outrage

	"Safe"	"Risky"
1.	Voluntary	Coerced
2.	Natural	Industrial
3.	Familiar	Exotic
4.	Not memorable	Memorable
5.	Not dreaded	Dreaded
6.	Chronic	Catastrophic
7.	Knowable	Unknowable
8.	Individually controlled	Controlled by others
9.	Fair	Unfair
10.	Morally irrelevant	Morally relevant
11.	Trustworthy sources	Untrustworthy sources
12.	Responsive process	Unresponsive process

Source: Sandman *(4)*.

Outrage must be carefully managed. If hazard is high and outrage low (e.g. in the case of smoking), people must be alerted. If hazard is low and outrage high (e.g. in the case of electromagnetic fields), outrage must be managed with caution as simple reassurance can upset people. The challenge is to narrow the distance between the risk transmitted by the communicator's message and the actual risk. Science claims a certain degree of uncertainty about many risks and the magnitude of many risks is not fully known. Furthermore, not everyone is faced with the same degree of risk, which is often unequally distributed in the population. For these and other reasons, risk management and communication are very complex tasks relying on variables such as timely and correct information, empathy, candour, public trust in authorities and effective policies.

The conundrum of risk comparison

When dealing with different kinds of risk, people often compare them in terms of the consequences and probabilities associated with them. This can be a good idea if risks of a similar type are being compared, in order to make clear the relative dimensions of a given risk. If risk comparison is used to lessen the sense of outrage felt by people, the result can often be the opposite to that desired, either because comparisons are incorrect (e.g. comparing voluntary and involuntary risks) or because the figure associated with the risk might be highly controversial. Artificial and natural risks cannot be placed on the same level.

The perception of risk perception

Risk and the perception of it are filtered differently by people according to their attitudes and moral values. Often, people do not want to receive information about unknown risks; they prefer to ignore threats because they feel that they do not have any effective defence against them (i.e. they are unavoidable). Those who prefer to get information want to know (3):

- how one is exposed to the risk;
- the consequences of exposure;
- whether the risk is controllable;
- other people's experience with the risk;
- who is responsible for the negative consequences; and
- whether there are any advantages.

Risk and cognitive systems

Risk perception is also influenced by moral values and on the framing activity of people.[2] Generally speaking, since the 1980s, psychologists have distinguished two kinds of reasoning (thinking):

2 Framing in the social sciences refers to a set of concepts and theoretical perspectives on how individuals, groups and societies organize, perceive and communicate about reality (http://en.wikipedia.org/wiki/Framing_%28social_sciences%29).

- system 1, characterized by a simple way of reasoning that focuses only on some relevant information filtered by "intuition"; and
- system 2, characterized by a conscious analytical way of thinking, with a mature capacity to evaluate a broad range of information (including statistical data).

While system 2 is typical of scientific assessment, system 1 is the common way of thinking shared by most people (including scientists when they act as "lay people"). It is important to know that communication based on reasoned argument about relevant statistics on safety, effective risk management practices, etc. is unlikely to influence people if their understanding is derived from system 1 thinking *(3)*. These two kinds of reasoning mark one of the greatest challenges in risk communication – how to reframe information in order to be understood by lay people.

On probability

It is important to consider how to communicate statistical data to deal with uncertainty. The correct evaluation of risks depends prima facie on the appropriate knowledge of probability. Generally speaking, people do not understand probability and it is very important to find straightforward methods to help people understand the real probability of risks *(5)*. The most common biases for probability are:

- availability bias: events that are more memorable are perceived as being more frequent than others, even if this is not the case;
- confirmation bias: people pinpoint events that confirm their idea and filter out the others; and
- overconfidence: people believe that their predictions/estimates are more correct than they really are.

These biases concern not only lay people but also experts and other professionals. It is not sufficient to help people by providing simpler and more intuitive methods of understanding probabilities. Communication regarding probabilities needs to be reframed in order to avoid these biases. For

instance, information about health interventions such as screening should be formulated in terms both of benefits and of harm. Some studies have shown that in the former case people tend to make the riskiest choice, whereas in the latter case they tend to be more prudent.

When communicating probabilities, it is sometimes better to use words instead of numbers. The European Commission, following Council Directive 92/27, chose particular terms to classify the risk of side-effects of medicines, from "very common" to "very rare" *(6)*. Some studies show that people do not always interpret these words correctly: while "very rare" refers to a risk of 0.01%, the mean estimate given by people is 4%. As can be seen from Table 2, the Intergovernmental Panel on Climate Change (IPCC) has linked written terms to number ranges (in percentages) in its "likelihood scale" *(7)*.

Table 2. Likelihood scale

Terminology	Likelihood
Virtually certain	> 99% probability of occurrence
Very likely	> 90% probability
Likely	> 66% probability
About as likely as not	33 to 66% probability
Unlikely	< 33% probability
Very unlikely	< 10% probability
Exceptionally unlikely	< 1% probability

Source: Intergovernmental Panel on Climate Change *(7)*.

Communicating uncertainties

According to Bauman *(8)*, "uncertainty is the natural habitat of human life – although it is the hope of escaping uncertainty that is the engine of human pursuits". Uncertainty also plays an important role in environmental risk assessment, management and communication. As van der Sluijs *(9)* observes:

> *The knowledge base available for decision-making on global environmental problems in the context of sustainable development is not of the type of well established knowledge that one can find in handbooks and textbooks of many disciplinary sciences. One could see this type of knowledge base as mixtures of knowledge and ignorance, where preliminary assumptions, scenarios, and expert judgements mask the ignorance.*

Other authors have stressed the importance of forging a new kind of science ("post-normal science") that acknowledges uncertainty as a central component in deliberative management of environmental risks *(10)*. As van der Sluijs *(9)* further observes:

> *Because scientific consensus about the truth of complex environmental risks is likely to be achieved given the post-normal situation (facts uncertain, values in dispute, high decision stakes), we still have to drop our demand for a single certain truth and strive instead for transparency of the various positions and learn to live with ambiguity and pluralism in risk assessment.*

Uncertainty should be acknowledged as a central component in the management of environmental risks. It is important to assimilate uncertainties in the risk assessment process, since not doing so leads to a distortion of study conclusions. Recognition of uncertainties allows for the further reduction in future studies and unmasking in previous cases. It can also help in the taking of political and regulatory decisions (see Box 2).

Uncertainties that should be presented to the public are those that are relevant to policy- and decision-making. An example of this are results that have a considerable impact on policy-making or may become a target of policies, results that are close to legal standards or thresholds being sought and controversial results or those that may lead to changes that conflict with stakeholders' values.

The cases of tobacco use and climate change show how uncertain results have been used to refute claims for both issues. General public reaction to uncertainties should be foreseen, considering what the target audiences are likely to do with the information, what strategic use could be made of the information and whether there are any issues that illicit fright or that might serve as media triggers. In the case of a low risk, consideration should be given to whether the general public impression of high risk will lead to distrust. Fig. 2 shows how uncertain information from reports is handled by non-scientific readers and Box 3 outlines suggestions for communicating uncertainties.

Box 2. A method for assessing uncertainties

The following steps can be taken when assessing uncertainties.

1. The initial step, **problem framing**, allows for reflection on why the study is being carried out. In this step, the problem and its context and history are outlined and major issues identified, including the expected role of the assessment in the policy- or decision-making process. The role that the study is expected to play in the policy-making process should also be outlined at this stage, as well as the relation with previous studies on the subject (policy context and problem history).

2. **Involvement of stakeholders** should occur from the outset to help design the study and capture local needs and sensitivities and to decide on an appropriate level and form for their participation. Experts from different disciplines can be included among the stakeholders, bearing in mind their limits. During this stage, the problem is viewed from the perspective of policy goals, the types of knowledge needed and what is at stake with regard to the uncertainties at hand.

3. **Selection and reassessment of indicators** should be carried out to ascertain whether current indicators are sufficient to provide a picture of the situation and whether they take into account local stakeholder values as well as political nuances.

4. **Assessment of the knowledge base** focuses on the adequacy of the available knowledge base for the assessment, including questions pertaining to the relevant quality criteria for answering the research questions, the knowledge and methods needed to obtain answers of the required quality and the most important bottlenecks in achieving this in the light of existing controversies and weaknesses in the knowledge base.

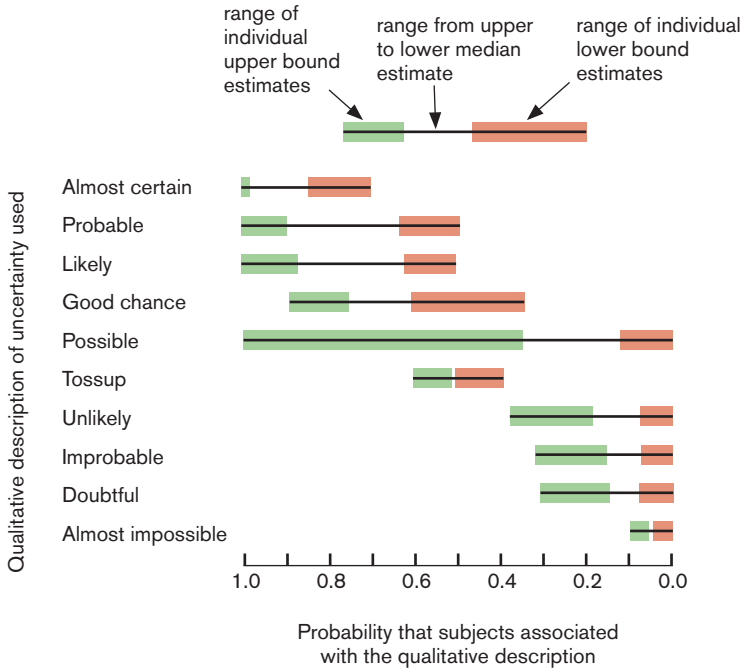
5. This step involves the **mapping** of relevant uncertainties to determine whether they are statistical, methodological, epistemic (i.e. cognitive) or social. Consequences of uncertainties should be noted and a way of how to assess the most important uncertainties and their consequences should be indicated. The planning and performing of the uncertainty assessment completes this step.

6. **Reporting** of uncertainty data takes place during the entire environmental assessment process, not only on delivery of the final results. The context of the reporting (why, to whom, on behalf of whom, when and where) and the robustness of the main messages for uncertainties in the knowledge base should be reported. Results should be presented in a balanced and consistent way, providing a traceable account and adequate backing of the presented material (i.e. in a step-wise fashion or presenting strategic points such as the introduction, conclusions, summary and text boxes).

Source: Janssen et al. (11).

Fig. 2. Words have different meanings for different people

An extreme case of different interpretations by different people us the word 'possible'. In a study in which people were asked to indicate the probability thatis expressed by this word the answers may range from circa 0 to circa 1



Source: Figure redrawn from Wallsten et al. (1986). Adapted by permission of the American Psychological Association. *(12)*.

Box 3. Tips on communicating uncertainties

- To increase the likelihood that results are readily received, it is important to communicate the main study results rather than fragments.
- The nature and origin of results and the way in which they influence conclusions and subsequent choices (such as side-effects of medication) should be explained.
- Uncertain results should be shown in a precise manner using graphs, figures and lay descriptions that avoid the use of technical language.
- Statistical parameters should be used sparingly, avoiding the use of decimals and not overloading the recipient with information. Frequencies (i.e. "1 in 100 people") should be used instead of percentages.
- Confirmation bias should be kept in mind, e.g. "I read/remember what I want to hear and mentally delete what is not interesting to me ...".

The role of the media in risk communication

As Nelkin *(13)* observes, "Media coverage of risk events reverberates through the political system, forcing responses from politicians. By calling public attention to an issue, the media may affect the nature of regulation, the course of litigation or the direction of research and development".

The media play an important role in risk communication. The mass media are regarded as one of the most important "amplifiers" of risk, behaving according to the same rules outlined in the concept of outrage. The traditional media do not rely on data or evidence but on stories and plot.

Drama – a story with heroes and villains – is the best ingredient for a news story. Risk, harm, death and illness are often important key points of media coverage. For this reason, the media tend to emphasize some risks and downplay others according to their "media appeal". Another approach taken by the media is sensationalism, an editorial approach that consists of exaggerating some elements of news to increase its appeal to the audience. This approach relies on misrepresenting events, omitting facts and exaggerating minor details to appeal to emotion. Such an approach may be particularly dangerous in health communication, since it could generate false alarms or, on the other hand, false impressions concerning a possible solution to a problem. Box 4 outlines the elements that increase the public's perception of risk.

Box 4. Elements that escalate the public's perception of risk

- Questions of **blame**
- Alleged **secrets** and attempted **cover-ups**
- Human **interest** through identifiable heroes, villains, victims, etc.
- Links with existing high-profile issues or **personalities**
- **Conflict**
- **Signal value**: the story as a portent of further ills ("what next?")
- **Many people exposed** ("It could be you!")
- Strong **visual impact**
- Links to **sex** and/or **crime**

Source: Bennet & Calman *(3)*.

Blame and the suspicion of a cover-up of risk are certainly the most important drivers of media attention. In covering risk topics, press and television reports are also more prone to using the blame factor, which causes journalists to misjudge risks.

How the social media are changing the media landscape

Communication today has moved from one-way to interactive; the public needs to be a stakeholder in communicating risk, thereby making communication an exchange of information in an effort to find solutions. An example of this can be seen in Weibo, the Chinese version of Twitter, the means by which the H7N9 virus outbreak was brought to light despite initial censorship by the Chinese authorities. The Chinese Government was unable to block such information. The strength of the social media is the sharing aspect: Facebook allows for "liking" and Twitter for "retweeting". Such simple actions create a sense of sharing and active communication that allows people to create their own information strategy. The name of this new phenomenon is "apomediation",[3] described by Eysenbach *(14)* as:

> *An information seeking strategy where people rely less on traditional experts and authorities as gatekeepers, but instead receive guidance from … agents which stand by … to guide a consumer to high quality information and services without being a prerequisite to obtain that information or service in the first place, and with limited individual power to alter or select the information being brokered.*

Social networks can also be source of misinformation. The occurrence of pandemic influenza in 2009 was an example of how the social media transmitted the suspicion that the pandemic was just a creation of the pharmaceutical industries to sell more vaccines, a suspicion that undermined the credibility of those institutions expected to plan efficient preventive measures in case of a real pandemic. As a result, health authorities are now aware of the importance of monitoring and being present on the social media *(15)*:

> *The response from health care authorities to the appearance of the new avian flu virus H7N9 in China (2013) has been more proper, transparent and adequate than in 2009. But there is still room for improvement. Communication plans that involve health workers should have been already established, and institutions should have been already active on the main channels – like Facebook, Twitter, YouTube – to report and explain facts also at the national level, to hinder conjectures and exploitations, and at the same time to monitor what is going on in the blogosphere.*

3 See http://patients.about.com/od/glossary/g/apomediation.htm.

Box 5 outlines ways of making effective use of social networking.

Box 5. How to use the social media effectively

- Identify the social networks that are most relevant to the intended target audience.
- Allow several trusted individuals in the relevant organization access to the social media sites, to help spread the workload.
- Ensure that the organization's presence is built and maintained on social media sites before a crisis. Building a community presence is important to make sure that it is recognized in advance as an authoritative and trustworthy source of information.
- Provide regular updates about the organization's work and respond to community questions or concerns.
- Identify other organizations involved in crisis communication and develop partnerships with them, in order to spread consistent messages and work together to challenge misinformation.
- Develop resources adapted to a variety of media (fact sheets, news reports, blogs, podcasts, videos).
- Use the community as an information source by asking questions about people's experiences or concerns. The social media provide two-way communication and the public could prove to be an invaluable source of information.
- Avoid overly didactic language and aim to strike a consistent balance between authoritative and personable communication.
- Clearly communicate risk; help users gain a better understanding of the level of risk to themselves and those in their online and offline networks.
- Demonstrate that the organization listens to users by regularly responding to their concerns.
- Make it easy for users to share content on the web site with their own networks by adding buttons for sharing the social media.
- Do not confine communications to just one social media platform. Some social media sites are liable to crash owing to a high level of use and it is important to ensure that your message reaches as many people as possible.
- If using multiple platforms, it is crucial to be consistent in conveying messages and other information.

Source: TellMe Project *(15)*.

Key points to consider for effective communication

The challenge remains as to how to communicate appropriately and effectively, especially when trust is low and scientific evidence is scarce, when risks are inequitably distributed (e.g. in contaminated areas, industrial plants or waste disposal facilities) and the evolution of risk is not clearly predictable (e.g. impacts of climate change or the evolution of a pandemic). Risk communication is an interactive process of exchange of information and opinion among risk assessors, risk managers and other interested parties. It is most effective when integrated with risk analysis and risk management and requires the involvement of stakeholders.

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Challenges for the risk communicator involve reaching the intended audience, making the risk comprehensible and analogous to other risks, having appropriate respect for audience values related to the risk, and predicting audience response to the communication. An important goal

of risk communication is to improve collective and individual decision-making. The communicator should also pay attention to the coherence of messages and be open to changing opinion. Timeliness of communication is also crucial, since it is better to be preventive rather than reactive and to communicate in a continuous and timely manner. The language employed should be kept simple, avoiding jargon and adapting it to the target audience. Factors that increase public trust in communication are illustrated in Fig. 3. Box 6 outlines some lessons in communication learned as a result of the accident at the Fukushima Daiichi nuclear power facility in Japan in 2011.

Fig. 3. Factors that increase public trust in communication

Source: Adapted from TellMe Project *(15)*.

Box 6. Lessons in communication learned from the 2011 accident at the Fukushima Daiichi nuclear power facility

Sandman *(4)* advises: "Don't lie and don't tell half-truths. This elicits terrible suspicion of cover-up and manipulation by public opinion". The Fukushima Daiichi nuclear disaster taught, among other things, the following useful lessons on communication.

- Pay attention to communication. Communication cannot be avoided and ambiguous and passive communication is worse than not communicating at all.
- People's concerns should not be underestimated because they are a sign that some improvement is needed.
- It is better to be more cautious than not cautious enough; it is worse if mistakes are made and the situation deteriorates.
- Communication should not be in the hands of one person; it should be integrated throughout an organization. If there is only one spokesperson, journalists normally search for other sources of information.

Source: Sandman *(4)*.

From communication to participation

Good communication is not enough; creation of a true and balanced dialogue between responsible authorities and different stakeholders through mutual trust and participation is essential. The Sandman formula can be enhanced by adding the following mitigating factors namely, T + M + P, where T is the *transparency* of the communication, M is the *monitoring* capacity of the hazard and P is the *participation* of principal stakeholders in the process. Transparency determines how and why information is conveyed through various means. It contributes to better dissemination of information, which in turn leads to greater knowledge and social progress. Monitoring refers to the capacity of public authorities (and some stakeholders) to collect and disseminate all relevant environment and health data (health statistics, emissions, radiation, contamination) *(16)*.

Routine monitoring and communication of results can greatly increase trust, empower people and reduce fright factors. Examples can be found in Italy with the Monitoraggio degli inceneritori nel territorio dell'Emilia-Romagna

(MONITER) and Studio Epidemiologico Nazionale dei Territori e degli Insediamenti Esposti a Rischio da Inquinamento (SENTIERI) projects, summaries of which can be found below. Stakeholder participation refers to people having the right to express their opinions, choices and concerns and to be heard and taken into consideration in risk assessment and management. Stakeholder groups are usually involved in the decision-making process and may influence knowledge and attitudes in working towards the best solutions. They also bring resources to bear in support of public health communication, since their importance when dealing with environment and health governance and their engagement allows for building trust and partnerships, dialogue and agreement on objectives and establishing roles and responsibilities. Inclusion of transparency, monitoring and participation are key mitigating factors in reducing feelings of outrage in the population facing risks. These factors are strategic also for building up mutual trust and collaboration in managing risks.

Stakeholder involvement challenges the way in which scientific assessment and management are performed. The former technocratic view, in which experts determine the "right" evidence for decision-makers, is no longer tenable and must be replaced by a more transparent and broader form of science and governance. To achieve this it is important to:

- follow the rules of sound scientific information and use clear and correct data;
- enrich traditional risk assessment by considering other risk dimensions: not only probabilities and potential for harm but also uncertainties, ubiquity, continuity, possible delayed effects, possible inequities and the potential for social mobilization;
- integrate hard data with general public values: participatory risk analysis involves consideration of hard scientific data and local sensitivities and values; and
- go beyond "expert only" logic and look at new forms of evidence integrating "experts" from different disciplines – those with traditional knowledge and local area stakeholders (see the section on contaminated sites below).

Much of the literature on risk management emphasizes the dilemma in which authorities find themselves whenever decisions about the placement and/or evaluation of a new plant/facility have to be taken and its possible environmental and health impacts. New requirements for environmental impact assessment, public information and references to the precautionary principle put in place by national and international authorities can be effective only if they are supported by a truly public participation in every step of the process *(17)*.

Given the challenge to resolve environmental conflicts by authoritative means and legal routes, a participatory decision-making process, "where participants agree in advance to follow clear rules to verify or refute opposing situations and come to a decision on which of the many possible strategies to use to resolve ambiguities and uncertainties" is beneficial *(18)*. Negotiations involving representatives of the general public can help to reach consensus on a solution. Trials have been carried out in Canada, Germany, Switzerland, the United Kingdom, other northern European countries and the United States with the aim of finding the right balance between technical skills, norms and the values of the general public *(17, 19)*.

Following the introduction on managing and communicating risk and uncertainty, case studies from Italy were presented illustrating how theory can be put into practice.


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The following is a summary of work carried out in Italy at contaminated sites and the lessons learnt. It focuses on three case studies: the sites at Gela and Biancavilla and a study of 44 Italian polluted sites (the SENTIERI study) in which these two sites are situated. It also describes the Italian approach to epidemiological characterization of a contaminated site and the European approach *(20)*. As documented in the scientific literature, industrially contaminated sites can entail concrete and measurable health risks and in addition have several of the characteristics described above by which risks can be perceived acutely. In fact, there have been many instances of controversy around the health effects of these sites, where local or national authorities are faced with difficult issues of risk management. Given the complexity of these questions, the high stakes and the conflicting interests (i.e. jobs vs environmental protection), it has become increasingly clear that a careful communication strategy is crucial.

The Gela site, a case in point, is a petrochemical plant in Sicily that opened in 1960 and that at one time was the largest in Europe. Prior to this, there was no industry in this mainly agricultural area. This move was an attempt to help the economy of the region, but instead it created significant damage to the area's visual appearance and tourist appeal. A chaotic building programme, carried out in the absence of a planning process, created almost intractable social problems.

Intensive studies were undertaken to assess the health of local residents and workers. The authors of these studies highlighted the need to define goals for the "epidemiological characterization" of polluted sites through *(a)* retrospective heath impact assessment, *(b)* contributing to the definition of priorities for remedial activities and *(c)* defining epidemiological surveillance programmes. In line with a recognized need to establish interactive communication, they used qualitative approaches from sociology (focus groups) to address the main objectives and verify the hypotheses of the epidemiological studies. Groups of workers were studied to find out whether they were being exposed

to hazardous waste and whether any risk applied only to workers or also to residents. The study found a higher risk of lung cancer among male workers in the petrochemical industry, with a higher likelihood of this occurring in workers living in Gela than in non-resident workers.

Biancavilla is another contaminated site, where material from a local quarry used to build the town was found to be contaminated with fluoro-edenite, an asbestos-like fibre with the same toxicity as asbestos. Residents were found to be at high risk for mesothelioma and chronic obstructive pulmonary disease. This site is an example of a situation where the nature of the hazard, the risks and the impacts were clear and specific; yet economic interests and local values influenced the perception of risk, even though physiological effects had already occurred among the population. In such a case, despite the strong evidence, clinical manifestations among the population contributed to the sense of outrage, thus considerably affecting the perception of risk.

In studying the health impact of contaminated sites, the use of sociological approaches with qualitative studies can be carried out both *ex ante*, prior to the epidemiological investigation to understand local habits, and *ex post* to verify the limits of the analysis itself. These qualitative approaches contribute to reducing the sense of "outrage" that might otherwise be felt by affected residents.

Box 7 illustrates a case study from a district in the city of Ferrara with industrial waste contamination of soil and groundwater.

Box 7. Study of residents in a district with industrial waste contamination of soil and groundwater

The "Eastern Quadrant" area is a residential neighbourhood of Ferrara in the Emilia-Romagna region of Italy. Between the 1940s and 1981, a brick kiln was active in the area and the quarrying of local clay for the kiln left large, deep pits that are in contact with underground aquifers. Parts of the unused pits were used between the 1950s and 1970s as dumps for urban waste and unknown amounts of chlorinated pitch from the chloromethane distillation process carried out at a plant operated by a local chemical complex. Studies conducted by the Ferrara municipal authorities revealed evidence of contamination with chlorinated organic compounds, some of them carcinogenic, that had leaked into the water table and affected a wide surrounding area.

During the 1950s, this area became an urban settlement. A retrospective cohort study of the health of its residents was initiated in parallel with an environmental monitoring programme.

Study characteristics

- The residents explicitly asked for an epidemiological study to be carried out, even though there were intrinsically large uncertainties.
- The study was retrospective but also could be used for epidemiological perspective surveillance.
- Part of the study population belonged to a high-risk group/susceptible population (schoolchildren).
- In developing the study, great emphasis was laid on communicating with the population.
- The population was informed that the study protocol could be changed if other risks were identified.

Objectives of the study

- To evaluate the residential history of the Eastern Quadrant.
- To define the information base for eventual epidemiological surveillance.
- To verify a priori the association between residence, outcome and cause on the basis of evidence of site contamination.
- To include, in the communication process and plans for risk management, specific information on the health status of residents.
- To establish an information database that could allow for an association between buildings, homes and residents that could be used to define targets for action.
- To check the validity of the residents profile obtained by the data in the registry (comparing permanent residents to temporary inhabitants).

In situations where risks are uncertain or possibly controversial, and where study results planned to verify specific hypothesis are unambiguous, it is necessary to involve experts from different disciplines. Furthermore, interaction with stakeholders is needed to identify appropriate studies and understand attitudes that influence exposures to environmental risks.

The Italian SENTIERI study applies a standard approach to analysing 44 national priority contaminated sites, with the aim of describing the health

profile of populations residing in polluted areas. Each site has specific characteristics, and input from experts in different disciplines is necessary to understand the kind of studies that need to be undertaken. Considering the sensitive nature of the issue, surrounded by preoccupations, conflicts of values, uncertain risks and vested interests (i.e. a high outrage factor), the involvement of the local population is considered essential. Such involvement aims at both providing and obtaining information and has shown a positive effect: involving local people in the preliminary exploratory phases helps gain their trust in and commitment to the interventions proposed. The SENTIERI study has become a national reference point and is quoted by national and local authorities as well as by different stakeholders. So far, the study has revealed an increase in mortality and the overall burden of disease among residents at individual polluted sites. This increase could be attributed to multiple risk factors, including environmental exposures inherent in the sites.

These cases at contaminated sites illustrate how sociological approaches to collecting information can be used to validate epidemiological risks in studies. Sociocultural approaches involve obtaining input from multiple stakeholders, establishing a long-term dialogue, and ensuring interaction and communication among the local health and environmental services and key stakeholders. In the cases presented here, the qualitative social sciences were able to make an important contribution to clarifying study findings where conflict arose among the traditional disciplines.

The overall lesson from these experiences is that communication should be integrated into the protocols of epidemiological studies carried out at contaminated sites. Communication with the general public should be integrated throughout and the affected population should receive information on the plans for the study at the outset, intermediate findings on outcomes of interest and results of epidemiological analyses in a manner that is understandable to a lay audience. Planning for such studies should take into account the importance of encouraging risk communication, both for the people affected by pollution and for those who will later determine the appropriate public health interventions and risk mitigation.

Study protocols should consider:

- planning communication events at key stages, both during and at the end of the study;

- adjusting communication so that local authorities are able to understand the needs of the population;
- planning for flexibility in the study protocol and for the possibility of changing technical aspects once the study has begun;
- clearly describing roles and responsibilities from the outset; and
- directly involving the general public in all stages so as to gain their trust and commitment, thus ensuring that the project results are more likely to be accepted and promoted.

Section II. Examples from Italian regions

Experiences in communicating risk in the Piedmont Region

Regional experiences from the Piedmont Region of Italy show how communication had been carried out with respect to two cases: the building of a tunnel for the high-speed train (*treno alta velocità* or TAV) and a cement factory in the municipality of Robilante in the province of Cuneo. The TAV provides an example of government or institutionally led communication. Prior to beginning the building of the tunnel, word got out that there were asbestos and radioactivity in the area. Despite the results of a technical analysis showing no risk of negative health outcomes for the population, communication became distorted and residents began to protest. This effect was exacerbated by an existing lack of trust in the local authorities and in a nongovernmental organization that sent representatives into the tunnel to measure radioactivity and place results on the news. This is a case where risk communication was built around incorrect facts and relied instead on information that fed pre-existing beliefs.

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The Buzzi Unicem cement factory in Robilante, one of the largest in Italy, is responsible for 30% of all nitrogen dioxide emissions in Cuneo province. Since 2006, the factory's main source of fuel has been combustibles derived from waste. In 2007, the factory was found to be emitting dioxins (Polychlorinated biphenyls and dioxins derived from burning aluminium). Analysis of the health status of the population showed an increase in various pathologies, some of them possibly related to the emissions from the factory. Increases in hospital admissions among both men and women in the area were found for infectious diseases (37% in men and 45% in women), thyrotoxicosis (46% in men and 44% in women) and hypothyroidism (56% in men and 16% in women). There was a slight increase in admissions for neuropsychiatric illnesses (8% in men and 12% in women), alcohol abuse (37% in men) and Alzheimer disease (43% in men). Respiratory infections also increased slightly, by 4% in men and 8% in women. In the Robilante municipality itself, there was a 53% increase in respiratory diseases (53% in men and 39% in women). A participatory health impact assessment (HIA) has now been initiated, as proposed by the local health and environmental services. This assessment involves the province, local citizens' associations and Buzzi Unicem. A long-term plan of activities has been agreed on and the HIA will be finalized at the end of 2013.

The two cases presented served to show different approaches taken in communicating risk: the former top-down and technical with a one-way approach to communication; the latter an open, participatory approach looking for solutions. The presentation provided further details on the two approaches.

The traditional technical approach exemplified by the construction of the TAV tunnel relies on input from the engineering, statistics, psychology, economics and epidemiology disciplines with little contribution from lay audiences. Risk is defined as the probability of negative consequences arising from verification of an adverse event. This approach focuses on accuracy in identifying or estimating the risk, causal and predictive models for risk projection taking into account people's reactions and possible future conflicts that could arise. It also views risk as a quantitative measure, neutral and not open to subjectivity. In this model, there is no room for non-scientific approaches and risk is seen as objective whereas a reaction to risk or the perception thereof is seen as non-scientific and therefore invalid.

In the sociocultural approach exemplified by the cement plant in Robilante, evidence from disciplines such as cultural anthropology, sociology and geography as well as science and technology are all considered valid

sources of information, and the social and cultural context is essential when interpreting risks. In developed societies, risk is seen as a cultural and political concept influenced by individuals, social groups or institutions. Whereas risk is defined by objective data, the perception of risk is also conditioned by social, cultural and political factors and perception of risk plays a major role. Following the sociocultural approach, risk can be viewed as something that must be addressed with input from multiple stakeholders, establishing a long-term dialogue and relying on interaction and communication between local health and/or environmental authorities and key stakeholders to establish a sustainable network. The HIA attempts to use elements from this approach.

In Piedmont, guidelines for the HIA process were proposed in 2011. The process in this approach can be carried out in two phases.

1. At the regional level, the environment and health authorities define guidelines for the planning of local authority activities. There should be an additional contribution from the local environment and health services in defining general strategies to be adopted for the joint evaluation of environment and health impact.
2. At the local level, in the implementation phase of the regional guidelines, the bodies that are to carry out the environmental impact assessment and strategic environmental assessment and issue the integrated environmental authorization should make use of the local environment and health service technicians in developing local-level integrated assessment based on the available technical specifications.

Five steps are followed in HIA:

1. screening, to assess the need for an HIA;
2. scoping, to determine how to carry out the HIA;
3. assessment, to evaluate the impacts on population health;
4. reporting and recommendations;
5. monitoring, to verify whether HIA objectives have been reached.

A set of checklists used by the local environmental services in Piedmont is shown in Fig 4.

Fig. 4. Three checklists for HIA used by the local environmental services in Piedmont

Checklist 1: Screening-Scoping

The examination of some major components linked to the implementation of a policy / project / program and its health effects allows for assessment of the need to conduct a Health impact assessment (HIA).

	NO	UNCERTAIN	YES
Project characteristics			
Geographical scope: Will the project have influence over an entire block or a large area (>2km^2)?	0	1	2
Reversibility: Will the project bring irreversible transformations (not possible to return to starting conditions)?	0	1	2
Population size: Does the project affect a significant portion of the population?	0	1	2
Vulnerable groups: Does the project involve population vulnerable groups?	0	1	2
Cumulative impacts: Are there are potential health or environmental risk factors in addition to those identified in the project design?	0	1	2
Land use: Will carrying out the project or plan modify the current land area?	0	1	2
Political and social-economic characteristics			
Institutional capacity: Is the political-administrative context suitable to support the actions necessary for an HIA?	2	1	0
Integration with local policy planning: Will the launch of the new plant / project / plan lead to significant changes in local policies?	0	1	2
Economic importance: Could the plant / project / plan become a considerable employment and economic resource for the area?	0	1	2
Characterization of the risk: Are there known environmental and health risks linked to the installations in the area?	2	1	0
Social value: Is there foreseen socio-economic impairment or improvement in the surrounding project area?	0	1	2
Social participation: Has engagement of the population in decision-making been foreseen?	0	1	2
Interest groups: Have interest groups (committees, groups of citizens, associations, etc.) been engaged?	0	1	2
The HIA process in the area of the installation plant / project / plan			
Could the HIA in the area in question lead to the recognition of the need for improvement actions and priorities for action?	0	1	2
Could the HIA in the area in question provide a contribution to the integration of information and improve collaboration between different actors?	0	1	2

Fig. 4. contd

Checklist 2:

Relationship between contextual elements and impacts of health determinants.

		Health determinants							To be completed by the staff of the Department of Prevention → indicate the partial scores obtained by each element of context
Contextual elements impacted	Impacted element	Biological factors	Behaviours and lifestyle factors	Living and working conditions	Environmental factors	Social factors	Economic factors	Public services	
Emissions									
Air									
Water									
Soil									
Physical agents: noise									
Physical agents: EMF or ionizing radiation									
Odours									
Intended land use									
Agricultural zone									
Residential zone									
Industrial zone									
Leisure zone									
Induced mobility									
Roads and highways									
Transport of waste or dangerous substances									
Links with public transport									

Fig. 4. contd

Checklist 3:

Description of impact on health determinants, mitigation actions and subject responsible for action.

Determinants	Description of health impact	Actions for improvement or mitigation	Subject responsible for action
Biological factors			
Behaviours and lifestyle factors			
Living and working conditions			
Environment			
Social factors			
Economic factors			
Services			

Source: E. Cadum, unpublished data, 2013.


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A new model is proposed that moves from communicating risk to sharing risk among various stakeholders, thus finding solutions in a participatory manner. It suggests that the role of public health professionals be decentralized, making them just one of many disciplines involved in communicating risk. They should have the specific task of determining the qualitative or quantitative dimensions of a particular risk.

Valuable lessons can be learnt from the case of the TAV tunnel construction, where the main target audience for risk communication would have been the residents in the area. It would have also been important to involve the media early on so that they could have correct information to report and could assist in dispelling possible fears. In fact, communication from the very beginning followed a top-down procedure and used very technical language that the general public would not have understood. Communication was one-way and only decision-makers were involved; the local community was neither consulted nor included in the first phases of the consultative process. In retrospect, an ideal way of communicating risk in this case

would have been to involve various stakeholders and to use a public, open and multidimensional approach to the various media and means of communicating rather than take a defensive stance. This participatory approach was recognized as necessary only after the preliminary project had been heavily criticized and after much public protest. The formal protocols for the latest version of the project, foreseen for 2013/2014, include a comprehensive HIA.

Monitoring population exposure and effects on health from the outset: the MONITER project in Emilia-Romagna

In 2007, the Emilia-Romagna region invested about €3 million in a series of scientific activities under a project called MONITER in order to better understand the health and environmental effects of a series of eight incinerators in the region. The five major themes of the project were: a study of incinerator emissions in the environment; a study on the environmental effects of emissions; the identification of exposed populations over the long term; two epidemiological studies on the effects of exposure to incinerators on population health and laboratory research on the toxic effects of incinerator emissions.

The main objective of MONITER was to set up a monitoring system that would allow for assessment of the amount of environmental pollutants emitted from incinerators and the surrounding areas, population exposure and the relative effects on health. Its specific objectives were to harmonize environmental monitoring methodologies for the incinerators; to gain a quantitative understanding of the characteristics of the pollutants emitted from the incinerators; to assess the health status of the exposed population in a uniform manner; to assess the toxicological mix being emitted from the incinerators; and to define the HIA criteria for future incinerators. Questions to be answered by MONITER addressed the nature of the main pollutants coming from the incinerators in the Emilia-Romagna region; whether these emissions can be distinguished from other sources of air pollution; to what degree the pollutants from the incinerator emissions affect the surrounding air quality; and whether living close to an incinerator resulted in an increased risk to health.


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Particular importance was given to the communication aspects of the study. There are several incinerators in the Emilia-Romagna region (almost one per province, markedly more than in other regions) and prior to MONITER, other local studies had been carried out on the environmental and health effects of pollution due to incinerators. The MONITER study also arose from a need for information expressed by the population. To obtain this, the study included communication in the project from the outset (see Fig. 5). Models and communication protocols were developed, conflict management was planned and training and engagement in the project were arranged for local authorities. A project web site (www.moniter.it) was set up where all information was made available to the public. Results of scientific committee meetings and project results were posted in a timely manner. Information was also made accessible to a lay audience by means of, inter alia, frequently asked questions, fact sheets on what incinerators are and the effects of emissions on health.

An important issue faced by the study was uncertainty in exposure assessment and related health effects, owing to low levels of pollution from the incinerators. To tackle this, a rigorous geographical approach was set up at all sites to characterize residential exposure of the two populations under

study: a population of newborn babies and a residential retrospective cohort of residents.

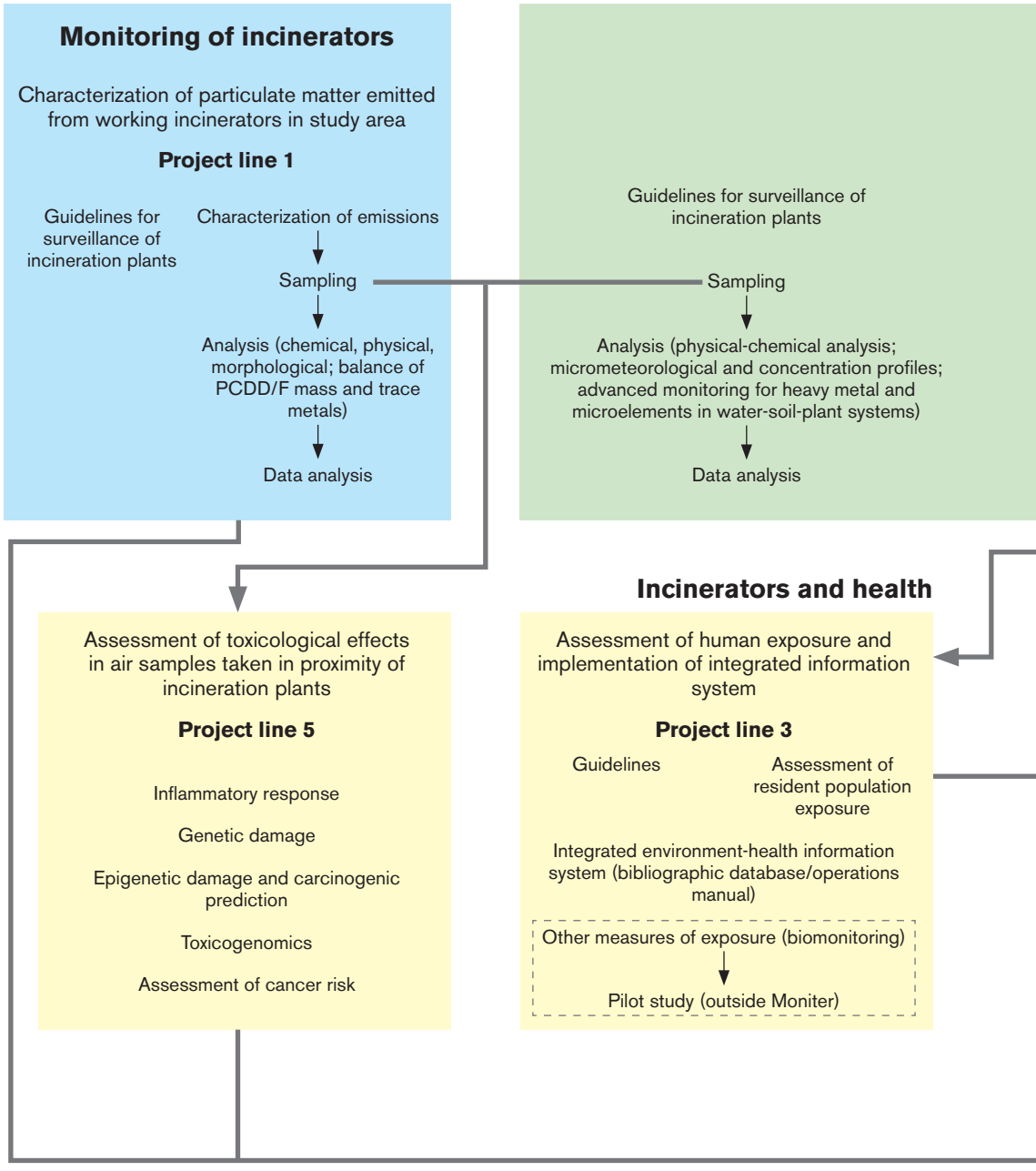
The main epidemiological result of the project is related to an association between exposure to incinerators and risk of pre-term childbirth *(22)*. This association was robust and increased with the improvement in the exposure assessment method. Overall, the cohort study did not show a consistent association between levels of pollution from incinerators and cancer mortality or incidence. The reported associations, of which it is not possible to assess the causal relationship with exposure to incinerators, are the only indications of the possible carcinogenicity of emissions from incinerators *(23)*.

Project results were presented at two events open to the public, with contrasting reactions. After two years, the study had three cohorts: 1995, 1991 and a Modena cohort. Results showed colon cancer and non-Hodgkin's lymphoma in exposed females. Liver cancer, while appearing in other studies, did not show a strong association in these cohorts. Pancreatic cancer, not appearing in other studies, was observed in exposed males. When the results were published, considerable press coverage ensued. The issuing of an official press release was followed by public demand for officials to take the study results into account prior to authorizing the building of new incinerators.

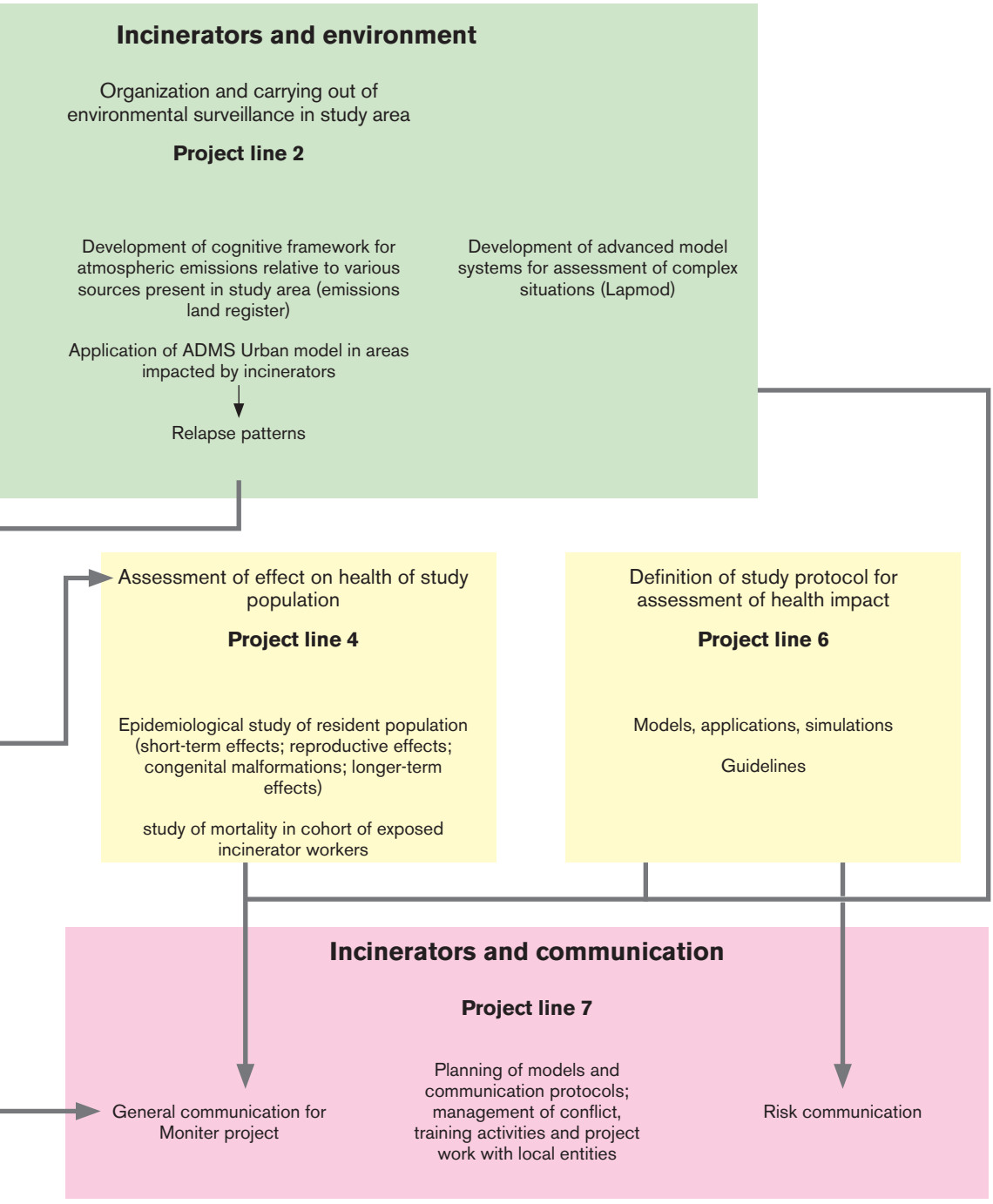
The medium-term results of the study were the centralization of waste management at the regional level; the inclusion of a health component in the evaluation of different scenarios; and ongoing regional limits on the number of incinerators in the Emilia-Romagna region when assessing the construction of new incinerators.

Important aspects to consider when communicating risk that can be highlighted by the MONITER project are linked to factors that could considerably affect outrage, such as the importance of listening, transparency, continuity in providing information, timeliness of communication, completeness of information, simplicity, knowing how to manage risk in the face of uncertainties and dealing with reaction from different stakeholders.

Fig. 5. MONITER project general framework and correlation between various project lines



Source: Ranzi & Caranzi (*21*).


Incinerators and environment
Organization and carrying out of environmental surveillance in study area
Project line 2
Development of cognitive framework for atmospheric emissions relative to various sources present in study area (emissions land register)
Application of ADMS Urban model in areas impacted by incinerators
Relapse patterns
Development of advanced model systems for assessment of complex situations (Lapmod)
Assessment of effect on health of study population
Project line 4
Epidemiological study of resident population (short-term effects; reproductive effects; congenital malformations; longer-term effects)
study of mortality in cohort of exposed incinerator workers
Definition of study protocol for assessment of health impact
Project line 6
Models, applications, simulations
Guidelines
Incinerators and communication
Project line 7
General communication for Moniter project
Planning of models and communication protocols; management of conflict, training activities and project work with local entities
Risk communication

Balancing risk communication and economic effects: the West Nile virus epidemic in the eastern Veneto Region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The eastern part of the Veneto Region is part of Health Authority 10 and includes 20 municipalities with about 220 000 inhabitants. This territory is characterized by vast lagoon areas and countryside with three rivers (Piave, Livenza and Tagliamento) that flow into the Adriatic Sea. This is a historically malaria-endemic area and from the 1920s underwent a massive remediation campaign. The major economic activity that has developed over the last 50 years is tourism due to the seaside towns of Cavallino, Jesolo, Caorle, Eraclea and Bibione. Each year from May to September, millions of tourists arrive to spend their vacations in this Region. The proximity of the city of Venice and the wide selection of accommodation make this an attractive holiday destination that provides employment for some 10 000 people.

In 2004, the Veneto Region transferred the responsibility for public health campaigns (normally run by local health authorities) to the municipalities. The municipalities have the pest control mandate for public areas and distribute larvicides to families to deposit in gutters and bodies of stagnant water, but individuals need to take a number of precautions to prevent mosquito larvae developing in stagnant water. The health authorities retained responsibility for coordinating and carrying out medical and veterinary surveillance. In 2010, the first clinical cases in humans of West Nile neuro-invasiveness were seen, affecting older people in eastern Veneto. The Department of Prevention initiated a campaign to raise awareness in the municipalities of the importance of pest management and control. From 2010 to 2012, neither the municipalities nor individuals took disinfection seriously and not all municipalities carried out three cycles of disinfection as prescribed. There was also a general slowdown in clean-up operations. Hazardous infection sites in public areas amount to only 20–30% of the total; the remaining 70–80% are privately owned. As private areas contribute considerably to colonization by mosquitoes, full coverage cannot be reached without the active participation of private citizens.

In 2012, the problem of West Nile virus emerged at the beginning of the tourist season. Warnings given by Health Authority 10 on the need to disinfect were not taken seriously and interventions were implemented in a fragmented and limited fashion, even slowing down over time. The first cases of West Nile infection appeared, with a gradual increase in the number of cases, and the press began to request confirmation and details. The challenge faced was deciding how to intervene in terms of public communication and how to manage information provided to the media and the general public. There was also possible legal action due to economic loss from tourists leaving the area.

Box 8 provides some background to West Nile virus infection.

Box 8. West Nile virus

West Nile virus was discovered in Uganda and isolated for the first time in 1937 in a woman with high fever. The first outbreak of the virus occurred in the western Nile area, thus giving rise to its current name. The disease carrier is the *Culex* mosquito, the most common type of mosquito, which bites at dusk. The natural cycle of the virus involves the passage of the pathogen from vector-infected mosquitoes to diverse wild bird species. Wild birds are involved in viral replication and represent the natural reservoir of infection. The virus is then transmitted by the bite of an infected mosquito to domestic and non-domestic mammals, including horses, which develop life-threatening symptoms but for which a vaccine has been developed. Humans can also develop symptoms and a vaccine is not yet available.

The virus dies in all mammals so there is no further transmission. There is the possibility of human-to-human transmission through blood transfusion, organ transplants or infected tissues. Some 80% of West Nile virus infections in humans are asymptomatic. The remaining 20% manifest fever similar to the common flu. In less than 1% of infected people, the virus produces a neuro-invasive disease (encephalitis, meningoencephalitis or flaccid paralysis) that affects the elderly, immunosuppressed patients or, less frequently, children. There is no specific therapy for West Nile disease.

The health authorities were faced with a number of choices, including alerting the general public of the dangers or blaming the general public for not following their advice. The result of either of these two scenarios could have been uncontrolled media coverage, an exodus of tourists from the region and possible legal action by those with economic interests in the tourism sector. The choice made was to adopt a low-profile communication strategy consisting of: *(a)* awareness-raising for

the general public through the placing of posters in the windows of pharmacies, medical centres and ambulatory care settings, including making information on West Nile virus widely available; *(b)* issuing formal notices to municipalities sensitizing them to take on the commitment to pest control work, followed by operational meetings *(c)* alerting emergency department physicians of the symptoms of West Nile virus infection; *(d)* placing all prevention information on the Health Authority 10 web site; and *(e)* keeping the Regional Monitoring Service informed of actions taken by the health authorities. This approach resulted in fewer (15) cases of West Nile disease with a further 14 neuro-invasive cases. All cases occurred between August and September and resulted in hospital admission. Seven months after the epidemic, the death was reported of an elderly person infected with the virus in August.

There are many lessons to be learned from this outbreak, as communicating prevention is not a simple matter and the underestimation of a problem is a real risk. On the other hand, when an outbreak occurs it is already too late to talk of prevention. The challenge is to balance cost and benefit; at the height of an epidemic such as this, the economic cost of alarmist media messages would have been high. The cost–benefit balance must bear in mind the responsibility of the communicator and should not omit or neglect to provide all information to the public and institutions. It should be clear how to move towards institutional channels and carry out correct and transparent communication.

Tools for preventing and managing environmental risks

Environmental issues dealt with by the Province of Turin from 2009 to 2013 provide examples of careful communication in handling environmental conflict. During this period, the province was faced with controversy ranging from traffic restrictions, photovoltaic installations, electromagnetic fields, and biomass and animal waste incinerators. The summary below provides information on the cases and the various factors affecting risk management options. Conflict resolution tools are presented for each case, along with success stories and areas for improvement.

Air pollution limits in the Province of Turin had been exceeded and the need for traffic restrictions arose. Traffic restrictions can be highly controversial, since various groups have an interest in them both for their positive and their negative implications. In this case, a number of options were available,

including the creation of "protected" areas in the city that would limit traffic and restrict the entry of vehicles to certain city zones according to car certification type (i.e. Euro 0, 1, 2, 3, etc.). In order to reach an accord, conflict resolution methods were utilized to encourage dialogue and joint decision-making, mutual exchange of information, open discussion and knowledge sharing. Meetings and scientific seminars were also held with professional associations. Prior to introducing traffic restrictions, input was solicited from various stakeholders (such as people who were both parents and commuters) in an attempt to resolve conflicts of interest and engage them in an issue that affected their lives as residents and commuters. Successes in dealing with this issue included the fact that national media campaigns on the need for traffic restrictions were also carried out. The challenge remained as to how to arrive at a compromise among all the interested parties.

The Province of Turin also faced challenges brought about by the proposed construction of photovoltaic installations in a nature reserve. Conflicts centred on renewable energy sources versus use of the land area; promotion of clean energy sources versus maintenance of a natural reserve; and the benefits or otherwise such an installation would bring to the area. To resolve these conflicts, negotiation of environmental compensation, stakeholder mediation and limitations on authorization of the site were employed. The health impact assessment carried out and led by the Province of Turin and the economic size of the project allowed for sharing benefits and a strong polarization of interests.

The uncertainty around the issue of electromagnetic fields was also presented in a case where the public called for a reduction in emissions from installations. This issue was of major concern for people living near the installations and the municipality administration and was heightened by public prosecution cases. Conflict resolution tools involved legislation and the official establishment of a residents' committee. Resolution of the case benefited from the fact that the administration of the installation showed willingness to find a solution and accepted a series of measures proposed by the court. Challenges centred around dealing with contrasting interests on the issue of electromagnetic installations,

since few people were affected by electromagnetic fields at any given time even if outrage on the issue was high. There was also a lack of clarity of national regulations around such installations which made such a controversial issue stand out.

Two cases of incinerator construction were also presented. One dealt with the challenge of handling over 50 requests for authorization of biomass and animal waste incinerators. Interested parties were private companies, municipality administrations, the general public and farmers. The main conflicts cantered around atmospheric emissions, procurement and traffic. Conflict resolution tools utilized were in the form or working groups and committees such as mixed working groups from the province, municipality and the local environment services (ARPA). Provincial technical experts were made available to the residents' committee. Conflict was resolved by agreement on a number of environmental compensation measures and by identifying possible economic, environmental and occupational benefits to the region, as well as engaging opinion leaders in the process.

The second case concerned the planned construction of incinerators for use in the province. Residents, political parties and relevant institutions were involved. In 2004/2005, the location of the first incinerator and the technology to be used was determined involving planners, residents, institutions and academia. From 2006 to 2009, an HIA and an Integrated Environmental Authorization (*Autorizzazione*

Integrata Ambientale) were carried out involving planners and technical bodies. From 2009 to 2010, legal appeals and a hearing took place. The building of the incinerator took place between 2011 and 2013, involving the project planners, the construction company and the magistracy, and the incinerator began operating in 2013. The stakeholders were people living in the immediate area of the proposed construction site and residents of the province, municipality administrations, farmers and schools. In this case, conflicts centred on all health and environment issues related to incinerators. Conflict resolution tools employed were the use of a local inspection and control committee, a scientific committee and a round-table process to gather input among local administrations. Success factors were the technical excellence of the proposed project, the fact that there were few other credible alternatives and political coherence over a long period of time. There was political opposition to incinerators and it was a challenge to identify funds to finance investment in the installations. An unstable political system marked by the economic crisis was also a challenge.

Table 3. presents a checklist used for assessing such cases.

Table 3. Criteria for assessing environmental cases in the Province of Turin

	Aspect	Rating
1	Clarity of the regulatory framework	● Excellent ● Average ● Poor
2	Political role	● Strong ● Average ● Poor
3	Technical strength of the arguments being supported	● Strong ● Average ● Poor
4	Citizens' arguments	● Strong ● Average ● Poor
5	Innovation of technical solutions adopted	● High ● Medium ● Low
6	Community empowerment	● Strong ● Average ● Poor

Source: R. Ronco, unpublished data, 2013.

Key messages

Based on the presentations and discussion, the following key messages regarding risk communication in environment and health can be extracted.

The public is among the key stakeholders that should be involved in risk communication from the outset and can contribute to the assessment and management of risk. Stakeholders are public and private groups that have active concerns about environmental and public health issues. Their involvement challenges the way in which scientific assessment and management are performed. The former approach, in which experts determine the "right" evidence, is no longer tenable and should be replaced by a more transparent and broader form of science and governance. Involving the public as stakeholders helps make communication an exchange of information in an effort to find innovative solutions, thus moving away from the previously utilized one-way communication.

Information needs to be reframed to be understood by a lay audience. Communicating to a lay audience should involve distilling information while communicating the main study results rather than fragments. Science disciplines should not use technical jargon but, instead, language that can be understood by a lay audience. Participatory tools, consensus-building, information exchange and joint solution-finding should all be employed. The nature, origin and way in which results influence conclusions and subsequent choices (such as side-effects of medication) should be clearly explained. Statistical parameters should be used sparingly, avoiding the use of decimals and taking care not to overload the recipient with information (i.e. frequencies such as "1 in 100 people" should be used instead of percentages. When communicating, risks should not be hidden and results should be reported together with their limitations. Words should be supported by illustrations (see Box 3).

Essential elements for effective risk communication are information quality, transparency, simplicity and coherence of messages, receptivity to public concerns and timing. Quality of information and use of a credible, verifiable source, as well as honesty and transparency, are critical elements to consider for risk communication, especially in the face of uncertainties. Messages should be coherent, simple and uniform, focusing on a few key issues. Qualitative techniques such as focus groups should be used; they help obtain information

on how best to communicate risk on a given topic, as they reveal public concerns, sensitivities and values. Timing and timeliness of communication are also key to effectiveness. In the face of ambiguity, it is best to explain the uncertainties around the issue in question. "Over-assurance", one of the most common pitfalls of risk communication, should be avoided, as should be alarming people about unreal risks.

Multisectoral and multi-stakeholder involvement are essential for communicating risk. As stated in WHO's "health in all policies" approach, one multisectoral involvement is key to improving health, as each sector can contribute in its unique way. Reliance on public health professionals alone to communicate risk no longer makes for a comprehensive approach; they should be one category among many involved in communicating risk (the public health professional could have the task of determining the qualitative or quantitative dimensions of a particular risk). Multiple stakeholders (the general public, industry, local authorities) can also be valid stakeholders in communication of risk as they bring different perspectives to the table.

Communication approaches should be based on a clear methodology, be participatory and integrate sociological methods into traditional public health-oriented ones. A methodological approach to finding a solution and getting consensus among the general public should be adopted. While this can lead to additional cost and effort, it is necessary to avoid conflict. The challenge remains to achieve balance and integrate technical skills, norms and public values. The result can be a considerable sense of public ownership of decisions taken. When the general public get closer to science, they are empowered to request more data and risk estimates and innovative solutions often the result. The challenge remains to convince institutions to lead such participatory processes.

Communication vehicles such as the social media, when used correctly, promote a sharing aspect that creates a sense of active communication. The abundance of information available and the ability to quickly respond, provide an opinion and create an image all put social networks at risk of being a source of misinformation. There are a number of ways to use social media in a constructive way (see Box 5).

Outrage can distort risk perception. To communicate risk effectively, it is important to understand the reasons behind variations, perceptions and biases.

Outrage plays an important role since it focuses on the situation, the type of risk and how it is being managed. Inclusion of transparency, monitoring and participation help reduce the sense of outrage in the population facing risks.

Uncertainty should be acknowledged as a central component in the management of environmental risks. It is important to assimilate uncertainties into the risk assessment process, since not doing so leads to a distortion of study conclusions. Recognition of uncertainties allows for further reduction in future studies and unmasking in previous cases. It can also help orient political and regulatory decisions. Uncertainties that should be presented to the general public are those that have policy- and decision-making relevance. These may include results that have considerable impact on policy-making or may become a target of policies, results that are close to legal standards or thresholds being sought, controversial results or ones that may lead to changes that conflict with stakeholder values. The reaction of the general public to uncertainties should be foreseen, considering what target audiences are likely to do with the information. In the case of low risk, consideration should be given to whether the general public's impression of high risk may lead to distrust.

Communication of risk should be embedded within scientific studies from the outset. The affected population should receive information on study plans, intermediate findings on outcomes of interest and results of epidemiological analyses in a manner that is understandable to a lay audience. In situations where risks are uncertain or possibly controversial, and where study results planned to verify specific hypotheses are unambiguous, it is necessary to involve experts from different disciplines. Furthermore, interaction with stakeholders is needed to identify appropriate studies and understand attitudes that influence exposures to environmental risks.

Capacity-building is needed in the area of risk communication. Individuals and institutions need knowledge on how to carry out correct and transparent communication within their means. Communicating prevention is not a simple matter and the underestimation of a problem can be a real risk. The balance between the costs and benefits of a given action must be considered as there are multiple implications of incorrect communication or alarmist messages. The cost : benefit balance must bear in mind the responsibility of the communicator and should not omit or neglect to provide all information to individuals and institutions.

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