# ANNEX 5: PRECAUTIONS AGAINST THE SABOTAGE OF DRINKING-WATER, FOOD, AND OTHER PRODUCTS

## 1. Introduction

Civilian drinking-water and food supplies have been sabotaged throughout recorded history, usually during military campaigns. More recently, however, in situations not associated with open warfare, such sabotage has been used to terrorize or otherwise intimidate civilian populations *(1)*. Terrorists may have a variety of motives, from settling grudges to political destabilization. It is not necessary to inflict mass casualties to cause widespread panic and disruption, particularly economic. While the deliberate contamination of drinking-water can cause human illness, the long-term disruption of drinking-water supplies will have catastrophic consequences for public health and confidence. Although the deliberate contamination of all food supplies in a given area is unlikely, pre-existing food shortages could be considerably worsened by such contamination. All populations are vulnerable to such attacks.

Governments as well as commercial and other organizations in the private sector should be aware of the need to prevent and respond to deliberate contamination. While threats aimed at extorting money, particularly from organizations in the commercial sector, are usually not considered terrorism, they are far more common than is generally believed. Their economic and social impacts can be the same as those of acts that are clearly terrorism. Security and safety precautions should therefore be evaluated to make sure that they can respond to threats of deliberate contamination. Providers of water supplies, manufacturers, and other private sector organizations must therefore be involved in the development and implementation of safety assurance plans designed to prevent, detect, and respond to deliberate contami-

nation. Such plans must include consumer education and active means of communicating with the press and the public. An improved climate of vigilance will reduce vulnerability to both deliberate and accidental contamination. The threat of terrorism should not, however, mean that other pressing safety concerns, such as the prevention of unintentional contamination of drinking-water and foods, are ignored, nor should it be allowed to cause panic.

Since drinking-water, food, and medicines are consumed by the population, they probably provide the easiest way to deliver lethal or debilitating amounts of toxic chemicals or biological agents. Drinking-water systems and those for manufacture and distribution of food and other consumer products present many opportunities for deliberate contamination. Although globalization and the complex production and delivery systems for many foods and medicines have increased vulnerability, this diversity of sources also reduces the likelihood that all supplies of food and medicines will be contaminated. For water, the lack of alternative sources in most areas creates a more serious problem and increases the potential for panic and hysteria.

Widespread human illnesses have been associated both with a variety of food- and waterborne microorganisms and with drinking-water and food products contaminated with toxic chemicals. Large-scale disruption of food supplies caused by diseases of farm animals has also occurred. Such outbreaks have strained or overwhelmed public services, and given rise to intense media coverage, with consequent adverse economic, social, and political effects. They have also resulted in a loss of public confidence. Where terrorists are successful in spreading contamination or otherwise disrupting services, the same effects are likely to occur.

Programmes designed to prevent the sabotage of drinking-water, food and other consumer products, such as cosmetics and medicines, are based on:

1. Prevention
2. Detection
3. Response

In all of these, *preparedness* plays an essential role.

There is no way of preventing all contamination, whether accidental or the result of the deliberate introduction of chemical, biological, and radioactive agents. A determined terrorist with access to the required resources can penetrate virtually any system. However, the risk of human exposure can be reduced by increasing security and the ability to detect contamination or disruption. Early detection of contamination or attempts to contaminate would prevent or significantly reduce the magnitude of any resulting disease outbreak. While systems that rapidly and effectively detect and respond to disease outbreaks resulting from contamination and other causes are essential, those available are often not rapid enough to prevent all human exposure.

Given the large number of potential threat agents, it is impossible to monitor all of them all of the time. However, adopting sensible precautions is an effective approach to safeguarding public health, whether in areas with complex modern production and distribution systems for water and food or in those where drinking-water is obtained from a catchment and most food is locally produced, stored, and consumed. Proactive risk analysis can reduce vulnerability in the same way as for accidental contamination. Available resources should be allocated based on threat and vulnerability assessments, and should be appropriate to the nature and likelihood of the threats, whether accidental or deliberate.

The purpose of this annex is to increase public awareness of the threat of the deliberate sabotage of drinking-water, food, and other consumer products and services, and to provide general guidance on actions that can be taken to prevent, detect, and respond to this threat. Most multinational and other large commercial organizations and service providers have the resources to develop appropriate security and detection systems. Emphasis should therefore be placed on assisting small or less-developed businesses and utilities to develop and implement systems for the prevention and detection of deliberate contamination.

Worker safety is important in all activities. While not directly covered in this annex, the physical and mental health of workers should be major considerations in the development of security and safety plans.

# 2. Prevention

## 2.1 Security

Organizations involved in the supply of drinking-water and food production, processing, and distribution, as well as in the manufacture and distribution of other consumer products should:

- develop security and response plans, including establishing and maintaining up-to-date points of contact, internally and externally, with the public health and law-enforcement authorities, in case an incident is suspected or detected;
- safeguard sources of raw materials, including storage facilities and transport systems;
- restrict and document access to all critical areas, such as processing, storage, and transport;
- screen employees to ensure that their qualifications and background are appropriate to their work and responsibilities;
- screen other personnel (including sanitation, maintenance, and inspection personnel) with access to critical areas;
- minimize opportunities to contaminate the final product in the supply chain;
- for food and other consumer products, increase the ability to trace where any product is and where it has been in the supply chain and to remove it from that chain if it is believed or shown to be contaminated; and
- report threats and suspicious behaviour and activities to the proper authorities, and take appropriate action to make certain that security is maintained.

Preventive approaches do not necessarily require high technology. Increased awareness of potential problems and greater vigilance are among the most effective measures that can be taken. The wax seal is a tamper-evident device that has been used for several thousand years. A variety of such devices can be used to provide evidence of unauthorized access to critical areas and materials. While these precautions are primarily concerned with security and not directly with safety, they

can increase safety from deliberate contamination. Increasing security measures will not, however, guarantee safety. Threats, both inadvertent and deliberate, will change. Nevertheless, a culture of secure operations and quality control will deter contamination by creating robust proactive systems that are harder to penetrate and where the likelihood of detection will be increased.

## 2.2 Reducing the availability of potential threat agents

International efforts to eliminate chemical and biological weapons should be strongly supported. While some of the agents that have been developed as weapons by the armed forces can be used to contaminate food and water, significant threats are also posed by toxic pesticides and industrial chemicals, as well as microbiological pathogens, such as those that are often inadvertent contaminants of food and water. In addition, certain highly toxic pharmaceuticals could be diverted for terrorist use. While most radioactive materials that are widely available for medical use would not cause serious injury if used to contaminate food or water, their presence would cause considerable public alarm. For the purposes of this annex, non-fissionable radioactive materials are considered to be chemical contaminants. Highly toxic pesticides and industrial chemicals, including chemical wastes, are widely available. Information on the preparation and use of chemicals for purposes of terrorism is also readily accessible, particularly on the Internet. Pathogenic microbiological agents are present in clinical and other laboratories, including those concerned with water and food control. A university-level knowledge of chemistry or microbiology is sufficient to produce many agents. Governments and commercial organizations must therefore increase the security of stores of toxic drugs, pesticides, radioactive materials, and other chemicals, and immediately report to the proper authorities any theft or other unauthorized diversion. Increased efforts must also be made to prevent the use of microbiological pathogens in terrorist activities. It is vitally important that clinical, public health, research, and water and food laboratories are aware of this potential and that appropriate security measures are taken to minimize the risk that dangerous materials are diverted for such purposes.

### 2.3 Screening of employees

Opportunities for the deliberate contamination or sabotage of drinking-water supplies exist at many points in water-supply systems, particularly for those with experience of such systems. Opportunities for the deliberate contamination of food exist from pre-farm to the table, and for other consumer products from pre-production to the consumer. Employers should screen staff to ensure that their qualifications and background are appropriate to their work and responsibilities. All staff should be strongly encouraged to report all suspicious behaviour and activities to the appropriate authorities, but care should be taken to prevent the use of false or unwarranted reports as a means of harassment.

## 3. Detection

The possibility of the contamination and interruption of water and food supplies should be taken into account in the assessment of safety-assurance systems, such as water safety plans, good manufacturing practices (GMP), and the Hazard Analysis and Critical Control Point (HACCP) system. This is a scientific and systematic way of increasing safety from primary production to final consumption through the identification, evaluation, and control of hazards that are significant for safety *(2)*. However, HACCP systems are designed to control specifically identified hazards. Some HACCP requirements, such as record keeping, may not be necessary or appropriate when the aim is to detect deliberate contamination. Safety-assurance systems should be designed for the specific operation concerned. Proactive risk analysis is needed to reduce vulnerability in the same manner as risks of inadvertent contamination. The resources allocated for this purpose should be proportional to the likelihood of the threat, the magnitude and severity of the consequences, and the vulnerability of the system. The possibility of deliberate contamination must be an integral part of safety planning, and efforts to prevent sabotage should complement, not replace, other essential safety activities.

Early detection of contamination or attempted contamination is essential in reducing the likelihood or magnitude of human exposure. The effects of pathogens are often delayed, so that exposure to contaminated

products will continue until the contamination or the outbreak is detected. The failure of disease-surveillance systems, even in more advanced countries, to detect large-scale waterborne outbreaks emphasizes the importance of the prevention or early detection of contamination. Monitoring for contamination in all drinking-water systems and the production of food and other consumer products should be an integral part of routine quality control. Monitoring programmes can include a number of activities, ranging from careful visual examination to high-technology, in-line detection systems. As for inadvertent contamination, it is impossible, both technically and economically, to test for all possible agents all of the time. There may often be indicators of nonspecific variations in product quality, such as appearance, smell, or taste. Allocation of available resources for routine monitoring should therefore be appropriate to the specific product, process, and distribution situation. Rapid follow-up is essential when variations in product quality or in water service indicate the possibility of contamination. Public health officials should work closely with utilities and commercial and other private sector organizations and, where possible, assist in the development of appropriate monitoring programmes.

Individual consumers have a significant role to play in detecting both deliberate and inadvertent contamination. Consumers are often the first to detect differences in water quality, e.g. in taste, odour, or colour, and to become aware of health problems caused by water. If the packaging of a food or other consumer product is not intact, e.g. when anti-tamper seals have been broken, or if the product has an abnormal appearance, odour, or taste, it should not be consumed. If tampering is suspected, the retailer or supplier and the appropriate public health and law-enforcement authorities should be notified.

# 4. Response

## 4.1 Surveillance of water, food and other consumer products

Activities carried out in response to outbreaks of illness associated with infectious diseases and food- and waterborne pathogens are also appropriate to the identification of outbreaks associated with deliberate

chemical and biological contamination. In general, separate systems should not be developed specifically for dealing with terrorism or other concerns, such as food safety. Public health surveillance should be strengthened to respond to disease outbreaks and other adverse public health events, whatever their cause. Questionnaires used for the surveillance of disease outbreaks should include questions designed to identify the route (for example, air, water, or food), the levels and the source of the contamination. Public health authorities should coordinate their activities with those of drinking-water suppliers and manufacturers and suppliers of food and other consumer products to ensure that appropriate measures, such as trace-back and market recall of foods and other consumer products, are taken as rapidly as possible. If deliberate contamination is suspected, the appropriate law-enforcement authorities should be advised.

## 4.2 Monitoring of contamination

In response to suspected contamination, threats, or disease outbreaks, the public health authorities and the industry concerned should ensure that all available analytical and investigative resources are called upon to prevent contaminated products from reaching consumers. Response plans should include mechanisms for notifying the appropriate government officials and private sector organizations that monitoring is necessary to determine the extent of the contamination. Public health authorities should prepare inventories of the analytical resources and skilled personnel available in international organizations and governmental, commercial, and academic laboratories. With drinking-water, the time between the end of processing and consumption is often only a few hours. It is therefore important to ensure that monitoring is effective and can give early warning of contamination.

## 4.3 Trace-back and market recall

Trace-back and market recall of food and other consumer products are needed in the investigation of incidents associated with these products, and should be included in response plans. The rapid determination of the source of the contamination and the location of contaminated products will greatly reduce the number of casualties by facilitating the rapid removal of contaminated products from the market.

Recall is not usually required with drinking-water. Arrangements should be made to notify rapidly all parts of the water-supply system that may be involved, together with consumers. Advance planning and a thorough understanding of the distribution system dynamics and the flow from different sources in the system are extremely important.

Trace-back and market recall are essential in responding to food contamination, whether deliberate or inadvertent. However, neither trace-back of problems nor trace-forward of contaminated products is always simple, as shown by the Belgian dioxin crisis *(3)*, and cannot be used in many agricultural production systems. Where small quantities of raw agricultural products are produced on small farms, they are usually combined, and these lots are then combined with other mixed lots to form larger shipments. It is therefore very important to link a contaminated shipment with an individual producer. With raw materials, the extent of recall will depend on the resources required for trace-back and market recall compared with those required for analysis and other measures for determining the safety of the raw materials at the critical control point of entry into the processing stream. Many foods are produced at centralized plants and distributed over large geographical areas, often globally. Contamination at such plants has affected large numbers of people and has often spread very widely before the outbreak was detected. Rapid determination of the source of the contamination and the location of contaminated products would greatly reduce the number of casualties by facilitating the rapid removal of contaminated products from the market. Market recall from the point of processing is essential.

## 4.4 Communications

Preparedness must include methods of communicating with the press and the public in order to manage fear and avoid unfounded rumours. Panic and hysteria may result in far more serious consequences to public health, as well as to industry and commerce, than the threat itself. Social and political dislocation and a sense of vulnerability are likely to persist long after the incident, whether or not an outbreak resulted. Some perpetrators of terrorist attacks may therefore regard the resulting publicity and social disruption as more effective in spreading their “message” than the number of people infected or killed, as in the

planting of bombs in busy places but giving warnings to avoid injuries and deaths. Accordingly, it is unwise to regard the terrorist threat of the release of biological, radioactive, and chemical agents as one that is purely intended to cause numerous injuries or illnesses. This makes water-supply systems and food supplies attractive targets for deliberate contamination. Achieving sufficient contamination to cause ill health may be less important than ensuring that some physical evidence of a contaminating agent is present and discovered, and that the public is made aware of this.

Public health, safety and law-enforcement authorities, commercial and other private sector organizations, and the media must develop and use methods of communication that provide the information necessary for public safety but that do not contribute to panic. They must communicate actively with the public. Methods must include providing information on incidents that do not result in outbreaks. Such incidents are common and can contribute to public concern. Withholding information from the public can lead to a loss of confidence in the authorities, so that the public must be given the appropriate information, including advice on avoiding exposure and medical advice relevant to the nature of the incident. Cultural aspects should also be taken into account in communications associated with threats and the response to them. For this reason, some types of communication may not be universally applicable.

A systems approach has been taken in the sections below on drinking-water, food, and other consumer products. This can be used to assess vulnerability and the precautions that can be taken to improve safety.

## 5. Drinking-water supplies

The effects of deliberate contamination of water-supply systems are usually limited by dilution, disinfection, and filtration, nonspecific inactivation (hydrolysis, sunlight, and microbial degradation/predation), and the relatively small amount of water to which individuals are usually exposed compared with the total supply. However, with determination and the necessary resources, any part of the system can be penetrated. Outbreaks of cryptosporidiosis, including the large outbreak in Milwaukee,

Wisconsin, USA (which was not due to deliberate contamination), demonstrate that water-supply systems are vulnerable *(4)*. Water sources in many parts of the world are generally insecure and therefore more vulnerable to deliberate contamination by chemical or biological agents and the sabotage of equipment and facilities. The level of security at treatment plants varies widely.

Deliberate contamination can have not only the direct effects of injury or illness, but also the indirect effects of denial of the supply of drinking-water. A successful terrorist attack, whether by contamination or by other forms of sabotage, such as the use of explosives or other physical means, can disrupt the drinking-water supplies of a large city for months, with serious consequences not only to public health but also to industry and commerce. The sabotage of wastewater-treatment facilities could likewise cause public health problems and similar disruption, particularly downstream, but not of the same magnitude as those caused by the sabotage of drinking-water treatment plants or distribution systems.

Recreational water areas, such as swimming pools, that are not intended for use as sources of drinking-water, are also potential targets for deliberate contamination, but this will not be considered here. However, much of what is said here about drinking-water systems will also apply to water used for recreation.

Drinking-water supply systems consist, in general, of the following components:

- *a water source*, such as a lake, reservoir, river intake, spring catchment tank, or groundwater borehole;
- *a raw water main*, which connects the drinking-water source via a pipeline or aqueduct to a water-treatment plant;
- *a treatment plant*, in which processes such as coagulation, sedimentation, filtration, active carbon treatment, ozonization, and chlorination are carried out;
- *a piped distribution* system in which drinking-water is transported to end-users or, more commonly, to water tanks or water towers elevated above the end-users;
- *water tanks and towers*, which can provide a steady supply of drinking-water at a more constant pressure; and

– *a local piped distribution* system in which pumped or gravity-fed water under pressure is provided to residential water tanks and taps or other end-users.

A large distribution zone in a well-monitored drinking-water supply system can be relatively difficult to penetrate and contaminate effectively. There is often only one supplier of drinking-water in each locality, and drinking-water produced in one place is not normally transported to large areas of a country, so that, for each water system, surveillance and security measures can be concentrated on protecting key local installations. Access to points in the system where chemical or biological agents could be introduced in sufficient quantities to cause a large-scale health threat to water ready for end-use is usually limited. In addition, where disinfection with a residual disinfectant is practised, the range of chemical and biological agents that a terrorist might use to cause illness or injury is restricted to those that are resistant to disinfection and stable in water for more than a few hours. However, a massive biological contamination might not be neutralized by the residual disinfectant.

Nevertheless, there are very few water systems that are not potentially vulnerable to contamination at many points. The distribution system can be the most vulnerable part of the water-supply system, particularly to an experienced water services technician. Commercially available pumps could be used to inject relatively large quantities of contaminants into the system. It may not be necessary to contaminate a large part of the system in order to cause considerable damage and panic.

Most water-supply systems differ in their operational requirements and practices. In areas that rely on the transport of drinking-water, often over considerable distances, greater security may be required, so that the vulnerability and the actions required to reduce it may vary from system to system. The action needed to reduce the threat of deliberate contamination at specific points in the system will therefore depend on the extent of the vulnerability and the potential impact of contamination at any particular point in the system.

The complicity of the staff of the water-supply system, or their coercion, in introducing chemical or biological agents into the water or compromising the water-treatment process, is a possibility that cannot be neglected. Staff should be screened to ensure that their qualifications

and experience are appropriate to the work for which they will be responsible. All staff should be encouraged to report suspicious behaviour to the appropriate authorities, but care should be taken to prevent false or unwarranted reports for purposes of harassment.

## 5.1 Water sources

The possibility of serious human health effects as a result of the contamination of water sources can range from low, as with large reservoirs and rivers, because the water will be diluted and treated before reaching the end-user, to high, as in catchment systems and open shallow wells where treatment is not provided.

The security of the source will depend on:

- the ease of access to the source and the ability of the terrorist to deliver to it quantities of chemical or biological agents sufficient to cause injury or illness in end-users;
- the nature of subsequent water treatment and analysis, and the time available after the detection of a potential problem for a suitable response to be made.

To minimize the risk of unauthorized access to water sources, intakes, inspection points and pump houses, various physical measures, such as fencing and locks, are commonly used. These can be supplemented with on-site security personnel, intrusion detectors, and silent alarms linked to the police and the water-supply company or authority. If resources permit, remote-controlled television surveillance can also be introduced. Local citizens should be strongly encouraged to report suspicious activities to the proper authorities. Certain water sources, such as rivers, can be vulnerable to large-scale contamination, e.g. from the discharge of large quantities of industrial chemicals and the sabotage of wastewater-treatment facilities upstream.

## 5.2 Raw water mains

Raw water mains carrying water to a treatment plant may be vulnerable to contamination. However, their position upstream of the treatment plant in the overall water-supply system means that subsequent inactivation of toxic chemicals and pathogens or their detection is more likely. However, it will be difficult to detect certain types of

chemicals or radioactive materials. In addition, certain microbial agents cannot be detected immediately. Most chemicals and radioactive materials, and certain microbial agents, will not necessarily be removed or inactivated by conventional treatment.

Physical security measures, such as those suggested above for water sources, can also be applied in pipelines and pumping stations.

## 5.3 Treatment plants

Water-treatment plants are of vital importance in water-supply systems. Reducing or eliminating disinfection, in combination with the deliberate introduction of pathogenic organisms, will greatly increase the likelihood that an infectious dose containing a large number of organisms will be delivered. Some recent outbreaks of waterborne diseases have resulted from the interruption of disinfection operations *(5)*.

For the traditional reasons of protecting public health from communicable diseases and industrial chemicals, access to water-treatment plants in large water-supply systems is usually closely controlled, and on-site laboratory staff analyse samples for a wide range of potential pollutants. Small to medium systems may be more vulnerable. Undetected access to a treatment plant to introduce a contaminating agent should be made more difficult by introducing multi-barrier security and access. These can be supplemented by other measures, such as patrols at irregular intervals, closed-circuit television, and anti-tamper locks and alarms on important equipment and inspection covers.

Chlorination is effective against many, but not all, pathogenic biological agents, and can easily be overwhelmed. In addition, the presence of large chlorine-gas storage tanks, especially in areas with large populations, poses its own terrorist risk. Ozonization is a more expensive form of disinfection, but is generally more effective against contaminating agents, pathogens, and toxins. However, it does not provide any residual protection, such as that provided by chlorination.

## 5.4 Piped distribution systems

Treated water is usually distributed to end-users through piped distribution systems under pressure and below ground. While the main function of pressurized piped distribution systems is to convey water

to people, the pressurized nature of the network can prevent surface water, groundwater, and sewage from coming into contact with treated drinking-water. This makes the deliberate introduction of contaminating agents more difficult, but not impossible. An experienced technician can easily gain access to these systems. Since the water has already gone through the treatment process, any contamination will most likely remain undetected until it reaches the end-user.

## 5.5 Water tanks and water towers

In many systems, most end-users do not receive their drinking-water directly from the distribution mains, but from local water tanks and water towers elevated above the end-users. The final distribution to end-users through a local pipe network is often gravity-fed at lower and steadier pressure. The treated water in these tanks and towers is not under pressure and may therefore be more vulnerable. However, since they are in specific locations, tanks and towers are easier to protect.

To improve the security of water tanks and towers, they must be made difficult to access. This can be accomplished by securing the sites with strong fences, erecting multiple barriers to entry, and sealing entry points. These measures can be supplemented by intrusion detectors and silent alarms connected to the police and the water control room. If resources permit, monitoring of water quality parameters, closed-circuit television surveillance, or appropriate on-site security personnel can be used.

## 5.6 Local piped distribution systems

While systems for piped water pumped or gravity-fed to residential water tanks and taps or other end-users have many points that are vulnerable to deliberate contamination, this is not likely to affect large populations. However, since drinking-water in these distribution systems has already been treated and is not subject to significant dilution, the risk of injury and death among populations exposed to agents introduced at this point in the drinking-water system is high. Certain buildings and houses have their own community piped distribution systems, with water often received from tanks. This makes intrusion by terrorists much easier than in other parts of the water-supply system. Deliberate introduction of contamination in distribution systems could be used to

target specific buildings or areas or various points in the overall water-supply system. Widespread public panic could result from the contamination of even a small part of a distribution system.

Both water suppliers and consumers should pay special attention to local distribution systems, and these should also be included in preparedness planning. In local distribution systems, such as those of office and apartment buildings, water lines and meters should be secured, e.g. by means of locked access covers and utility rooms. All suspicious activities, particularly if associated with unusual maintenance or repair work, should be immediately reported to the proper authorities.

The separation of individual parts of the water-distribution system improves control and permits the rapid isolation of suspect or contaminated parts of the system. This is a routine design feature in most modern water-distribution systems, and is used in dealing with conventional problems, such as pipe repair and replacement, and the removal of non-deliberate microbiological contamination.

In particularly sensitive facilities, such as hospitals, public health services, security services, and bottled water and food-processing plants, additional water-treatment processes can be considered.

## 5.7 Monitoring

Monitoring should be carried out as necessary to give time for an appropriate response. The ability of the quality-control system to detect the presence of contaminating agents will depend on the frequency and range of the analyses undertaken. However, it is impractical to carry out specific analyses for all of the potential chemical and biological agents that could be used. On-line monitors for certain parameters, such as conductivity and pH, may provide some nonspecific indication of a change in water quality and of potential problems. Instrumentation is available for in-line or rapid general screening of processed water for specific chemical contaminants, and is being developed for biological agents. Bioassays can be a low-technology component of monitoring programmes, and can sometimes give rapid results. A number of nonspecific in vivo and in vitro assays are useful in detecting contamination, particularly by chemicals, and simple immunoassay screening tests for certain bacteria and viruses can be used in response to specific threats.

Emergency-response plans must include specific instructions for an immediate response to abnormal values and for preventing contaminated drinking-water from entering the distribution system, since there will not be time to discuss how to handle a problem once it is detected. These instructions should include the immediate notification of the appropriate public health authorities. When there is evidence that a drinking-water system has been contaminated by toxic chemicals or pathogenic microbes, the temporary suspension of the water supply may be the only practical way to prevent serious public health problems. However, this may cause great social inconvenience. The decision-making process on such occasions should be carefully planned and modelled in advance so that such decisions can be reached very quickly.

# 6. Food

Safeguarding food supplies and food ingredients from the deliberate introduction of chemical, radioactive, and biological agents by terrorists is a major challenge in industrialized countries, and especially those with access to a wide range of raw and processed foods and other products from around the world. At the pre-farm stage, e.g. in feed ingredients, in farms, or in the case of meat products, in slaughterhouses, there are opportunities for chemical or microbiological contamination with a resulting spread of disease of considerable magnitude. The unintentional contamination of food at retail markets and in local catering sites such as restaurants, schools, hospitals, and other institutions, is quite common and much more difficult to prevent. The opportunities for post-processing contamination of packaged foods in bottles, jars, packets and cans have been reduced substantially by the widespread introduction of tamper-resistant containers. This has been in response to incidents of tampering with food and medicines aimed at extorting money from large companies and retailers. While contamination at the retail level is not likely to result in large-scale adverse health effects, coordinated contamination at a number of different locations could lead to widespread disruption. Although tamper-resistant and tamper-evident containers are not fail-safe, they can be cost-effective in reducing the opportunities for deliberate contamination.

The precautions that should be taken to safeguard food supplies should be considered systematically for each stage in the production process from farm to retail and by the consumer. The number of precautions required may be considerable in complex processing operations. With street vendors and restaurants, perhaps the most appropriate precaution that can be taken is to promote more careful observation by the workers concerned, particularly of any suspicious behaviour by individuals and any unusual appearance of the food. As with inadvertent contamination, individual food preparers and consumers must play their part in food safety.

Agricultural and other production problems that do not directly result in human illness include short- or long-term loss of use of tracts of land or water resources, the economic disruption of agriculture, food processing, or other economic sectors (e.g. by non-human pathogens in livestock, insect infestations or diseases of crops, and the contamination of food-processing facilities with agents that are difficult to remove) are not considered here.

A general food-production system includes the following stages:

- pre-farm;
- agricultural production and harvesting;
- storage and transport of the raw materials;
- processing;
- storage and transport of processed products;
- wholesale and retail distribution; and
- food service and individual home food preparation.

Such systems range from families who sell to nearby communities to organizations with global production and distribution systems. Many foods, such as fish, meat, poultry, fruit, and vegetables, undergo only minimal processing before consumption. Others, such as most cereal products, cooking oils, and sweeteners, have undergone considerable processing before reaching the consumer. The food-production systems and the specific steps vulnerable to attack may be different for each type of food. The interfaces between the components of the food-production system – where the food changes hands – are the most vulnerable parts. While food safety plans should include measures designed to

ensure physical and personnel security, different methods for deciding whether contamination is deliberate or inadvertent may be required.

## 6.1 Agricultural pre-production, production and harvesting

### *6.1.1 Security of animal feeds*

The contamination of animal feeds that resulted in the spread of bovine spongiform encephalopathy (BSE) and the contamination of poultry feed with dioxins demonstrate the impact that inadvertent contamination has had and that deliberate contamination could have on human health, consumer confidence, and the economy. Many animal feed ingredients are important commodities in the international marketplace, and safety-assurance systems should be included in the quality control of such ingredients. Security measures, such as control of access and tamper-resistant or tamper-evident systems, should be considered during manufacture, transport, and storage. Mechanisms for the recall of animal feeds and animal feed ingredients should be developed where feasible.

### *6.1.2 Security of agricultural production areas*

Agricultural production areas range from those of small farms to very large commercial farms and feedlots. In general, priority has been given to production, and not to food safety *per se*. Recent programmes designed to promote good agricultural practices have also included food safety. Agricultural production areas can be vulnerable to deliberate contamination, such as with highly toxic pesticides and other chemicals. Irrigation water can be easily contaminated with chemical and biological agents. Subsequent processing may sometimes provide critical control points where inadvertent or deliberate contamination can be detected and controlled. Because fruits and vegetables are consumed directly without processing, there are limited opportunities for critical control points for the detection or removal of contamination. The large number of incidents of inadvertent contamination with pathogenic micro-organisms during the production of meat, fish, poultry, and milk products are clear indications of the vulnerability of these products.

The good agricultural practices (including the application of HACCP systems) that are being implemented in many areas, coupled with routine inspections, can greatly reduce the likelihood of inadvertent or deliberate contamination. The latter should be taken into account in the

establishment and monitoring of critical control points. Certain harvesting practices, such as open-air drying, offer opportunities for deliberate contamination. Controlling access to and the surveillance of agricultural production areas should be considered, particularly in response to known or probable threats.

## 6.2 Storage and transport of raw materials

Although storage facilities for raw agricultural commodities range from the open air to large elevators, and means of transport range from human carriers to large ocean-going vessels, there are some precautions that are generally applicable. Physical measures, such as fencing and locks, can be used to secure and prevent unauthorized access to storage facilities and transport containers. These can be supplemented with on-site security personnel, intrusion detectors, and silent alarms linked to the appropriate authorities. If resources permit, remote-controlled television surveillance is another feature that can be introduced. Tamper-resistant or tamper-evident locks or seals on bulk containers should be used where feasible. These can be improvised from materials such as annotated tapes and waxes, which are widely available.

## 6.3 Processing

Precautions designed to prevent deliberate contamination should be included in food safety plans for processing operations, such as those where the HACCP system is used. Slaughterhouses are particularly vulnerable, especially when not covered by HACCP or comparable systems. The water used in food processing is also important, particularly for minimally processed foods such as fruits and vegetables, where washing is often the critical processing step. Precautions similar to those for drinking-water systems, including the analysis of the water used, should be taken. Air systems in processing plants can also be sources of inadvertent and deliberate contamination. In many food-processing systems, a heat-treatment step is often a critical control point for microbiological contaminants. If HACCP approaches are extended to cover deliberate contamination, normal time/temperature treatments at these control points might not necessarily be adequate for all the

microbiological agents that could be used, and would have little or no effect in reducing contamination by toxic chemicals.

### 6.3.1 Security of processing areas

Access to all critical areas and equipment, including storage areas and water and air systems, should be controlled and monitored. Closed systems, which are often perceived to be less vulnerable and therefore subject to less surveillance, should also be considered. Personal items, such as lunch containers, should not be allowed in critical areas.

### 6.3.2 Analysis of raw materials and processed products

The introduction of raw materials into the processing stream is a critical control point in most processing operations. Sources of raw materials known to be secure should be used whenever possible. Since analysis for all possible threat agents is impossible, emphasis should be placed on deviations from normal characteristics. The possibility of deliberate contamination should always be taken into account in sampling and analysing the final processed products. All deviations from normal that may indicate contamination should be carefully investigated.

## 6.4 Storage and transport of processed products

Physical measures, such as fencing and locks, should be used to secure and prevent unauthorized access to storage facilities and transport containers. These can be supplemented with on-site security personnel, intrusion detectors, and silent alarms linked to the appropriate authorities. Remote-controlled television surveillance is another feature that can be introduced. Tamper-resistant and tamper-evident packaging for larger lots as well as for single packages should be considered. All returned products should be carefully examined before reshipment.

## 6.5 Wholesale and retail distribution

Wholesale establishments and retail markets are among the most vulnerable parts of the food-supply system.

While tamper-resistant and tamper-evident containers have proved to be extremely useful in reducing deliberate contamination, all such containers are vulnerable to individuals who know how to penetrate such protective measures. Controlled access and increased vigilance,

including security cameras and other types of surveillance, may be needed. Stopping customers from bringing packages into retail markets can reduce the likelihood of contaminated products being placed on the shelves. Bulk foods in many markets are particularly vulnerable to deliberate contamination. More secure containers for bulk foods and the use of prepackaged materials may be required to prevent deliberate contamination. Wholesale and retail managers should use reliable suppliers. Substitution of substandard food products for products of perceived greater value (counterfeiting) occurs in most parts of the world, and has included the use of products with false labels and replaced ingredients, which have sometimes been contaminated. These same approaches could be used to distribute deliberately contaminated products. Buyers should be suspicious of food being sold under unusual circumstances, e.g. at much less than its normal price or from outside the normal distribution systems.

## 6.6 Food services and home food preparation

### *6.6.1 Security in food-service operations*

Food services have already been the target of criminal attacks *(6)*. Condiments in open containers in restaurants and institutions are vulnerable to deliberate contamination. Increased monitoring of salad bars and other communal food services may be necessary to deter deliberate contamination. Vending machines may constitute targets of opportunity since they are often unsupervised. Increased surveillance may be necessary and additional tamper-resistant and tamper-evident devices may be required.

### *6.6.2 General food safety in food preparation in individual homes*

Consumer education programmes should include information on deliberate contamination. As with inadvertent contamination, washing and cooking food adequately before consumption should be emphasized. Careful attention should also be given to tamper-resistant or tamper-evident seals. Products for which the integrity of the seal or the container is in doubt or that do not meet the usual quality expectations, e.g. having an abnormal appearance, odour, or taste, should not be purchased or consumed. If tampering is suspected, the retailer or

supplier and the appropriate public health and law-enforcement authorities should be informed.

# 7. Other products

A wide variety of manufactured products are used in everyday life, some of which come into contact with the human body and could therefore be exploited by terrorists to disperse chemical and biological agents. Among these consumer products, cosmetics, such as shampoos and lotions, and pharmaceuticals are especially important. In a well developed market economy where many competing products are available, deliberate contamination of a single product is unlikely to lead to widespread disease outbreaks. Similarly, it is unlikely that a terrorist would have the resources to contaminate simultaneously all brands of a particular product. However, the loss of public confidence in the safety of their environment might be far greater than would be justified by the actual extent of the incident. The economic impact on the company and the country producing the affected product might have repercussions that will affect human health. Much of what has been said about food production will also apply to other consumer products. To reduce the likelihood of deliberate contamination, measures such as the careful screening of employees, confirmation of the identity and safety of the raw materials, maintaining security during the manufacturing process, using tamper-resistant or tamper-evident containers, and providing security during transport and storage, and in retail premises may be considered.

In most countries, the manufacture and distribution of medicines are controlled to very high standards, and include the licensing of all those involved in the prescribing and direct dispensing of these products. However, these quality-control processes should be reviewed from the perspective of deliberate contamination. The analytical methods used in quality control may not always detect certain chemical contaminants and toxins. Security systems during storage and transport should also be reviewed for vulnerability to tampering and the substitution of products. International counterfeiting of certain drugs demonstrates the need for such precautions. As with retail food markets, the checking of all packages brought into the market can reduce the possibility that

deliberately contaminated products may be placed on the shelves. The increasing international nature of the marketplace, and particularly the availability of many products via the Internet and mail order, has increased the vulnerability of medicines to deliberate contamination. In addition, the deliberate inactivation of certain drugs and biological products by heat treatment could compromise their effectiveness.

Traditional medicines are often not controlled to the same standards as pharmaceuticals. There have been several recent reports of the inadvertent substitution of toxic plant materials for the intended medicinal plant in some of these preparations in international trade *(7)*. This is clear evidence of the vulnerability of this market to deliberate contamination. As a minimum, the same precautions as those taken in food production should also be taken with traditional medicines. These include the careful screening of employees, the confirmation of the identity and safety of the raw materials, maintaining security throughout the manufacturing process, using tamper-resistant or tamper-evident containers, and providing security during storage and transport and at the retail level. Recall of raw materials, if necessary, is essential, but may prove difficult, as some of these are harvested in the wild by individuals and sold to buyers who generally mix the individual lots together.

## 8. Conclusions

The possibility that terrorists may deliberately contaminate water supplies, foods, and other consumer products must be taken seriously. Reducing the risk of sabotage will require an unprecedented degree of cooperation among the public health and law-enforcement agencies of governments, utilities, commercial and other private sector organizations, and the public. WHO has developed guidelines on preventing terrorist threats to food to assist Member States *(8)*. Public health authorities must not only take the lead in disease surveillance and incident response, but also strongly support planning and preventative measures.

There are often security and legal difficulties in sharing sensitive intelligence information, particularly about nonspecific threats. Since

the public availability of information on systems operations and vulnerability to threats can increase the danger of sabotage, direct partnerships between water-treatment systems and trade and other commercial private sector organizations should be used to share information necessary to improve security. Mechanisms should be developed and put in place to improve monitoring and surveillance.

Publicity given to threats can be as effective as an actual attack in destroying public confidence. In addition to the possibility of generating panic, such publicity often encourages hoaxes and "copycat" actions that can rapidly overwhelm emergency-response systems. National and local governments should consider their responsibilities and their ability to manage these situations and, in close cooperation with commercial, service, and other private sector organizations, draw up appropriate action plans and carry out training exercises. These plans must include provision for communication with the public to manage fear and avoid unfounded rumours.

The total elimination of all risk of inadvertent or deliberate contamination is impossible. The goal must be to reduce this risk to the greatest possible extent and to respond rapidly when contamination and disruption do occur. Safety-assurance systems should incorporate appropriate mechanisms to deter deliberate contamination. The resources allocated for dealing with threats and accidents should be appropriate to the magnitude of the risk. Consumers have an important part to play in preventing exposure, and need to be more aware of the risk. Threats and suspicious actions should be reported to the proper authorities. Consumer education should therefore be included in preparedness planning. Consumers must be aware of the possibility of deliberate contamination and how to respond appropriately. However, efforts to prevent such contamination should complement, not replace, other activities.

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