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Early identification systems for emerging foodborne hazards

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Abstract

This paper provides a non-exhausting overview of early warning systems for emerging foodborne hazards that are operating in the various places in the world. Special attention is given to endpoint-focussed early warning systems (i.e. ECDC, ISIS and GPHIN) and hazard-focussed early warning systems (i.e. FVO, RASFF and OIE) and their merit to successfully identify a food safety problem in an early stage is discussed.

Besides these early warning systems which are based on monitoring of either disease symptoms or hazards, also early warning systems and/or activities that intend to predict the occurrence of a food safety hazard in its very beginning of development or before that are described. Examples are trend analysis, horizon scanning, early warning systems for mycotoxins in maize and/or wheat and information exchange networks (e.g. OIE and GIEWS).

Furthermore, recent initiatives that aim to develop predictive early warning systems based on the holistic principle are discussed. The assumption of the researchers applying this principle is that developments outside the food production chain that are either directly or indirectly related to the development of a particular food safety hazard may also provide valuable information to predict the development of this hazard.

Keywords: Emerging foodborne risks; Risk analysis; Holistic; Predictive systems

Abbreviations: AIDS, acquired immune deficiency syndrome; BSE, bovine spongiform encephalopathy; CDC, US center for disease control and prevention; CDN, communicable disease network; DEFRA, the UK department for environment food and rural affairs; DG SANCO, the European commission's directorate on public health and consumer affairs; DON, deoxynivalenol; ECDC, European centre for disease prevention and control; EFSA, European food safety authority; EIP, emerging infections program; EFORS, electronic foodborne outbreak reporting system; EU, European union; FAO, food and agriculture organization; FDA, food and drug administration; Foodnet, foodborne diseases active surveillance network; FVO, food and veterinary office; GIEWS, FAO global information and early warning system; GLEWS, FAO/WHO/OIE global early warning system; GPHIN, the global public health intelligence network; HIV, human immunodeficiency virus; INFOSAN, international food safety authorities network; ISIS, national (Dutch) infectious diseases information system; ITX, 2-isopropyl-thioxanthone; LCI, the national (Dutch) coordination structure for infectious disease control; NGO, non-governmental organization; OECD, organization for economic co-operation and development; OIE, office international des epizooties; PHS, public health service; SARS, severe acute respiratory syndrome; SCENIHR, scientific committee on emerging and newly identified health risks; RASFF, rapid alert system on food and feed; USDA, United States department of agriculture; vCJD, variant Creutzfeld Jakob's disease; WHO, world health organization; ZEA, zearalenone.

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1. Introduction

The large number of food safety problems experienced in the last decade in Europe and elsewhere has brought to light the vulnerability of modern food production systems. Public trust in regulatory institutions responsible for the governance of food safety has declined due to public distrust in how such risks have been handled and managed (Siegrist and Cvetkovich, 2000), in part attributed to the high levels of media exposure directed towards these problems (Frewer, 2003).

In Europe, the European Commission responded to this development by issuing the General Food Law (EU, 2002) which clearly describes the food safety framework in the Europe Union including the role and responsibilities of the different parties involved. It is anticipated that this new law will ensure improvement in the safety of the food supply and will contribute to the restoration of public trust.

The process of decision-making on food safety risks has been termed *risk analysis* and consists of the major components: *risk assessment*, *risk management* and *risk communication*. Risk is defined as the likelihood that, under particular conditions of exposure, an intrinsic hazard will represent a threat to human health. Hence, risk is a function of hazard and exposure where hazard is defined as the potential of an agent or situation to cause an adverse health effect(s)/event(s). *Risk assessment* is a process of evaluation, including the identification of the attendant uncertainties, of the likelihood and severity of an adverse effect(s)/event(s) occurring to man or the environment following exposure under defined conditions to a risk source(s). A risk assessment comprises: hazard identification, hazard characterization, exposure assessment and risk characterization. *Risk management* is the process of weighing policy alternatives in the light of the result of a risk assessment(s) and of other relevant evaluations, and, if required, of selecting and implementing appropriate control options (including, where appropriate, monitoring/surveillance activities).

Risk communication is the interactive exchange of information and opinions throughout the risk analysis process concerning risk.

The above presented definitions are in line with the international accepted principles and definitions (FAO/WHO, 1995, 1997; EU, 2000).

It is apparent that food safety risks can be reduced if food safety hazards are recognized in an early stage and if necessary information is exchanged between parties engaged in maintaining food safety.

Many information and monitoring systems on food safety have been put in place at international level (such as Rapid Alert System on Food and Feed (RASFF) in Europe; WHO-INFOSAN) and at national levels (national monitoring and survey programmes) which have demonstrated their usefulness in the control of food safety risks. These systems have in common that they generally detect problems (i.e. the presence of a (food safety) hazard) after they have occurred. Therefore any intervention will be reactive. It is apparent that (monitoring) systems that do not require an outbreak to stimulate control activities but instead rely on signals/information directly and/or indirectly associated with the development of a hazard are preferable.

Recently, EFSA has defined the term "emerging risk" (to human, animal and/or plant health) as a risk resulting from a newly identified hazard to which a significant exposure may occur or from an unexpected new or increased significant exposure and/or susceptibility to a known hazard (EFSA, 2007). Hence systems capable of identifying or predicting the development of such risks are called "emerging risk identification systems," which are synonymous to "predictive early warning systems". These predictive systems should not be confused with reactive early warning systems which are based on monitoring known hazards.

The enforcement of food safety measures such as the establishment of early warning systems to ensure safer food should reduce the number of foodborne illnesses. By systematically collecting such information, it is expected that the outbreak of foodborne illness can be prevented at an early stage, hence providing the opportunity to minimize the societal losses often associated with such incidents (Buzby and Roberts, 1997).

In this report we present an overview, with examples, of the various types of reactive early warning systems that are in operation in various places in the world. In addition, their possible use to predict the development of the hazard will be discussed, using RASFF as an example. Furthermore, we will present examples of predictive early warning systems (hence emerging risk identification systems) for the early identification of food safety risks. New developments in this field will also be discussed.

2. Overview of *reactive* early warning systems

2.1. Introduction

Effective surveillance systems are critical for the detection of accidental or intentional contamination of the food supply chain. There are currently several types of surveillance systems in operation in the developed nations of the world. The various surveillance systems in place track and forecast emerging foodborne safety risks through the collection, integration, analysis and interpretation of data followed by dissemination of the information through reports, advisories and warnings. Some examples are discussed in this paper. The focus of these surveillance systems may pertain to different aspects of food safety. For example, systems may record the occurrence of diseases or intoxication as caused by pathogens and toxicants present in foods. These are cases where the actual risk, i.e. the endpoint, has already occurred before a report is filed. Other systems are hazard-oriented, measuring the presence of the pathogen, toxicant, or other hazardous agents present