

# Global surveillance for chemical incidents of international public health concern

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**Objective** In December 2001, an expert consultation convened by WHO identified strengthening national and global chemical incident preparedness and response as a priority. WHO is working towards this objective by developing a surveillance and response system for chemical incidents. This report describes the frequency, nature and geographical location of acute chemical incidents of potential international concern from August 2002 to December 2003.

**Methods** Acute chemical incidents were actively identified through several informal (e.g. Internet-based resources) and formal (e.g. various networks of organizations) sources and assessed against criteria for public health emergencies of international concern using the then proposed revised International Health Regulations (IHR). WHO regional and country offices were contacted to obtain additional information regarding identified incidents.

**Findings** Altogether, 35 chemical incidents from 26 countries met one or more of the IHR criteria. The WHO European Region accounted for 43% (15/35) of reports. The WHO Regions for Africa, Eastern Mediterranean and Western Pacific each accounted for 14% (5/35); South-East Asia and the Americas accounted for 9% (3/35) and 6% (2/35), respectively. Twenty-three (66%) events were identified within 24 hours of their occurrence.

**Conclusions** To our knowledge this is the first global surveillance system for chemical incidents of potential international concern. Limitations such as geographical and language bias associated with the current system are being addressed. Nevertheless, the system has shown that it can provide early detection of important events, as well as information on the magnitude and geographical distribution of such incidents. It can therefore contribute to improving global public health preparedness.

**Keywords** Chemical industry; Chemicals; Accidents; Safety management (source: MeSH, NLM).

**Mots clés** Industrie chimique; Produits chimiques; Accidents; Gestion sécurité (source: MeSH, INSERM).

**Palabras clave** Industria química; Productos químicos; Accidentes; Administración de la seguridad (fuente: DeCS, BIREME).

## Arabic

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## Introduction

Chemical incidents that lead to human exposure present an important public health challenge both nationally and globally. These incidents can range from an obvious chemical release, e.g. a leak or spill, to a less immediately apparent event such as contamination of a product.

The international community, through the World Health Assembly, has recognized the need to strengthen surveillance for chemical incidents. There are three main reasons for doing this. First, the continuing rapid growth and globalization of the chemicals industry means that chemical incidents will continue to be a problem. Second, chemical incidents may have an impact beyond their original location, in some cases crossing national borders. For example, in north-west Romania cyanide was released from a gold mine into the local river system, leading to fish deaths in three countries (1). The global sale of a brand of dialysis filters contaminated with perfluoroisobutylene is another example. This led to deaths in Colombia, Croatia,

Germany, Italy, Spain, and the United States of America, before the problem was discovered (2, 3). Third, there is concern regarding the deliberate use of chemicals for terrorist purposes, engendered by events such as the use of sarin on the Tokyo underground system and reports of the threatened use of ricin (4, 5).

In December 2001, an expert consultation was convened by WHO through the International Programme on Chemical Safety (IPCS — a joint activity of WHO, the International Labour Organization and the United Nations Environment Programme). The participants concluded that there was a need to strengthen both national and global chemical incident preparedness and response through the development of an early warning system and capacity strengthening (6). In May 2002, the World Health Assembly agreed a resolution urging Member States to strengthen systems for surveillance, emergency preparedness and response for the release of chemical and biological agents and radionuclear materials (7).

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The revision of the International Health Regulations (IHR), which began in 1995, has provided a framework for WHO to take action in this area. This revision has resulted in a fundamental change from the obligation by Member States to notify WHO of outbreaks of communicable diseases to one for notification of “public health emergencies of international concern”, which could include those caused by chemical agents (8, 9). The revised IHR were finally adopted at the 58th World Health Assembly in May 2005.

In August 2002 WHO, through IPCS, initiated a pilot project to determine whether a system complementary to that for communicable disease surveillance and response could be developed for chemical incidents and outbreaks of illness of possible chemical etiology. The system is currently managed by the WHO Alert and Response Operations (ARO) team for communicable diseases. This team functions through two major interconnected components: the outbreak verification team and the Global Outbreak Alert and Response Network (GOARN) (10). The outbreak verification team screens information from a wide range of sources about disease outbreaks. The team seeks verification from official sources of those outbreaks that may have international public health significance according to the revised IHR. A risk assessment is conducted to determine whether an international response is required, and what form it should take. GOARN is a global technical partnership coordinated by WHO that provides a means for reporting, investigating, verifying and responding to communicable disease events of international importance in a timely manner. Members of GOARN comprise national health services and academic and technical institutions, as well as individuals (11). Linking the international response capabilities of GOARN to global surveillance activities coordinated by WHO ensures that the burden of international preparedness and response is not borne by a single country, institution or organization.

The IPCS pilot project adapted the above model for the identification, investigation and verification of acute chemical incidents that had possible implications for international public health. The project also began work on developing an international network of experts on poisonings and injuries from chemicals (ChemiNet) that would function in a way similar to GOARN. ChemiNet members include: principal government officials with experience and/or responsibility for the surveillance and management of chemicals and environmental health; physicians and scientists working in academic, research and health care institutions with a focus on toxicology, contamination of products or environmental health; poisons centres; relevant WHO Collaborating Centres and other United Nations agencies; members of GORAN and individuals.

The present study had two main aims. The first was to identify and describe the frequency, nature and geographical location of acute public health chemical incidents of potential international concern, as determined by the proposed revised IHR. The second was to assess the utility of the systems used to detect outbreaks of communicable disease for detecting chemical events. This report focuses on the events that were identified during the first 17 months of the project, from 1 August 2002 to 31 December 2003.

## Methods

### Incident definition

We defined a public health chemical incident as an incident that resulted in actual or potential exposure to a chemical substance or its hazardous by-products that caused, or had the potential to cause, ill health. Incidents that occurred on industrial premises and only resulted in exposure to employees were excluded.

### IHR criteria

Annex 2 of the revised IHR provides a decision instrument and guidelines to assist in determining whether an event has international public health concern. There are four main criteria: (i) serious public health impact; (ii) unusual or unexpected event; (iii) risk of international spread; and (iv) risk of international trade or travel restrictions. During the IHR revision process, the detailed guidance for these criteria changed; in the pilot project the criteria used were those provided in the document before consideration by the Intergovernmental Working Groups (9).

### Identification, verification and response to acute chemical incidents

On a daily basis, information from a range of informal and formal sources was reviewed to identify acute chemical incidents and outbreaks of disease of unknown etiology that might be of chemical origin. The principal informal sources were the Global Public Health Intelligence Network (GPHIN), ProMED-Mail, and Hazard Intelligence (HInt) (Box 1 contains further information on these sources), as well as other news media. GPHIN and ProMED-Mail were selected because they had already been valuable for communicable disease surveillance and were of sufficiently broad coverage to include chemicals. HInt was a chemicals-specific source. All three had international scope. Formal information sources included reports from national authorities, WHO offices, WHO Collaborating Centres and other United Nations agencies. ChemiNet and the communicable disease outbreak verification teams were additional sources, the latter particularly for diseases of unknown etiology.

#### Box 1. Information sources

**GPHIN** ([http://www.phac-aspc.gc.ca/media/nr-rp/2004/2004\\_gphin-rmispbk\\_e.html](http://www.phac-aspc.gc.ca/media/nr-rp/2004/2004_gphin-rmispbk_e.html)) is a “web crawler” service developed by Health Canada in collaboration with WHO to provide early warning of potential global health protection threats worldwide. It continuously monitors all major news wires, newspapers and biomedical journals for public health events of both national and international concern, in addition to sending email alerts according to pre-defined criteria.

**Hazard Intelligence (HInt)** (<http://www.saunalahti.fi/ility/IncidentHistory.htm>) is an international journal of hazardous incidents that occur in the chemical and related industries. It is published by Ility Engineering. The incidents reported in HInt are gathered by a network of local correspondents and by a meta-search engine developed for Ility Engineering.

**ProMED-Mail** (<http://www.promedmail.org>) is a moderated, Internet-based reporting system for the global dissemination of information about outbreaks of infectious diseases; outbreaks of chemical origin are also reported. It is a programme of the International Society for Infectious Diseases. Sources of information include media reports, official reports, online summaries, local observers and others.

Table 1. Chemical incidents of international public health concern by WHO region and country<sup>a</sup>

Reference	Place, date	Incident
<b>Africa</b>		
Africa News (2002) (W1)	South Africa, September 2002	Leaking fuel and toxic chemicals from a burning cargo vessel.
World Socialist Web Site (2002) (W2)	Nigeria, September 2002	Fire at a rubber goods factory leaves 37 dead and 11 critically ill.
Baier (2003) (W3)	Nigeria, March 2003	Radioactive material missing from an oil company.
The Africa Newswire Network (2003) (W4)	United Republic of Tanzania, September 2003	Unusual number of cases of unexplained spastic paralysis observed in a village.
<b>Americas</b>		
ReliefWeb (2002) (W5)	Ecuador, November 2002	Volcanic explosion resulting in contamination of air and water. Millions exposed.
Biosafety News (2002/2003) (W6)	Mexico, January 2003	Unexplained deaths of >20 babies at a regional hospital.
<b>Eastern Mediterranean</b>		
CBS News (2002) (W7)	Yemen, October 2002	Explosion on board an oil tanker, thought to have been due to a terrorist attack, leads to extensive oil spill.
Greenpeace International (2003) (W8)	Iraq, June 2003	Uranium compounds dispersed from a nuclear facility leads to radiation sickness in a local population.
ProMED mail (2003) (W9)	Iraq, July 2003	Cluster of pneumonia cases. No evidence of person-to-person spread. Cause unknown.
SKY News (2003) (W10)	Iraq, September 2003	Gas leak from a plastics factory results in 14 deaths.
Health Protection Agency (2003) (W11)	Somalia, October 2003	Contamination of water and soil with pesticides from an abandoned pesticide storage depot.
<b>Europe</b>		
Muan et al. (2004) (W12)	Norway, September 2002	Outbreak of methanol poisoning due to sale of black market vodka results in five deaths.
BBC News (2002) (W13)	Russian Federation, October 2002	Chemical weapons used to end hostages siege, >120 deaths.
Food Safety Network (2002) (W14)	Russian Federation, November 2002	Outbreak of unknown illness affects 222 children.
CNN.com/WORLD (2002) (W15)	Spain, November 2002	Break-up of oil tanker carrying more than 19 million gallons of fuel pollutes coastlines of two countries.
Institute for War and Peace Reporting (2002) (W16)	Former Yugoslav Republic of Macedonia, December 2002	Outbreak of unknown illness among school children.
European Cetacean Bycatch Campaign (2003) (W17)	France, January 2003	Sale of oysters and shellfish banned over fears of contamination with toxic fuel oil spilled from a sunken tanker.
BBC News (2003) (W18)	United Kingdom, January 2003	Discovery of ricin in a house associated with suspected terrorists. Six arrested.
Outside online (2003) (W19)	France, February 2003	Oil sludge from a sunken tanker washing up onto a tourist beach.
Henley (2003) (W20)	France, March 2003	Traces of ricin discovered in a luggage locker at a railway station.
Korina (2003) (W21)	Kazakhstan, July 2003	Unknown illness affecting 101 children in Kazakhstan.
ProMED mail (2003) (W22)	Norway, July 2003	Public warning that black-market rum containing ethylene glycol emanating from Estonia had caused fatal poisoning in Finland.
Perharic (2005) (W23)	Slovenia, October 2003	Contamination of imported buckwheat grain and flour with seeds of the poisonous plant, <i>Datura stramonium</i> . 60 ill; products withdrawn.
ProMED mail (2003) (W24)	Israel, November 2003	Thiamine-deficient, soy-based infant formula associated with a cluster of cases of encephalopathy. Product withdrawn.
FoodHACCP.com (2003) (W25)	Italy, December 2003	Deliberate contamination of mineral water and other drinks with chemicals.
<b>South-East Asia</b>		
ProMED mail (2003) (W26)	India, June 2003	Deaths from an unknown cause in two villages, mostly affecting young children. Possibility of chemical cause investigated.
Wananukul and Kaojarern (2003) (W27)	Thailand, July 2003	Herbal wine found to contain gamma-butyrolactone and tetrahydrofuran. Wine possibly exported. Two die, eight ill.
ProMED mail (2003) (W28)	India, July 2003	Deaths of >30 children from unknown cause in three districts.

(Table 1, cont.)

Reference	Place, date	Incident
<b>Western Pacific</b>		
BBC News (2002) (W29)	China, September 2002	Deliberate poisoning of food with tetramethylene disulfotetramine, an illegal rodenticide, found in food.
BBC News (2003) (W30)	China, August 2003	Workers on a construction site found and opened old barrels containing mustard gas. Widespread contamination.
Dajiyuan.com (2003) (W31)	China, September 2003	Sudden illness after consumption of sheep meat. Unclear if infectious or toxic cause.
ProMED mail (2003) (W32)	Viet Nam, December 2003	Outbreak of an illness of unknown cause affecting 200 factory workers after meal in a restaurant. Possibility of contamination with a toxic substance considered.
UNEP-APELL (2003) (W33)	China, December 2003	Leak of natural gas and hydrogen sulfide covering an area of 25 km <sup>2</sup> . 28 villages affected; 233 deaths and >9000 hospitalized.

<sup>a</sup> Two of the 35 incidents are not included in the table as they were internal requests for assistance; one was in the WHO African Region and the other was in the WHO European Region. References cited in Table 1 are available on the web version only (<http://www.who.int/bulletin>).

that might be linked with chemicals. Members of GOARN were included in the chemical network of information sources because several GOARN members, particularly those in poorly resourced countries, were responsible for the surveillance and management of both communicable diseases, as well as acute chemical incidents.

Each identified event was assessed against IHR criteria, as described above, by the chemical alert and response team. If an event was deemed to be of potential international importance, WHO regional and country offices were contacted to obtain additional information, including official verification of the event through the health authorities of the Member State concerned. Once verified, and depending on the nature of the event, a decision was taken about the need for a response. Such a response might include laboratory support (e.g. identification of a laboratory to carry out analyses, arranging supply of an analytical standard), on-site epidemiological assistance (e.g. assistance with investigation, control measures) or the provision of technical information. The level of response was determined by several considerations, including the type of assistance requested by the Member State and the capacity of WHO and its global network to respond to the event. A final decision on whether or not to proceed with a response usually required further consultation with the health authorities of the Member State, the WHO regional office and the WHO country representative.

## Findings

From 1 August 2002 to 31 December 2003, 779 chemical events were evaluated and 35 (4.5%) events of potential or actual international public health importance were identified in 26 countries (Table 1). The WHO European Region accounted for 43% (15/35) of reports; the Regions for Africa, Eastern Mediterranean and Western Pacific each accounted for 14% (5/35), and South-East Asia and the Americas accounted for 9% (3/35) and 6% (2/35), respectively.

Almost half of the incidents of international importance (16 out of 35 events; 46%) were identified by GPHIN. Other events were identified directly from news media (six), internally within WHO (six) and via ProMED (three). In addition, three incidents were outbreaks referred from the communicable disease outbreak verification team to the chemicals team because

the etiology was unknown and a possible chemical cause was being considered. ChemiNet notified one additional event. A total of 23 (66%) events were identified within 24 hours of their occurrence, and the remaining 12 (34%) were identified 48 or more hours later.

Several incidents met more than one IHR criterion (Table 2). Of these, 10 involved the accidental or deliberate use or release of chemicals, and 12 were of unknown cause. On further investigation, three of the latter events were found to be chemical, although the chemical was unknown, and four were thought to be of infective origin, although there was no clear diagnosis. There was insufficient information to determine the etiology of the remaining five events.

## Conclusions

The need for international surveillance and response to emerging and re-emerging communicable disease threats to global public health is now well established. The WHO system for communicable disease outbreak detection and verification established in 1997 relies on careful monitoring of formal and informal sources of information. It is supported by GOARN, which facilitates the provision of resources for response to international public health threats related to communicable diseases. No such system has existed previously for chemical threats.

The awareness of the international community concerning chemical releases has been heightened by major incidents such as those in Seveso and Bhopal, the oil spill off the coast of Spain and terrorist action in the United States of America on 11 September 2001 (12–15). The development of systems for the early detection of, and public health response to, chemical incidents has become a high priority at both national and international levels.

This pilot project has shown that it is possible to adapt systems for the detection and response to infectious disease outbreaks for the purposes of detecting and responding to chemical events. Indeed, a system for detecting chemicals can complement systems for detecting infectious diseases, particularly where the cause of an outbreak of illness is not immediately apparent. As with the global surveillance system for communicable diseases of potential international importance, the majority of chemical incidents in this instance were identified from unofficial sources (10).

Table 2. Number of incidents meeting the criteria for events of international importance<sup>a</sup>

Question	No. of incidents
<b>Is the public health impact serious?</b>	
High morbidity and/or mortality	14
The potential for high public health impact	8
External assistance needed to detect, investigate, respond to and control the incident	10
<b>Is the event unusual or unexpected?</b>	
An illness of unknown origin	12
Known origin but unusual characteristics, e.g. unusual clinical features	0
An incident known, or suspected to be, as a result of an intentional or accidental release	10
<b>Is there a risk of international spread?</b>	
Similar unexpected cases reported in other countries	0
The incident is, or has the potential to be, a transboundary event	6
<b>Is there significant risk of international trade or travel restrictions?</b>	
Suspected or known source of incident is food or other imported/exported good(s)	9
Similar events in the past triggered restrictions	0
The incident is in an area of international tourism	4
The incident has attracted a high degree of media attention	13

<sup>a</sup> Some incidents met >1 criterion.

The recent outbreak of severe acute respiratory syndrome (SARS) demonstrated to the global public health community that surveillance does not always meet its primary objective of providing "information for action" because of several inherent weaknesses (16). These weaknesses include poor reporting of events by health care workers, unequal distribution of health resources and infrastructure (both between and within countries) and suppression of reporting for fear of sanctions. To address these weaknesses, the global chemical surveillance system used both formal and informal information sources, as well as networks of organizations.

### Information sources

The use of informal Internet-based sources, particularly news reports, meant that information about chemical incidents occurring globally was obtained rapidly. However, there was a bias towards incidents reported in English, thereby limiting the geographical coverage of the surveillance system. Since the completion of the pilot project, however, GPHIN, the main information source about chemical events, has expanded its

linguistic coverage and is now able to provide news reports in all six official UN languages. Moreover, IPCS continues to search for additional sources of information and for partners who can broaden the linguistic and geographical coverage of the system.

There was also a bias towards reporting events that occurred in Europe. This may have been a reflection of the predominance of reports in English and the established capacity in the region for detecting and reporting chemical events. Moreover, in continental Europe there is a greater possibility of transboundary impact than in the USA or Australia, for example. This means that, by definition, a chemical incident in one country could trigger an event of potential international importance. Although most countries have developed surveillance systems for communicable diseases, many still lack adequate chemical incident surveillance capability and trained personnel. This is a particular problem in developing countries where the risk to public health from chemical events is arguably higher than in the developed world. This is especially so in view of the current trend for the manufacture of industrial chemicals to shift to these countries (17, 18).

Only a small proportion of the identified chemical events were judged to be of actual or potential international public health concern. This reflects the fact that most chemical events tend to be localized, in contrast to communicable diseases, which are readily spread around the world by human or animal carriers.

### Concluding remarks

This paper reports the first global surveillance system for acute chemical incidents of potential international concern. The lack of global data on the occurrence of chemical incidents of potential international concern makes planning for major incidents difficult. With approximately 70% of events identified within 24 hours of occurrence, there is still scope to improve the sensitivity, timeliness and geographical coverage of the surveillance system by adding more information sources. Despite these limitations, the results of this WHO initiative provide a useful baseline for further development of this system. The system can also contribute to improving public health preparedness and provide an estimate of the frequency and geographical distribution of chemical incidents of potential international concern. ■

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## Résumé

### Surveillance mondiale des incidents chimiques pouvant avoir une incidence dans plusieurs pays

**Objectif** En décembre 2001, une consultation d'experts convoquée par l'OMS a jugé prioritaire de renforcer la préparation aux interventions nationales et mondiales en cas d'incident chimique. L'OMS œuvre en ce sens en mettant sur pied un système

de surveillance et d'intervention en cas d'incident chimique. Le rapport décrit la fréquence, la nature et le lieu géographique des incidents chimiques aigus, susceptibles d'avoir une incidence internationale entre août 2002 et décembre 2003.

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**Méthodes** Les incidents chimiques aigus ont été activement recensés à partir de plusieurs sources informelles (informations trouvées sur Internet, par exemple) et formelles (divers réseaux d'organisations, par exemple) et évalués en fonction de critères définissant les urgences de santé publique de portée internationale, en se référant à ce qui était alors le projet de révision du Règlement sanitaire international (RSI). Les bureaux régionaux de l'OMS et ses bureaux dans les pays ont été contactés afin d'obtenir des informations supplémentaires concernant les incidents recensés.

**Résultats** Au total, 35 incidents chimiques survenus dans 26 pays répondaient à un ou plusieurs critères du RSI. La Région européenne de l'OMS contribuait à hauteur de 43 % (15 sur 35) au nombre total d'incidents notifiés. Les Régions OMS de l'Afrique, de la Méditerranée orientale et du Pacifique occidental

contribuaient chacune pour 14 % (5 sur 35) ; les Régions de l'Asie du Sud-Est et des Amériques pour 9 % (3 sur 35) et 6 % (2 sur 35) respectivement. Vingt-trois des événements (66 %) ont été signalés dans les 24 heures.

**Conclusions** A notre connaissance, il s'agit du premier système de surveillance mondial des incidents chimiques pouvant avoir une incidence dans plusieurs pays. On s'efforce actuellement de résoudre les problèmes posés par des biais géographiques ou linguistiques dans le système actuel. Néanmoins le système a fourni la preuve qu'il permettait de dépister précocement des événements importants et d'obtenir des informations sur l'ampleur et la répartition géographique de ces incidents. Il peut donc contribuer à améliorer la préparation aux interventions de santé publique.

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## Resumen

### Vigilancia mundial de los incidentes químicos que amenazan con riesgo para la salud pública internacional

**Objetivo** En diciembre de 2001, una reunión consultiva de expertos convocada por la OMS señaló que el fortalecimiento de la preparación y respuesta ante incidentes químicos nacionales y mundiales constituía una prioridad. Trabajando para lograr ese objetivo, la OMS está desarrollando un sistema de vigilancia y respuesta ante los incidentes químicos. En este informe se describen la frecuencia, la naturaleza y la ubicación geográfica de los incidentes químicos graves de posible impacto internacional ocurridos entre agosto de 2002 y diciembre de 2003.

**Métodos** A partir de varias fuentes informales (p.ej., recursos de Internet) y formales (p.ej., diversas redes de organizaciones) se identificaron activamente los incidentes químicos graves para evaluarlos con los criterios empleados para las emergencias de salud pública de interés internacional, usando al efecto el proyecto de Reglamento Sanitario Internacional (RSI) revisado por entonces disponible. Se estableció contacto con las oficinas regionales y en los países de la OMS para obtener información adicional sobre los incidentes identificados.

**Resultados** En total, 35 incidentes químicos de 26 países cumplían uno o más de los criterios estipulados en el RSI. El 43% (15/35) de los eventos correspondían a la Región de Europa de la OMS. Las regiones OMS de África, el Mediterráneo Oriental y el Pacífico Occidental concentraban cada una el 14% (5/35); y Asia Sudoriental y las Américas suponían el 9% (3/35) y el 6% (2/35) de los casos, respectivamente. Veintitrés (66%) eventos se descubrieron antes de transcurridas 24 horas.

**Conclusión** Por lo que sabemos, éste es el primer sistema mundial de vigilancia de los incidentes químicos de posible impacto internacional. Se están abordando las limitaciones, por ejemplo de índole geográfica e idiomática, asociadas al sistema actual. No obstante, el sistema ha demostrado que puede detectar prontamente los eventos importantes, y aportar información sobre la magnitud y la distribución geográfica de tales incidentes. Por consiguiente, puede contribuir a mejorar la preparación de la salud pública mundial.

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