Chemical Hazards and Poisons Report

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Contents

Editorial

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Our front cover for this issue shows a water pipe – also known as a shisha pipe. These Middle Eastern pipes are used for smoking flavoured tobacco, which is heated by burning charcoal. But few are aware of the possible risks of carbon monoxide (CO) poisoning from their use indoors. Between 2008 and 2010, five CO poisoning incidents associated with shisha pipes were reported to the HPA, four involving single people smoking in a residential property, often with poor ventilation and for prolonged periods of time. The fifth incident occurred in a commercial venue and resulted in 12 young adults presenting to the emergency department of a large London hospital with various symptoms of CO toxicity, such as dizziness and headaches. It is likely that CO poisoning incidents associated with smoking water pipes are rare but increasing in number as the pipes become more popular, and therefore it is prudent to increase awareness for frontline medical services and environmental health inspectors by including an article on such incidents in this issue of the Chemical Hazards and Poisons Report.

Hospital-impacting events are of note as they may significantly disrupt our ability to maintain healthcare systems for our population. Two articles in this issue provide examples based on recent chemical incidents:

- The first summarises three incidents that occurred outside hospital emergency departments, focusing on the fact that the current emergency medical system encourages ready communication between pre-hospital and hospital practitioners. However, the author concludes with a suggestion for a modification to current, unwritten practice, which would allow a more defined emergency department response to be decided upon with clarity.
- The second reviews eleven chemical leaks from refrigerators inside healthcare settings in London – most of which resulted in evacuation of patients and staff. It suggests that awareness could be increased among healthcare staff, of the possibility and impact of a refrigerator leak, so that incidents are identified and contained quickly, minimising adverse impacts. For example, healthcare organisations could review their refrigerator purchasing decisions and maintenance procedures in order to prevent or reduce the possibility of leaks.

Extreme weather events and natural hazards are increasingly important issues in health protection – as exemplified by recent flooding in Australia, cold weather conditions in Northern Europe, earthquake in New Zealand and tsunami in Japan. This last event has, at the time of writing, led to serious, complex risks to the health of the population. A paper addressing the emergency public health response to water shortage following floods in Europe is included in this issue.

Climate change and its potential influence on extreme events is therefore also of import. The HPA held a workshop on climate change and health protection in October 2010 in recognition of the importance the organisation is placing on this issue. A review of the workshop is given in this issue, along with one of the papers presented on the day considering vector-borne diseases. The paper summarises the work currently being undertaken by the Medical Entomology and Zoonoses Ecology group in the HPA to assess, quantify and mitigate the impacts of climate change, both directly and indirectly through adaptation and environmental change, on arthropod vectors and vector-borne disease in the UK.

The next issue of the report is planned for summer 2011; guidelines for authors and a permission to publish form can be found on the website at www.hpa.org.uk/chemicals/reports. Please do not hesitate to contact us about any papers you may wish to submit on chapreport@hpa.org.uk, or call us on 020 7811 7141.

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Front cover image: Shisha pipe

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Nearly 700 articles have been published in the Chemical Hazards and Poisons Reports and its predecessor, the Chemical Incident Report. These have been written by authors from organisations as diverse as the police, universities and hospitals, on subjects ranging from chemical terrorism to contaminated land legislation. Uniquely we publish case studies providing examples of the multi-agency risk assessment and response undertaken by the HPA and its partners to protect public health in the UK.

Now we want to know what you think so we can keep improving our service. Which articles do you find of interest and what would you like to see more of? We hope you will let us know by filling out our short survey at

http://www.hpa-surveys.org.uk/TakeSurvey.aspx?SurveyID=76L3lo6

Incident Response

'Don't shoot the messenger…' – lessons identified in communicating with emergency departments during chemical incidents

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A spate of three chemical incidents affecting London in a ten-day period during the summer of 2010 provides the emergency response community with the opportunity to evaluate hospital emergency department (ED) responses and learn potentially valuable lessons for the future. Details given below come from contemporaneous logs from the Centre for Radiation, Chemical and Environmental Hazards (CRCE) of the Health Protection Agency (HPA), the London Ambulance Service (LAS) and the London Fire Brigade (LFB), and from formal debriefing exercises and interviews with involved personnel.

Incident 1

At 10.30am on a midweek morning, contractors carrying out renovation work on a school swimming pool accidentally mixed approximately 100 litres of sodium hypochlorite and sodium bisulphite, generating chlorine gas. The LAS was called to two symptomatic individuals with respiratory irritation. More than 100 children from a summer school were evacuated to a local playing field. Within 90 minutes of the onset of the incident, four adults and eight children were conveyed to a hospital ED with mild symptoms of chlorine exposure. The LFB issued an incident 'stop' after two and a half hours; however, a second wave of symptomatic individuals required a further six patients to be taken by ambulance to another hospital ED in the area and three further individuals to two more satellite EDs. In total, four London EDs were involved. No patients required overnight admission.

Post-incident debriefings and interviews with involved responders highlighted a number of discussion points relating to the response at the ED level.

Although not declared a major incident at any point by the LFB or LAS, the first responding hospital was given warning of a 'potential chemical major incident' by the LAS and ED staff began to prepare for a major incident. Under such circumstances the content of such an 'informal' warning is clearly critical and, on this occasion, the message reported the potential for 150 patients, this being the number of people evacuated. It is likely that this was interpreted by junior staff as a trigger to prepare for a major incident.

In the early stages of the incident, a hospital registrar contacted CRCE for advice on managing the incident and requested a call back; however, when CRCE staff attempted to return this call to provide advice and reassurance there were difficulties as no dedicated channel was available and ED staff were busy preparing for a major incident. Preparations were scaled back once an experienced ED consultant became involved, demonstrating the invaluable role to be played by experienced personnel in managing such incidents.

Media reporting of this incident was both early and comprehensive[1,2], with one 24-hour news channel reporting attendances at outlying hospitals before any centrally involved agencies were aware. Under such circumstances, EDs should be aware of the potential for self-presenters both from the incident and potentially from the 'worried well' peripheral to it.

Hospitals should also note the potentially lengthy time lag between the incident and patients attending their ED. On this occasion, two hours passed from the time of the incident and some patients or worried well self-presenting to ambulance staff still at the scene, with multiple hospitals becoming involved.

Incident 2

One week later, CRCE was called directly by an ED consultant following an incident in which a number of police officers self-presented to the ED having had an unknown corrosive substance (later identified as sulphuric acid) thrown over them. The ambulance service courtesy call arrived at the same time as the police personnel, who had rapidly left the scene. On this occasion, the ED generated a full chemical response; a separate 'dirty area' was rapidly established and ambulances diverted away from the hospital. Initially eight police officers were assessed, decontaminated and treated – five who were involved in the initial incident and three who assisted with their transport to hospital. Subsequently further police officers, ambulance personnel and nursing staff were decontaminated to differing extents, totalling 22 patients from this incident. The ED involved was closed to ambulances for a morning.

Formal multi-agency debriefing and discussion with involved ED personnel raised a number of issues related to the response to this incident, some pertinent to the ED response.

By transporting themselves to hospital without prior decontamination, the police officers involved generated a requirement for a greater incident response at said hospital than if a controlled decontamination/triage/transfer process had been commenced at the scene. It is not unlikely that such actions may be repeated in future incidents. The ED response was appropriate and effective, directed by an experienced consultant with an interest in major incidents and CBRN (chemical, biological, radiological and nuclear) incidents. However, good communication from agencies at the scene could have negated the need for such a comprehensive response; the first presenters to hospital walked in via the ambulance entrance, thus contaminating this entrance and the route of entry into the resuscitation room. They were physically stopped from continuing into the ED by nursing staff who were also therefore contaminated. A timely advance warning communication from the scene could have prevented this complication and the significant impact upon this ED. As with incident 1 this was not declared a major incident by any agency and the decision was also made at an ED level not to do so on a number of grounds. But as with incident 1 it is the early involvement of senior ED decision makers that is crucial at this stage.

Incident 3

Ten days after the first incident, on a Saturday afternoon in central London, the LAS received notification of one patient reporting a 'chemical smell' and developing mild respiratory symptoms whilst visiting the British Museum. Within 20 minutes of this first call, eight patients were identified who required assessment after noting symptoms. All had been in one wing of the museum. An evacuation of the museum was initiated and between 8,000 and 10,000 visitors and staff left the building[3]. Ambulance service logs note that one hour after the initial call a message was sent to three EDs warning them of the possibility of an increase in self-presenters due to a potential chemical incident at the museum. Again no formal major incident standby or declaration was made by the LAS or other agencies.

Two of the three EDs receiving the LAS call have answered enquiries regarding their response, and both managed low level response. At one hospital, ED staff were briefed, hospital management and Bronze Command informed but no further actions initiated; at the second hospital the on-call ED consultant was called in and a plan for the isolation of self-presenters from the incident was made. The third hospital involved has no record of its actions so we can presume that they were similarly low key.

As with the previous two incidents it is the interpretation and response to the courtesy call that defines this incident, and the benefit of senior ED staff in playing a crucial role in generating an appropriate response. The risks with this particular incident were high due to the sheer numbers of people being evacuated. Had the response to the courtesy call been more involved the impact on the emergency health capability of London would have been great by virtue of three EDs being affected.

Discussion

Any chemical incident raises learning points both for the involved hospital EDs and for the wider community, but these three incidents, presenting together in a short time-frame, specifically highlight the topic of communication with EDs as an area for discussion.

In all three incidents an informal courtesy call or 'heads-up' message was passed directly to the EDs. In one instance this message generated what seemed to be a transient, inappropriate response, in another it arrived too late to prevent significant adverse impact, and in the last it met a presumed objective of informing EDs without generating unnecessary actions. This variability of outcome is in itself a marker of the problem with informal message use.

It is a standard operating procedure for most emergency systems in the UK that major incident declarations, or major incident 'standby' messages, are conveyed via receiving hospital switchboards[4]. It is widely observed and accepted that a lower level of warning, the 'courtesy call', is often sent directly to EDs via their priority phone, but the three incidents discussed here have identified potential issues with this current practice. The level of response to such a courtesy call is dependent on the quality and accuracy of information in the message and the interpretation of that message by the ED staff receiving the call. This interpretation is to some extent a factor of the experience of the individual receiving the message. It is not inconceivable that a junior ED sister or middle-grade doctor, when faced with a courtesy call such as those detailed in the incidents above, may initiate an inappropriate ED response driven by inexperience and anxiety. In terms of content, as these courtesy call messages are not formally structured in the same way as major incident messages, there is scope for inaccuracy, such as that seen with incident 1, generating inappropriate ED anxiety.

One of the great strengths of the current emergency medical system in the UK is the ready communication between pre-hospital and hospital practitioners. It drives improvements in cardiac, stroke, trauma and other acute medical presentations by means of early alerting of receiving hospitals. Whilst there is no imperative to curtail communication, there is a growing body of anecdotal evidence to suggest a need to improve the structure of the courtesy call process. ED staff report confusion as to how best to respond to such messages and this confusion represents a risk to the smooth running of EDs. Is there now scope to consider a 'third tier' of formal message below major incident standby – a 'for information only' message for when it is unclear that a major incident may develop, or for incidents such as these where a full major incident response is unwarranted? This type of message would clearly lend itself to response to chemical incidents but would also be of utility in many other clinical scenarios. A slight modification to current, unwritten, practice would allow a more defined ED response to be decided upon with clarity and consistency, mitigating the risk of unpredictability.

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Investigation of chemical leaks from refrigerators in healthcare settings in London

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Introduction

Refrigeration is achieved through the use of chemical cooling agents, which can escape if a refrigeration unit is damaged. In the UK, many industrial refrigeration units use anhydrous ammonia, whereas domestic and commercial refrigerators are more likely to use halocarbons. An overview of chemicals used in refrigeration is given in Box 1.

The Health Protection Agency (HPA) in London assists with up to 20 incidents per year involving refrigerant leaks in residential, commercial and healthcare settings. The risk to health from leaks associated with these chemicals is well known and well documented (Table 1).

In the first six months of 2010, four refrigerant leaks were reported in healthcare settings in London. The first three incidents were reported within a period of two weeks. This compares with 2008 and 2009, where there were four and three similar incidents reported, respectively, in London for the entire year. Although this was not considered to be an increasing trend, the impact of these incidents on healthcare services was of concern. This prompted an investigation with the following objectives:

- identify all healthcare-associated refrigerant leaks reported to the HPA in London between 1 January 2008 and 30 June 2010
- review the outcomes of each incident and establish the possible causes
- recommend future incident management and preventive actions.

Method

Data were extracted from the Centre for Radiation, Chemical and Environmental Hazards (CRCE) incident database and Early Alerting System, with additional information obtained from colleagues at NHS London and the London Fire Brigade. Only incidents that fulfilled the following criteria were included in the investigation: those that occurred in London between 1 January 2008 and 30 June 2010, in a healthcare setting and where there was a recorded release of a refrigerant.

Summary of incidents

In the time period studied, eleven incidents were reported to the HPA in London: four in 2008, three in 2009 and a cluster of four in the first six months of 2010 (Figure 1). This suggests an apparent increase in 2010, compared to incidents reported in previous years; however, information gathered during the course of this investigation indicates that this was an incidental cluster.

Box 1: History of refrigerants

Refrigerators contain chemicals that act as coolant agents. Classical refrigerants in use since the 19th century include ammonia, sulphur dioxide, diethyl ether, carbon dioxide, methyl chloride (a halocarbon), water and air. The 20th century saw the introduction of other halocarbons and the hydrocarbons propane and isobutane[1].

Refrigeration that uses vapour compression can be traced back to Glasgow in 1755 when ice was produced by the evaporation of water at lower pressure. This was followed in the USA by a patent issued in 1834 for a vapour compression refrigeration system using ethyl ether. By this time, the classical refrigerants, ammonia, sulphur dioxide and carbon dioxide, had been isolated and were available for use – but complex compressors and prime movers were required to use them – and the original refrigerants, air and water, competed with water/ammonia absorption machines in the production of artificial cooling systems. The use of ethyl ether continued, however, and in 1860s the use of methyl ether, which operated at higher pressure with reduced risk of forming an explosive mixture, was introduced. During this period other coolant agents such as carbon dioxide and methyl chloride were also introduced. In the years to come, the use of methyl chloride was superseded by that of other halocarbons.

In the 20th century, industrial refrigeration was dominated by the use of ammonia, whilst domestic and commercial refrigeration used ammonia as well as other agents such as sulphur dioxide, hydrocarbons (eg propane and isobutane) and halocarbons (eg methyl chloride). However, each of these agents had serious drawbacks, especially for domestic refrigeration:

- the halocarbon methyl chloride was dangerous because it is odourless yet toxic, as well as being flammable
- ammonia and sulphur dioxide were unpopular because of the possibility of leakage and associated toxicity but at least had an odour, so providing a warning of any such leak
- the hydrocarbons, propane and isobutane, are highly flammable[1]
- the use of chlorine-containing coolant agents such as hydrochlorofluorocarbons (HCFCs), chlorofluorocarbons (CFCs) and others (eg methyl chloride) was phased out in the 1980s due to the chlorine damaging the ozone layer[1,2].

This meant that the advent of halocarbons that do not contain chlorine made them popular for use as they are, in general, non-toxic and non-flammable[1]. Halocarbons and hydrocarbons, ammonia and carbon dioxide continue to be used in industrial, commercial and domestic refrigeration systems to different extents. However, the ideal refrigerant, which is still being sought, would be one which[1]:

- does not contain chlorine
- is efficient, minimising power required for operation thus reducing the carbon footprint
- has a low direct global warming impact/potential on its release
- is non-toxic and non-flammable.

Table 1: Health effects of common refrigerants[1–3]

Group	Hazardous properties	Effects of acute inhalation	Gas/air mixtures explosive	In case of leak
Ammonia	Irritant Flammable in high concentrations	Burning sensation Cough Laboured breathing Shortness of breath Sore throat Breathing difficulty secondary to lung oedema may be delayed by a number of hours	Only above 15% ammonia (unlikely in practice)	Close room and seek specialist advice with a view to ventilate area Consider evacuation as gas is irritating in high concentrations
Carbon dioxide	Asphyxiant Non-flammable	Dizziness Headache Elevated blood pressure Increased heart rate Suffocation Unconsciousness	No	Close room and seek specialist advice with a view to ventilate area
Hydrocarbons	Highly flammable	Shortness of breath Suffocation Drowsiness Unconsciousness	Yes	Close room and seek specialist advice with a view to ventilate area Consider evacuation as gas/air mixture is explosive
Hydrochlorofluorocarbons (HCFC) and chlorofluorocarbons (CFC)	Asphyxiant Certain halocarbons may be combustible	Cardiac arrhythmia Confusion Drowsiness Unconsciousness	No	Close room and seek specialist advice with a view to ventilate area

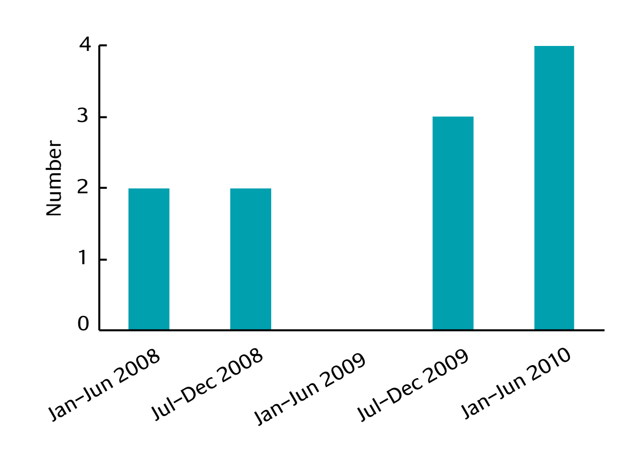

Figure 1: Number of healthcare-associated leaking refrigerator incidents reported to the HPA in London

Most of these incidents (eight out of eleven) occurred in a hospital setting, with the remaining three incidents occurring in a health centre, an ambulance station and a dental institute (which is part of a general hospital) (Table 2). Two hospitals had refrigerant leak incidents twice in the time period investigated, whereas the rest had only one reported incident. For the incidents where the exact location was recorded, there were no reports of any of the refrigerant leaks occurring in a hospital ward but, in one incident, the smell of the chemical released had reached a maternity ward. Four of the eight hospital incidents occurred in a public administration/office area.

In nine of the eleven refrigerant leak incidents, staff and/or patients were reported to have been evacuated and medical assistance was required in five of these. All four incidents in 2010 resulted in evacuation. The number evacuated varied depending on the incident, with up to 200 patients and staff reported to have been evacuated from at least two incidents. However, the exact figures of how many people were evacuated and whether they were staff or patients were not consistently reported or recorded for each incident. The symptoms reported ranged from being found unconscious to needing treatment in hospital to non-specified symptoms. Decontamination was carried out in one incident only. Where it had been reported, the chemical/refrigerant released in all of the incidents was ammonia (Figure 2). The reasons why the refrigerators leaked were reported in only two incidents; these occurred following a refrigerator being defrosted and as a result of one being damaged by fire.

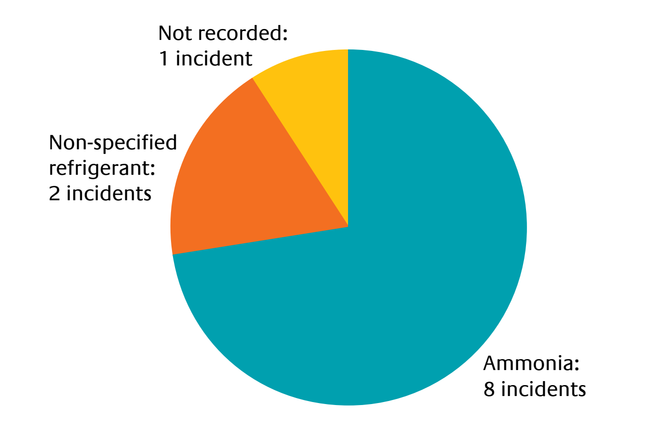

Figure 2: Type of chemical/refrigerant released

Discussion

A cluster of healthcare-associated refrigerant leaks was reported to the HPA in London in the first half of 2010. It appears likely that this is a chance occurrence; however, investigations are ongoing where more than one incident has occurred at a single facility. The London Fire Brigade continues to monitor these events and will inform the appropriate health authorities if it identifies an increase. The usual cause of these incidents is not obvious, but it is most likely to be from general wear and tear of the refrigerators, or from defrosting being carried out with sharp objects.

Table 2: Outcome of refrigerant leak incidents

Date of incident	Location	Evacuation	Symptoms	Decontamination of people carried out
Jan 2008	Hospital office, London	Yes, number not known Not known whether staff or patients	None	No
Feb 2008	Ambulance station, London	Yes, six ambulance crew/staff	All six treated at hospital	No
July 2008	Hospital, London	Yes, 13 people Not known whether staff or patients	Two people suffering effects of ammonia inhalation	No
Dec 2008	Health centre, London	Yes, number not known Not known whether staff or patients	Three adults needed treatment by ambulance staff	No
Aug 2009	Hospital administration area, London	No	None	No
Oct 2009	Hospital, London	Yes, number not known Not known whether staff or patients	None	No
Oct 2009	Hospital sealed room, London	No	None	No
Apr 2010	Hospital office, London	Yes, 12 people Not known whether staff or patients	None	No
Apr 2010	Hospital, London	Yes, 200 people Not known whether staff or patients	Six to ten staff reported symptoms/ treated on scene	No
May 2010	Hospital office, London	Yes, number not known Not known whether staff or patients	None	No
June 2010	Hospital dental department, London	Yes, approximately 200 staff and patients	Two staff unconscious	Yes, two

Note: Two hospitals had two incidents each in the period analysed

The majority of the incidents resulted in evacuation with a number of casualties. Usually, evacuation is considered as a last resort. The impact of undertaking any level of evacuation in a healthcare setting on patients, hospital staff and the emergency services can be considerable.

In spite of the fact that only small amounts of refrigerants are used in refrigerators, all refrigerants could be harmful to health if the concentration reached is above the health effect threshold[3]. Rapid identification of a leak is therefore essential to prevent and mitigate any adverse health effects (Table 1). The first sign that there is a leak could be an unusual odour – staff in healthcare settings should be made aware of this possibility and the need to alert emergency service providers immediately.

If a refrigerant leak is suspected, it is recommended that:

- emergency services (both within and outside the healthcare setting) are alerted immediately
- the door to the room where the leak has happened is shut, if the room is empty
- consideration is given to evacuate the immediate area if on a ward or the room is occupied
- advice is sought from the emergency services and CRCE with regard to any other specific actions that may need to be taken, such as ventilation.

Emergency incident management

These types of incidents may require attendance by specialist Hazmat (Hazardous Material) teams from the fire and rescue service, who will enter the affected area in personal protective equipment to locate the problem, identify the chemical and measure its concentration, and either ventilate the area or remove the leaking refrigerator. When the concentration of the refrigerant released is below the long-term workplace exposure level (where available) and an area is safe, fire officers will hand over responsibility to those in charge, usually the managers of the healthcare facility.

Figure 3: Hospital evacuation in progress (source: London Fire Brigade)

The decision to evacuate may often, in practice, have been made before the arrival of the emergency service experts, due to an unpleasant odour or symptoms. However, the decision for further evacuation will be made by the fire and rescue service's Hazmat Environmental Protection Officers (HMEPO) in consultation with the management of the healthcare organisation where the incident occurred and CRCE, as appropriate. The resources and logistics necessary to evacuate a hospital can be extensive.

Prevention of further incidents

In the geographical area that this investigation covered, purchasing of refrigerators within the NHS is through the NHS Supplies online site[4]. In order to prevent or reduce the likelihood of refrigerant leaks, healthcare organisations may wish to:

- purchase only from approved suppliers
- carry out checks on all refrigerator units and replace those which are damaged beyond economic repair
- ensure that no sharp implements are used to remove ice from units while defrosting
- ensure they have user data sheets for all the units by the design or type of refrigerator on-site covering cleaning, maintenance, repair, defrosting, disposal, etc
- issue advice on how to manage refrigerant leaks should the need arise.

However, even with all of these measures, it may not be possible to prevent all healthcare-associated refrigerant leaks as some of these incidents are unpredictable and can occur with no prior warning or signs of disrepair. In this investigation for instance, it was apparent in only two out of eleven incidents as to why the leak had occurred.

Conclusions

This investigation was conducted following a cluster of healthcare-associated refrigerant leaks reported to the HPA in London in the first half of 2010. As there was no single apparent source for the rise in number of reported incidents in 2010, the situation is being monitored and further investigation will be instituted should the rise be sustained.

The disruption that these incidents can cause to patients, staff and the attending emergency service providers is noteworthy. The majority of the incidents described in this investigation, including all four incidents in 2010, resulted in evacuation of patients and staff. In addition, some of the evacuees in the incidents described required medical treatment. To mitigate the disruption that can result from this type of incident, awareness could be increased among healthcare staff to the possibility and impact of a refrigerant leak, so that incidents are identified and contained quickly. Organisations may also wish to review their refrigerator purchasing decisions and maintenance procedures in order to prevent or reduce the possibility of leaks. However, this recommendation is made with the caveat that not all refrigerant leaks can be prevented or avoided.

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The water pipe – an increasingly common source of carbon monoxide poisoning?

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Background

In many countries of the Middle East and Asia, the smoking of water pipes ('shisha', 'nargheele' and 'hookah') is common. Smoke generated by burning charcoal is drawn through 10–20 g of a special tobacco preparation, then filtered and cooled through water and inhaled via a hose (Figure 1). Water-pipe smoking is often a social event and routinely multiple users share the same apparatus including the mouth piece. The water pipe and the tobacco used are not well standardised; however, the most widely used tobacco is ma'assel ('molasse'), which contains about 30% tobacco and 70% honey or syrup. Ma'assel often contains fruity additives (eg apple, mint or banana). Other common forms of water-pipe tobacco are jurak (with a higher tobacco content) and tumbac (pure dark tobacco).

It is difficult to estimate accurately the prevalence of water-pipe smoking across the world and there is a scarcity of well-designed studies investigating the epidemiology of its use and its effects. However, surveys in Syria and Lebanon estimated a point prevalence of 20–30% in young male adults[1,2]. There is some evidence of an increase in popularity of water-pipe use over recent years, both in the Middle East as well as in Europe and North America[3,4], and a possible shift to younger age groups and females, at least in the Middle East[3,5].

The adverse health effects of smoking water pipes are believed to be similar to those for cigarettes and include a carcinogenic potential for the lung, mouth and bladder, and an increased risk for asthma and chronic obstructive pulmonary disease and cardiovascular disease amongst others, although the magnitude of risk is much less clear compared with that of cigarette smoking[3,5]. Other health risks have been described, such as an increased transmission risk of tuberculosis and respiratory viruses. Water-pipe smoking in pregnancy is likely to be associated with low birth weight and respiratory distress in the neonate[3,6].

Carbon monoxide (CO) is a colourless and odourless gas, which is formed during incomplete combustion (partial oxygenation) of carbon-based fuels. When inhaled it binds to human haemoglobin to form carboxyhaemoglobin (COHb). In higher concentrations it can therefore leads to asphyxiation. Cigarette smokers have higher background concentrations of COHb due to the incomplete combustion of tobacco products, whereas water-pipe smokers are additionally exposed to CO from charcoal combustion. Compared to cigarette smokers this can

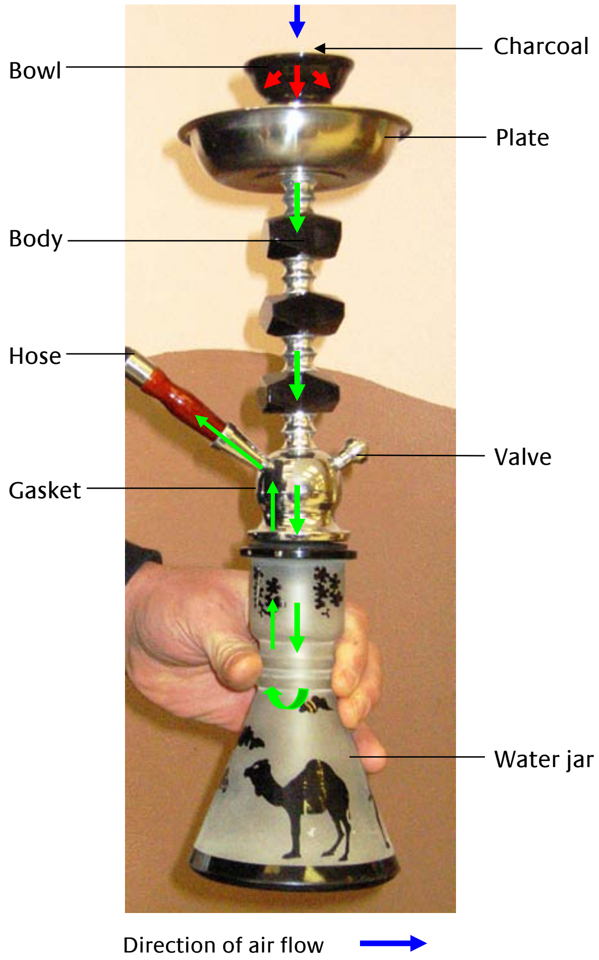

Figure 1: A typical water pipe

lead to higher COHb levels in water-pipe smokers[3,7], and cases of CO poisoning associated with water pipes have been reported previously[8,9].

Although CO poisoning through the use of water pipes is relatively uncommon and therefore less known amongst clinicians, the increasing popularity of water pipes in the UK may lead to more frequent emergency presentations. The aims of this paper are to review water-pipe related incidents reported to the HPA in England and Wales, to discuss their implications for policy and to draw attention to this phenomenon.

Summary of incidents

Between January 2008 and December 2010, a total of five CO poisoning incidents likely to be associated with water-pipe smoking were reported from across England and Wales to the Centre for Radiation, Chemical and Environmental Hazards of the Health Protection Agency. Of these, three were reported from the London region in 2010, representing almost 14% of all CO poisoning incidents reported in London that year (22 incidents in total). The other two incidents were reported in 2008 from Birmingham and Leicester, respectively.

Four of the five incidents involved single people associated with smoking water pipes indoors in a residential property, often with poor ventilation and for prolonged periods of time, during winter and early spring (January to April). In these four incidents, all the cases were males with an age range of 15–59 years. COHb levels ranged from 9.7–29%. Symptoms varied between headaches and palpitations to semi-consciousness and collapse, and were not always well correlated to the COHb level reported. Ten other people were exposed to CO in these households; however, upon assessment none of them had symptoms or raised COHb levels. All the cases were treated with high-flow oxygen and experienced rapid recovery of their symptoms. It is routine procedure to check all relevant gas appliances and this is carried out by the emergency gas service (National Grid) or the local authority. In none of these cases was any faulty appliance identified, and water-pipe smoking was concluded to be the likely source of CO exposure.

The fifth incident occurred in June 2010, involving attendees at a private function in a shisha bar in Westminster. The guests smoked water pipes in a poorly ventilated area of the basement. About ten water pipes and a coal burner to heat the charcoal were reported to have been used.

Figure 2: Vessels to hold the burning charcoal for water-pipe use in the Westminster venue

Figure 3: Equipment for storage and heating charcoal for water-pipe use in the Westminster venue

A total of 19 people were believed to be exposed; 12 young adults (four females and eight males) presented to the emergency department of a large London hospital with various symptoms of CO poisoning, such as dizziness and headaches. The mean COHb level was 8.6% (median 7.5%, range 2–16.5%). Median COHb levels were higher in males (10%) than females (5.6%). Notably, median COHb levels were also higher in self-presenters (12%, five cases) compared with those using an ambulance (5.9%, seven cases), possibly due to the administration of oxygen by paramedics. All patients were treated with high-flow oxygen, recovered rapidly and were discharged within six hours of initial presentation.

In total, a series of five incidents involving 16 cases and 17 exposed asymptomatic people occurring over three years were reported to the HPA. The numbers are too small to make conclusions about trends, but a true increase cannot be excluded.

Discussion

Carbon monoxide poisoning associated with water-pipe smoking has previously been reported as a rare event[8,9]. The case series described in this paper occurred over a relatively short period of time and possibly represents an increase in cases.

Carbon monoxide poisoning in water-pipe use is biologically plausible and there is evidence that CO blood levels of water-pipe smokers usually exceed those of cigarette smokers[3,7], although the level depends on many factors, such as the type and size of the water pipe, the type of tobacco used and the ventilation of the environment[10]. Carbon monoxide poisoning cases have been reported before, with typical COHb levels of 20–30%[8,9]. It is worth noting, however, that all of the cases reported in this paper had additional risk factors, such as poor room ventilation, excessive exposure to water-pipe smoke or operating a charcoal burner indoors.

The health relevance of environmental tobacco smoke of water pipes is still debated. Whilst it would be intuitive to hypothesise effects similar to those of cigarette smoke, water pipes do not emit any side stream smoke (ie the smoke emitted from the burning cigarette end) and may therefore be less toxic[10]. Since water pipes are operated with charcoal however, it is possible that ambient CO concentrations are higher than those from cigarette smoking through partially burnt fuel, although there is no clear evidence for this. Excluding the private function using a charcoal burner, none of the family members of cases had measured high COHb levels in our case series.

In the UK the Health Act 2006 bans any form of smoking in workplaces, premises, public transport and work vehicles. It was introduced in England on 1 July 2007 and affects every public house, club, café and restaurant. Smoking is no longer permitted inside any of these premises, including the smoking of water pipes. Enforcement of the smoking ban is the responsibility of local authorities in the UK, although capacities for this vary between councils. Recent licensing inspections have discovered that some shisha cafés in Westminster are allowing smoking indoors illegally, thus increasing the potential for such CO poisoning incidents as those described here. Additional partitions have often been constructed within rooms, or patrons have been locked in to avoid detection by the enforcing authorities. Recent visits by enforcement officers in Westminster have also raised health and safety issues and found poor fire safety precautions. As a result of the multiple poisoning incident described here, Westminster Council is working together with the fire and rescue services to tackle these issues as well as educating duty holders on the risks of CO poisoning.

Surveys have indicated a widespread perception that water-pipe smoking is less harmful for health[5,11], and it seems more acceptable than cigarette smoking for females. The World Health Organization has therefore issued an advisory note on water-pipe smoking, advising of health risks comparable to those of cigarette smoking[12].

A lot of public health efforts regarding water-pipe smoking in the UK are therefore focused on health education and promotion strategies, often through providing information and advice to shisha bar owners and water-pipe users. Although the public health response shows considerable variations between regions, there are some large and noteworthy projects online[13] and in areas with high densities of water-pipe users.

In conclusion, CO poisoning incidents associated with smoking water pipes are rare but possibly increasing in number, and therefore it may be prudent to increase awareness for frontline medical services and environmental health inspectors. There have been some notable projects, mainly focused on enforcement and health education. Since the smoking of water pipes is a social event which is very much culture-bound, any health education efforts need to be tailored to the target groups, and close collaboration with relevant community leaders and organisations would help to achieve this.

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Lead, poultry and the food chain: three case studies

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Introduction

All animal species are susceptible to lead poisoning; it is the most frequent cause of chemical poisoning diagnosed by the Veterinary Laboratories Agency (VLA) in grazing livestock in the UK[1]. This article highlights three recent case reports whereby lead toxicity has occurred in laying hens resulting in an increased body burden and increased concentration in eggs. All three case reports relate to contamination of the ground environment with lead, from industrial processes (smelting), clay pigeon shooting and the localised burning of a Victorian greenhouse. The risk of high lead soils to animal and public health has already been described extensively in the June 2010 Chemical Hazards and Poisons Report[2]. The toxicity of lead and its uses are summarised in Box 1 and why it poses an issue specific to poultry and the food chain is summarised in Box 2.

Box 1: Lead – toxicity and uses[3]

Toxicity most frequently results from ingestion or inhalation and rarely from dermal or ocular exposure.

Lead is a chronic toxin that builds up in the body; long-term exposure may causes anaemia, headaches, irritability, tiredness, muscle weakness, paralysis, kidney and liver damage, and stomach upsets.

In children, chronic exposure, even at very low levels, may lead to cognitive deficit, such as a decrease in IQ; there is no identified threshold for such effects.

Lead exposure may cause miscarriages or stillbirths or fertility problems in males.

Lead compounds are probably carcinogenic to humans.

Metallic lead is used in storage batteries, cables and in electronic equipment.

Inorganic lead salts are used in the production of pesticides, paint, ceramics, glass, plastic and rubber products.

The HPA UK Recovery Handbook for Chemical Incidents, due for publication in May 2012, is split into three parts: food production systems, inhabited areas and water management. Lessons identified from incidents such as these are important in building an evidence base for how to recover from food-related chemical incidents. The handbook contains detailed information on managing incidents with regard to issuing dietary advice to consumers, culling of animals, restricting access to the food chain, and appropriate waste disposal of contaminated carcases[6].

Box 2: Lead, poultry and the food chain

Poultry, in order to obtain calcium, ingest grit as part of their diet as it aids digestion and provides mineral nutrition.

Because of this natural behaviour, free range poultry are at risk of ingesting contaminants, such as lead minerals, if they are present in the environment.

Insoluble sources of lead can remain in the gizzard (the muscular part of the stomach) of birds over a prolonged period. During the grinding process small fragments are released. These small fragments can react with the stomach hydrochloric acid, produced by the glandular stomach, resulting in the production of a soluble form of lead which can be absorbed.

Poultry are quite susceptible to poisoning by lead shot or particles of lead minerals in soil[4].

Poultry can absorb significant quantities of lead that could subsequently enter the food chain via meat, offal or eggs.

Soil background concentrations are[5] total lead soil 40 mg/kg and extractable (bioavailable) lead 15 mg/kg.

Background tissue concentrations (eg in the liver or kidney) are usually below 0.01 mg/kg.

Case study 1

The incident occurred on a free range chicken farm in Berkshire. The authorities were alerted in June 2010 when lead toxicity had been diagnosed by the VLA in a flock of 4500 birds in a single house unit at the farm. A problem was initially suspected as there was increased mortality within the flock and a private veterinary surgeon had noticed that the flock had only reached about 80% of expected egg production. Five birds were submitted to the VLA for disease investigation by post mortem. Analysis of four birds revealed increased kidney and liver concentrations of lead (see Table 1).

Photo 1: Free range chickens

Table 1: Post-mortem tissue analysis of birds in incident 1

Date	Bird number	Lead concentration in liver*,† (mg/kg)	Lead concentration in kidney*,† (mg/kg)
8 June	1	2.0	Not known
8 June	2	Not known	0.7
17 June	3	5.4	9.9
17 June	4	5.8	8.8

* Background tissue lead concentrations are usually <0.01 mg/kg

† The maximum permitted concentration is 0.5 mg/kg (The Contaminants in Food (England) Regulations 2009[7])

Subsequent analysis of ten egg yolks was undertaken by the VLA and a mean lead concentration of 1.53 mg/kg was determined. Yolk lead concentrations correlate with blood lead concentrations, whereas albumen lead concentrations are in general low. Eggs from hens which have not been exposed to lead should contain very low concentrations of lead. Trampel et al (2003) report yolk concentrations at <10 µg/kg in control hens[8].

Following a site inspection by the VLA, a likely source of lead contamination was identified. The farmer and his family operated a small lead works (and had for a number of years), situated close to the free range hens, which smelted down lead for use in garden ornaments. Soil lead samples were collected close to the lead works and within the ranging area. Lead concentrations were measured at 88,597 mg/kg, 179,197 mg/kg and 590 mg/kg, all well above expected background levels[5] of 40 mg/kg (see Box 2).

As a result of the findings, the poultry were culled as the owner and private veterinary surgeon deemed the flock to be non-profitable. The VLA and the Food Standards Agency (FSA) advised that any culled hens should not enter the food chain and should be disposed of by incineration at an approved site. The owner decided not to restock his house due to the downturn in industry profitability and the difficulty in providing suitable uncontaminated ranging for another flock.

Case study 2

The incident occurred on a small (ten birds) private free range dwelling in Suffolk. The carcase of a dead hen was submitted to the VLA for post-mortem examination following five deaths of Andalucian hens over a six-month period. Post-mortem analysis revealed a kidney lead concentration of 9.2 mg/kg, well above the permitted kidney concentration of 0.5 mg/kg, were the kidneys to enter the food chain. This therefore initiated a food safety investigation. Measurements from four eggs from the remaining hens identified a mean egg yolk concentration of 0.59 mg/kg.

The source of lead contamination was identified as bonfire ash resulting from the disposal of a wooden Victorian greenhouse; the lead is likely to have been present in paint and window putty. Sampling of the ash revealed a lead concentration of 18,648 mg/kg. Subsequently, the hens were prohibited from accessing this area and the bonfire ash was cleared. The VLA and FSA advised the owner not to eat or give away the eggs for a minimum of 16 weeks to allow the body burden of the hens to decrease. In addition, the VLA advised that following this period the owner should consider submitting further eggs for lead analysis to ascertain that the lead residues had reduced to concentrations suitable for human consumption. Prior to identification of the incident, eggs from the contaminated flock may have been consumed by family and friends but following an FSA risk assessment the risks from lead to human health were considered extremely low and no human investigations were carried out.

Case study 3

A third incident occurred on a poultry farm in Oxfordshire involving 2000 free range laying hens. The hens were 42 weeks into lay and had been in lay since they were 22 weeks of age. Investigations were undertaken as a result of hens failing to reach their expected egg production potential. Lead toxicity was confirmed when post-mortem examinations revealed several cases of egg peritonitis and lead shot was repeatedly seen in the birds' gizzards; one bird was found to have 59.0 g of lead shot in its gizzard. Analysis of three birds revealed increased kidney concentrations (see Table 2).

Table 2: Post-mortem tissue analysis of birds in incident 3

Bird number	Lead concentration in kidney*,† (mg/kg)
1	7.1
2	89.4
3	31.4

* Background tissue lead concentrations are usually <0.01 mg/kg

† The maximum permitted concentration is 0.5 mg/kg (The Contaminants in Food (England) Regulations 2009[7])

During an on-site visit the source of lead was easily identifiable as the birds ranged next to an active clay pigeon shoot. The birds were poisoned by lead shot scatter accidentally falling into their ranging area. Clay pigeon shooting has the potential to release very large quantities of lead shot into the environment, although most of this should fall into a defined area. A typical clay shooting cartridge contains 28 g of lead.

Egg yolk analyses revealed a mean lead concentration of 0.89 mg/kg. Upon discovery of the incident and consultation with the FSA, a decision was taken to recall all eggs still in the distribution system. For economic reasons a decision was taken to cull all of the contaminated flock. The VLA and FSA advised that the dead hens needed to be disposed of in accordance with the Animal By-products Regulations[9], ensuring no carcases entered the food chain.

Photo 2: Chicken gizzard contaminated with lead shot (courtesy VLA)

Lessons identified

- There are no specific European Union maximum contaminant levels for lead in eggs to prevent eggs being sold which could potentially cause an adverse effect in humans. However, the general food regulations prohibit food being placed on the market if it unsafe or injurious to health.
- Food safety legislation does not apply to home grown produce.
- Poultry (and the eggs they produce) with clinical lead poisoning are unsuitable to enter the food chain. However, subclinical poisoning of poultry may occur that results in tissue residues and lead levels in food that exceed statutory limits or, in the case of eggs, exceed an acceptable level as determined by the FSA following a risk assessment.
- Lead, a potential health hazard, is a contaminant that may be found in poultry and eggs.

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Emergency Planning and Preparedness

Exercise Black Velvet: rehearsing elements of the strategic and tactical response to a toxic plume

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Introduction

On 11 December 2005 the Buncefield oil depot in Hertfordshire, England, was involved in an explosion (Figure 1). The resulting fire burnt for four days in which time 22 tanks of diesel, kerosene and aviation fuel were destroyed, creating a dense black plume of smoke that could be clearly seen on satellite imagery covering large parts of southern England. At the time it was thought by industry experts in the UK that this was an unprecedented event, although it was later considered that other incidents involving large, unconfined petrol vapour clouds have occurred elsewhere previously[1]. More typically, potentially toxic plumes are created on a much smaller scale – for example, during fires at industrial sites – especially where chemicals are stored or used extensively in manufacturing processes.

Figure 1: Fire and explosion at Buncefield oil depot, Hertfordshire, December 2005 (© Chiltern Air Support Unit)

In 2008 there were 1800 recorded fires at industrial premises in the UK[2]. It is estimated that there are up to 15 major incidents every year which could have an impact on air quality. Where there is a possibility of a major incident affecting air quality, the Environment Agency (EA), supported by the Health Protection Agency (HPA), the Health and Safety Laboratory (HSL), the Food Standards Agency (FSA) and the Met Office, has created an operational capability, the Air Quality Cell (AQC), to monitor and assess the risk to public health. Monitoring capability was notably lacking during the Buncefield incident. Consequently the recommendations of the Buncefield Major Incident Investigation Board[3] provided a driver for the development of monitoring capability for deployment during major incidents affecting air quality.

Monitoring equipment is deployed by the EA to monitor the plume, identifying chemical constituents and their levels. This information is assessed by the AQC, a multi-agency grouping of the EA and HPA, together with the FSA, HSL and the Met Office as required. The interpreted air quality information from the AQC is then fed into the Scientific and Technical Advice Cell (STAC) and subsequently the Strategic Coordinating Group (SCG) to inform decision making.

The exercise

Exercise Black Velvet, held in Epsom on 17 March 2010, was the annual Department of Health funded desk-top exercise for the South East coast region as defined by the Strategic Health Authority (SHA) footprint. Designed and delivered by the HPA Exercises Team, the exercise aimed to explore the health response to a major chemical fire and interaction with multi-agency partners. In all, the 130 participants included representatives from many health organisations from across the region including the SHA, primary care trusts (PCTs), acute trusts and the ambulance service, and partner agencies including the emergency services, local authority, the EA and the Met Office. This exercise was the first run by the HPA to explore the link between the AQC and the SCG.

Exercise scenario

The exercise scenario involved a significant fire which lasted a number of days and resulted in a plume which crossed the Sussex county border into the county of Kent, requiring the engagement of two SCGs.

The seat of the fire was a plastics warehouse located in a business park, near an industrial estate. The warehouse contained approximately 10,000 tonnes of mixed pelletted plastics including PVC, an 80 litre open tank of sodium hydroxide and a further pallet of bagged sodium hydroxide. Outside the building was a cage containing gas cylinders. A large lorry loaded with tyres parked outside the plastics warehouse also became engulfed by flames. The overall effect was the creation of a very large, dense, black acrid smoke cloud which covered the surrounding area and was visible over 15 km away. Weather conditions at the start of the exercise were dry with a brisk south-westerly wind; however, the wind was predicted to move to a more westerly direction. The fire also spread to other units within the business park, including an upholsterers, creating additional hazards.

Exercise structure

The exercise was divided into three sessions. The first session began two hours into the incident with a state of emergency assumed, the emergency services in attendance, a 200 m evacuation cordon established and the SCG, STAC and AQC convened. Session two covered six to eight hours into the incident and session three looked at recovery issues. A mock news broadcast and a written background briefing set the scene at the start, with further injects over the course of the day developing the incident scenario.

SCGs were established in Sussex and Kent, a Recovery Coordinating Group (RCG) was convened and advice was provided by STAC along with specialist technical support from the AQC. The organisations present in the STAC included the local PCTs, acute trusts, HPA, the Met Office and EA. The AQC had representatives from the EA and HPA. Initially the STAC and AQC provided advice to the primary SCG (Sussex). As the incident unfolded, with the plume crossing the county border, Kent SCG also drew on their services. The AQC is envisaged to be virtual; however, for the purpose of this exercise the cell was located in a syndicate room allowing face-to-face discussion. Exercise control (Excon) monitored and managed the progress of the exercise working closely with the umpires in each syndicate.

Exercise evaluation

Comprehensive evaluation and analysis is vital to the success of an exercise as without it lessons can be missed and learning from the exercise is not maximised. Evaluation relies upon the successful capture of the outcomes from the exercise and, to maximise this, a variety of data capture methodologies are used.

Each syndicate, excluding those that were notional – as indicated in Figure 2 – was allocated an umpire for the day's event. The majority were members of the exercise planning team who therefore had an informed insight into the exercise. Others from the EA, HPA and the NHS were drafted in as umpires for their particular specialist expertise. All umpires were briefed prior to the exercise on their role, which included making sure that syndicate activity ran smoothly and followed the scenario. They were also asked to make notes and produce a report of the syndicate discussions and activities against the following headings:

- crisis management and coordination
- public information/media handling/communication
- further policy development
- business continuity/resilience.

Observers who attended the exercise, primarily from the health community, were invited to submit their comments, also based on the criteria outlined above.

A 'hot' debriefing session was carried out at the end of the exercise to collect immediate impressions from the players. A representative from each syndicate had five minutes to give a presentation on the collective key issues and learning points from their syndicate.

At the conclusion of the exercise all the players were invited to submit an individual evaluation form based on the criteria outlined above. Of the 130 players present at the exercise, 109 provided feedback.

The final element of the evaluation process was a formal structured debriefing session of the exercise planners and umpires, with the HPA Exercises Team.

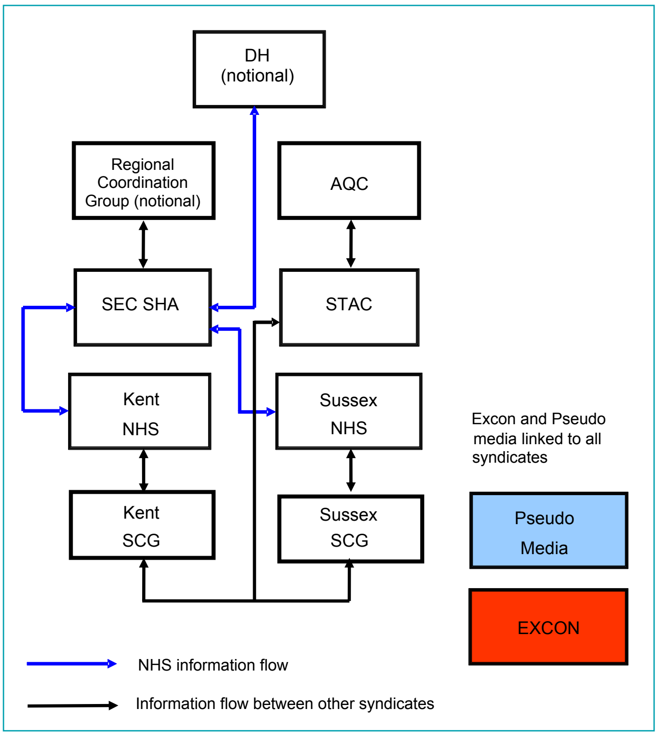

Figure 2: Exercise syndicate structure and information flows

Together, all the listed elements of the debriefing process informed the formulation of lessons identified and an action plan to address those lessons.

Key lessons identified

Cross-border working

The exercise highlighted some of the difficulties likely to be experienced in the cross-county-border management of major incidents where more than one SCG is established. Coordination was hampered by the limited, common multi-agency approach at the strategic level and noticeably, within the health groupings, at the tactical level.

There was an early, mutual decision to share the output of the Sussex STAC between the Kent and Sussex SCGs rather than form a separate STAC for Kent. However, the STAC prioritised its work in support of the Sussex SCG which was not surprising as many of the players represented organisations based in the county of Sussex. This led to a situation where very limited information was available to the Kent SCG, hampering its ability to make timely, informed decisions. Overall the relationship between the STAC and the two SCGs worked poorly during the exercise, suggesting that greater direction and guidance are required on how STACs should be established when servicing more than one SCG.

Communications

The ability of the communications players to respond rapidly to journalists' enquiries and the procedure for SCGs to sign off all statements and responses before they could be issued were disconnected. Delays which were experienced during the exercise in reality could lead to conflicting and possibly even inaccurate information being released to the media by different organisations if no central agreement or clearance process is established early in the incident. Allied to this was a lack of coordination between the SCGs, resulting in the overall communications strategy being disjointed.

Air Quality Cell

The AQC was introduced into this exercise as a new concept. As expected therefore, there was considerable debate on the precise role of the AQC and its relationship to the STAC among the players. The capabilities and limitations of the AQC were poorly understood, resulting in misunderstandings and difficulties in maintaining the flow of required information in a timely fashion into the SCGs. As the role of the AQC becomes more widely publicised and practiced, understanding of its capabilities and limitations will gradually improve.

Conclusions

The scenario in this exercise set out to explore the response to a major chemical fire where the consequences and therefore the response crossed county borders and in this case also police force boundaries. Added to this was the introduction of a new component into the armoury of advice and information, the AQC. Despite the artificialities that a desk-top exercise creates because of its format, valuable lessons were identified.

The roles and responsibilities of a STAC are defined in Cabinet Office guidance[4]. However, turning the STAC guidance into operational arrangements has been left with local and regional organisations. This has given those organisations ownership of the STAC with the expectation that, during an incident, every SCG will, if required, have its own STAC to call upon. However, STAC members are specialists in their own fields and the STAC role itself is a specialist one so the numbers available to participate in STACs are strictly limited. Therefore in a cross-boundary, regional or national incident the requirements of providing each SCG with a STAC are impractical and unnecessary duplication. Multiple STACs may also lead to contradictory advice. There therefore needs to be more consideration and guidance given as to how STACs might operate in an incident which reaches beyond county or police force boundaries.

The provision of an AQC is clearly a welcome addition to the capabilities of the STAC, with the rapid provision of expert advice into the SCG enhancing informed strategic decision making. As with all new capabilities, it will take time to bed into what is already a complex command structure, but this will be assisted by continuing awareness raising, training and exercising alongside multi-agency partners.

Desk-top exercises continue to provide an ideal opportunity to explore challenging but realistic situations in a safe environment. The positive responses from the vast majority of the 130 delegates suggest that this exercise generated good discussions and highlighted many issues and lessons were taken away by participants for further consideration. In addition, these were shared with a wider audience through the production of an exercise report.

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Computerised decision support for chemical, biological and radiological contaminated fatality management

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Introduction

This article considers how a computerised decision support tool can be used to aid the operation of complex guidelines in the management of emergency situations. It reports work carried out to look into the feasibility of converting an existing paper guideline, in this case the Contaminated Body Process Pathway[1], into an easy-to-use computer application. The software system developed and described in this paper is not intended as an end-product, rather it illustrates a means for developing the concepts and demonstrating what is possible.

Contaminated Body Process Pathway (CBPP)

The Health Protection Agency (HPA) was commissioned by the Home Office to develop a set of guidelines for the safe handling and disposal of contaminated fatalities[1]. These guidelines included algorithms for the management of normal and contaminated fatalities. The algorithm for the management of contaminated fatalities was designated the Contaminated Body Process Pathway (CBPP). This provides rapid guidance for emergency responders and others with the aim of reducing or eliminating the spread of contamination to responders for mass fatalities from the scene of death to final disposal[2]. The CBPP is used in this paper as an example of how a paper algorithm can be applied quickly and efficiently in an emergency using computerised techniques.

Figure 1 shows the CBPP flowchart which outlines the steps to be taken for the processing of a body following an overt or covert release of a chemical, biological or radiological (CBR) agent. The process required, as well as the personnel involved, for the management of a covert as opposed to an overt incident differ as shown in Figure 1. In the case of an overt incident, it is immediately evident that a CBR agent was involved. Following a covert incident, the release of a CBR agent may not be immediately obvious or noticeable. As such there may be no incident scene and the contaminated people may further contaminate others in the community.

The CBPP comprises a sequence of tasks, processes, decision points and transport procedures. It identifies the routes from recovery, through storage and transportation, to final disposal. At each stage, specific data from different users or agencies are required in order to activate the step-by-step tasks which continue until the final disposal of the fatality. For example, during the body recovery stage, CBR trained police, recovery officers, fire and rescue services, engineers and utility service personnel are likely to be involved. Similarly, the transportation of the body would probably involve, for example, the police, commercial service providers, forensic pathologists, anatomical pathology technologists, police disaster victim identification personnel and mortuary personnel. All these people are at risk of secondary contamination, and so processes have to be put in place not only to decontaminate the body but also to minimise the risk of secondary contamination.

Currently, the CBPP is in the form of (paper) manuals[3], which can be difficult to use in operational circumstances. The complexity and diversity of incidents and the processing of contaminated bodies is such that the manuals will inevitably be long and involved. This renders the CBPP cumbersome and hard to use in a tense situation where rapid decision making is required and where the consequences of those decisions can have far-reaching effects. However, it is possible to 'unpack' the complex process into a managed sequence of simple-to-operate steps using suitable software. It is for this reason that we have developed a prototype computerised decision support system to demonstrate how the use of such a system can assist in the decision making process. The developed approach aims to present or process only the relevant information from the CBPP at any stage in any given situation. This is, however, not just a question of building a table look-up or an online query system. The complexity and consequences demand that the computerised system be able to manage and support the application of a guideline and justify any of the recommended courses of action.

Prototype computerised CBPP system

A prototype computerised CBPP decision support system has been developed to explore and illustrate how such a system could provide a means to electronically support and track the progress of the pathway in real time. The computerised system is dialogue based with a visual front end that is straightforward to use, particularly by users who are not HPA or IT professionals. At each stage, users such as toxicologists, pathologists and the police provide information that is relevant for the particular stage of the decision making process – for example, contamination data and religion can influence the choice of burial or cremation. The users are able to record, cross-check and update the multiple and complex data collected during the incident, ie they naturally construct an audit trail that can be examined subsequently. The system also automatically generates recommendations of specific tasks and procedures at each stage of the complex CBPP that comply with the guideline to support the users in making informed decisions and to take the appropriate actions.

The decision support interface used for this work consists of a set of interaction windows, each with a different function, see Figure 2. This is known as the Tallis[4] process modelling system interface.

The status of each task is visualised by different colour codings:

- When a task is currently being performed it is displayed as yellow
- When a task is completed it is coloured blue
- When a task is potentially necessary it is shown in grey
- When a task is discarded it is shown in black.

The progress of the pathway can thus be visualised quickly and tracked simply by observing the colour code. Alternatively, different symbols or mechanisms could be used to indicate the progress.

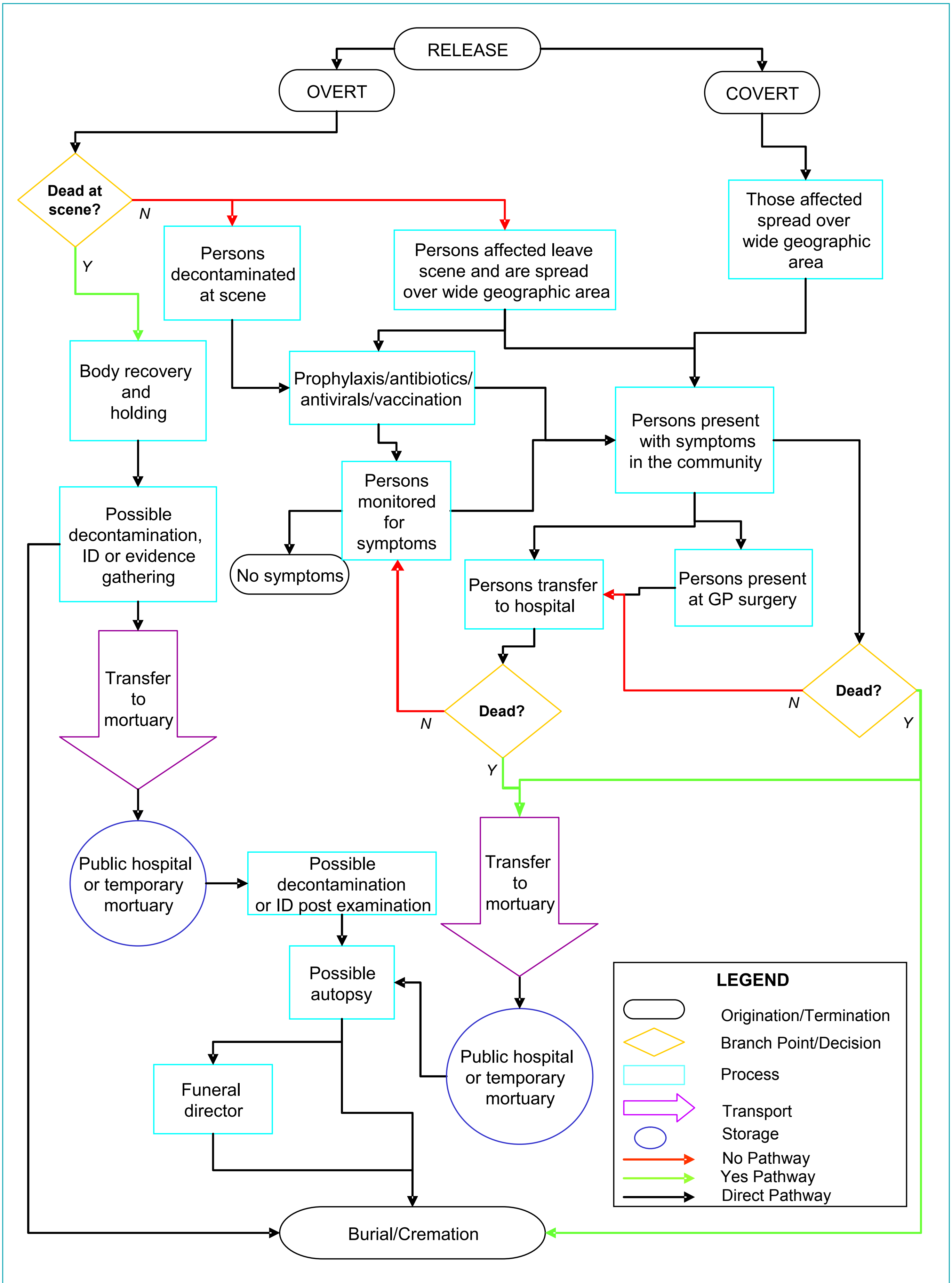


Figure 1: Contaminated Body Process Pathway[2]

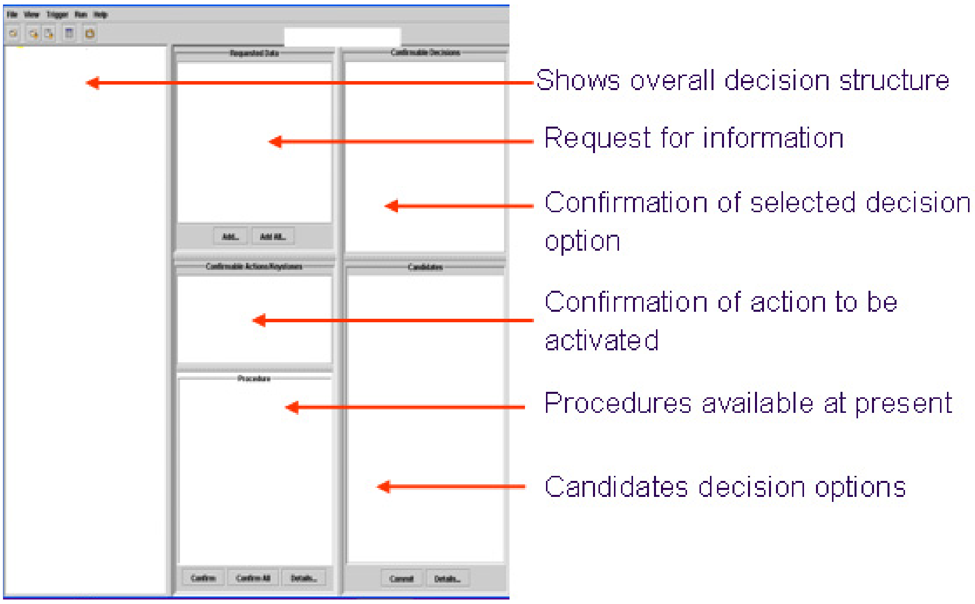


Figure 2: Decision support system interface

Example incident

The function of the developed decision support system is best understood by working through a short, relatively straightforward, example incident.

The system is initiated when an incident happens (or is first reported and responded to). At this point, the user is asked whether it is appears to be an overt or covert incident as shown in Figure 3. The 'request for information' window is active, together with a 'decision option' box, and the current task is labelled in yellow in the overall decision structure on the left.

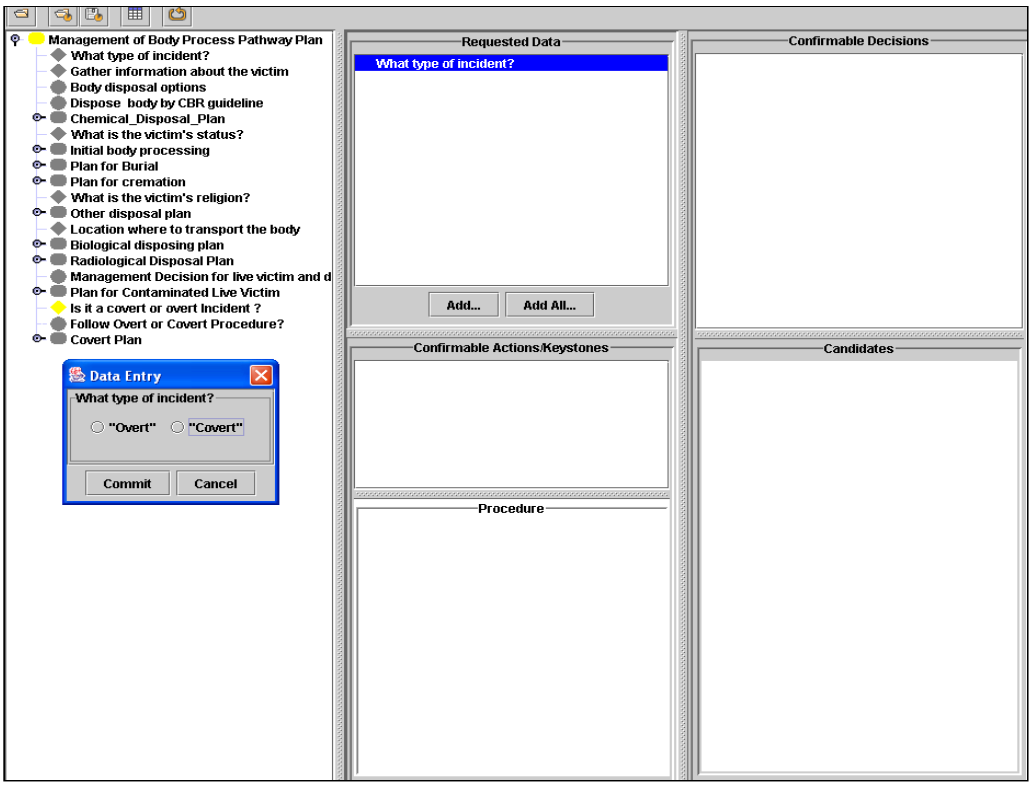


Figure 3: Start system

In this illustrative example, an overt incident has occurred and, to keep things simple, a single fatality was recovered. The users are asked to provide more detailed information about the incident and fatality, as shown in Figure 4.

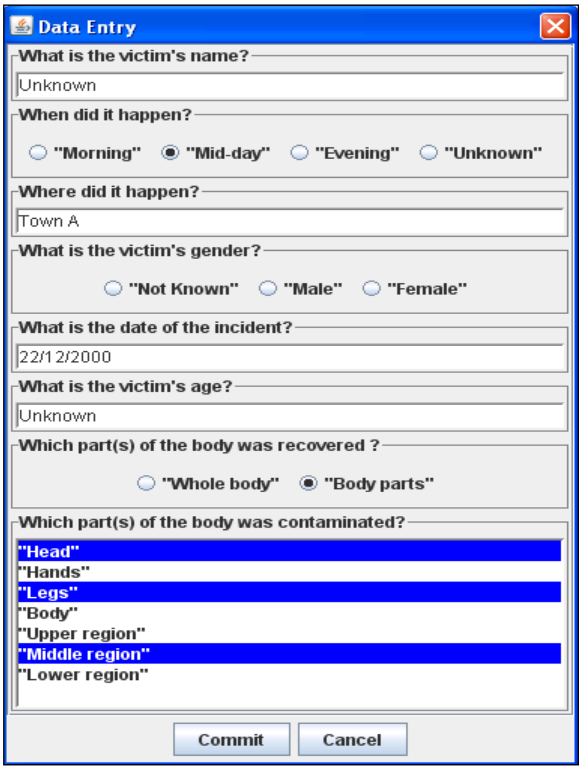


Figure 4: Fatality data entry

As shown in Figure 5, the users are then asked what type of hazard was involved. In this example, a chemical hazard was identified.

Note the colour coding for the tasks in the overall decision structure shown on the left: blue for completed tasks and yellow for current tasks. One of the advantages of the system developed here is that information can be entered in any order, potentially by a variety of users, and information can be revised and updated as circumstances demand.

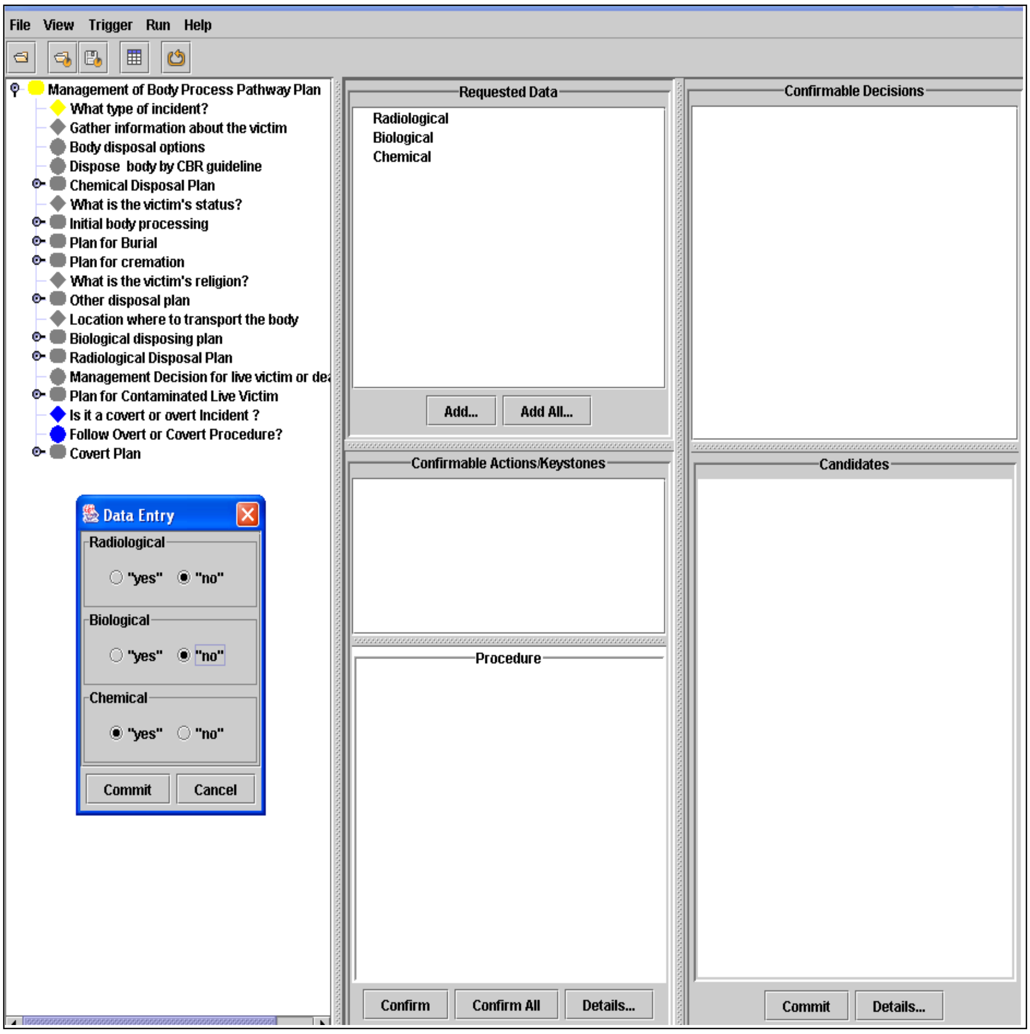


Figure 5: Hazard entry

Information on the victim's religion is then requested, see Figure 6. This information will be used to support decisions regarding whether the body should be cremated or buried. In some circumstances preferential disposal procedures may not be feasible – for example, the city of New Orleans is below sea level, and therefore almost all bodies there are cremated. In these cases, permission may have to be sought or special arrangements made.

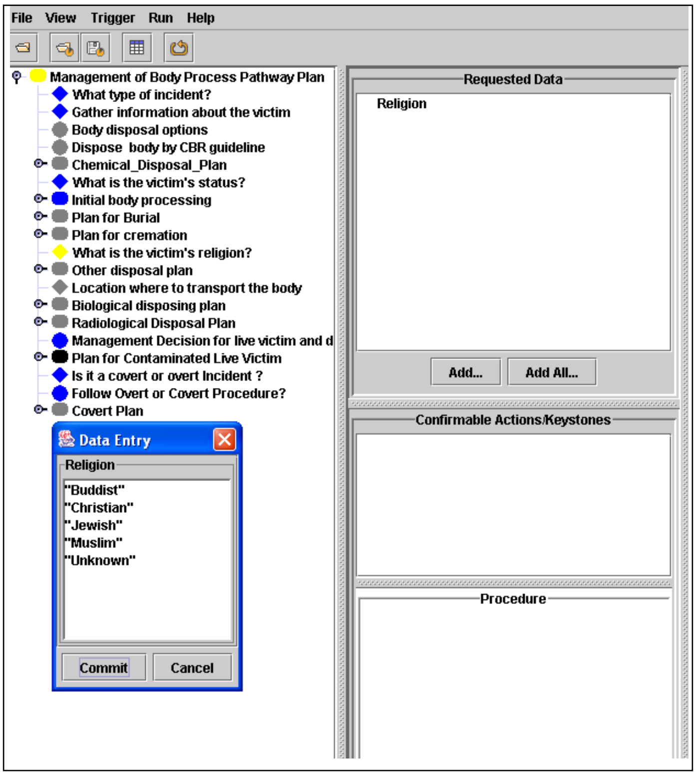


Figure 6: Victim's religion entry

The active 'candidate decision' and 'confirmed decision' windows indicate the possible options and the decision as shown in Figure 7. For the current example, in accordance with the guideline and the victim's religious beliefs, burial has been recommended by the system as highlighted by the colour coded green recommendation. As with all recommendations offered by the system, the decision can be overridden by the user.

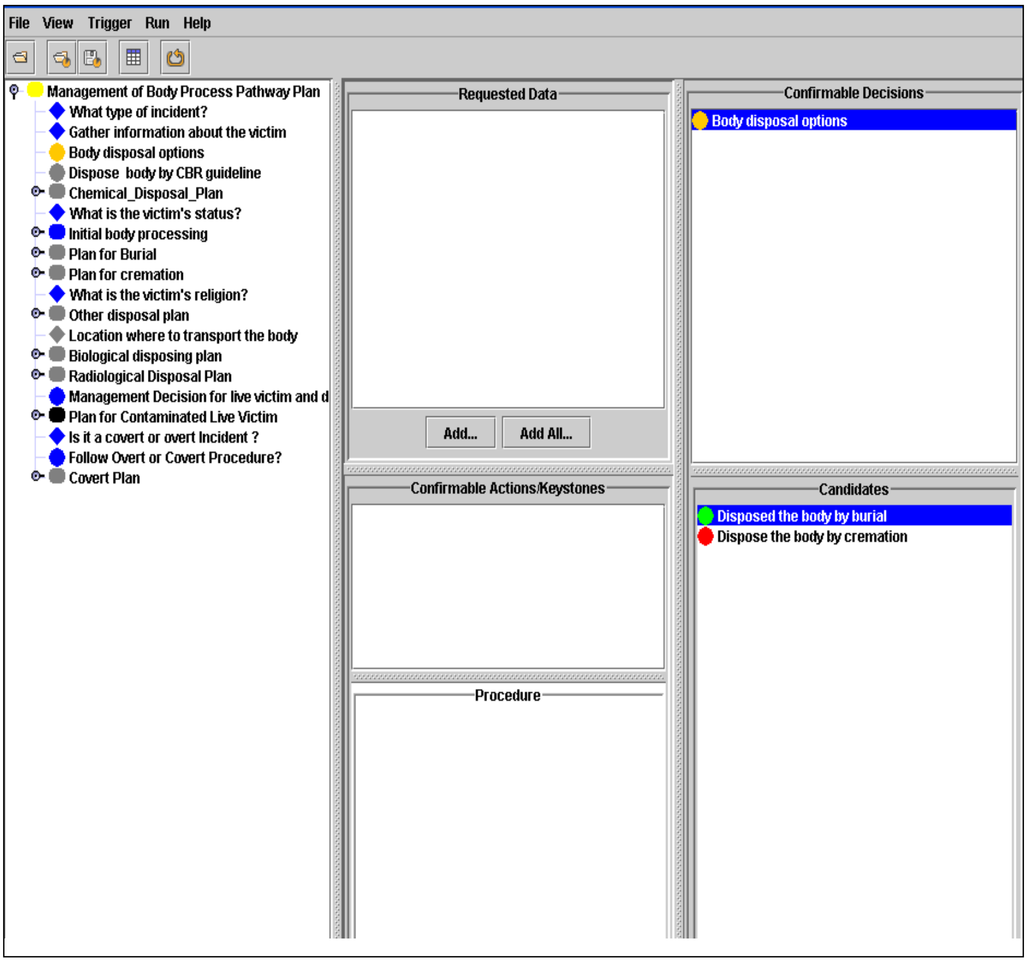


Figure 7: Disposal recommendation

In this illustrative example it has been assumed that it is known to be a chemical incident. As a result, the user is asked further questions, as shown in Figure 8, which include details of the location of where the body is to be taken and whether additional processes are required, eg further decontamination. Again the 'request for information' window is active together with a 'data entry options' box and the status of the overall decision structure is colour coded on the left.

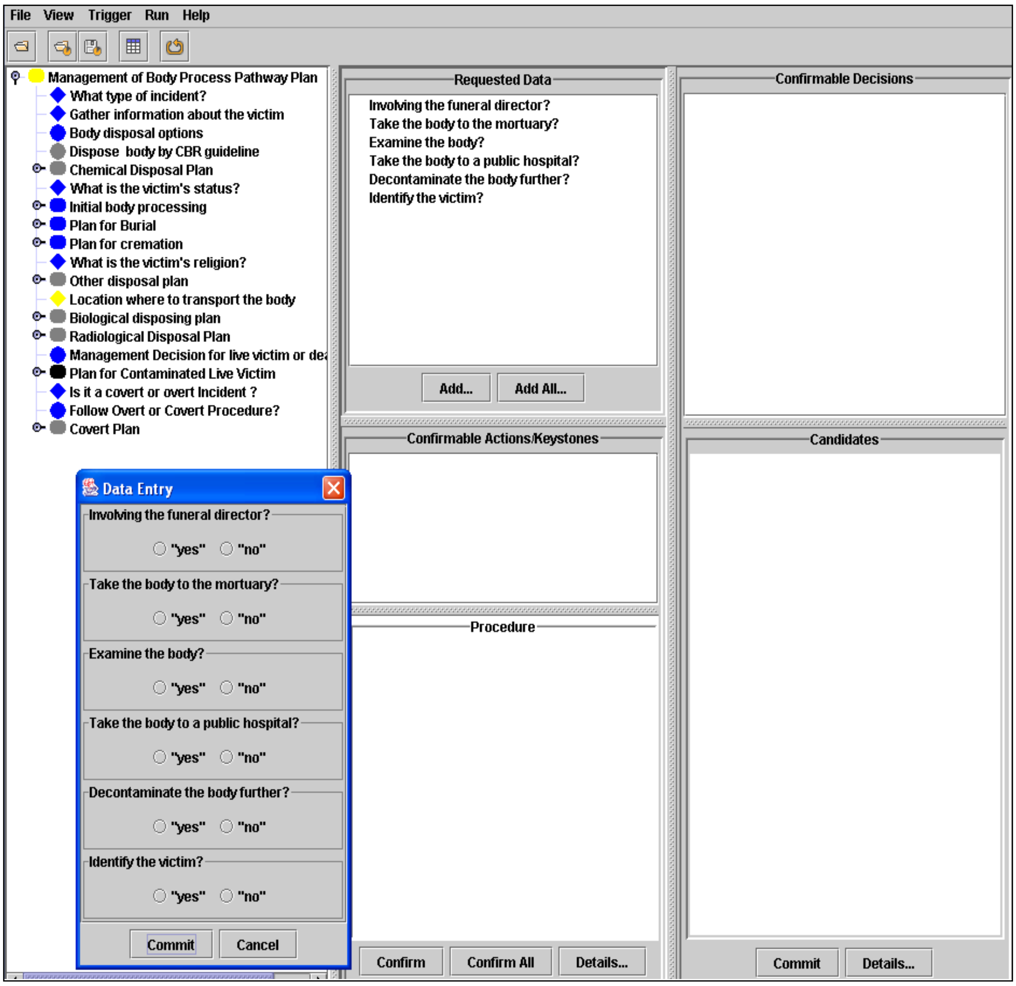


Figure 8: Transportation and additional processes entry

Given all the above information provided by the users, the system recommends the chemical disposal plan for the body in question, as shown in Figure 9. Note that the 'decision candidates' and 'confirmed decision' windows are active.

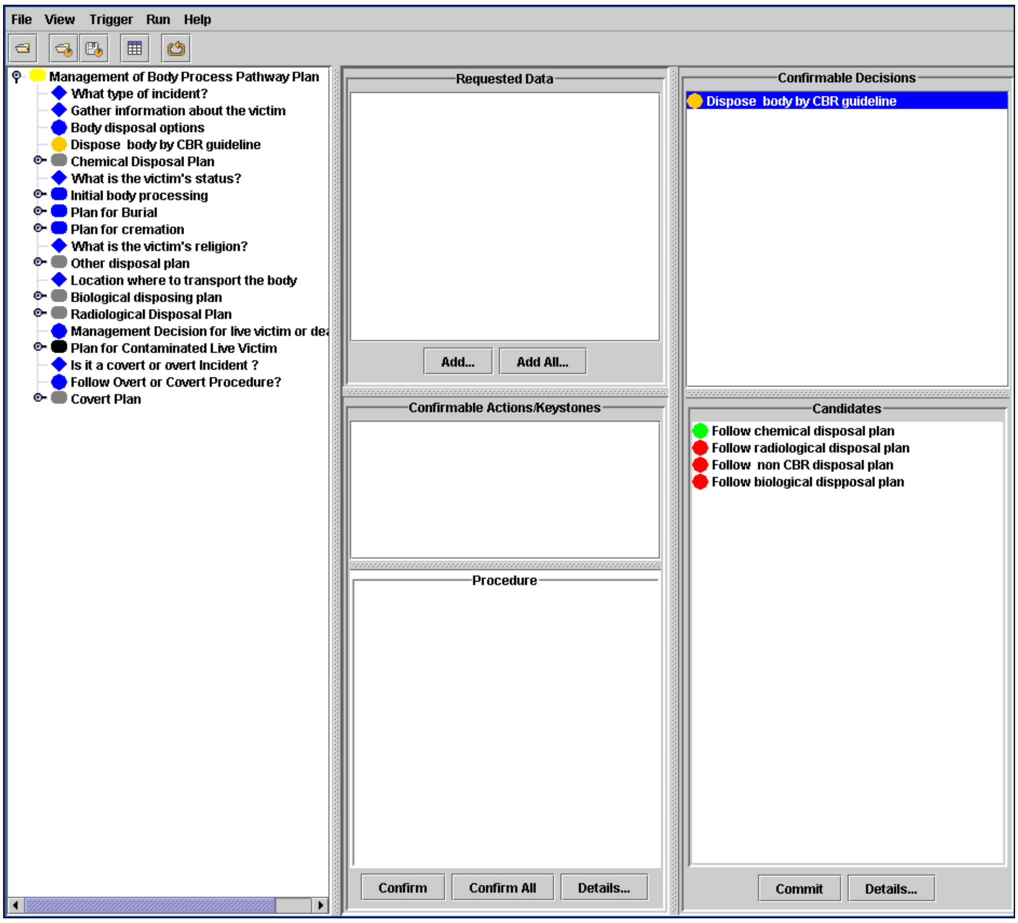


Figure 9: Automated system recommendation

Once the chemical disposal plan is recommended and activated, all the required processes are complete. The Contaminated Body Process Pathway has been successfully completed and the process is concluded as shown by the colour coded status of all the elements in the overall decision structure, see Figure 10.

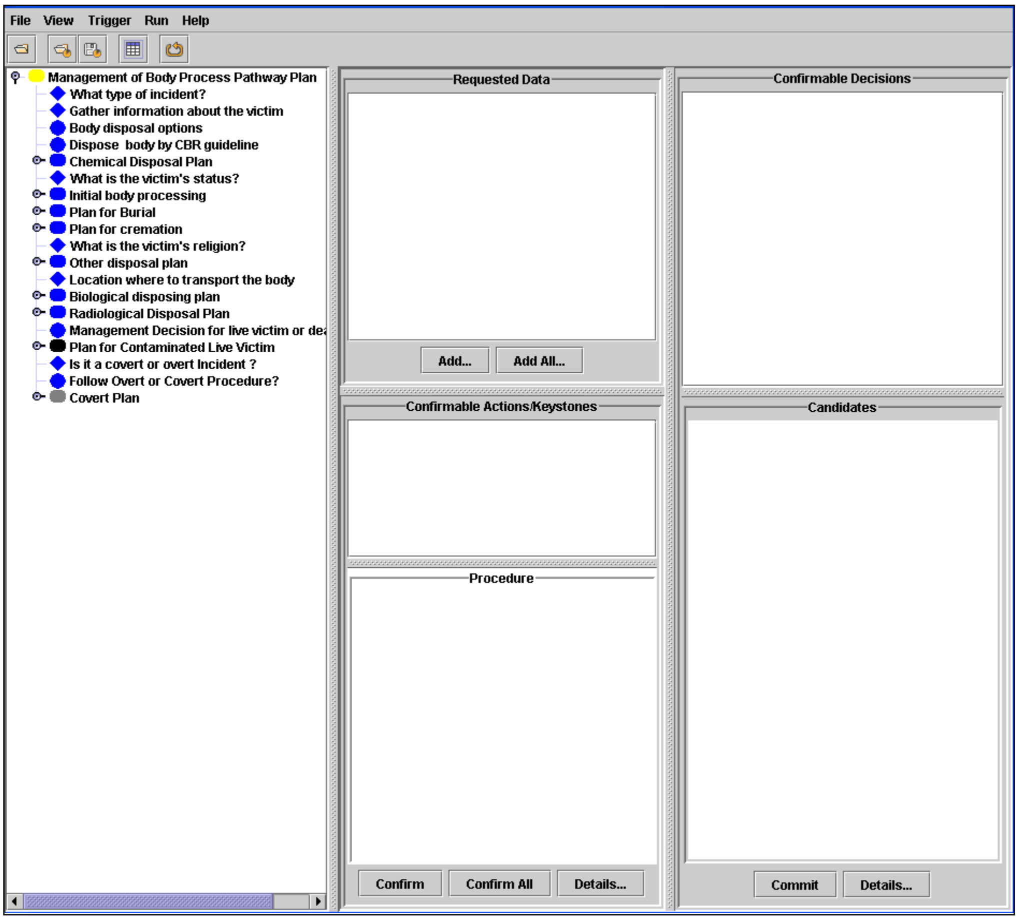
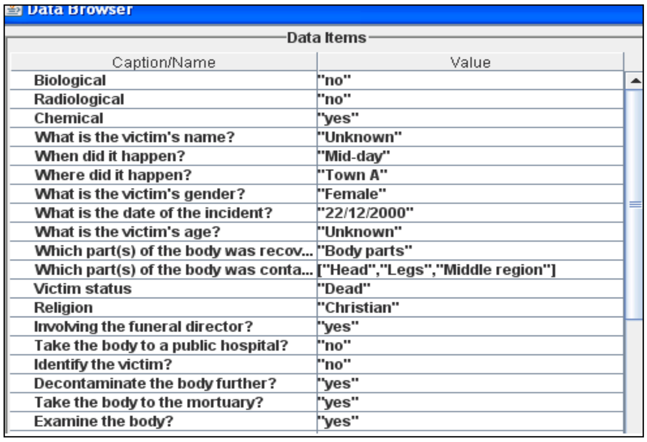


Figure 10: End of process with colour coded decision structure

The data entered in the system can be examined any time during the process, as shown by the example data record in Figure 11. This enables the users to confirm the data that have been entered into the system, cross-check data to identify any potential mistakes, contradictions or unknowns, and update data entries when circumstances change or data become available.

The system inherently cross-checks the data entered and highlights data that are still required in order to come to a final decision. The data record also provides an invaluable audit trail as a means to understand why certain decisions were made, ie to see which data were available at the time a decision was made. Furthermore, it provides an opportunity to assess the role of each data item in the decision making process.



Data Browser

Data Items

Caption/Name	Value
Biological	"no"
Radiological	"no"
Chemical	"yes"
What is the victim's name?	"Unknown"
When did it happen?	"Mid-day"
Where did it happen?	"Town A"
What is the victim's gender?	"Female"
What is the date of the incident?	"22/12/2000"
What is the victim's age?	"Unknown"
Which part(s) of the body was recov...	"Body parts"
Which part(s) of the body was conta...	["Head","Legs","Middle region"]
Victim status	"Dead"
Religion	"Christian"
Involving the funeral director?	"yes"
Take the body to a public hospital?	"no"
Identify the victim?	"no"
Decontaminate the body further?	"yes"
Take the body to the mortuary?	"yes"
Examine the body?	"yes"

Figure 11: Example data record

Conclusions

The prototype computerised Contaminated Body Process Pathway (CBPP) decision support system that has been developed demonstrates how it is possible to 'unpack' a complex decision process into an automated tool that provides an easy-to-use and effective means to support and track the progress and status of necessary tasks – in this case, the safe handling and disposal of contaminated fatalities. The status of each task can be clearly seen through different colour codings. The prototype system automatically generates real-time recommendations according to the guidelines based on data entered by the users/responders for the particular incident and fatalities. The tool developed could readily be extended to other applications. It is, for example, envisaged that this approach could be used to cover live victims of a chemical incident. It also provides an automated audit trail and there is provision for the users to override or change recommendations if circumstances demand.

In summary, decision support tools of this type provide an intuitive computerised visualisation interface for the analysis and management of operational guidelines – for instance, for fatalities resulting from CBR incidents. Such tools will be easy to use and require minimal training.

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Environmental Science and Toxicology

Legislative developments: the Industrial Emissions Directive

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This paper provides a summary of the forthcoming Industrial Emissions Directive (IED).

Why have a new directive?

The Integrated Pollution Prevention and Control (IPPC) Directive has been in place for over ten years. It introduced a permit system to prevent and limit pollution from large-scale industrial installations, covering around 52,000 industrial and agricultural sites with a high pollution potential, from refineries to pig farms[1].

To obtain a permit, installations covered by IPPC rules must apply 'best available techniques' (BATs) to optimise their all-round environmental performance. Emissions to air, soil or water, as well as noise and safety, are all considered.

From 2005 the European Commission undertook a two-year review to examine how the IPPC Directive, and the related legislation on industrial emissions, could be improved[2]. As a result of this review process, a proposal for a directive on industrial emissions was adopted in December 2007[3]. This Industrial Emissions Directive (IED) aims to improve health and environmental protection, while making its rules clearer and easier to implement. It recasts seven existing air pollution directives related to industrial emissions into a single legislative instrument. In addition to the IPPC Directive, this new legislation includes the Large Combustion Plant Directive (LCPD), Waste Incineration Directive (WID), Solvent Emissions Directive (SED) and three directives related to the production of titanium dioxide.

The IED is expected to provide significant benefits for the environment and human health. The European Commission predicts that emission reductions achieved at large combustion plants alone are likely to offer net benefits ranging between €7 billion and €28 billion per year and should reduce premature deaths and years of life lost by 13,000 and 125,000, respectively[1].

What are the requirements of the IED?

Initial proposals called for legally-binding emission limit values applying to all installations, in order to avoid widespread exemptions. Subsequent negotiation led to agreement that member states could deviate from the standard for certain technical reasons or local circumstances if they could prove that the costs of implementing the standards would be disproportionate compared to the environmental benefits.

The main thrust of the IED is to increase the consistent application of BATs across Europe, placing an obligation on industrial operators to use the most cost-effective techniques to achieve a high level of environmental protection. It contains provisions related to standards for the inspection of installations and the process of permit review. The primary impacts of the new directive will be on existing and newly-proposed regulated industrial sites that will have to meet the more stringent requirements of the IED. Stricter minimum emission limits will apply to large combustion plants; for example, stricter limits on emissions of oxides of nitrogen, sulphur dioxide, and particulate matter will apply from 2016 (although large combustion plants may have up to 2020 to meet the rules, or else limit their operating hours and cease operation by 2023).

The scope of the legislation has been extended to include additional activities such as medium-sized combustion plants of between 20 and 50 megawatts (MW), production of wood-based panels and preservation of wood. The Commission's proposal also clarifies the scope of certain activities already covered by existing legislation, such as waste treatment and food production.

What will happen next?

On 24 November 2010 the European Parliament and European Council gave their official seals of approval to the text[4]. Member states (including the UK) are required to transpose the directive into their national legislation by 7 January 2013.

What are the implications for public health professionals in the UK?

As with the existing Environmental Permitting Regulations, regulatory bodies will enforce the requirements of any new UK legislation that will implement the IED. The Heath Protection Agency currently responds to environmental permit applications on behalf of primary care trusts. Applications for large combustion plants are beginning to make reference to the IED and to base their impact assessments on emission limits specified in the directive, on the assumption that, by the time the plant is commissioned, the IED will be in force.

Further reading

- Questions and Answers on the Commission's proposal for the revision of industrial emissions legislation in the EU. Available at http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/07/623&format=HTML&aged=0&language=EN&guiLanguage=fr (accessed 23/12/10)
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Legislative developments: review of the Environmental Impact Assessment and Strategic Environmental Assessment Directives

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This paper provides a brief overview of the European Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Directives, recent legislative developments, and their implications for public health.

Figure 1: Large industrial processes may be subject to Environmental Impact Assessments

The Environmental Impact Assessment (EIA) Directive

What is an EIA?

Before granting development consent for any project that is likely to have significant effects on the environment, authorities must carry out a procedure known as Environmental Impact Assessment (EIA). The requirement for an EIA comes from the Environmental Impact Assessment Directive*. Annex I of the directive lists projects which have significant effects on the environment and for which an EIA is mandatory. For projects listed in Annex II of the directive, the national authorities have to decide whether an EIA is needed. This is done by a 'screening procedure', which determines the effects of projects on the basis of thresholds/criteria or a case-by-case examination.

Annex I projects include:

- long-distance railway lines
- motorways and express roads
- airports (with a basic runway length of 2100 m or more)
- installations for the disposal of hazardous waste
- installations for the disposal of non-hazardous waste (over 100 tonnes per day)
- waste water treatment plants (over 150,000 population equivalent).

The projects listed in Annex II include developments such as urban development projects and flood-relief works.

The EIA procedure requires the developer to compile an Environmental Statement (ES) describing the likely significant effects of the development on the environment and proposed mitigation measures. Early on in the process, at the 'scoping stage', the developer may request an opinion from the competent authority (eg in the UK, the Local Planning Authority or Infrastructure Planning Commission) as to what should be covered by the EIA. The final ES must be circulated to statutory consultation bodies and be made available to the public for comment. Its contents, together with any comments, must be taken into account by the competent authority before it grants development consent. The public is informed of the decision afterwards and can challenge the decision before the courts.

The EIA Directive primarily focuses on environmental, rather than health, impacts. In UK legislation, whilst the Health Protection Agency (HPA) is a consultation body for EIAs undertaken in relation to applications for Nationally Significant Infrastructure Projects (under the Planning Act 2008), it is not a consultation body for EIAs undertaken in relation to local planning applications under the Town and Country Planning Regulations.

Evaluating the EIA Directive

In July 2009 the European Commission published a report on the application and effectiveness of the EIA Directive[1]. The two major benefits of the EIA Directive were identified as:

- ensuring that environmental considerations are taken into account as early as possible in the decision making process
- by involving the public, ensuring more transparency in environmental decision making and, consequently, social acceptance.

Whilst the report concluded that the objectives of the EIA Directive have generally been achieved, areas identified as requiring improvement included:

- concerns regarding the 'screening procedure' (the criteria and process for deciding whether an EIA is required)
- concerns regarding the quality of EIAs, in terms of the process and information used (eg consideration of project alternatives and implementation of post-project monitoring)
- lack of harmonised practices for public participation
- difficulties regarding trans-boundary procedures
- better coordination between the EIA Directive and other directives (such as the Strategic Environmental Assessment Directive and the Integrated Pollution Prevention and Control Directive).

* Directive 85/337/EEC, on the assessment of the effects of certain public and private projects on the environment, as amended by Directives 97/11/EC, 2003/35/EC, and 2009/31/EC

Future of the EIA Directive

The EIA Directive has evolved over 20 years of implementation, during which European legislation has grown and new policies have developed. Public consultation on the review of the EIA Directive closed on 24 September 2010[2]. This consultation aimed to collect opinions on:

- the overall view on the functioning and effectiveness of the EIA Directive
- the need to amend the EIA Directive
- the possible policy options for review
- the areas to be improved or amended.

The Commission will publish a summary paper on its public consultation website in due course[3].

The Strategic Environmental Assessment Directive

What is a SEA?

Under the Strategic Environmental Assessment (SEA) Directive†, a SEA must be applied to plans and programmes (but not, notably, to policies) where these are required by legislative, regulatory or administrative provisions.

Figure 2: Road building programmes may be subject to Strategic Environmental Assessments

In contrast to the EIA Directive, the SEA Directive does not have a list of plans or programmes for which a SEA is mandatory. A SEA must be undertaken for any plans or programmes which have been determined to require an assessment under the Habitats Directive and for any plans or programmes which are prepared for certain areas‡ and which set the framework for future development consent of projects listed in the EIA Directive. Broadly speaking, for those plans or programmes not included above, a screening procedure must be carried out to determine whether the plans or programmes are likely to have significant environmental effects. If there are significant effects, a SEA is needed.

The requirements of a SEA include:

- producing an environmental report in which the likely significant effects (including health) and the reasonable alternatives are identified
- consultation with the public, the environmental authorities, and with other member states in the case of trans-boundary impacts.

† Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment
‡ Agriculture, forestry, fisheries, energy, industry, transport, waste/water management, telecommunications, tourism, town and country planning or land use

The environmental report and the results of the consultations must be taken into account before adoption and, once a plan or programme is adopted, relevant information should be made available to the consultees. To identify unforeseen adverse effects at an early stage, significant environmental effects of the plan or programme must be monitored.

Health is specified as one of the areas which must be considered within a SEA. The HPA is not, however, a statutory consultee to SEA consultations under UK legislation.

Evaluating the SEA Directive

In July 2009 the European Commission published a report on the application and effectiveness of the SEA Directive[3]. Consideration and identification of alternatives in the environmental report is one of the issues that has given rise to problems in member states. Other difficulties include:

- lack of good quality information
- time-consuming nature of data collection
- lack of homogeneous criteria for the scope and content of the baseline analysis
- absence of a standard set of environmental and sustainability criteria against which to assess plans and programmes.

The SEA Directive is relatively recent and experience of its application across member states is limited. However, the report concluded that the directive could contribute to improved organisation and structure of planning procedures (eg consultation and increased transparency) and change the content of plans and policies, not least through integration of environmental considerations into decision making.

SEA Protocol and the future of the SEA Directive

The Espoo Convention on EIA in a Trans-boundary Context – to which the European Commission has acceded – has been supplemented by the SEA Protocol[4]. The SEA Protocol was adopted in Kiev on 21 May 2003 and was signed by 38 states (including a number of non-EU member states) and the European Union. It entered into force on 11 July 2010. The UK is a signatory to the protocol but it is not one of the 19 parties that so far have ratified it.

Differences between the SEA Protocol and SEA Directive

The protocol addresses policies and legislative proposals, which are not addressed by the existing directive.

The protocol focuses more on health effects than the directive, stipulating throughout that environmental impacts must be considered in tandem with health impacts.

The protocol specifically requires consultation with health authorities.

In contrast to its predecessor, the SEA Protocol is not limited to trans-boundary impacts from plans and programmes; it is also concerned with impacts from plans and programmes within a contracting state. It is broadly similar to the SEA Directive in that it requires its parties to evaluate the environmental effects of certain plans and programmes.

The entry into force of the SEA Protocol may result in changes to the SEA Directive, requiring, among other things, greater involvement of health organisations within the SEA process. Amendments may also extend the scope of the SEA Directive (so as to better address certain issues such as climate change, biodiversity and risks) and reinforce synergies with other pieces of environmental legislation.

Relationship between the EIA and SEA Directives

The two directives address different subjects and are distinct in nature: the objectives of the SEA Directive are expressed in terms of sustainable development, whereas the aims of the EIA Directive are purely environmental. The SEA Directive applies 'upstream' to certain public plans and programmes at an early planning stage, while the EIA Directive applies 'downstream' to certain public and private projects that come through at a later stage. However, the boundaries between what constitutes a plan, a programme, or a project are not always clear.

Differences between SEA and EIA procedures

- SEA requires the environmental authorities to be consulted at the screening stage
- scoping is obligatory under SEA (ie the stage of the process that determines the content and extent of the matters to be covered in the final report)
- SEA requires an assessment of reasonable alternatives (under EIA the developer chooses the alternatives to be studied)
- under SEA member states must monitor the significant environmental effects of the implementation of plans or programmes in order to identify unforeseen adverse effects and undertake appropriate remedial action
- SEA obliges member states to ensure that environmental reports are of a sufficient quality.

The relationship between the two directives is explored further in an EC-commissioned report[5].

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Health risks from the sea

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Summer 2010 saw a number of reports that highlighted continuing dangers to holidaymakers and others from marine toxins. Increased tourism over the past years has produced increasing numbers of people at risk but public perception of the dangers of marine toxins is probably still low. Raising awareness of the potential health problems amongst holidaymakers and health professionals alike is therefore a priority. This article presents a short overview of common marine toxic hazards in and around the UK and continental Europe, grouped according to pathways by which people may become exposed.

Envenomation

Recent reports of weever fish poisonings around the UK[1] have provided a sharp reminder of dangers in the sea and along the shoreline, with over 30 cases of envenomation occurring in one week from *Echiichthys vipera*, or the Lesser Weever.

Weever fish live in warm shallow waters between Morocco, the Atlantic coast of France and Spain. During the warmer summer months they are found on shorelines of the south coast of England and Wales. It is difficult to know exactly how many cases of weever fish poisonings occur as many may go unreported.

Echiichthys vipera (Figure 1) is about 15 cm long and hides in sand leaving only its spikes exposed. The spines puncture skin (usually the foot) and venom enters the body causing excruciating pain. Complications such as gangrene of the wound have been reported but fatalities are rare. Treatment consists of immersing the affected area in the hottest water that can be tolerated (above 40°C), since the venom, a protein, is deactivated by elevated temperature. Pain is treated conventionally with analgesics. Swimmers and people walking along beaches can prevent stings by wearing protective footwear.

Figure 1: *Echiichthys vipera* – the lesser weever fish (© Hans Hillewaert / CC-BY-SA-3.0)

Also last summer, Spain suffered an invasion of the jellyfish *Pelagia noctiluca,* commonly known as the Mauve Stinger as a result of its characteristic colour (Figure 2). Less well known than the Portuguese Man of War (*Physalia physalis:* see Figure 3), the newcomers stung more than 700 bathers in one week off the Costa Blanca, with more than 300 victims reported in one day[2]. Although painful and distressing, the stings are rarely dangerous. Treatment consists of the removal of any remaining tissue from the jellyfish and the application of vinegar. In rare cases, antivenom and supportive medical treatment may be required.

Figure 2: *Pelagia noctiluca* – the mauve stinger jellyfish (© Hans Hillewaert / CC-BY-SA-3.0)

In addition to the invasion of mauve stingers there have been more than 300 reported cases of envenomation from the more dangerous Portuguese Man of War in Cantabria and the Basque country on the northern Spanish coast. Commonly believed to be a jellyfish, this organism is in fact a siphonophore (a form of life that lies on the boundary between a colony of small organisms and a complex multicellular single organism).

Envenomation from the Portuguese Man of War causes characteristic red welts on the skin which may last for several days. The accompanying pain usually subsides after an hour but spread of the venom to the lymph nodes may lead to an allergic reaction. Immediate treatment of the sting is to avoid any further contact and to remove any tissue from the creature that may still be attached. The affected area should be liberally washed with saltwater; freshwater worsens the situation. As with the weever fish, secondary application of hot water (at 43°C) will help the denaturation of the toxin. Application of vinegar is not helpful for Portuguese Man of War poisoning.

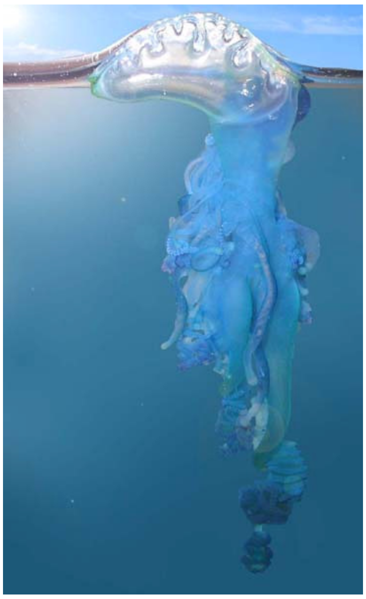

Figure 3: *Physalia physalis* – the Portuguese Man of War (source: Wikimedia Commons)

Poisoning from ingested marine toxins

Apart from direct contact with venomous marine life, holidaymakers and others may come into contact with marine toxins by ingestion. The pathways of poisoning in this way can be summarised as follows:

- toxicity caused by eating contaminated fish
- toxicity caused by eating contaminated shellfish
- toxicity from toxins in contaminated water.

It should be noted that the first two cases are examples of bioconcentration of toxins. The origins of the toxins are with microscopic organisms (dinoflagellates) which form part of the diet of the fish causing the intoxication.

Toxicity caused by eating contaminated fish

Scrombrotoxin poisoning

Scrombrotoxic poisoning is relatively common in the UK and is more likely to occur in warmer weather after eating fish that has been improperly stored and handled. Two outbreaks and two incidents of scrombrotoxic fish poisoning were reported to the HPA in July 2010. These were all associated with restaurants serving tuna and mackerel.

Failure to store fish in refrigeration leads to bacterial breakdown of histidine, an amino acid, with a resulting build up of histamine, as well as production of other substances which inhibit the break down of histamine. Following ingestion of spoiled fish, the reaction can be almost immediate with flushing, headache, nausea, dizziness, vomiting, diarrhoea, rash, respiratory distress and cardiac dysrhythmias.

The condition usually needs no treatment and signs and symptoms resolve in a few hours. Occasionally an antihistamine or adrenaline is needed. Prevention is based on ensuring that tuna, mackerel and other fish, including grouper, are properly refrigerated to prevent production of histamine. Cooking will not destroy the toxins.

Ciguatera fish poisoning

Ciguatera fish poisoning can produce serious cases of poisoning with long-term effects on the nervous system. Tropical reef fish eat *Gambierdiscus toxicus* dinoflagellates, which produce ciguatoxins. Toxins build up in larger fish (having become concentrated whilst moving up the food chain), most often barracuda. Ciguatoxin activates voltage-dependent sodium channels on the cell membrane following ingestion of contaminated fish. A wide range of signs and symptoms develop within a few minutes to a few hours, including diarrhoea, vomiting and abdominal cramps, parathaesia, headache, weakness (usually of the lower extremities), myalgia, pruritus, arthralgia, malaise, hypersalivation, blurred vision, dysphagia, tremor, ataxia, headache, toothache, metallic taste, chills, sweating, dysuria, dizziness and erythema.

Tetrodotoxin

This neurotoxin is a powerful research tool due to its ability to block sodium channels and therefore nerve impulse transmission. It is found in various species of puffer fish and, in cases of poisoning, tetrodotoxin is ingested via the consumption of improperly prepared puffer fish. Once in the body, it blocks the sodium channels in both motor and sensory neurons. Symptoms usually occur within two hours of ingestion and include a characteristic numbness and tingling around the mouth, nausea, vomiting, pain, speech difficulties, respiratory difficulty, paralysis and death from respiratory failure.

Toxicity caused by eating contaminated shellfish

Saxitoxin

Saxitoxin poisoning is also known as paralytic shellfish poisoning. A red-brown dinoflagellate produces a toxin that concentrates in shellfish in the Pacific region.

Saxitoxin, like tetrodotoxin, blocks sodium channels and thus nerve transmission. It is found in contaminated mussels, cockles, clams, scallops, crabs and lobsters. The toxin is again concentrated following ingestion of dinoflagellate organisms. Following ingestion of contaminated shellfish symptoms begin within 15 minutes to a few hours, starting with numbness and tingling of the face, arms and legs, followed by headache, dizziness and muscle incoordination. Rarely, respiratory failure and death can result unless advanced life support and ventilation is started.

Red tide/neurotoxic shellfish poisoning

Neurotoxic shellfish poisoning involves another toxin produced by dinoflagellates that builds up in oysters, clams and mussels. Symptoms begin within one to three hours following ingestion and include numbness and tingling around the mouth and limbs, diarrhoea and pain.

Toxicity from toxins in contaminated water

Apart from ingestion of toxin-contaminated fish and shellfish, toxins may also be transmitted to people through contaminated water. Aerosolised red tide toxin and brevetoxins are inhaled and cause irritation of the respiratory tract.

Another important class of toxins from contaminated water are the cyanobacteria (blue-green algae). Blooms may be blue, green or brown and usually float on the surface of the water. They can produce neurotoxins which affect the nervous system, hepatotoxins which affect the liver and toxins which promote tumour growth. Symptoms include fever, sore throat, dizziness, stomach cramps, diarrhoea and vomiting.

Conclusions

This short update on marine toxins has focused on the more common risks found in European waters. Health risks have been demonstrated in the UK from exposure to such toxins but the effects are rarely serious and usually require only first aid treatment. Food poisoning from ingested toxins remains a problem, particularly for travellers to more distant parts of the world.

The problems associated with scrombrotoxic fish poisoning in the UK have been highlighted. Prevention of effects is based on education and an awareness of the problems. Strict hygiene regulations to ensure food safety are already in place within the food processing and preparation industry.

In the UK, dangers from a number of toxins are increased during the warmer summer months; in more exotic locations they are constantly present. The general public and, in particular, holidaymakers both at home and abroad should be aware of the dangers and the benefits of taking simple measures such as wearing protective footwear while swimming and awareness of the potential problems with fish and shellfish.

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Natural Hazards and Climate Change

Impacts of climate change on vector-borne disease in the UK

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Introduction

It is frequently quoted that climate change will lead to an emergence of vector-borne disease. Many such statements are made in the context of a change in weather, or a changing trend in climate. Undoubtedly increased or decreased temperature and rainfall at certain times of the year will affect invertebrate vectors and the pathogens they might transmit. However, the changes occurring in the UK in the 21st century are due to more than just a change in the weather. Adaptation to climate change is now a regular discussion point in relation to how biodiversity will be able to cope with the changes in climate and weather events. For example, to facilitate this adaptation there are large plans for wetland restoration and expansion in rural areas, flood alleviation schemes in river valleys and urban areas, sustainable urban drainage programmes in new housing developments, green corridor initiatives in towns and cities and, through coastal realignment, the creation of salt-marsh and grazing marsh to mitigate the impacts of coastal erosion and storm surges. Allied to these adaptation strategies are biodiversity-enhancement initiatives supported by government and wildlife organisations – for example, grants for environmental stewardship on farms, grants for woodland management for biodiversity and schemes that aim to link fragments of existing biodiverse-rich habitat on a national scale. Wildlife populations and their distributions are already being beneficially affected as a result of these initiatives – for example, deer numbers are on the increase and their incursion into peri-urban areas is becoming more common.

All of these changes will create a different landscape in the UK and will benefit a range of wildlife species including invertebrates, and significantly from a public health perspective, both ticks and mosquitoes. Coupled to these environmental and climate changes is an increasing trend in humans for foreign travel, and increasing rates of global trade and transportation, some of which have combined to change the status of vector-borne disease in 21st century Europe[1].

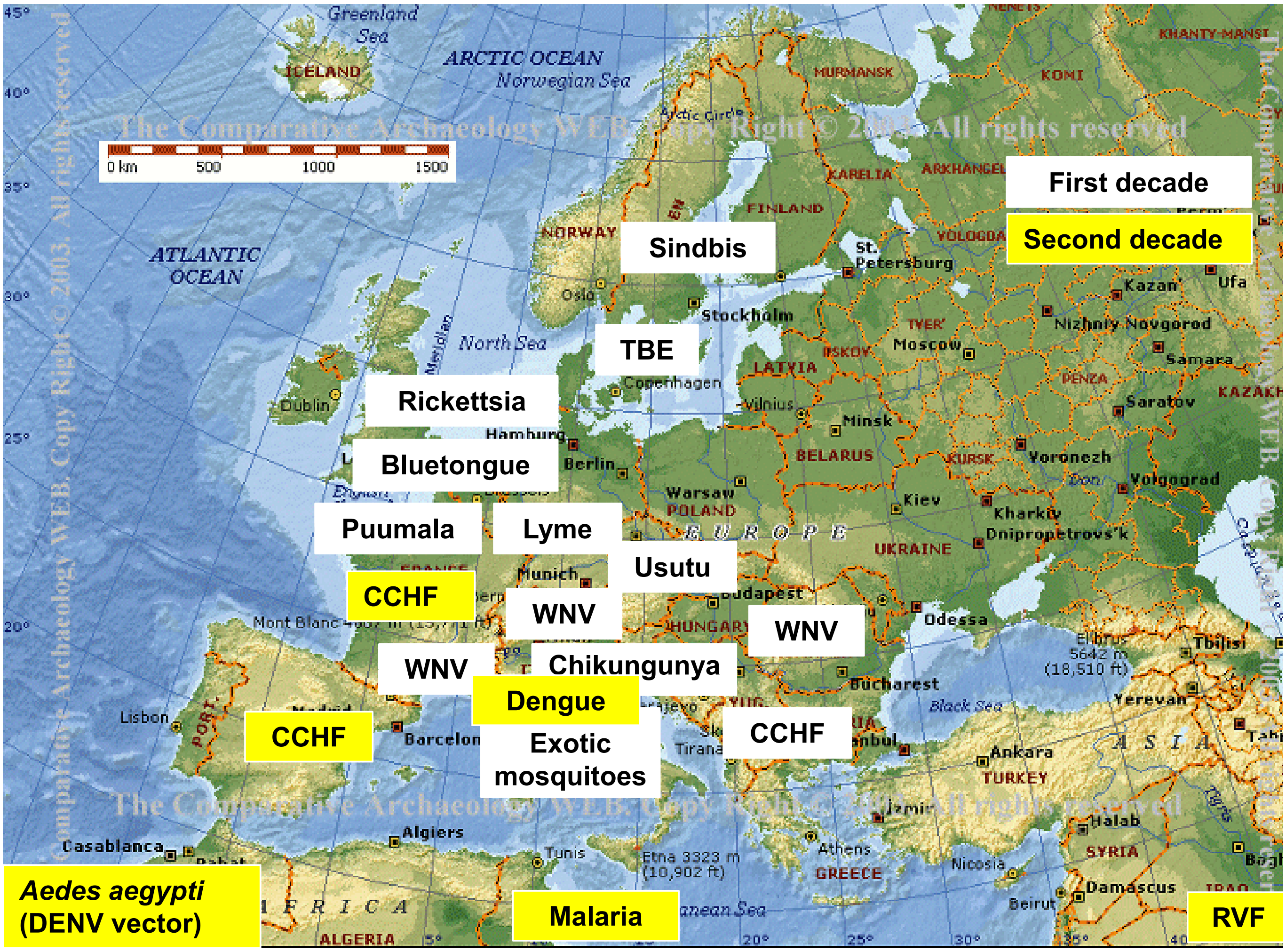

Figure 1: Vector-borne disease issues in Europe during the 21st century

Vector-borne disease in 21st century Europe

During the first decade of the 21st century, Europe has witnessed unexpected outbreaks of bluetongue virus (BTV) in northern countries, the continued spread and establishment of the exotic mosquito *Aedes albopictus* to most of the Mediterranean region (facilitated by the global trade in used tyres which act as carriers of mosquito eggs), and the emergence of Chikungunya virus (CHIKV) in Italy. Crimean-Congo haemorrhagic fever virus (CCHFV) and its *Hyalomma* tick vector have also emerged in parts of Turkey, and for the first time caused clinical disease in humans in both Turkey and Greece. New foci of tick-borne encephalitis virus (TBEV) have been reported further north in Scandinavia. Usutu virus (USUV) has emerged in Austria, Hungary and Spain and outbreaks of West Nile virus (WNV) continue to appear in France, Hungary and Romania; it has also emerged in Italy and Greece. One of our commonest vector-borne diseases, Lyme borreliosis, has also seen an increase in incidence rates between 2001 and 2005 in many European countries, with some rates increasing two- or three-fold. Similarly, the detection of pathogenic tick-borne *Rickettsia* is becoming more common, implicating a range of tick species in a number of new geographical areas including the UK.

The arrival and expansion of BTV, CHIKV and USUV raises questions as to which pathogens and/or vectors will next appear in Europe during the second decade. Will we see the movement of Rift Valley fever virus (RVFV) from Africa and the Arabian Peninsula? Will CCHFV expand to match the distribution of its vector? Will *Aedes aegypti,* the principal vector of dengue (DENV), spread from Madeira to mainland Portugal and beyond? Already in Europe during 2010 there have been autochthonous cases of dengue, which is transmitted by invasive exotic mosquitoes, and malaria. Will these diseases re-emerge in previously endemic zones in the Mediterranean basin? For example, large outbreaks of DENV occurred in Greece during the 1920s. The last few might seem fanciful, but given recent events we should not be complacent. If we learn any lesson from the past it is to expect, and prepare for, the unexpected.

UK perspective and Health Protection Agency activities

This article details some of the strategies and research currently being undertaken by the Medical Entomology and Zoonoses Ecology (MEZE) group (part of the Microbial Risk Assessment unit in the Emergency Response Division at Porton Down) in the Health Protection Agency (HPA) to assess, quantify and mitigate the impacts of climate change, both directly and indirectly through adaptation and environmental change, on arthropod vectors and vector-borne disease in the UK.

Direct effects of climate change on vectors, their pathogens and vertebrate hosts

Warmer drier summers, wetter milder winters, and longer 'growing seasons', as well as more frequent extreme weather events such as heatwaves and flooding, all have the potential to directly affect the occurrence of vector-borne disease. This will impact directly on the invertebrate vector in relation to its seasonality and abundance, on the pathogen and its development in the vector, and on the population dynamics and survival rates of vertebrate hosts for both the vector and pathogen. Often these effects act to compound each other, creating a seemingly complex transmission cycle. To understand the impact on vectors there is a requirement to understand which potential vector species are present in the UK and their current distributions, and then to gauge whether their range is expanding. The role of exotic species in vector-borne disease transmission in Europe necessitates an understanding of the pathways for these species to be imported into the UK and an assessment of their potential for establishment, and whether the public are becoming more exposed to vector biting.

Figure 2: Blood-feeding British mosquitoes

To address some of these issues, MEZE has been running a tick and mosquito surveillance scheme since 2005, and the results of the tick scheme have recently been published[2]. Data on tick and mosquito distribution and biting incidence is submitted to the schemes by the public, GPs, veterinarians, environmental health officers, wildlife charities and ecologists, as well as amateur naturalists via two designated websites (www.britishticks.org.uk and www.britishmosquitoes.org.uk). The HPA now has baseline data on potential vector species and already, through comparison with historical data (1880–2004), there is demonstrable evidence of expansion of some of these vectors, particularly the Lyme borreliosis vector, *Ixodes ricinus*. Submissions have also led to the discovery in the UK of non-native tick species, the expansion of geographically restricted species to new foci[3], and the discovery of new (previously overlooked) mosquito species[4], as well as the detection of previously unrecorded rickettsial pathogens in British ticks[5]. This data is also being used in supporting the Department of Health case to the European Union for the continuation of tick controls on pets travelling into the UK.

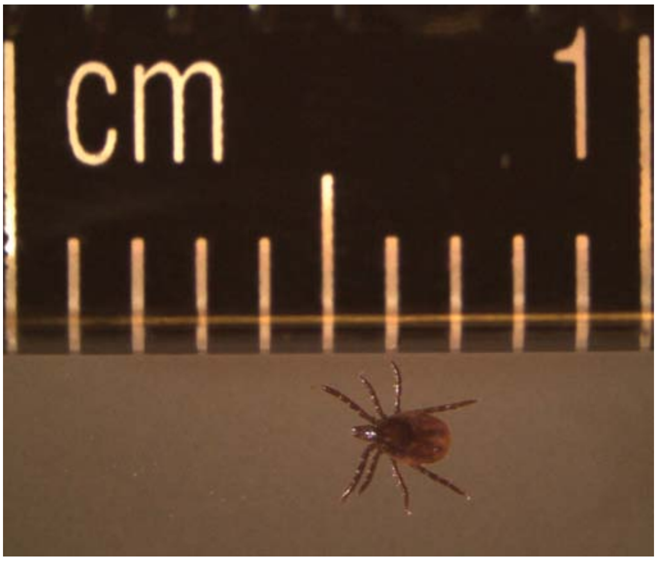

Figure 3: Nymphal stage of *Ixodes ricinus* tick – vector of Lyme disease

Table: Tick- and mosquito-associated diseases

Disease	Symptoms
Tick-associated diseases	
Lyme borreliosis	Most commonly a rash spreading from the site of a tick bite More serious problems include viral-like meningitis, facial palsy, other nerve damage or arthritis
Tick-borne encephalitis	Inflammation of the brain: symptoms may include fever, headache and seizures, and changes in mental state (lethargy, irritability and changes in personality or behaviour) European form consists of two phases: 1st includes fever and flu-like illness 2nd can involve central nervous system, eg meningitis, encephalitis or myelitis Long-lasting or permanent neuropsychiatric sequelae observed in 10–20% of affected patients Fatality rate of 1%
Crimean-Congo haemorrhagic fever	Begins abruptly, with fever, muscle aches, dizziness, neck pain and stiffness, backache, headache, sore eyes and photophobia. Nausea, vomiting and sore throat may also occur, with diarrhoea and abdominal pain Over the next few days the patient may experience mood swings, confusion and aggression, followed by sleepiness, depression and liver enlargement More severe symptoms may follow, including petechial rash, bruising and generalised bleeding of the gums and orifices. In severe cases patients develop failure of the liver, kidneys and lungs, and become drowsy and comatose after five days Approximately 30% of cases are fatal
Mosquito-associated diseases	
West Nile fever	Fever, headache, body aches, nausea and vomiting, and sometimes swollen lymph glands or a skin rash on the chest, stomach and back. Symptoms can last for as little as a few days, to several weeks In the USA, approximately 80% of those infected have no symptoms. Approximately one in 150 people will develop severe illness, including high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis, sometimes lasting several weeks. Neurological effects may be permanent
Chikungunya virus	Characteristically begins with a rapid onset of fever and joint pains, which may or may not be accompanied by muscle pain, conjunctivitis and rash
Malaria	Cyclical fevers, sweats and chills, muscle pains, headaches, cough and diarrhoea Complications can occur with life-threatening cerebral malaria associated with falciparum malaria

To ensure that we can detect the incursion of exotic vector species, MEZE is working with the Association of Port Health Authorities and Salford University to conduct surveillance for endemic and exotic mosquitoes at eleven UK seaports and airports, the importance of which is outlined in the WHO International Health Regulations. This work is supported by spatial risk mapping/modelling work to aid in our understanding of the potential for establishment and seasonal activity of *Aedes albopictus* in the UK[6] and continental Europe[7]. This work concludes that this particular exotic species, which has successfully travelled from Asia to Europe via North America, could establish in the current British climate, with adult activity occurring over four months. The importation of used tyres and wet-footed plants are the most likely routes by which such species could enter the UK as eggs. In line with similar activities in continental Europe, during 2010 MEZE commenced surveillance of imported tyres for exotic mosquitoes.

MEZE has also been working with the Chartered Institute of Environmental Health (CIEH) to assess the incidence of mosquito nuisance biting reported to local authorities (LAs) across the UK, a follow up to previous surveys conducted in 1985 and 1996. The HPA, in conjunction with CIEH, actively encourages environmental health officers to submit samples for identification, particularly as endemic species are often mis-identified and reported as exotic species. Results from a 2009 survey suggest that 26% of LAs have responded to nuisance mosquito issues in the last ten years, and 14% within the last year. This constitutes a three-fold increase in LAs reporting such issues compared to the 1996 survey.

Many pathogens, particularly parasites such as *Plasmodium* malaria and the dog-associated heartworm *Dirofilaria,* have an obligatory development phase within a vector, in this case the mosquito. The speed of this 'extrinisic incubation', which involves the parasite passing from the midgut bloodmeal through the thoracic muscles and into the salivary glands, is temperature dependent. Through analysis of daily weather data, MEZE has developed a degree-day model[8] that assesses the potential for development of *Dirofilaria,* an emerging zoonotic parasite potentially imported into the UK by travelling dogs. This can equally be applied to malaria.

Changes in seasonal weather also impact on the seasonal activity of different tick stages. In relation to tick-borne encephalitis virus (TBEV), coincident feeding of larvae and nymphs on small mammals is crucial in facilitating transmission of the virus sub-dermally, whereby ticks that feed in close proximity infect each other. Currently the UK is free of TBEV, but the virus is emerging in new foci in Scandinavia in response to changing seasonal climate. Current MEZE field activities are assessing the weekly infestations of small mammals with different tick stages to determine whether a similar scenario could occur in the UK in response to changing climate, and this data is enabling the validation of climate-based models of TBEV transmission.

Small mammals are also important in sustaining transmission cycles of hantavirus in northwest Europe. Recent studies, including those by MEZE[9], have highlighted the importance of the impact of sequential weather on the production of beech and oak nuts. Using weather data, peak nut years (mast years) can be predicted as well as the consequent peak in mammals and increased number of human hantavirus cases.

Indirect effects of climate change on ticks and mosquitoes: adaptation for biodiversity

Ecologists are already reporting changes in the distribution and abundance of various wildlife species in the UK and attributing these to a change in climate. There are concerns now that owing to the fragmentation of habitats in the UK during the last century, the possibility for natural dispersal and migration of some of the rarer, or more ecologically defined, species, is limited and that many species will not be able to adjust to climate change, leaving only remnant populations surviving in isolated ark communities. In coastal areas, the prospects of sea-level rise, storm surges and ageing sea defences are posing challenges to protected coastal habitat. To ensure that wildlife species can adapt, a raft of strategies have been initiated in recent years which include identifying sites for the creation of new wetlands (Wetland vision project), through expansion of existing wetlands onto neighbouring arable farmland (eg Great Fen project, Wicken Fen vision), restoration of old wetlands and the creation of salt-marshes and coastal realignment projects to soften the impact of saltwater incursions.

Landscape scale ecological networks (eg A Living Landscape, environmental stewardship) are also promoting enhanced management of existing habitats and connectivity between these habitats to ensure that we 'restore, re-create and re-connect'. These strategies also extend into urban areas through development of urban green space/ corridors and sustainable urban drainage. There is no doubt that all these initiatives should be supported as their value for wildlife is without question. In addition, they assist in improving the well-being of local communities, thus contributing to public health. However, it is possible these initiatives could contribute to an increase of available habitat for ticks and mosquitoes, after all they too are wildlife. In the case of ticks, deer (the principal host of *Ixodes ricinus*) numbers are increasing and deer are now more frequently associated with peri-urban areas. This may explain the increase in garden-tick problems reported to the HPA. In addition to these 'landscape design' strategies are natural events such as flooding, and there has already been an increase in reports to NHS Direct on mosquito biting.

Mosquitoes and wetland expansion

MEZE is working closely with Defra, the Wildlife Trusts, Natural England, the Environment Agency, the Food and Environment Research Agency and local land managers to begin to understand the impacts of these wetland management schemes on ticks and mosquitoes and begin to develop environmentally sensitive vector mitigation strategies. In relation to wetlands, MEZE has recently contributed to a report to Defra on wetlands and disease, which includes a specific discussion on mosquitoes[10]. Coupled to this is an intensive field-based research project at the Great Fen in Cambridgeshire. Working with the Wildlife Trust and Natural England, MEZE has been assessing the impact of wetland management on a range of British mosquito species and the colonisation of neighbouring arable land by mosquitoes as these are flooded[11]. This is enabling evidence-based assessment of the risks of wetland expansion on mosquito abundance, which is being used to inform and update ongoing HPA public health risk assessments on disease risk[12,13].

Figure 4: Surveying for mosquito larvae in recently flooded farmland in the Cambridgeshire fens

Ticks and habitat connectivity

Strategies such as de-fragmentation of habitats (ie improved connectivity), woodland ride (path-side vegetation) management for biodiversity, and urban green corridors act to increase the ecotonal habitat (ie habitat interface, favoured by tick hosts) and peri-urban wildlife, facilitating an increased abundance and spread of deer. This may also lead to an increase in abundance and distribution of ticks and an increased exposure to humans of ticks in peri-urban areas – for example, gardens. Whatever the driving forces, the expansion of *Ixodes ricinus* ticks in the UK is now well established[2] and MEZE has been working to translate some of the national tick data into landscape[14] and habitat-scale[15] maps through the identification of ecological and environmental factors that determine tick hotspots.

The occurrence of *I. ricinus* across landscapes and within woodlands is determined by vertebrate host availability and microclimate; the latter being influenced by vegetation structure and soil/bedrock permeability, as well as by various topographical features that impact environmental exposure. These field-validated findings are now being used to provide evidence-based guidance to the public in reducing their exposure to ticks and guidance to land managers in ensuring that tick hotspots can be mitigated using existing woodland/habitat management strategies across a range of rural and peri-urban habitats. Other tick-related studies include an investigation of the role of field margins (ie agri-environment schemes) as new habitats for supporting ticks, the development of mathematical models to understand wildlife cycles of *Borrelia burgdoferi* (Lyme borreliosis) and, in collaboration with bird observatories and quarantine kennels, the potential for exotic ticks to be imported and become established in the UK.

Conclusion

In conclusion, the status of vector-borne disease has changed dramatically in Europe during the last ten years. Climate change can be implicated for only part of this change, but the impacts of climate change on arthropod vectors, in a UK context, should be considered more broadly than just a change in temperature and rainfall. In light of the strategies to adapt to climate change, including changes in land management, there exist possible future conflicts between biodiversity-enhancing strategies and vector-borne disease that require an evidence-based approach. It is fair to conclude that our adaptation strategies to climate change may impact on vectors and associated pathogens more significantly than changes in weather and climate alone. This illustrates the importance for close working between the HPA and its sister agencies in the environmental and veterinary sectors.

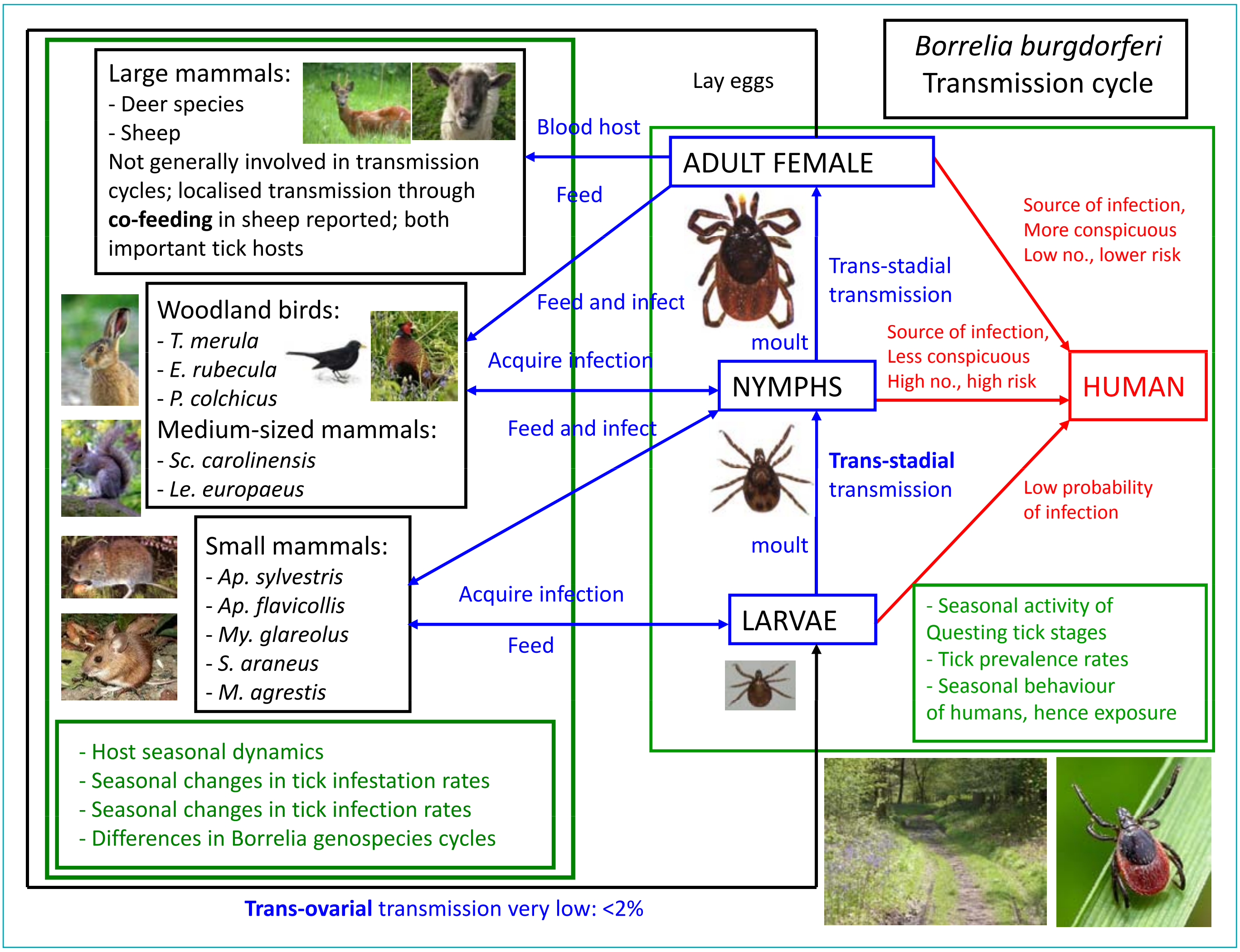

Figure 5: Transmission cycle of Lyme borreliosis, illustrating the complexity of tick–animal-host *Borrelia* interactions

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Emergency public health response to water shortage following floods in Europe: implications for policy

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Introduction

The Pitt Review (independent inquiry into the 2007 UK flooding emergency) defines a flood as a "temporary covering by water of land not normally covered with water" (p458)[1]. Floods, although not preventable, are manageable environmental disasters affecting 50 million people a year worldwide[2]. Their frequency and severity are set to increase due to intensified precipitation, global climate change[3,4] and anthropogenic landscape changes such as deforestation, soil erosion, building on floodplains and increased paved surfaces[5,6].

The infrastructure, utility systems, type of flood, governmental structures, socioeconomic make-up, population displacement and underlying endemic diseases all contribute to the public health consequences of a flood[1,7]. As a result, countries will have different capacities to respond.

Water shortage

Flooding can cause shortages in the availability of consumable water for a number of reasons:

- flooding of electricity substations can result in power failure to water treatment works (WTW) rendering them incapable of providing a piped and treated supply[1,8]
- direct flooding of WTW will interrupt supplies
- failure of transport networks secondary to electricity cuts prevents people accessing water supplies[1,9]
- agricultural/toxic waste site runoff, storm water overflow and damage to sewerage works can contaminate existing supplies[2,4,10–12]
- inundation of underground aquifers with saltwater can lead to contamination following coastal flooding[12].

Although water shortages do not occur in every flooding disaster, over recent years a number of developed countries have experienced shortages during or after flooding[12–14]. These include Gloucestershire (UK, 2007) when flooding of the Mythe WTW cut off the public distribution system to 350,000 people for two weeks, resulting in the biggest deployment of equipment in the UK since World War II to deliver the necessary volume of alternative supplies to the public[8,13,15]. In Hungary (2006), when an underground aquifer flooded, contamination of supplies affected 174,000 people and reports of gastrointestinal illness were the highest they had been in over 50 years[14]. After Hurricane Katrina (2005), 26% of households in New Orleans relied upon emergency water because electricity cuts and infrastructure damage had severely affected supplies[16–18].

Public health issues

Water shortages can lead to increased risk of dehydration, infectious disease and disrupted psychological well-being[19–21]:

- dehydration – 1–2% loss of body weight in water can result in hypertonic dehydration[22]
- infectious disease – the WHO states that "ensuring uninterrupted provision of safe drinking water is the most important preventive measure to be implemented following flooding, in order to reduce the risk of outbreaks of water-borne diseases"[19]. Although large outbreaks following European floods are rare[23], Ahern et al (2005) report in their critical literature review that some industrialised countries have shown increases in diarrhoeal disease among flooded populations[24]
- psychological well-being – water shortages have been documented to cause panic, despair, feelings of exposure, distress and helplessness among affected populations[1,13,20,21].

Aim

The aim of this paper is to explore the public health responses to emergency water provision during or immediately after floods in Europe and make recommendations for future responses.

Method

A literature review was used in conjunction with the results from eight semi-structured interviews. Ethical approval was gained from the LSHTM ethical board prior to initiation of the project.

Bibliographic databases including Medline, Embase, Global Health and the Cochrane Collaboration were searched using a keyword matrix developed from the research question. The keyword matrix included the synonyms of key terms – 'flood', 'public health' and 'water shortage'. Limits were set to 'English' and '2005 – current'. Grey literature was retrieved from searching the websites of key organisations such as the Environment Agency, World Health Organization (WHO) (Regional Office for Europe) and the Health Protection Agency.

A purposive sample of eight interviewees was undertaken, including two WHO country representatives working in the field of emergency public health and six experts in the fields of public health and water engineering. Two semi-structured interview guides were constructed as the project sought to gain the views from the two different sources (historical experience and expert advice).

Both interview guides followed the themes identified from the literature review to achieve consistency and help a synchronised set of recommendations to evolve.

Semi-structured questions allowed the participants to give unrestricted information in their own words. It was felt that this had the advantage of evoking discussion of challenges not considered by the researcher or identified from the literature review.

Transcriptions were interpreted using framework analysis based on the themes identified.

Results

The following themes emerged from both the literature review and at interview:

- quantity and quality
- alternative supplies
- vulnerable groups
- communication
- emergency response.

Each theme will be discussed in turn prior to making recommendations on these concepts.

Quantity and quality

The Sphere Project, which produces internationally recognised guidelines on the minimum standards in disaster response, recommends a quantity of water of 15–20 litres per person per day (hospitals = 40–60 litres per inpatient per day) for the immediate emergency phase, with adequate provision of supplies so people do not have to wait longer than 15 minutes for collection[25].

Interviewees reflected this target stating that consumer feedback following the water shortage in the UK (after the Gloucestershire floods of 2007) had resulted in the increase of the previously set 10 litres per person per day to 20 litres.

The duration of the shortage was also taken into account, with an acknowledgement that after a period of time without water, people would require more to maintain personal hygiene and general activities of daily living.

According to the Sphere Project, the quality of alternative supplies should be "palatable, and of sufficient quality to be drunk and used for personal and domestic hygiene without causing significant risk to health"(p66)[26].

Alternative supplies

Alternative methods to supply water can be by tankers or bottles or by advising on home treatment of water through boiling or chlorination.

Tankers

Many of the interviewees felt that although tankers were the best method for providing large quantities of water to the public, there were also problems associated with their delivery. Respondents reported problems such as access of large vehicles along small roads, vandalism of tankers, confusion on collection point location, delayed initiation, dislike of water from tankers, tankers being found empty, and secondary public health problems such as road traffic accidents and pollution.

Bottles

Interviews revealed that distribution of large quantities of bottled water has created issues with storage, plastic waste and crowd control in the past. Other issues include the sodium content of the bottled water as this may differ from the piped supply and therefore pose a risk to babies fed on formula feed. Interviews also revealed the maximum sodium content to be 200 mg per litre for babies on formula feed.

Boiling water

Boiling water should only be promoted if the public health authority deems the risk from consuming untreated water to be greater than the secondary risks of burns posed by boiling[18]. Case studies showed that more emphasis on why water should be boiled should be made available to the public[18].

Chlorination

Although not recommended by water authorities in every country, studies have shown that the public should be made aware of how to do this safely and correctly in the event that delivery by alternative supply routes, such as tankers and bottles, is not possible[18].

Vulnerable groups

Although not exhaustive, Table 1 shows those who should be prioritised in the emergency phase to receive water supplies.

Table 1: Vulnerable groups[18,27,28]

Closed communities	Individuals
Schools	Physically disabled
Prisons	Psychiatrically unwell
Nursing homes	Dialysis dependent
Hospitals	Lone parents
Caravan parks	Homeless
Hostels and shelters	Non-native speakers
Nurseries	Bottle-fed babies
Transient populations	Elderly
Deprived communities	Immunocompromised
	Cystic fibrosis patients
	Sick infants

With regard to updating vulnerability lists, the majority of interviewees recommended that many sources are used rather than one central body. They also highlighted the importance of promoting social cohesion within communities and encouraging people to help their neighbours and those who cannot access supplies as readily.

Communication

As UK Water states, "communication is the cornerstone of maintaining public health during a flooding event both to advise consumers what they can ... and cannot drink and where to find potable water" (p20)[13].

Transparent, direct, honest and ongoing communication should be achieved through the greatest number of possible routes whilst avoiding overloading people with too much information. A pre-defined communication plan to facilitate this is suggested as an essential component within an emergency plan[15]. UK Water and Severn Trent Water advise that communication should be accurate, consistent and up-to-date, and take into account disrupted communication channels, increased website and call centre needs, vulnerable consumers and potential lack of electricity[13,27].

Accounts of cases exist where information arrived too late, was of poor quality, questionable accuracy or conflicted between agencies, which led to confusion and anger amongst the public[15,28]. The most important point regarding communication that was discussed during the interviews was this concept of consistency and not distributing conflicting advice.

Regular contact with the community is essential to give reassurance that alternative supplies will be provided, prevent false rumours of disease outbreaks spreading and keep people updated on when it is safe to return to their piped supply[29,30]. It will also help to avoid panic buying and hoarding of bottled supplies as has happened in the past as a result of inadequate community communication[13].

Interviewees highlighted the importance of simplifying advice into a range of languages with easy-to-understand images to enhance accessibility. Two respondents spoke about the positive benefits of delivering health information in person by having representatives at water distribution points.

Potential routes of communication between water companies, public health authorities and the public have been summarised in Table 2.

Table 2: Communication methods[1,13,15,27]

Electricity dependent	Electricity independent
Television news bulletins	Loudspeakers
Radio – regional/national	Word of mouth
Call centres – 24 hour	Notices in street
Websites	Posters in public houses, health centres, shops, restaurants
Internet blogs and forums	Newspapers
Television storylines	Door to door leaflets
Teletext	Letters
Texting services	Notices on tankers

Emergency response

As C Jackson, the Deputy Chief Inspector of the UK Drinking Water Inspectorate declared, "we can never predict the unpredictable but, with good planning and preparation, something approaching perfection may be achieved by way of a response" (p38)[31].

Criticism has been made of uncoordinated responses to water shortages in the past, with the public believing no emergency plan existed[15].

Other findings

Sub-themes emerging from the interviews covered areas such as coordinating different agencies (including the voluntary sector) and involving the army and local supermarkets to organise distribution of resources. Also discussed was the concept of having pre-defined plans in place that were available to the public to view and emergency planning that took into account extreme scenarios. Two other important concepts to arise were that of organising a mutual aid scheme whereby local authorities could share emergency water delivery equipment and that of ensuring each agency involved in the emergency had a good understanding of the roles and responsibilities of the other acting agencies.

A final important point highlighted by one interviewee was that during a flooding emergency, the emergency plan should be able to be initiated remotely. If roads and buildings are cut off from floodwater, this should not delay the ability of the authorities to commence the chain of command.

Limitations

The small sample interviewed due to time constraints limits the potential for generalising these results. English language restrictions on the part of the researcher further limited those who could be interviewed and the literature that could be incorporated into the project. Owing to the lack of epidemiological studies found, the project relied heavily upon grey literature which is not peer reviewed and is based on the opinion and experience of individual organisations. However, local guidance, international resources and institutional reports are an extremely important tool within policy making and, despite their inherent weaknesses within evidence-based public health, they are seen as an essential component of this project.

Discussion

The results described here cover case studies and lessons identified from flooding events in Europe and North America and the opinions of some experts in the field. The following general recommendations have been made by the author as a result of this research; however, it is acknowledged that some countries already have comprehensive emergency flood plans which may include some or all of these elements.

1. Increasing the Sphere Project recommendation of 15–20 litres per person per day to 20 litres per person per day after five days of water shortage.

2. Alternative water provisions should be made through a combination of tankers and bottles:
   - tankers (where possible) should be supervised to avoid vandalism, monitor filling and deliver person-to-person advice
   - mutual aid schemes to share equipment between areas
   - army involvement to support mobilisation and secure delivery
   - maximum 200 mg per litre of sodium content in bottled water – tanker water is advised for use in baby formula feed but where this is not available bottled water is better than none at all.

3. Communication should be diverse in delivery but consistent in content:
   - easy to access and understand, incorporating a range of languages
   - pre-prepared and ready to be disseminated immediately
   - one designated agency should lead on advice delivery where possible
   - advice should incorporate the health-related reasons explaining why consumers are being asked to perform techniques such as boiling
   - the volume of advice being delivered should be controlled to avoid overloading the public with too many health messages simultaneously.

4. Involvement of the voluntary sector is advised in the planning stages and should be well coordinated in the event.

5. Emergency planning should aim to include water delivery:
   - documentation of agency roles and responsibilities within planning and ensuring all organisations understand
   - involvement of the community, supermarkets and water companies in emergency planning

- allowing communities to view plans will strengthen relationships, building trust
- training and practice exercises in water delivery are recommended
- responses should be able to be activated remotely.

6 The empirical base of public health research into emergency water provision needs to be strengthened in order to confidently formulate effective future policy decisions.

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HPA Project Updates

Alerting System for Chemical Threats, Phase II – update

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5 European Association of Poisons Centres and Clinical Toxicologists (EAPCCT)

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Introduction

To date there has been no formal protocol or mechanism to enable European Union member states to share information about chemical incidents or emerging chemical health threats throughout Europe, but instead reliance has been upon informal information networks such as the European Association of Poisons Centres and Clinical Toxicologists (EAPCCT)[1]. Yet poison centres have a leading role in detecting new threats[2] and protecting the health of the population[3].

The Heath Protection Agency (HPA) coordinates the Alerting System for Chemical Health Threats (European Commission project number 2007210, ASHTII) a project partly funded (60%) by the Executive Agency for Health and Consumers (EAHC)[4]. The aim of this project is to improve the speed and effectiveness of the public health response to toxic exposures following deliberate release or accidental chemical incidents, and improve information transfer by developing the Rapid Alert System for Chemical Health Threats (RAS-CHEM). RAS-CHEM will provide a mechanism to facilitate the rapid communication of information concerning chemical health threats, ranging from reports on unusual cases to potential mass poisoning incidents. Furthermore, RAS-CHEM will include toxicological profiles for toxic chemicals identified as potential agents and threats for mass intoxications[5]. RAS-CHEM is a web-based application that will be housed in the Health Emergency Operations Facility (HEOF), alongside other Rapid Alerting Systems such

Photo: ASHTII Workshop, Göttingen, Germany, October 2009
Left rear: Al Bronstein, Stacey Wyke, Hugo Kupferschmidt, Herbert Desel, Kevin Manley, Gabija Dragelyte, Nick Edwards
Left front: Rob Orford, Raquel Duarte-Davidson, Alison Good, Daniela Pelclova, Monique Mathieu-Nolf, Andreas Schaper

as the Early Warning and Response System for communicable diseases (EWRS)[6], RASFF for food and feed[7], RAPEX for non-food consumer items[8] and the Rapid Alerting System for CBRN health threats (RAS-BICHAT)[9].

The ASHTII project has built on previous work (Alerting System and Health Surveillance System project, ASHTI), which demonstrated that poison centres are a feasible resource to detect sentinel events. ASHTI also outlined the initial concepts required to establish RAS-CHEM[10].

As part of the ASHTII project, RAS-CHEM has been further developed and extended to allow different levels of access to the alerting system by the creation of the *risk assessment* platform (formerly termed the EUPC Forum, EU Poisons Centres Forum) that will enable service providers (ie European Poisons Centres) to communicate with each other directly for issues concerning the risk assessment of an exposure or poisoning event (ie symptoms, exposure route, and chemical agent either suspected or confirmed to be involved). If the incident or event reported to the risk assessment platform fulfils the criteria to classify it as a chemical threat of public health concern then the alert will be escalated to the *risk management* tier of RAS-CHEM. System users of the risk management tier of RAS-CHEM include national public health authorities and officials (eg the Department of Health in the UK or the Health and Emergency Situation Centre in Lithuania), ministers and RAS-BICHAT representatives (Rapid Alert System for Biological and Chemical Alert Threats)[5]. Standard operating procedures for competent authorities to report events to RAS-CHEM are being developed by the European Commission.

Figure 1: Emergency responders on the scene of a chemical incident exercise

Achievements to date

- EU-wide testing of RAS-CHEM (v2.0.1) by invited representatives from EU member states and elsewhere was completed in 2010 (February–July 2010), led by the EC and the ASHTII working group. Countries that participated in the testing and fed back into the iterative design of RAS-CHEM (v2.2.0) included Austria, Belgium, France, Germany, Hungary, Ireland, Italy, Latvia, Norway, Slovakia, Sweden, Switzerland, the UK and the USA.
- RAS-CHEM is now operational and further testing continued until March 2011. Final revisions and amendments (if required) will be made before the system is implemented in autumn 2011.
- RAS-CHEM will be housed in the Health Emergency Operations Facility (HEOF), alongside other Rapid Alert Systems such as the Early Warning and Response System for communicable diseases (EWRS)[6] and the Rapid Alerting System for CBRN health threats (RAS-BICHAT)[9].
- The ASHTII working group reviewed all clinical effects reported in the literature following exposure to over 100 highly toxic chemicals, and after an evaluation of available standardised clinical effect reference terminology systems, worked with the 'Medical Dictionary for Regulatory Activities' (MedDRA) to update symptoms and features of poisoning[11]. ASHTII recommended revisions have been incorporated into the latest version of MedDRA (v13.1), which is available to view online at http://www.meddramsso.com
- The ASHTII working group has recommended that MedDRA is incorporated into RAS-CHEM. This will ensure that RAS-CHEM can operate with existing terminology and classification systems across Europe.
- The ASHTII working group has developed a number of model cases, for exposures to toxic chemicals, based on chemical agent clinical effect profiles included within RAS-CHEM.
- There will be a series of EU-wide chemical exercises during 2011, which will partly test the functionality and application of RAS-CHEM in a simulated public health threat.

ASHTII at the EAPCCT Congress, Dubrovnik 2011

During the forthcoming International Congress of the European Association of Poisons Centres and Clinical Toxicologists (Dubrovnik, 24–27 May 2011)* there will be a session in the main congress themed 'The public health role of poisons centres'. Within this session there will be a subtopic on the ASHTII project. The aims of this session are to:

- update delegates on the role of RAS-CHEM in detecting chemical health threats
- provide information on the clinical effect profiles incorporated in the system
- inform delegates on the use of MedDRA as a standardised clinical effect reference terminology system to describe symptoms of poisoning.

Following this session there will be a satellite symposium on ASHTII activities and the implementation of RAS-CHEM. The aims of the satellite symposium are to:

- update invited EU national public health officials and European Poisons Centres on the overall function and purpose of RAS-CHEM, including an overview of the reporting process

* The XXXI International Congress of the European Association of Poisons Centres and Clinical Toxicologists will be held at Valamar Lacroma Resort, Conference and Spa, Dubrovnik, Croatia from 24–27 May 2011. For further details of the Congress see the EAPCCT website, www.eapcct.org

- demonstrate how the system can be used to report suspected chemical incidents (including incidents of unknown cause) in the perspective of a shared approach to the response coordination
- discuss how a European case database could be developed using lessons learned from past experiences.

The ASHTII project runs from October 2008 to September 2011 and is partly funded by the European Commission (grant agreement number 2007210) for which we are very grateful. If you would like further information about the project or would like to become a collaborating partner please contact asht@hpa.org.uk or visit www.hpa.org.uk/ASHTII

ASHTII Project Partners

Associate partners

European Association of Poisons Centres and Clinical Toxicologists (EAPCCT)

Giz-Nord Poisons Centre, University Medical Centre Göttingen (UMG), Göttingen, Germany

Guy's and St Thomas's Medical Toxicology Unit (GSTFT), UK

Centre Hospitalier Universtaire de Lille (CHRU de Lille), France

Health Emergency Situations Centre (HESC), Vilnius, Lithuania

General Faculty Hospital, Prague, Czech Republic

Subcontractor

National Poisons Information Service, UK

Collaborating partners

World Health Organization Switzerland

World Health Organization Europe

Health Emergency Situation Centre, Lithuania

Ministry of Health, Czech Republic

National Poisons Information Centre (Nordic countries), Norway

Centro de Informacao Antivenos, Portugal

National Centre for Epidemiology, Surveillance and Health Promotion, Italy

BICHAT representative, Germany

BICHAT representative, France

National Institute of Health, Rome, Italy

American Association of Poison Control Centers (AAPCC), USA

National Poisons Information Centre, Ireland

Figure 2: HPA staff providing public health advice during a chemical incident

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'Opportunity Knocks': communicating sustainability within the Health Protection Agency

Steve Owens
Sustainable Development, Health Protection Agency

The communication of sustainable development and its various elements is vital if members of staff are to feel part of any organisation's sustainability agenda. To help enable this, a sustainability quiz was held during the Health Protection Agency's (HPA) annual conference last year. This quiz was intended to help promote environmental sustainability by questioning staff about the impact of their everyday work activities using an informal approach where the audience would be the main players in the exercise, actively encouraging them using a game play approach.

Using the name of the 1970s TV show 'Opportunity Knocks', quiz master Steve Owens, who is the Head of Sustainable Development at the HPA, posed questions on the theme of sustainability, via a PowerPoint presentation, to an invited audience. After a particular question was posed a number of possible answers to the question were offered to the audience to vote upon; this was done by asking the audience to put their hands up when they believed they had the right answer. The correct answer was then given along with an explanation as to why it was correct. This informal approach let the members of the audience indulge themselves in the quiz format without any pressure being put on them if they lacked confidence in their answer, whilst at the same time being encouraged to participate by the host so that they could feel this learning experience was socially inclusive.

The theme to the first part of the quiz was travel, where the host asked the audience how they had travelled to the conference – had they travelled alone by car, or taken the train, bus, etc. Understanding what method of transport staff and their guests had used to travel to the conference would be interesting for future events. A study was undertaken to calculate how many business kilometres were travelled in 2007/08 by HPA members of staff; a staggering figure of 300 million kilometres was found to have been undertaken. Clearly this figure is extremely large; however, it has started to decline in the last few years as the HPA works towards its objective of a 10% reduction; for example, by using more tele- and video-conferencing.

Continuing on the travel theme, an interesting question was posed regarding which country produced the most environmentally friendly flowers for British shoppers looking for Valentine's Day gifts – Kenya, the Netherlands or Ireland. Surprisingly, to some of the audience, Kenya's rose-growing carbon footprint is less than that of the Netherlands; Ireland was included as a rouse. The energy used to warm up the acres of greenhouses in the Netherlands to produce the roses for Valentine's Day in the UK far outweighs the natural growing temperatures of Kenya and, even when the transportation of the flowers to the UK is taken into account, the carbon footprint for Kenya is still lower[1].

The next few questions looked at energy usage in the home, though in some cases the lessons to be learned could be transferred into the workplace. One particular question asked how many degrees would a thermostat need to be turned down to achieve a 10% reduction in the annual energy bill. The answers ranged from 1 degree, 3 degrees to 5 degrees. The answer is 1 degree, which according to the Energy Saving Trust would save the average household £55 annually. This message is being communicated across the HPA by the various facilities management teams to help reduce the organisation's large energy bill.

The final question was driven by the current affairs being discussed at the time. The question asked what 'old favourite' was finally being phased out of our shops; the answers being a 100 watt incandescent light bulb, a 100 watt toothbrush or a 100 watt microwave oven. The answer was the incandescent lamp. According to the government, phasing out these lamps will save up to a million tonnes of carbon dioxide annually by 2020[2].

The audience feedback for the quiz was very positive and it was an event that I enjoyed hosting, as it gave me an opportunity to engage members of staff and their guests in the sustainability agenda, be it only for a short period of time. I hope it left them wanting to know more about the issues that face us all and to get involved at a local level, encouraging more people to strive for a sustainable future.

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Conferences and Workshops

Climate Change and Health Protection: Looking Forward October 2010, London – a Health Protection Agency workshop

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Centre for Radiation, Chemical and Environmental Hazards, Health Protection Agency

Background

Building on sessions on climate change and health protection for the Health Protection Agency (HPA) Board, Royal College of Physicians and Royal Society of Medicine, a one-day workshop, funded by the HPA Global Health Fund, was held in the Institute of Materials, Minerals and Mining in London on 4 October 2010. The day consisted of a number of invited talks, question and answer sessions, and related discussions. The delegates were then divided into workshop groups in order to discuss and report back on specific topics relating to the HPA work on climate change. There were around 60 delegates, including HPA staff and representatives from external organisations. The aim of the day was to examine research and response issues relating to climate change and health protection, and to explore how to maximise future activities within the HPA and with key collaborators. The workshop is in recognition of the importance the HPA is placing on climate change and health protection.

Objectives

- to review current HPA research and related activities on climate change and health protection and look at future key areas
- to promote research collaboration on climate change and health protection between HPA staff, academics and other organisations
- to inform specific plans for action/response that relate to climate change, eg heatwave plan, flooding plan or drought plan.

Presentations

There were nine invited presentations (see the table), grouped into sets of three, with time for questions and discussion after each set. An introduction was given by Professor Anthony Kessel, focusing on the ethical and historical backdrop to environmental degradation and climate change, and sessions were chaired by Dr David Heymann and Mary Morrey. The presentations began with an overview talk by Professor Sir Andy Haines entitled 'Climate change and health – reducing risks in an uncertain future'. This overview considered climate change impacts around the world and the vulnerability of different populations. Adaptation and the potential co-benefits of climate change mitigation in terms of health and the reduction of greenhouse gases were also addressed.

Speakers from the HPA then covered topics which related to scientific research such as air pollution, vector-borne disease and climate change risk assessment for the UK, through to emergency response such as the heatwave plan and extreme events. The Department of Health was represented by Dr Louise Newport who talked about the Department's response to climate change. The breadth of experience of the audience and speakers ensured there was lively and informed discussion after each session.

Workshop groups

Following the invited talks, delegates split into four separate groups in order to discuss a different topic of relevance to the HPA work on climate change. The topics for discussion by the workshop groups were as follows.

Table: Presentations for the workshop: Climate Change and Health Protection: Looking Forward

Professor Sir Andy Haines London School of Hygiene and Tropical Medicine	Climate change and health – reducing risks in an uncertain future
Dr Sotiris Vardoulakis HPA	Scoping the climate change risks to future health for the UK
Dr Robert Maynard HPA	Air pollution and climate change
Jolyon Medlock HPA	Impacts on health of changes to vector-borne diseases
Dr Steve Leach HPA	Models of vector distribution
Professor Virginia Murray HPA	Extreme events
Dr Graham Bickler HPA	Heatwave plan – What is it? How has HPA helped develop it?
Dr John Simpson HPA	Emergency preparedness and response
Dr Louise Newport Department of Health	Department of Health response to climate change

1. **Developing an approach to extreme events**

   How should the HPA develop its approach to extreme events and the implications for public health?

2. **Identifying common areas for collaborative working**

   Are there any possible common areas of opportunities to further knowledge/collaborate on climate change and public health across HPA departments?

3. **Identifying subject areas or topics for research**

   What are the important subject areas or topics for research which relate to climate change and public health?

4. **Identifying existing cross-organisational topics and resources**

   Are there existing cross-organisational health protection topics and resources related to climate change and public health, eg surveillance, information, data, software or staff?

Each workshop group assigned a 'rapporteur' to record the discussion and feed back to all delegates at the end of the day. The workshops resulted in a broad range of ideas and information across the four topics. Some key observations included the importance of sharing and collaborating on existing sources of data, and the potential savings by using collaborative methods and reducing duplication. The importance of considering ethics, equality and novel forms of communication for responding to extreme events was discussed, as well as the need for consistent and unified advice. Methods and criteria which could be used to identify suitable subjects for research within the HPA were suggested, along with a comprehensive list of suggested research topics for climate change and health protection work. The value of mapping existing work and collaborations was also highlighted.

In the concluding remarks, John Cooper and Anthony Kessel expressed the highly positive atmosphere of the workshop, and the importance of now further progressing, in a strategic and coordinated manner, the HPA contribution – with partners – to work on climate change and health protection.

UK Disaster Education Seminar September 2010

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The final seminar in the Economic and Social Research Council (ESRC) series on disaster education in the UK[1] – reviewing how we can educate children in particular about disaster preparedness and response – was held at Kingston University, London, and hosted by Kingston and Hounslow councils, on 7 September 2010. Previous seminars in the series, jointly organised by Northumbria, Glamorgan and Kyoto Universities, and University College London (UCL), had been held in Newcastle, Edinburgh, Cardiff and Belfast.

The common theme across the five seminars, connecting directly to priority area 3 of the Hyogo Framework for Action[2], was education about disasters: why this should be done, how it should be done and what should be included. Examples of good practice were presented from around the world as well as some thought-provoking examples of reciprocal learning between adults and children.

The scene was set by Dr Andrew Collins of Northumbria University who presented the idea that disaster risk reduction is at the heart of sustainable development, and therefore there is a moral imperative to embed a disaster risk reduction perspective into the thinking of future generations.

This led on to the second presentation about educating people about risk. Risk communication is notoriously difficult. There are different scales that are used to try and codify risk – for example, the Bradford Disaster Scale[3], Richter Scale and Quantified Risk Assessment. What is most important, however, is that the educator understands how his/her audience perceives risk. There are manifold examples of differences in the perception of risk across the world, so what is regarded as risky in one country may not be regarded as carrying the same amount of risk in another.

Attendees of the seminar heard that another conundrum that resonates with public health practitioners is the issue of going beyond knowledge (giving, sharing, creating) into the realm of affecting behavioural change. Dr John Twigg of UCL shared some examples from Gujarat after the earthquake of 2001. Initial findings from a survey by an Indian institute for disaster mitigation found that a significant proportion of reconstructed schools were structurally unsound, fire extinguishers had been installed but no one knew how to use them, and government-funded training sessions were being run but were very poorly attended.

More widely, points raised included:

- the lack of evidence on the effectiveness of disaster education initiatives, particularly with regard to behavioural change, ie evidence of knowledge gained being translated into action
- the scope for disaster education to be generic, ie dealing with disasters and risk in general rather than being hazard specific and thus of wider applicability as a 'life-skill'
- the idea that because knowledge brings with it power, the distribution of knowledge is contested, ie there may be other agendas at play which relate to political gain or control over resources which affect how knowledge is shared.

The attendees then heard about two excellent examples of educational programmes in Hounslow. The first, called 'the Junior Citizen', is a stand-alone programme which delivers education to children using a 'participatory model'. In this programme children are encouraged to think about the practicalities of responding to a disaster and, by doing so, put together a plan of action. The second approach aims to embed disaster-related situations within the curriculum – for example, managing a business through a crisis as part of the 'A' level curriculum in business studies. From Turkey, we had another excellent example of disaster education through the use of a multimedia programme.

The attendees also heard that the role of children in disaster education should not be seen as merely passive. Many presenters alluded to the role of children as agents of change: from their ability to influence parental behaviour (pester power), to the unique perspectives they bring through their lack of inhibition.

"[Children] see things we don't see, and they say things we won't say."

Dr Nick Hall, of the charity Plan International, said the raising of the credibility of children's voices was one of the organisation's goals.

The seminar returned to the issue of development, and attendees heard that for the majority of people in the world the lack of development is a far greater threat to life than disasters. However, as we have seen in the case of Haiti, inappropriate development can significantly worsen the impact of a natural hazard. So while it is absolutely critical that development does occur, it must be sustainable and informed by an understanding of disaster risk reduction. This understanding should not be restricted to disaster specialists, but should be taught as a way of thinking to future generations, to children today who will become pivotal in shaping development in the future as homeowners, town planners, mayors, politicians, doctors, community members and educators, to name just a few.

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3 Keller AZ, Meniconi M, Al-Shammari I, Cassidy K. Analysis of fatality, injury, evacuation and cost data using the Bradford Disaster Scale. Disaster Prevent Manage 1997; 6(1): 33–42

Water Contamination Emergencies IV – Monitoring, Understanding, Acting Germany, October 2010

Gary Lau
Centre for Radiation, Chemical and Environmental Hazards, Health Protection Agency

This fourth conference followed on from three successful international conferences on water contamination emergencies and examined three key issues of monitoring, understanding and acting. It emphasised prevention strategies, how water companies prepare an overall strategy and how they deal with unusual or unpredictable situations related to drinking water. Relevant case studies were covered and the resulting lessons identified. The conference was held at the IWW Water Centre in Mülheim-an-der-Ruhr, Germany, over a three-day period. Highlights of the conference are presented below.

- Virginia Murray, Health Protection Agency (HPA) – Drinking water safety: guidance to health and water professionals and other health protection issues concerning water safety

  Professor Murray is a consultant in medical toxicology and environmental public health. Details and information regarding the roles and functions of the Drinking Water Inspectorate[1] and the HPA[2], Drinking Water Safety: guidance to health and water professionals[3], the UK Recovery Handbook for Chemical Incidents[4] and Millennium Development Goals[5] were presented. In addition, several case studies, concerning the management of water-related chemical incidents, were described[6,7].

- Thomas Zenz, German Technical and Scientific Association for Gas and Water (DVGW) – Crisis management approaches: relation to standardisation

  Mr Zenz is a senior water supply manager for, and coordinator of, international activities of the DVGW. Crisis management is an organisational capability designed to guide an organisation through a crisis, outside its normal operations. Through standardisation, eg setting guidelines, drinking water utilities are now enabled to take action in the event of a crisis in order to ensure a continued supply of water and restore normal operating conditions. In addition, the standardisation process has guaranteed the involvement of all interested stakeholders.

- Ben Tangena, Dutch National Institute for Public Health and the Environment (RIVM) – A novel approach for early warning of drinking water contamination events

  Mr Tangena is a project manager for drinking water in the RIVM. He described how early warning was essential for a proper response in the case of a contamination event in a drinking water distribution system. Together with spot sampling for standard compliance and continuous monitoring for process control, online early warning should form part of an integrated quality control system. In addition, an early warning sensor should have a fast response and low detection limit, detect a broad spectrum of harmful target contaminants and distinguish between accidents and normal quality fluctuations.

- Steve Allgeier, United States Environmental Protection Agency (US EPA) – Modelling the performance of drinking water contamination warning systems

  Mr Allgeier is an environmental engineering team leader at the US EPA. He described a contamination warning system pilot comprising five monitoring and surveillance components: online water quality monitoring, sampling and analysis, consumer complaint surveillance, public health surveillance and enhanced security monitoring. In order to evaluate the performance of the system, a mathematical model was developed to represent the physical system, including the five monitoring and surveillance components and consequence management.

- Jan Cortvriend, European Commission DG Environment – The risk-based approach in the revision of the EU Drinking Water Directive (98/83/EC)

  Mr Cortvriend is a policy officer of the Drinking Water Directive. In order to adapt the directive to progress in science and technology, to adopt it to the newest health standards, and to ensure consistency with EU water policy and legislation, in particular the Water Framework Directive 2000, the Commission was currently preparing a revision of the directive.

  The concept of risk assessment and risk management all along the production and distribution of drinking water was a cornerstone of the revision. It was introduced by the World Health Organization in the 2004 Guidelines for Drinking Water Quality[8]. This concept was presented in the context of water safety plans. By taking on board this new approach, drinking water quality surveillance would shift from the current sole control of drinking water parameters at the tap, towards quality and safety management along the entire production and distribution cycle from capture to tap.

- Barry May, Food and Environment Research Agency – Potable water contamination emergency: the analytical challenge

  Mr May is a Laboratory Environmental Analysis Proficiency (LEAP) Scheme manager of the Food and Environment Research Agency[9].

He said that potable water contamination incidents were rare events; however, past experiences had clearly shown that when they did occur they could have two major implications for water companies. The first was financial and the second was that of public health. In the event of a contamination incident, a laboratory would be called upon to rapidly identify any contaminant present, often without any information as to its source. Whilst the speed of contamination identification is important, the reliability of any result reported would be of equal importance. With this in mind a proficiency testing scheme (LEAP)[10] was designed, which would allow laboratories to assess their capability to deal with the analysis of chemically contaminated samples in an emergency contamination incident.

- Daniel Villessot, Suez Environment/Lyonnaise des Eaux, France – Why do water companies need to tackle health threats arising from drinking water supplies?

  Dr Villessot is the scientific director of the Suez Environment/ Lyonnaise des Eaux. Since the events of 9/11 in New York, water companies worldwide have been challenged by their regulators, and sometimes also by their customers, to better prepare strategies to prevent and cope with unusual and unpredictable emergency situations. This had been particularly challenging for those companies that had traditionally prepared only for emergencies linked to pollutants or to drinking water distribution failures due to pipe bursts. Dr Villessot said that results from research and development had shown that the development of new monitoring systems was of great help, and demonstrated that a water company must put in place prevention measures and strongly secure infrastructure. In addition, detailed and tailored site-specific vulnerability studies must be conducted on all parts of the infrastructure.

- Ilkka Miettinen, Finnish National Institute for Health and Welfare – A Scandinavian emergency for drinking water network contamination: the Nokia case study

  Dr Miettinen is the head of unit of the National Institute for Health and Welfare and presented a case study describing a severe drinking water contamination event that occurred in Nokia city (30,000 inhabitants) in Finland in November 2007. Cross-connection between a waste water system and a drinking water pipeline system caused massive faecal contamination of the drinking water distribution network. The network was finally declared to be clean in February 2008. A population survey conducted in Nokia and neighbouring towns showed a total of 8451 cases of gastroenteritis during the outbreak of disease; 1000 people sought care at the municipal health centre and nearly 200 were treated in hospital. The total costs of the outbreak including the mitigation actions exceeded €4.7 million.

  Dr Miettinen described how treated sewage contains a lot of pathogenic microbes and how pathogens can attach and survive in pipelines persistently, making the cleaning of a massively contaminated distribution network an extremely difficult and expensive operation. In addition, he stressed that providing notification/information to customers was an extremely important function in order to stop the outbreak.

Summary

During this conference, particular emphasis was given to the considerable amount of effort and detailed planning required in preparing for, and responding to, water contamination emergencies and achieving the best possible outcome. Water companies should never stop learning how to improve their response to the very low probability, but very high impact, major incidents. Water companies cannot afford to provide an unfit-for-purpose response to a major incident if they are to maintain the confidence of their customers. A lot can be learned by sharing knowledge on preparing and responding to emergency incidents. Efficient networking with all stakeholders was one of the key messages of this conference.

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Upcoming Conferences and Meetings of Interest

The International Network of Environmental Forensics Conference, Cambridge, July 2011

RSC | Advancing the Chemical Sciences

The International Network of Environmental Forensics (INEF) and the Royal Society of Chemistry conference will bring together researchers and practitioners from around the world to address the state of the practice and future needs of the environmental forensics community. Environmental forensics is the use of scientific techniques to identify the source, age and timing of a contaminant into the environment.

The conference takes place from 25 to 27 July 2011 at St John's College, Cambridge.

For more information, see www.rsc.org/inef

Emergency Scotland 2011, Glasgow, July 2011

Emergency Scotland is linking up with the Emergency Planning Society (EPS) to organise a joint exhibition and conference to be held from 5 to 6 July 2011 at the Scottish Exhibition and Conference Centre (SECC), Glasgow.

The event will directly address the needs of the Scottish emergency services industry with a devolved government in Scotland, with separate budgets. Emergency Scotland 2011 will offer buyers and specifiers of equipment throughout Scotland's police, fire and rescue, ambulance, coastguard, mountain rescue, non-governmental organisations, etc, an opportunity to view the latest equipment and services from the leading suppliers to the sector. The Emergency Scotland 2011 exhibition will run alongside the EPS annual conference.

For more information, see www.the-eps.org

Training Days for 2011–2012

The Centre for Radiation, Chemical and Environmental Hazards (CRCE) considers training in chemical incident response and environmental contamination for public health protection a priority. The 2011–2012 programme has been developed to offer basic and more detailed training, along with the flexibility to support Local and Regional Services initiatives as requested.

Training events are available to people within the Health Protection Agency and to delegates from partner agencies, such as local authorities, the NHS and the emergency services.

One-day training events

How to respond to chemical incidents

Dates TBC, London

These courses are designed for all those on the public health on-call rota, including Health Protection Unit staff, Directors of Public Health and Primary Care Trust staff, hospital emergency department professionals, paramedics, fire and police professionals, and environmental health practitioners who may have to respond to incidents arising from the transport of chemicals.

Aims:

- to provide an understanding of the role of public health in the management of chemical incidents
- to provide an awareness of the appropriate and timely response to incidents.

Topics covered:

- processes for health response to chemical incidents
- types of information available from the HPA Centre for Radiation, Chemical and Environmental Hazards to help the health response
- resources available for understanding the principles of public health response
- liaison with other agencies involved in incident management
- training needs for all staff required to respond to chemical incidents.

There will be a charge for these events; please see page 55 for booking details. A maximum of 40 places are available.

Understanding public health risks from contaminated land

Spring 2012, Victoria, London

This course is designed for those working in public health from the Health Protection Agency and environmental health practitioners who have to respond to incidents involving land contamination.

Aims:

- to explain the legislative and organisational frameworks that underpin contaminated land risk assessment
- to understand the role of public health in the management of contaminated land investigations.

Topics covered:

- principles and current issues relating to the management of contaminated land incidents and investigations including:
    - the toxicology underpinning derivation of tolerable concentrations
    - Soil Guideline Values
    - the local authority perspective on implementing Part II A
    - the risk assessment process
    - the nature of public health risks from contaminated land and risk communication
- process for public health response to contaminated land issues
- types of information available and potential limitations of risk assessment models used by different agencies investigating contaminated land
- roles and responsibilities of different agencies involved in investigating and managing contaminated land.

There will be a charge for these events; please see page 55 for booking details. A maximum of 40 places are available.

Training Days for 2011–2012

Carbon monoxide workshop

Summer 2011, London
Other dates TBC around the UK

These multi-agency awareness events are designed for health and other professionals with responsibility in carbon monoxide incident response or prevention, including: Health Protection Agency staff (local and chemicals specialists), environmental health practitioners (including pollution, housing, health and safety), paramedics, fire and police, hospital staff, Health and Safety Executive, policy makers and industry.

Aims:

- to raise awareness of carbon monoxide (CO) and reduce the number of CO incidents
- to improve multi-agency response to CO incidents.

Topics covered:

- toxicology and health effects of CO
- CO surveillance, reporting and mortality in England
- methods for biological and environmental monitoring of CO, their potential utility and limitations
- emergency and local response to CO incidents
- roles and responsibilities of different agencies in investigating and managing CO incidents
- tools available to responders for CO incident management
- government, regulatory, health service and other programmes preventing CO exposure
- examples of local-level programmes to raise awareness of, minimise, or eliminate CO poisoning
- information about research initiatives in CO poisoning.

There will be a charge for these events; please see page 55 for booking details.

Operational lead workshop

Dates TBC around the UK

These multi-agency awareness events are designed for public health and environmental health practitioners with responsibility for the management or prevention of lead poisoning incidents including: Health Protection Agency staff (local and chemical specialists), environmental health practitioners (including pollution, housing, health and safety), hospital staff, Health and Safety Executive, policy makers and industry.

Aims:

- to raise awareness of lead poisoning and reduce exposure to lead
- to improve multi-agency response to lead poisoning incidents.

Learning objectives:

- to understand the role of environmental and public health practitioners in managing cases of lead poisoning
- to be aware of the toxicology and health effects of lead
- to be aware of the methods for biological sampling
- to understand the process of environmental inspection, sampling and remediation
- to be aware of legislation for the investigation and management
- to be familiar with HPZone and lead 'action card' for Health Protection Units
- to be aware of current research initiatives for lead poisoning incident surveillance.

There will be a charge for these events; please see page 55 for booking details.

Training Days for 2011–2012

One-week training courses

Essentials of toxicology for health protection

23–27 May 2011, King's College London

This five-day course is designed for those working in public health, health protection or environmental health and who have an interest in or experience of toxicology and public health protection and would like to develop their skills.

The aims of this short course are to summarise the key concepts in toxicology, toxicological risk assessment and exposure assessment, and to examine the scope and uses of toxicology and tools of toxicology in local agency response to public health and health protection issues. Training sessions will use examples of real incidents to demonstrate how toxicology may be applied in the context of health protection. The course will also provide an understanding of the limitations associated with the lack of data on many chemicals, chemical cocktails and interactions. The course will provide an understanding of the advantages and difficulties of multidisciplinary and multi-agency working in toxicology and the use of strategies for communicating risks associated with the investigation of toxicological hazards.

The fee for this course will be around £600 for HPA staff and £1000 for non-HPA staff. A maximum of 30 places are available.

Participants will receive a CPD certificate, or may elect to submit a written assignment and take a test to receive a formal King's College London Transcript of Post Graduate Credit.

Please see the next page for booking details about this event.

Essentials of environmental science

Autumn 2011, King's College London

This five-day course is designed for those working in public health, health protection, environmental science or environmental health and who have an interest in or experience of environmental science and public health protection and would like to develop their skills.

The aims of this short course are to summarise the key concepts of environmental science, the study of the physical, chemical and biological conditions of the environment and their effects on organisms. The course will concentrate on the basics of environmental pathways – source, pathway and receptor – and consider the key issues in relation to health impacts of air, water and land pollution and the principles of environmental pollutants and impacts on health. Environmental sampling will also be covered: its uses and limitations for air, land and water, leading to a consideration of environmental impact assessment and links to health impact assessment. Awareness of the main environmental legislation will be provided along with an understanding of the process of determining environmental standards, what standards are available, how to access them and how to utilise them. Sessions will be based upon examples of incidents associated with health protection which may lead to adverse health effects. The course will also provide an overview and understanding of the advantages and difficulties of multidisciplinary and multi-agency working in environmental science, and the use of strategies for communicating risks associated with the investigation of this science.

The fee for this course will be around £600 for HPA staff and £1000 for non-HPA staff. A maximum of 30 places are available.

Participants will receive a CPD certificate, or may elect to submit a written assignment and take a test to receive a formal King's College London Transcript of Post Graduate Credit.

Please see the next page for booking details about this event.

Training Days for 2011–2012

Introduction to environmental epidemiology

Spring 2012, London School of Hygiene and Tropical Medicine

This five-day course is designed for those working in public health, health protection or environmental health and who have an interest in or experience of environmental epidemiology and would like to improve their skills.

The aims of this short course are to summarise the key concepts in environmental epidemiology, to explore the key concepts in exposure assessment and cluster investigation, and to examine the scope and uses of environmental epidemiology in local agency response to public health and health protection issues. The course will also show how to explore study design and the practical consequences of choices made when planning and undertaking an environmental epidemiological study. This will include an appreciation of the influence of finance, politics and time constraints on the choice of study, to review the advantages and difficulties of multidisciplinary and multi-agency working in environmental epidemiology, and to use strategies for communicating risks concerning investigation of environmental hazards.

The fee for this course will be around £825. A maximum of 20 places are available.

Please see below for booking details about this event.

Booking Information

Regular updates to all courses run by CRCE can be found on the Training Events web page: www.hpa.org.uk/chemicals/training

Those attending CRCE courses will receive a Certificate of Attendance.

For booking information on these courses and further details, please contact Karen Hogan on 020 7811 7141 or chemicals.training@hpa.org.uk

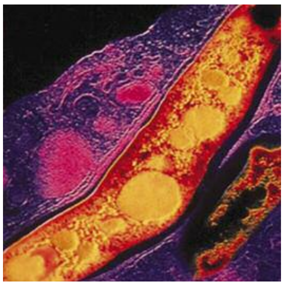
Other training events

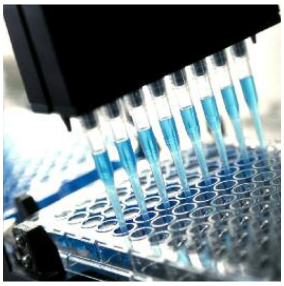
CRCE staff are happy to participate in local training programmes across the country and develop courses on other topics. To discuss your requirements, please contact Karen Hogan on 020 7811 7141 or at chemicals.training@hpa.org.uk

If you would like to advertise any other training events, please contact Karen Hogan

HEALTH PROTECTION 2011 **13-14 September**

University of Warwick





Call for abstracts

Abstracts are now invited for consideration for oral presentations and posters across a wide range of health protection categories.

Health Protection 2011 will showcase the latest scientific research and new developments in protecting against infectious diseases, environmental hazards and preparation for health emergencies. Five parallel tracks of themed sessions on both days, plus an extensive poster exhibition, will provide delegates with the opportunity to update their knowledge across the breadth of health protection.

Over 1100 delegates are expected to attend, from public health services and hospitals, environmental health, emergency planning, laboratories and research institutions.

Topics in the conference and poster exhibition will include:

- Antimicrobial resistance
- Blood borne infections
- Climate change and extreme events
- Developments in vaccines and therapeutics
- Emergency preparedness and response
- Environmental public health
- Field epidemiology
- Gastrointestinal infections
- Healthcare associated infections
- New technologies for rapid diagnosis
- Respiratory infections
- Sexually transmitted infections
- Tuberculosis
- Vaccine preventable infections

For further information on this leading multi-disciplinary health protection conference, abstract submission details and to book your place please visit:

www.healthprotectionconference.org.uk

Closing date for abstract submissions – 13 May 2011

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