Chemical Hazards and Poisons Report

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Contents

Editorial

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

The effective management of human exposure to chemicals, radiation and non-infectious environmental hazards is a very important public health issue.

The Health Protection Agency (HPA), in conjunction with other agencies, plays an important role in assessing environmental risks to public health through environmental risk assessment, responding to acute incidents and communicating risk. Environmental hazards associated with the legacy of industrial processes, extreme weather and other natural hazards or the pursuance of new or emerging technologies generate real challenges in developing the evidence base to aid risk assessment and supporting the provision on which to provide clear advice, policy guidance and effective health interventions. In most cases no single agency or organisation has primacy in the response to non-infectious environmental hazards and effective public health management requires a cohesive multi-agency response based on a good understanding of each other's roles and responsibilities. For example, the HPA works closely with a wide range of stakeholders from central and local government through to non-governmental organisations (NGOs) and charities and we recognise the importance of strengthening partnerships to enable us to work together to minimise the impact upon public health.

In terms of responding to such events, partnership working is as an important a skill as risk assessment or toxicology. The articles in this edition highlight examples of public health risk assessments with specific emphasis upon partnership working within the HPA and with local and national stakeholders and the development of cross-agency working to ensure a joint approach to environmental public health. They show a commitment to, and a willingness to be involved in, multi-agency working.

Contributors to this edition demonstrate the effective collaborative partnerships across practical and research-based work in undertaking environmental risk assessments for public health. They explore how partnership working can aid the identification of chemical and radiation hazards, help develop mechanisms for risk characterisation and communication, and show how successful working partnerships allow for positive public health outcomes.

Examples include:

- A multi-agency response to a suspected Second World War chemical vial found by a member of the public
- Evaluating the evidence base for recovery, remediation and decontamination methods
- A report on working with voluntary and community organisations on the public health impact of cold weather and the provisions of the Cold Weather Plan for England
- The benefits of hosting trainee environmental health practitioners in a health protection multi-agency environment
- EU multinational coordinated response systems for both chemical and radiological incidents with cross-border impacts.

The report also contains our regular features such as incident management, which this time looks at the public health issues and multi-agency response associated with responding to a large tyre fire, and emergency planning and preparedness, which considers guidance for chemical fatality related incidents.

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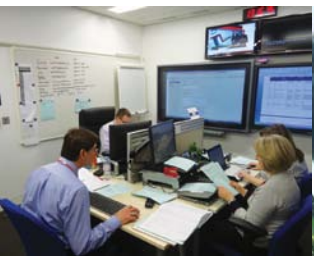

Incident Response

Suspected Second World War chemical vial: a potentially costly serendipitous find!

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Introduction

Periodically the Health Protection Agency (HPA) responds to incidents where Second World War chemical material or ordnance has been acquired by the public through serendipity[1,2]. This article presents a case study describing the unearthing of a suspected Second World War chemical vial by a member of the public (MoP) and his subsequent exposure to its contents through accidental breakage. The public health risk assessment of the immediate and wider public health implications presented by this incident and the multi-agency response are described. The lessons identified from the management of this incident are highlighted.

Overview of incident and potential public health implications

On the evening of 2 March 2011, a resident from North West Leicestershire self-presented to a hospital emergency department (ED) with a chemical burn on his foot. He was a Second World War enthusiast who had been digging at an old military base purported to be in east Northamptonshire. The man reported that he had had permission from the landowner to dig at the base. During this 'expedition' he had retrieved a 50 ml glass vial containing 30 ml of brown liquid, buried approximately 0.5 m under the ground, which he had taken home. On 1 March 2011, whilst carrying the vial in his garage he dropped and broke it, spilling its contents over his clothes, shoe-covered foot and carpeted floor. The man promptly vacuumed and cut out the soiled portion of carpet and placed this, together with the broken vial, in his domestic refuse bin. He then showered and washed his foot several times with ordinary soap and water and washed his clothes in his domestic washing machine. There did not appear to be any immediate ill effects but later that evening the man's foot started to go red. By the next day his foot had blistered so he self-presented at the ED to seek medical attention. The ED consultant treated the injury as a chemical burn and, having discussed the background to the cause with the patient, contacted the Centre for Radiation, Chemical and Environmental Hazards (CRCE) to alert the centre to the possibility of wider public health implications.

In light of the details of the site of exploration, the initial public health risk assessment included consideration of whether the vial had contained a Second World War chemical warfare agent. Further details provided by the MoP about the unknown substance revealed that the liquid had been oily in consistency, pale brown/brown in colour, gave off an acrid, phenol/hydrocarbon type odour when spilt, and volatised. At the time of the incident and subsequently, the MoP did not suffer any other symptoms over and above the burn on his foot. Other members of the same household – immediate family and a pet cat – remained asymptomatic in the days following the incident.

The MoP was advised by CRCE:

- Not to put his refuse bin out for collection. He was advised it would have to be recovered by a specialist contractor
- To ventilate the garage
- To keep the rest of the household away from the bin and the garage
- To cease using the vacuum cleaner and washing machine (both of which were deemed contaminated and so needed appropriate disposal)
- To seek immediate medical advice in the event of any delayed health effects.

The site from which the vial had been retrieved was reported as being on private land, with no public right of access. The excavated area had also been in-filled following the find. As a consequence, the wider community was not deemed to be at risk.

On 3 March 2011, CRCE liaised with the local health protection unit (HPU) about the incident which in turn informed North West Leicestershire District Council (NWLDC). NWLDC arranged for a new refuse bin to be delivered and alerted the refuse collection service to not collect the old bin if it was put out for collection. Both CRCE and NWLDC gathered information on potential contractors who could deal with the disposal of the bin, the vacuum cleaner and washing machine given that the assumption at the time was that the vial contained a possible Second World War chemical warfare agent. CRCE discussed the incident with the Government Decontamination Service (GDS). Contractor details were supplied to the MoP who subsequently sought a variety of quotes. He was advised to liaise with his insurance company with regard to clean-up costs although he did initially indicate that he was happy to cover this himself. However, quotations were in the order of £3,000 and the man's insurance company stated it was unable to provide indemnity for this. Due to the prohibitive costs, the contaminated bin and household items remained *in situ* over the weekend.

In an attempt to better identify the vial's contents and assist the clean-up, the following week NWLDC liaised with the Ministry of Defence (MoD) in the West Midlands. Based on the description of the vial's contents and the MoP's symptoms, the working hypothesis was that the content was possibly acidic. It transpired that the site had not stored chemical weapons but had held on site 'tester kits' – diluted chemical warfare agents. The kits were, in effect, a forerunner of modern day detection identification and monitoring (DIM) kits for chemical warfare agents. During a suspected chemical attack, the kits would be opened and their contents sniffed or applied to the skin. The crude theory was that knowledge of the odour and clinical symptoms of specific chemicals would assist in identifying the chemical weapon used in the attack. Photographs of original tester kits were provided by the MoD and shared

Figure 1: Smelling set instructions © *MOD Crown Copyright*

with the MoP to narrow down the nature of the vial. Examples of these photos are given in Figures 1 to 3.

In parallel, information on the glass vial, a description of its contents and the MoP's symptoms were shared with CBRN specialists at HPA Porton. They were prepared to travel to the MoP's residence to sample and identify any remaining residues of the chemical and advise on appropriate clean-up.

One week after the incident, the MoP confirmed that none of the MoD tester kit photographs matched the vial he had uncovered. Furthermore, he stated that the vial was actually 100 ml in size and its contents were watery, not oily. In addition, he had commissioned a contractor who had already removed the bin for the sum of £150. NWLDC subsequently closed the incident and the involvement of colleagues from HPA Porton was stood down.

Although investigation into this one source had closed, the find raised wider public health issues. There were no immediate concerns about the

Figure 2: Smelling set 1 © *MOD Crown Copyright*

original retrieval site due to it being on private land with restricted public access and in-filling of the area by the MoP.

Given that the site was purported in be in east Northamptonshire, East Northamptonshire District Council (ENDC) was alerted to the incident by the local health protection unit (HPU). Being familiar with the area, the location of the former base and also local landfill sites, ENDC liaised with the MoP to better identify the area excavated. On doing so, it transpired that this area was actually under the jurisdiction of Peterborough

Figure 3: Smelling set 2 © *MOD Crown Copyright*

City Council which was duly informed by ENDC, so bringing in the involvement of a third local authority. When Peterborough City Council liaised with the MoP, he stated that he did not undertake any digging and that he uncovered the vial by kicking over a log in some woods – not the former military base under initial consideration. By now, he was unable to be more specific about the exact location of his find. Peterborough City Council duly informed the Forestry Commission which owned the woods, advising it to undertake its own risk assessment and put into effect any necessary measures to ensure public safety. Peterborough City Council also informed the Health and Safety Executive and Environment Agency – the latter in respect of any key watercourses in case the find was not an isolated event. Finally, the HPU covering this area was apprised of the incident in the event that history should repeat itself.

Discussion

This incident was unique in that the MoP actively went looking for Second World War paraphernalia. If it were not for the accidental damage to this vial, it would probably be *in situ* in his garage to this day.

Chemical incident management typically involves a multi-agency response. This incident was no different although the breadth and number of organisations involved was perhaps atypical, reflecting not only the level of concern around the possible agent in the vial but also the spatial implications of what had happened. The response to this incident involved the engagement of a number of different organisations: environmental protection officers from three different local authorities (the MoP's own local authority, the local authority where he initially reported digging and the local authority where the vial was actually found), the local HPU covering the area where the MoP lived (and in addition the local HPU where the woodland was located), CRCE and, in an attempt to identify the chemical and obtain expert advice for subsequent decontamination and appropriate waste disposal, the MoD and GDS.

Incident management requires a dynamic public health risk assessment. This was complicated during this incident due to the information provided by the MoP: for example, the difficulties in identifying the original location of the vial.

Although the MoP was willing to pay for the removal of the contaminated bin, he was obviously shocked at the initial costings. Furthermore, the local authority advised it had limited powers of intervention. Consequently, this incident does raise the question of how the waste would have been dealt with if the MoP had been unwilling to commission a contractor or even sought alternative means of disposal. On reflection, the Health Protection Regulations (Local Authority Powers) 2010 may have been of use[3]. Taking the 'all hazards' approach, these (regulations 4 and 5) now allow local authorities to disinfect/decontaminate (from any cause) premises or articles on request with a recharge to the owner. However, ultimately these regulations do not consider the potential cost of remediation.

Fortuitously, NWLDC has an established MoD contact with whom it liaised throughout the incident. The MoD contact was able to provide site-specific inventories and information on chemical warfare agents not commonly encountered in the 'everyday' chemical incident arena, so supporting the ongoing management of the incident and providing an intriguing insight into the history of Second World War chemical agent identification.

The local HPU was able to facilitate cross-boundary coordination of this incident, drawing upon established partnership arrangements with local authority colleagues who in turn were able to draw upon colleagues in sister organisations beyond the East Midlands boundary. For most of the partners, their role and responsibility was confined to one particular jurisdiction – be it the residential property or the 'excavation' site. By keeping the wider public health in focus and thinking long term, even when the immediacy of the incident was over, the HPU was mindful of trying to take all reasonable actions to ensure that a similar incident did not happen in the future.

The HPA CBRN specialist testing capability and knowledge of decontamination services befitting the provisional assessment of the nature of the substance in the vial are an important capacity in informing the public health risk assessment.

Key learning points

Whilst incidents such as this are rare, the lessons identified from this particular incident are invaluable for informing the management of similar future incidents:

- Multi-agency partnership drawing upon existing relationships is fundamental to managing incidents which have the potential to become complicated
- The HPA is able to act as expert adviser for CBRN incidents with reach-back capacity to sampling and decontamination capability, in addition to demonstrating leadership in the management of such incidents
- Partner organisations are important in providing links to other organisations
- Liaison with the MoD in such incidents is important and may give rise to new information around chemical warfare; developing links with local MoD colleagues is important
- Local authority powers may not automatically be obvious in a non-industrial or private setting but consideration should be given to the Health Protection Regulations (2010).

Acknowledgements

The member of the public involved in this incident has kindly given permission for this article to be published.

Photos reproduced by kind permission from Ray Dickinson, Environmental Policy, DIO Secretariat, on behalf of the Ministry of Defence.

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Public health risk assessment and air quality cell for a tyre fire, Fforestfach, Swansea

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Background and incident overview

On 16 June 2011, public health agencies in Wales were notified of a fire at an unoccupied warehouse on an industrial estate in Fforestfach, Swansea. The fire generated a dense, dark smoke plume over the three-week period for which it burned (Figure 1). The source material comprised an estimated 5,000 tonnes of tyre ‘flock’, a tyre recycling by-product of nylon fibre with rubber crumb attached (Figure 2). Traditional fire-fighting techniques were ineffective due to the source material forming a ceramic crust when doused with water. When this ceramic crust broke down periodically, more smoke was released into the atmosphere. The scale of the incident and associated public health concerns were significant. The illegally stored tyre waste was already known to the Environment Agency and the local authority, and had been identified by the fire service as a fire risk.

In addition, there was an adjacent warehouse containing flammable waste and recycling materials. Agencies had been working collaboratively to improve conditions at the site and minimise associated risks; a notice had been served on the landowner by the local authority to secure the site, and due to close proximity of residential housing Public Health Wales and the Health Protection Agency (HPA) were informed of the potential implications for public health. The fire was extinguished on 8 July 2011, much earlier than originally anticipated, using novel fire-fighting techniques that involved repeatedly excavating batches of burning material, and cooling and extinguishing it in tanks and digger-created lagoons before safe removal from site (Figure 3). A formal post-incident debrief has since taken place to determine learning outcomes.

Figure 1: Fforestfach tyre fire, Swansea (courtesy of Phil Davies, South Wales Police)

Figure 2: Waste tyre ‘flock’ – Fforestfach tyre fire, Swansea (courtesy of Dr Jorg Hoffmann, Public Health Wales)

Figure 3: Digger-created lagoon for cooling and extinguishing – Fforestfach tyre fire, Swansea (courtesy of Dr Jorg Hoffmann, Public Health Wales)

Incident response

When the fire started, a major incident was declared immediately and appropriate command and control structures established, which after five days included a strategic coordination group (SCG) led by the local authority. The incident was the first in Wales requiring a scientific and technical advice cell (STAC), convened by the SCG at its first meeting to provide a single source of timely and coordinated specialist public health advice. An air quality cell (AQC) was also required to inform a comprehensive real-time ambient air quality monitoring strategy, which combines expertise from different agencies to collect, collate, analyse, interpret and disseminate data.

Throughout the incident Public Health Wales and CRCE Wales made significant contributions to support the multi-agency response which included the STAC, tactical (silver) and strategic SCG (gold) meetings. To ensure there was sufficient organisational capacity and resilience to provide an effective and sustainable 24-hour public health response (at all levels, i.e. executive, managerial, specialist public health and administrative), an internal Public Health Wales senior response team was established to coordinate/allocate resources accordingly. Public health representation was also required at a post-incident recovery group.

The Centre for Radiation, Chemical and Environmental Hazards (CRCE) of the HPA had a significant role supporting both Public Health Wales and the AQC to inform the dynamic public health risk assessments. Situation reports were issued daily by the AQC at the strategic and tactical meetings to ensure partners were kept informed, and key public health messages in relation to air quality shared to help minimise population exposure.

Air quality impacts and health effects

The box outlines some of the issues associated with impacts on air quality from fires in general. The Fforestfach fire was not a typical tyre fire involving whole or shredded tyres, but rather waste tyre 'flock'. Whilst the characteristics of this particular incident might be considered similar to whole or shredded tyre fires, there were differences in emissions due to the lower percentage of metal mesh and rubber in the source material. The fire generated a dark, dense smoke plume that persisted for over three weeks.

Meteorological conditions varied over the three-week period, affecting plume characteristics. To determine emissions to atmosphere, ambient air monitoring was carried out at a number of locations around the incident scene. Monitoring locations, some fixed and some mobile, were appropriately determined by forecasted modelled predictions of plume characteristics, observations at the scene (e.g. dispersion of smoke) and locations of vulnerable receptors including schools, nursing homes and day-care centres (Figure 4). A broad suite of substances were monitored over the course of the incident. Using available continuous monitoring data, the AQC was able to identify fine particulates (PM_{10}) as the pollutant of greatest public health concern. Other air quality parameters (namely the principal air pollutants: SO_2, NO_2, benzene, 1,3-butadine, lead, PAHs and O_3) were also continuously monitored but, with the exception of benzene, ambient concentrations of these did not cause any significant public health concerns. Following investigation, the elevated levels of benzene identified in ambient air were considered to be unlinked to the incident. Odours were reported over a wide geographical area.

Fires and public health

Fires and their consequences have the potential to impact adversely upon both the public's health and the environment. Generally, fires generate a plume which may contain gaseous pollutants, smoke and quite often particulates. Determining the precise constituents of smoke plumes is difficult, particularly when the composition of the source material is unknown. Uncertainties often exist around emissions due to the nature of the burning material; smoke composition will vary, influenced by fire characteristics, combustion temperature, oxygen availability and ventilation[1]. There is a developing evidence base around emissions from fires (Table 1)[2]

With specific regard to tyre fires, large amounts of particulate matter may be generated, and in some cases, significant yields of sulphur dioxide (depending on tyre type)[3]. Other emissions can include metals, carbon monoxide, polycyclic aromatic hydrocarbons, organic compounds including benzene, phenols and styrene[4,5] as well as inorganic irritants and possibly phosphorus pentoxide[1]. Polychlorinated dibenzo-*p*-dioxins and dibenzofurans may also be produced from the incomplete combustion of organic materials and, although unlikely to represent an inhalation risk, post-incident land deposition and animal uptake could lead to subsequent food-chain contamination concerns[2]

The available literature suggests that prolonged fires can adversely impact on local communities. For example, summer fires in Lithuania in 2002 (with significantly increased ambient air levels of nitrogen dioxide, sulphur dioxide, carbon monoxide and PM_{10} identified) resulted in raised respiratory complaints (representing described symptoms, primary care consultations and secondary care admissions)[6]. Similarly, during the Australian bushfires of 2002/03, raised PM_{10} levels were associated with increased emergency department attendances for respiratory complaints[7]. Interestingly, health surveillance during recent tyre fires in the UK at Wem, Shropshire, and Mexborough, Doncaster, showed that no serious health effects were reported[1,8]

The Fforestfach fire generated sufficient quantities of smoke to adversely affect local air quality with concentrations of PM_{10} exceeding the UK Air Quality Strategy Objective of 50 $\mu g/m^3$ measured as a 24-hour mean (Figure 5). In the immediate vicinity of the incident, short-term 15-minute average PM_{10} levels exceeded 6000 $\mu g/m^3$ at times. Due to the well-documented adverse health impacts associated with exposures to elevated levels of fine particulates and evidence to suggest that a 10 $\mu g/m^3$ increase in PM_{10} (measured as a 24-hour mean) is associated with a 0.75% increase in all-cause mortality[9], PM_{10} data was compared with the Air Pollution Index, an index describing likely health impacts as a result of short-term air pollution episodes[10]. The 'high' air pollution band (above 95 $\mu g/m^3$), where significant effects may be noticed by sensitive individuals and action is advised to avoid or reduce effects, was exceeded at several local monitoring sites (in residential areas) during the incident.

It was considered plausible that those living up to 2 km from the incident scene (estimated population 24,812) were exposed to the smoke plume on at least one occasion during the incident (Figure 6). Widespread public health advice to shelter was given and precautionary triggers (described below) were advised to inform decision-making for sheltering, closing public buildings and evacuation. Details relating to 98 separate incident-specific health concerns were recorded, based on daily reporting from local GPs (in and out of hours), NHS Direct Wales, Morriston Hospital Emergency Department, Public Health Wales, the fire and rescue service, local authority and Environment Agency Wales. Most health concerns referred to breathing difficulties (tight chest, shortness of breath, wheeze and increased need to use asthma

Table 1: Hazardous combustion products generated by material involved[2]

Material involved	Fire Zone*	CO	HCN	HCl/ HBr/ HF	NO_x	SO_2	P_2O_5	Organic irritants, e.g. acrolein/ formaldehyde	Inorganic irritants, e.g. phosgene/ ammonia	PAHs	Complex/ exotic, e.g. PCDDs/ PCDFs/ isocyanates/ PFIB	Particles
Polymeric materials	1	+++	+++	+++	++	+	+	++	+	++	++	+++
	2	±	±	+	+	±	–	++	+	±	++	++
Wood	1	++	–	–	+	–	–	++	–	+	+	+++
	2	–	–	–	±	–	–	+	–	±	+	±
Rubber/ tyres	1	+++	+	+	+	+++	+	++	+	++	++	+++
	2	±	±	+	±	+++	±	++	±	±	++	++
Oil/ petrol	1	++	–	–	–	±	–	++	–	++	++	+++
	2	–	–	–	–	±	–	++	–	±	+	++

* Zone 1 relates to the immediate vicinity/compartment of the fire. Zone 2 relates to the location immediately outside the source of the fire.

Key

+++	Likely to be present in very high quantities	++	Likely to be present in high quantities	+	Likely to be present	±	May be present at low level	–	Unlikely to be present

inhaler), coughs, sore throats, eye irritation, headaches and nausea. Some concerns about potential medium- to longer-term health impacts from possible exposures were raised. Reported health effects were consistent with exposure to elevated PM_{10} concentrations but public health agencies were mindful that other health impacts were biologically plausible as a result of exposures to other emissions (Table 2) but also that other factors not related to this incident could cause these symptoms.

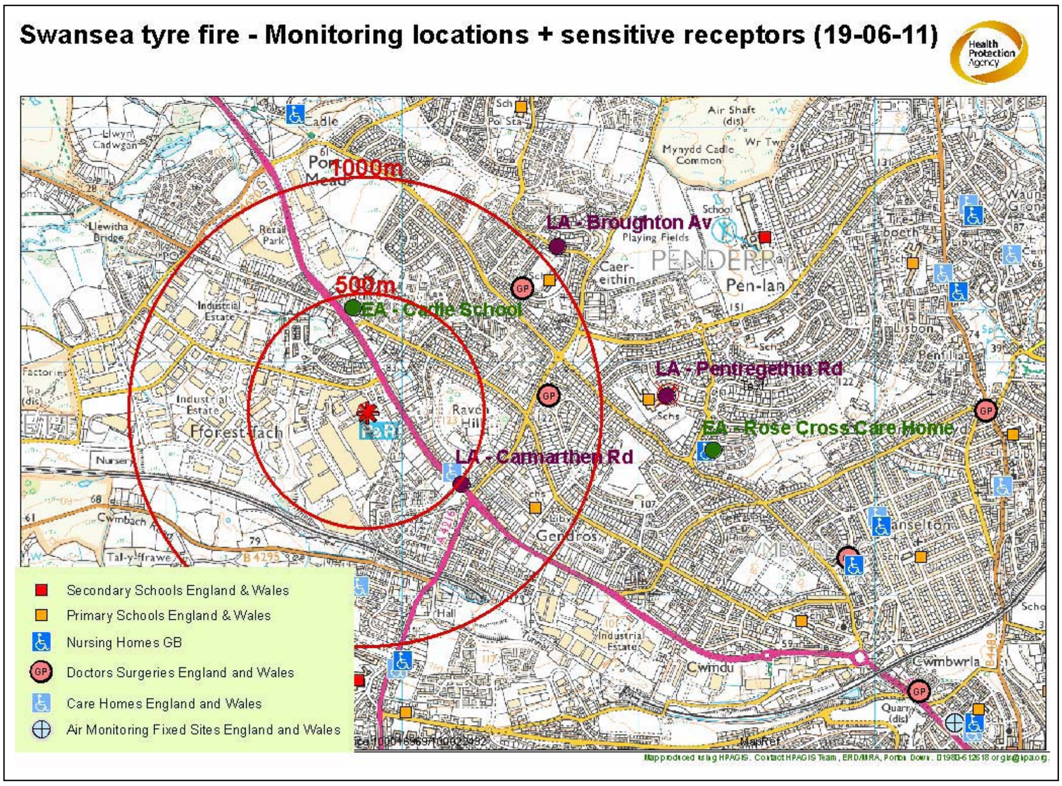

Figure 4: Map showing air quality monitoring locations and local sensitive receptors

Public health advice

The STAC considered 11 separate issues raised by the SCG concerning: ambient air quality monitoring, indoor air quality monitoring, triggers for shelter and evacuation, criteria for evacuees to return home, changing fire-fighting tactics, personal protective equipment and potential food-chain contamination. The following advice around precautionary triggers to inform decision-making for sheltering, closing public buildings and evacuation (based on pollutant concentrations, plume characteristics and modelled meteorological predictions) was probably the most significant output:

- Trigger to close public buildings: when outdoor concentrations of PM_{10} are predicted to be greater than an average of 160 $\mu g/m^3$ over a 24-hour period in an area then schools, nurseries, day-care centres and other similar facilities should be closed
- Trigger to evacuate: when outdoor concentrations of PM_{10} in an area have been greater than an average of 320 $\mu g/m^3$ over a 24-hour period and it is predicted that concentrations of greater than an average of 320 $\mu g/m^3$ will continue for at least another 24 hours, then adverse health effects are likely to be significant and evacuation should be considered.

The STAC advised that whilst levels suggested for pollutant concentration and duration of exposure were derived from the scientific evidence base, they should be interpreted and implemented in conjunction with other observations. In addition, decisions to allow evacuees to return home should not be based on a simple reversal of evacuation criteria.

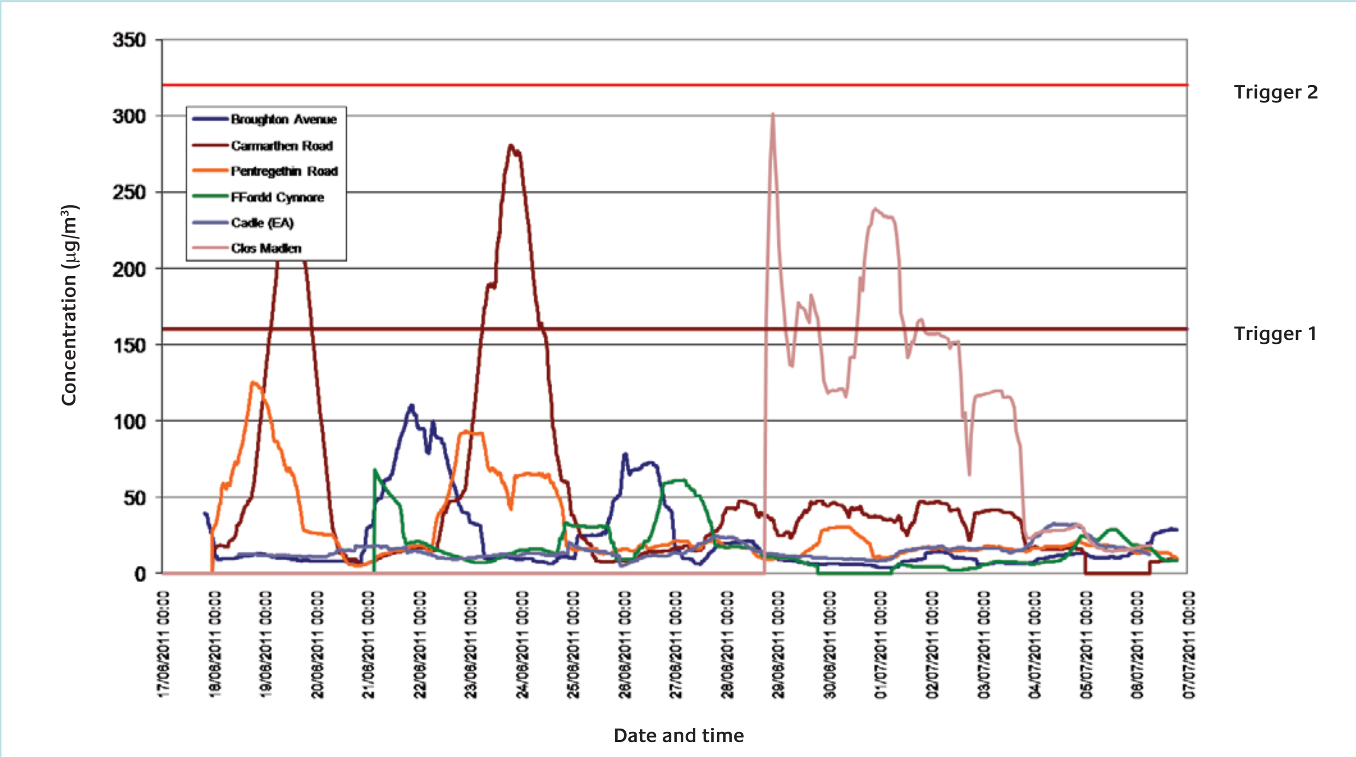

Figure 5: Ambient PM_{10} monitoring results (measured as a 24-hour running mean)

It was advised that a dynamic risk assessment approach would be required which should consider operational details of progress to date and future plans as well as actual and modelled pollutant concentration levels and trends and meteorological forecasts over a five-day period.

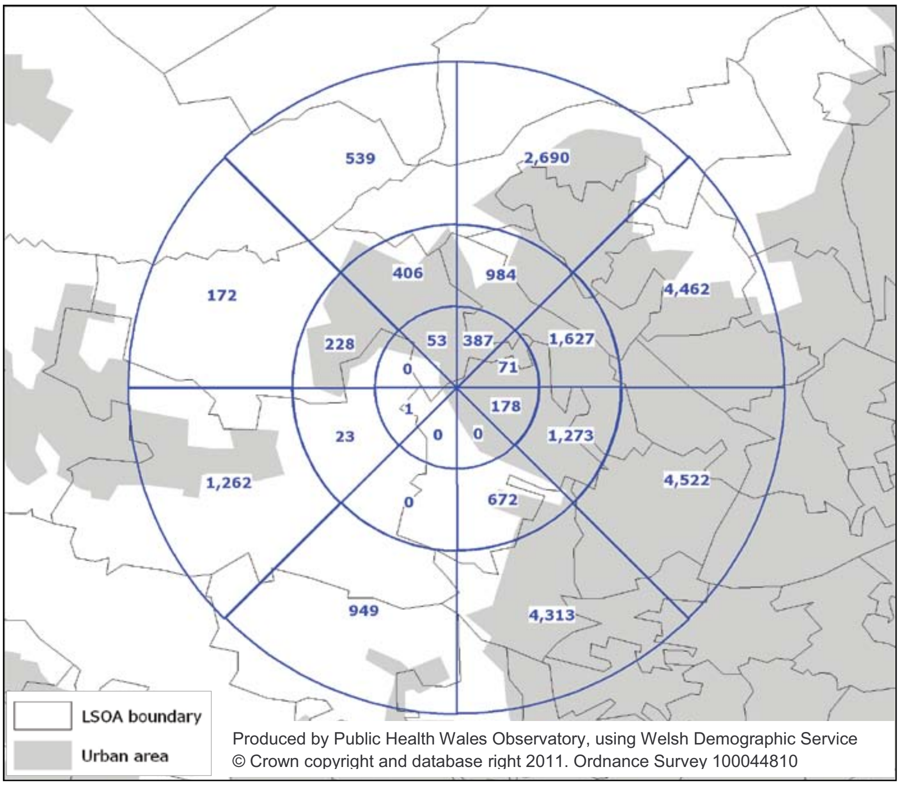

Figure 6: Population estimate (total population within a 500 m, 1 km and 2 km radius, 2008)

Discussion

Around 25,000 people within a 2 km radius, over a three-week period, were potentially affected by the plume resulting from the Fforestfach fire. Whilst further work is planned to determine and better understand the associated public health impacts, it is evident from the number of health concerns reported that incidents of this nature can adversely affect health and wellbeing.

In terms of incident response, evidence from the formal post-incident debrief carried out has recognised that there is a well-organised, committed and expert public health protection resource in Wales. The unique collaborative model established between Public Health Wales and the Health Protection Agency facilitates the best use of resources to provide integrated services. The debrief also highlighted the added value of notifying/engaging public health agencies early as they have a significant contribution to make to support the overall incident response.

This incident highlighted the importance of implementing a coordinated environmental sampling and monitoring strategy at the earliest opportunity to inform accurate risk assessments and communications. This is a crucial component in incident response and, whilst the air quality strategy implemented in response to this incident was well organised and effective, questions have been raised subsequently about the ability to sustain such a comprehensive response over a protracted period of time, and the capability across Wales to replicate the response in other areas where air quality monitoring resources are more limited. A lack of pre-agreed formal arrangements to coordinate environmental sampling and monitoring across agencies in response to incidents has also been raised as an issue warranting further consideration.

Table 2: Potential health effects by emission type

Emission type	Potential health impacts
Fine particulate matter	A link has been proven between particulate air pollution and respiratory and cardiovascular disease[11]. PM_{10}, the mass of particles of less than 10 µm diameter per cubic metre of air, are defined as the thoracic fraction of the ambient aerosol. This specifies those particles likely to pass through the upper airways of the nose, mouth and throat and which may be deposited, with varying efficiency depending on diameter, in lung airways and air spaces. Not only will particles vary in size (with the most health threatening being those finer particulates of 2.5 µm diameter or less), but also in composition; metal species such as vanadium, nickel, iron, zinc, chromium and arsenic are often present, as are inorganic and organic compounds[12] Short- and long-term PM_{10} exposure are consistently associated with cardiopulmonary morbidity and mortality and other ill-health effects. Associations are believed to be causal[13,14]. It is not currently possible to discern a threshold concentration below which there are no effects on health. Specific health effects associated with short-term exposure include lung inflammatory reactions, respiratory symptoms, adverse cardiovascular system effects, increased medication usage, hospital admissions and death. Long-term exposure may lead to increased lower respiratory symptoms, reduced lung function in children and adults, increased chronic obstructive pulmonary disease and lung cancer, and reduced life expectancy[11]. Within any large population, there is probably a wide range in susceptibility to disease. Some people are at risk even at low concentrations of PM_{10}[15]. This biological variability is important; those at greatest risk of ill-health effects associated with exposure to combustion products are those with pre-existing cardiopulmonary diseases such as asthma, chronic obstructive pulmonary disease, coronary heart disease and angina. Other susceptible groups include diabetics, pregnant women, newborn infants, children and the elderly In addition to the cardiovascular and respiratory effects amongst those with pre-existing conditions, evidence is building to suggest that PM_{10} exposure affects children's health. Exposure has been associated with deficits in lung function, lung function growth, increased respiratory illness and symptoms, increased school absences and respiratory disease hospitalisations. Literature reviews of air pollution and various birth outcomes generally suggest that there may be effects of ambient PM_{10} air pollution on birth outcomes and child health, but that these effects are not well understood. In long-term studies, it has been suggested that particulate matter has a greater association with reduced life expectancy in socially disadvantaged groups, and reduced lung development in children[11]. Although the evidence is reasonably compelling that exposure increases the risk of infant mortality, especially post-neonatal respiratory mortality, there remain serious knowledge gaps regarding the potential effects of ambient PM_{10} on foetal growth, premature birth, and related birth outcomes[16] Fine and ultrafine particulates present in smoke plumes have a large surface area and, as such, may become coated or 'enriched' with contaminants in other combustion gases or the atmosphere including toxic metals, sulphur, polycyclic aromatic hydrocarbons and dioxins and furans[17]. Fine particles are known to stabilise biologically active, organic radicals that induce oxidative stress and DNA damage[18]. The combination of particulate-matter-borne, persistent organics and metals can lead to biological interactions which, in turn, can represent a possible mechanism for the genesis of cancer due to exposure to fine particulate air pollution[19]
Sulphur dioxide	Sulphur dioxide causes constriction of the airways of the lung. This effect is particularly likely to occur in people suffering from asthma and chronic lung disease. Sulphur dioxide is a precursor to secondary particulate matter and therefore contributes to the ill-health effects caused by PM_{10} and $PM_{2.5}$[20]
Carbon monoxide	Carbon monoxide reduces the capacity of the blood to carry oxygen to the body's tissues and blocks important biochemical reactions in cells. People with existing diseases which affect delivery of oxygen to the heart/brain are at risk
Heavy metals	Chromium is a widespread environmental contaminant and a known human carcinogen[21]. Other carcinogens include nickel and arsenic, toxic by inhalation, ingestion and skin contact[22,23]
Benzene	Benzene is a human carcinogen and so no safe level can be specified in air. Occupational studies of high exposures have shown an excessive leukaemia risk
Polycyclic aromatic hydrocarbons	Polycyclic aromatic hydrocarbons refer to a group of several hundred chemically-related environmentally persistent organic compounds of various structures and varied toxicity. Benzo[a]pyrene (BaP) is commonly used as an indicator species for polycyclic aromatic hydrocarbon contamination and most of the available data refers to this compound. Generally, they are toxic by inhalation, ingestion or skin absorption; carcinogens, mutagens and reproductive toxins; long-term inhalation can cause a decrease in lung function, chest pain and irritation, long-term skin contact can cause dermatitis and warts; BaP is thought to probably cause lung and skin cancer in humans[24]
Polychlorinated dibenzo-*p*-dioxins and dibenzofurans	Dioxins and furans are ubiquitous environmental contaminants but are by-products of both anthropogenic and natural combustion processes. Dioxins refer to a group of 210 compounds with similar chemical structures but greatly varying toxicity, the most toxic being 2,3,7,8-tetrachloro-dibenzo-*p*-dioxin (TCDD) and most of the available data refers to this compound. Dioxins are toxic by inhalation or ingestion. Human ingestion of dioxins can lead to adverse effects on the skin, including chloracne, skin rashes or discolouration, and excessive body hair. Changes in the blood and urine, liver damage or changes in hormone levels may also occur. Exposure to very high levels of dioxins may cause vomiting, diarrhoea, lung infections and damage to the nervous and immune systems. TCDD is classified as causing cancer in humans and produces a range of toxic effects on reproduction relating to both fertility and developmental toxicity in animals[25]

This incident afforded valuable opportunities to gain experience by engaging public health staff, particularly those working at the multi-agency tactical and strategic levels. Those involved in the STAC developments also found the experience particularly valuable. There were also opportunities for those public health professionals working outside health protection to gain incident response experience – for example, from the disciplines of health development and health intelligence.

Lessons and further work

Ways in which emergency plans (internal and multi-agency) can be improved have also been identified, mostly through improving communication networks and infrastructures. Lessons learned are being incorporated into existing plans to ensure effective responses to any future incidents.

The longitudinal nature of this incident informed the development of guidance to support incident response. The STAC issued considered advice that can be used as a reference point for future incidents. In addition, the incident has been a driver for research with two epidemiological follow-up studies being undertaken to determine impacts on local population health. The first, currently underway, is a cross-sectional survey to assess psychological health impacts associated with the Fforestfach fire, explore the effectiveness of communications and identify a cohort of individuals that can be followed up in the future. The second study, to commence in June 2012, will seek to determine the impacts of the fire on acute and chronic health outcomes within the local population, using routinely collected information held in health and other datasets.

The incident has also given rise to some more practical learning outcomes. For example, a working group has been established through emergency planning structures in Wales to identify other waste tyre sites, undertake risk assessments and work with site owners to minimise associated risks. This work has already led to the identification of other high priority risk sites where preventative measures are currently being implemented. Experiences, lessons learned and best practice will continue to be shared and disseminated via forthcoming multi-agency emergency planning, preparedness and response training activities.

Acknowledgements

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Burton Latimer – an air quality cell case study

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Background

The air quality cell (AQC) is a virtual, multi-agency advisory group, chaired by the Environment Agency, which can be convened within two hours during a major incident to coordinate air quality monitoring and modelling. Partners include the Environment Agency, Health Protection Agency, Met Office, Health and Safety Laboratory, Food Standards Agency and other organisations providing specific expertise as required. It aims to provide timely, interpreted air quality and air modelling information to the scientific and technical advice cell (STAC) (if convened) or to a multi-agency incident coordinating group in order to inform the assessment of public health risks.

Activating the air quality cell (AQC)

The AQC is activated by agreement between air quality experts in the Environment Agency and the Health Protection Agency (HPA). The following criteria should be met in order to activate the AQC:

- Major incident where a strategic (gold) or tactical (silver) multi-agency coordinating group (SCG or TCG) has been set up
- Fire, explosion or chemical release
- Known hazards that the AQC has the capability to monitor for
- Significant public health risk
- Duration of incident is expected to be longer than six hours[1].

Incident overview

On the evening of 11 October 2011, the HPA Centre for Radiation, Chemical and Environmental Hazards (CRCE) was notified of a large fire at a waste processing and recycling centre in Burton Latimer, Northamptonshire. This was the second incident at the site in three weeks and was significantly larger than the first, involving up to 30,000 tonnes of mixed bailed recyclable waste, including plastics, paper and fabrics. The incident escalated rapidly and, on the morning of 12 October, CRCE became involved to support the incident management. An on-site, multi-agency coordinating group was convened on the same day, which comprised representatives from the fire and rescue service, police, the Environment Agency, the local health protection unit, primary care trust, CRCE, and local authorities who met regularly throughout the incident.

The site is located in a mainly agricultural area approximately 1.5 km to the south west of Kettering. A row of isolated residential properties were situated approximately 130 m to the north west of the fire. The main residential areas of Cranford St Andrew, Burton Latimer and Barton Seagrave are located approximately 1 km from the site. In response to the large plume of smoke from the fire and the numbers of complaints being received locally from residents, businesses and schools, CRCE and the Environment Agency agreed on 12 October, to activate an AQC to inform the risks to public health.

The AQC operated for 24 hours, during which time off-site grounding of the smoke plume appeared to be minimal. During this period the plume direction also switched from moving towards the east to moving towards the west. Monitoring for pollutants within the smoke was undertaken at two primary school locations selected by CRCE and the Environment Agency, based on their proximity to both the plume and sensitive

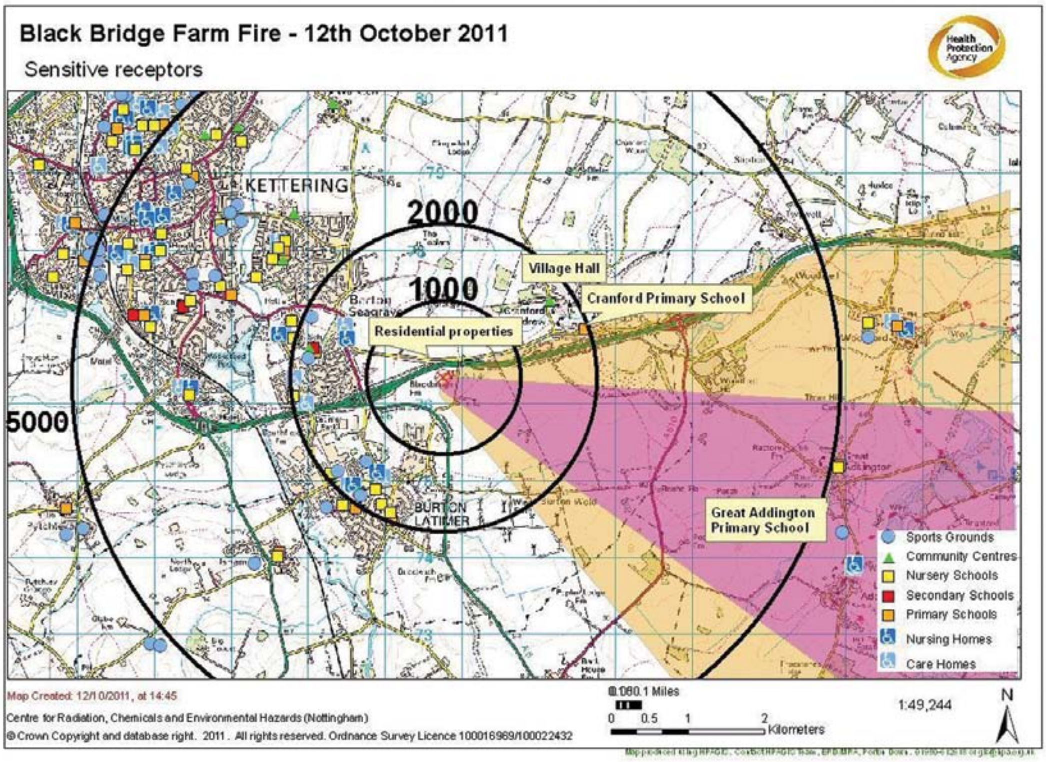

Figure 1: Site location relative to sensitive receptors and the monitoring locations with Met Office CHEMET plots for the afternoon of 12 October

receptors. Figures 1 and 2 show the incident location relative to sensitive receptors and monitoring locations, overlain with plume plots (CHEMET output), provided by the Environment Monitoring and Response Centre (EMARC) of the Met Office for the monitoring periods.

A summary of the AQC monitoring results is provided in Box 1.

Initial monitoring data indicated that significant health effects were unlikely and general health messages relating to exposure to smoke, as shown in Box 2, were provided jointly by the HPA and Northamptonshire PCT to the multi-agency coordinating group on the morning of 13 October.

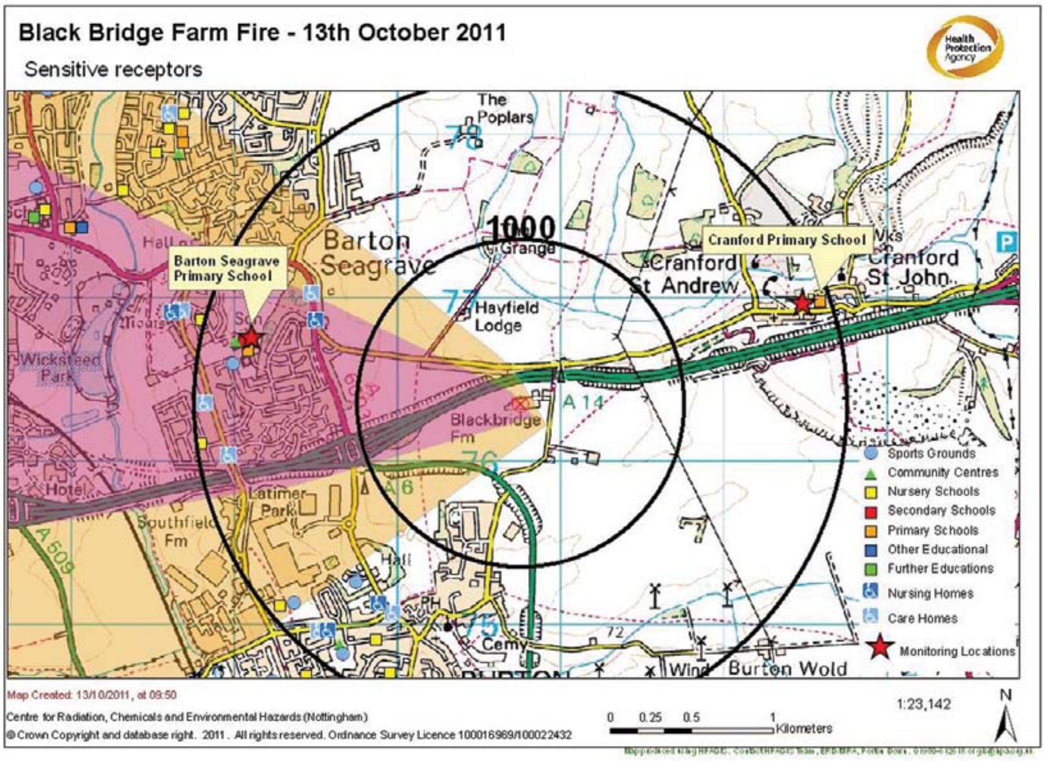

Figure 2: Site location relative to sensitive receptors and the monitoring locations with Met Office CHEMET plots for the morning of 13 October

Box 1: Summary of monitoring results

Location 1: Cranford St John Primary School, undertaken between 12/10/11 16:51 and 13/10/11 06:13

There were limited intervals of increased PM_{10} (particulate matter with a diameter of equal to or less than 10 μm) levels above background detected. The highest level recorded was 67 μg/m^3 and the average concentration was determined as ‘low’ using Defra 24-hour bandings[2]

Monitoring of gaseous substances showed no species significantly above the instrument’s limit of detection

Location 2: Barton Seagrave Primary School, undertaken between 13/10/11 09:05 and 13/10/11 11:22

Some intervals of increased PM_{10} levels above background were detected. The highest level detected was 164 μg/m^3 and the average concentration would be determined as ‘low’ using Defra 24-hour bandings[2]

Monitoring of gaseous substances showed only toluene significantly above the instrument’s limit of detection. The reported levels of toluene were determined as below acute exposure guideline levels[3] but capable of causing a detectable odour

Box 2: Health messages provided on the morning of 13 October

Any smoke can be an irritant and as such, if people need to be outdoors, they are advised to avoid outside areas affected by any smoke or ash, or to limit the time that they spend in them

Some of the substances present in smoke can irritate the lining of the air passages, the skin and the eyes. Respiratory symptoms include coughing and wheezing, breathlessness, sputum (phlegm) production and chest pain. If symptoms occur, people should seek medical advice or call NHS Direct on 0845 4647

Chemicals in the smoke can worsen existing health problems like asthma. People with asthma should carry their inhalers

The results of the further monitoring undertaken at Location 2 were made available in the late morning of 13 October and reinforced the original assessment that health effects were unlikely. The existing health advice was considered to remain appropriate.

On completion of the monitoring at Location 2, AQC members considered that sufficient data had been gathered to demonstrate that the incident did not present a significant risk to human health, provided that the health advice was adhered to. The AQC was then stood down whilst Northamptonshire Fire and Rescue Service continued to tackle the fire.

The fire and rescue service response was limited by the capacity of the site’s drainage with run-off having to be collected by interceptors and tankered off-site. Fire fighting continued for four weeks, during which time the smoke plume characteristics were affected by widely varying meteorological conditions.

Appropriate health advice on the incident was conveyed to local GPs by the PCT. Northamptonshire Fire and Rescue Service published a flyer summarising fire-fighting actions and continued to issue information via Twitter, Facebook, the county council website, and pre-recorded updates via a press-line. The operator also provided regular updates to the media and coordinated a series of community update meetings at various venues in the local area which were attended by multi-agency representatives.

As the incident entered its second week, the multi-agency coordinating group received reports of public concern about risks relating to smoke lingering at ground level at nearby residential properties. HPA advice was sought with regard to the resumption of air quality monitoring. Discussions between CRCE and the Environment Agency resulted in agreement that further monitoring was not necessary for the acute phase of the incident as it would be unlikely to contribute any additional knowledge which would alter management of the incident or the public health messages. This decision was relayed to the multi-agency coordinating group.

In response to the reported public concern, updated health messages shown in Box 3 were provided jointly by the HPA and Northamptonshire PCT to the multi-agency coordinating group on 28 October 2012.

The fire was extinguished on 10 November when smoke emissions ceased. The multi-agency coordinating group was disbanded and ongoing issues were to be managed by the Environment Agency as the regulator for the site.

Box 3: Updated health messages provided on 28 October

The Health Protection Agency and NHS Northamptonshire continue to assess the potential impact of this fire on the health of local residents. Air quality testing at the height of the fire did not find significantly raised levels of pollutants and indicates that the risk to health is low

Exposure to smoke can cause irritation and those most at risk are people with existing respiratory problems such as asthma and chronic bronchitis, or heart problems. People with pre-existing respiratory conditions may experience a short-term worsening of their condition if exposed to smoke and are therefore advised to keep their inhalers with them as a precaution

If people are affected, short-term effects are likely to be those such as coughing, wheezing or a tight chest. These symptoms usually disappear soon after exposure has ceased and are unlikely to result in any long-term health problems

Our precautionary advice to residents in areas affected by smoke is that they should remain indoors and keep their doors and windows closed, where possible. People are advised to avoid outside areas affected by smoke, or to limit the time that they spend in them. People in areas unaffected by smoke need take no further action but may wish to open doors and windows once smoke has passed

We will continue to closely monitor the situation and will provide further updates and advice if the situation changes

For general health advice or advice on managing symptoms, people should contact NHS Direct on 0845 4647 or **www.nhsdirect.nhs.uk/**

Key issues and points of note

- In the early stages of the incident, lack of information on the scale of the incident and absence of a multi-agency coordination reporting structure led to a delay in determining if the AQC criteria were fulfilled allowing deployment. Once these issues were clarified, the AQC team was deployed promptly within four hours. It is therefore vital that full information is sought and shared promptly with appropriate stakeholders to ensure rapid activation of the AQC response
- Over the course of the incident response, it became clear that the role and capabilities of the AQC were not fully understood by multi-agency group members. Further multi-agency awareness events to promote understanding of AQC capabilities and its limitations amongst emergency responders are therefore needed
- AQC data was useful in providing public reassurance during the early stages of the incident. However, for much of the 24-hour AQC monitoring period, a combination of the meteorological conditions and the buoyancy of the heated smoke plume appeared to prevent any significant grounding beyond the site boundary
- Very little in the way of real-time daily subjective assessments of the smoke plume characteristics such as density, location, duration or grounding were made during the incident. In future similar incidents, it is important that multi-agency coordinating groups continue to recognise that the AQC process does not replace dynamic subjective assessment in informing public health decision-making
- While the HPA has a clear role in activating the AQC in conjunction with the Environment Agency in the acute phase of an incident, any subsequent air quality monitoring is not covered by the AQC arrangements. In prolonged incidents, it is at the discretion of local authorities or multi-agency groups to commission further air quality monitoring. The HPA is usually asked to provide comment on any monitoring undertaken by external providers but interpretation of such data is influenced by the methodology, weather conditions and duration of monitoring undertaken. Consideration should be given to whether the HPA should be more involved in advising the local authorities/multi-agency groups in commissioning the most effective methods to monitor air quality when appropriate
- Over and above regular real-time visual plume assessments, the role of air quality monitoring in sustained fire events is unclear, especially when it is conducted outside the standard AQC arrangements. It is worth considering whether the HPA or AQC should make clear recommendations on any subsequent monitoring that is undertaken by multi-agency groups or local authorities.

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Chemical fatality and self-harm incidents: managing the risk to public health

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Background

Since 2008, Japan and the United States have reported a sudden increase of attempted suicides using chemicals[1]. In the period between 27 March and 15 June 2008 there were 220 reported cases of attempted suicide involving toxic gas in Japan, resulting in 208 deaths. In many of the incidents, emergency responders and neighbours in adjoining properties have also been affected. In one tragic case[2], a 14 year old girl committed suicide in her bathroom, which resulted in the evacuation of 90 residents in neighbouring apartments and the hospitalisation of her mother and a number of her neighbours. It was reported that the girl had accessed information detailing how to mix the chemicals from a website, and had affixed a warning sign to the bathroom door stating 'do not open, poison gas being produced'.

Recent incidents in England and Wales

A review was undertaken in England and Wales to identify the number of self-harm incidents and chemical fatalities reported to the Health Protection Agency (HPA). Data entered on the Chemical Incident Surveillance System (CISS) and its successor, the Chemical Incidents Reporting Programme (CHIRP) database, for the period January 2007 to December 2011 were extracted and analysed. The search focused on incidents involving toxic gases. The results of the review are illustrated in the figure. The graph highlights the recent increase in the reporting of these types of chemical incidents; however, it is likely that in the past there has been an under-reporting of incidents due to a less heightened awareness.

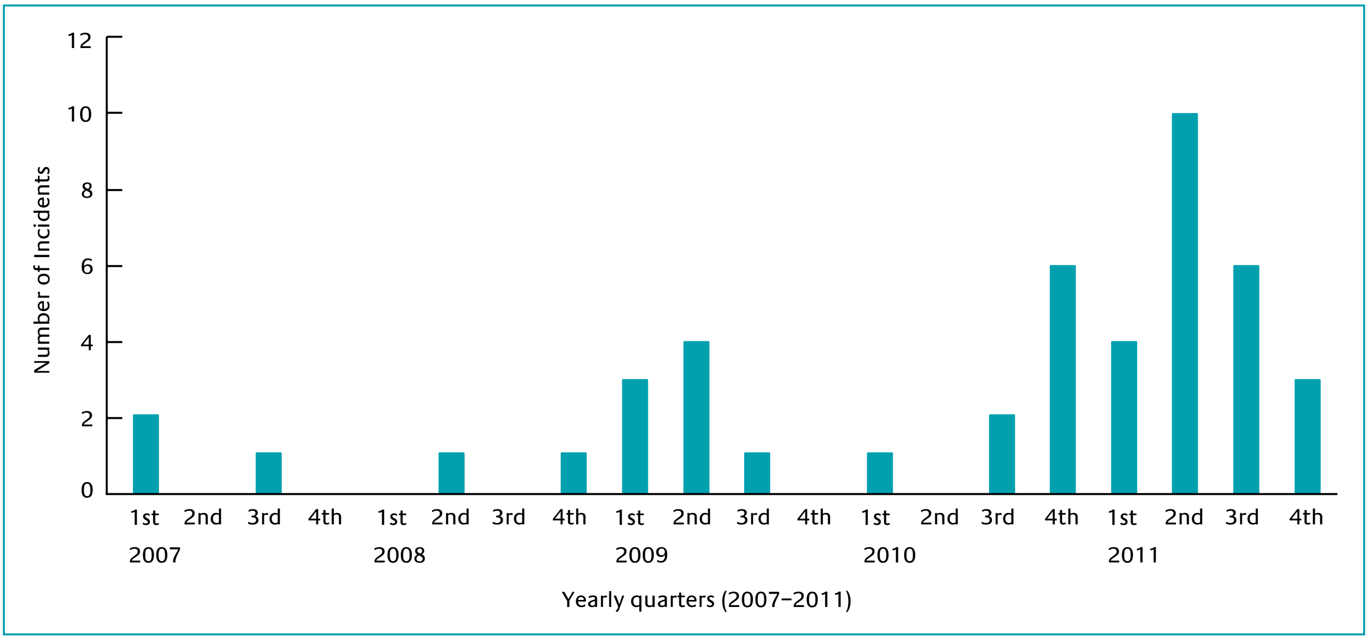
Overview of 'HPA guidance on the management of chemical fatality and self-harm incidents'

Evidence of an increase in chemical fatality and self-harm incidents involving chemicals has led to the development of HPA guidance, consistent with current emergency service protocols, to assist in the management of the potential health risks associated with these incidents. The aim of the guidance is the provision of practical advice for emergency responders and medical personnel to reduce the risk of secondary contamination and exposure. For example, the potential risks to those engaged in administering first aid and any subsequent treatment need to be identified early and appropriate measures taken. The guidance, which has been endorsed by the police, fire and ambulance services, can aid the development of local operating procedures.

The guidance document addresses the management of incidents resulting from:

- Ingestion of a potentially toxic chemical substance
- Inhalation of a toxic gas.

The document considers the risk to public health, emergency responders and hospital staff due to exposure to the original chemical or reaction products. The risks from secondary exposure and contamination are likely to differ significantly between these two scenarios. The following key points are considered.



Deliberate self-harm incidents for England and Wales reported to the HPA (January 2007 to December 2011)

1 Roles and responsibilities

The role of the HPA is to assess the risk to public health and provide advice to manage the risk. This will include advice on the health effects of exposure to chemicals, the need for monitoring and interpretation of data, and the need for clean-up and decontamination.

2 Risk assessment

- Identification of the source (e.g. substance used and chemical form, quantities involved, potential reaction by-products and resultant hazards)
- Route of exposure and potential for secondary contamination
- Location of the incident
- Significance of any reported symptoms (patient/bystanders/ responders)
- Timings of the incident (e.g. when it happened and potential duration of exposure).

3 Acute phase response

Considerations for emergency responders and hospital personnel, for example:

- Secondary contamination and potential routes of exposure
- Use of personal protective equipment (PPE) and the need for adequate ventilation
- Decontamination considerations
- Considerations for hospital emergency department personnel on admission of the patient.

In the case of a fatality, considerations for management of the deceased, for example:

- Use of chemical-resistant body bags
- Advice for the coroner, funeral homes and undertakers.

4 Clean-up and recovery

The objective of clean-up is to minimise secondary contamination and exposure to the original substance and to reduce toxic gases produced. Key points for consideration include:

- Need for clean-up and recovery
- Who will arrange clean-up and meet any clean-up costs
- Use of appropriate cleaning products and procedures.

Recent case study using the guidance

The HPA was contacted by the ambulance service after the death of a member of the public who had ingested a chemical substance defined as toxic by ingestion, inhalation and through skin contact. CRCE confirmed the substance had the potential to react with stomach acid to form a toxic gas. Hence, there was the potential risk of exposure to the chemical and reaction by-products from residual chemicals and contaminated bodily fluids present at the scene, and the off-gassing body. The local ambulance service, police, and fire and rescue service were all present at the scene.

The HPA was initially contacted regarding concerns of ambulance personnel who first attended the scene, and their potential for exposure due to limited PPE. The ambulance personnel had not moved the body, been in contact with any bodily fluids, or experienced any symptoms during the subsequent five hours, therefore their concerns were allayed.

The HPA was subsequently contacted by the police requesting advice regarding the management of the deceased. Following discussion with a pathologist with expertise in chemical fatalities, due to the involvement of a chemical not commonly used for intentional self-harm and the risk of off-gassing from the body, CRCE advised a precautionary approach should be taken, with the body placed in a chemical-resistant body bag before removal from the scene. Numerous conversations between CRCE and the police followed, with advice provided including where to obtain a chemical-resistant body bag and the use of appropriate PPE when handling the body. Following some confusion over whose role it was to handle the body, police CBRN officers were tasked with placing the body in the bag. The police raised a number of questions regarding the need to decontaminate their equipment following removal of the body from the premises. Advice based on the properties of the chemical was provided by CRCE. Police concerns regarding the need to evacuate neighbouring properties were also addressed, with the risk assessment based on knowledge of the quantities of chemicals reported at the scene. Additionally CRCE highlighted the need for ventilation of the property and appropriate clean-up, which was completed by a private contractor.

Additional questions were raised by the undertaker and coroner regarding transportation considerations, the use of a specialist mortuary, and the need for a post mortem. The HPA benefits from having links with a pathologist with expertise in chemical fatalities who was able to advise: from a transportation perspective, the need for a precautionary approach was emphasised, with the body ideally transported in a ventilated van to a category three mortuary having an air exchange system capable of extracting any chemicals off-gassed from the body. The pathologist recommended a post mortem was not undertaken, with blood analysis considered sufficient to confirm the cause of death. The undertaker raised concerns including the possibility of contamination of soil following burial of the body, and whether this might present a risk in circumstances where the grave needed to be reopened for future burials. Reassurance was provided by CRCE due to the minimal risk of contamination from the limited quantities of the chemical involved and in the soil.

Discussion

In the above example, a precautionary approach was taken during the management of the body and scene and, consequently, no other individuals were affected by the chemical involved. However, these types of incident can have potential health implications for emergency responders and the wider public due to the risk of secondary exposure and contamination. During any incident it is important for a dynamic risk assessment to be undertaken throughout. The assessment may change as the casualty is moved from the scene and transported, either to hospital for treatment or to a mortuary and, subsequently, funeral home/undertakers once released by the coroner. The case study illustrates the importance of early identification of the chemical involved to determine the potential risk of exposure from off-gassing, particularly if the chemical is not commonly used as a means of intentional self-harm.

At the multi-agency debrief held following the incident, the 'HPA guidance on the management of chemical fatality and self-harm incidents' was considered a useful tool by all the agencies involved. The majority of local responders who had been involved in the above example had not previously been involved in a chemical fatality incident, and it identified a number of gaps in their operational procedures which needed to be addressed. The potential for mixing chemicals to produce a toxic gas, or off-gassing from the body and contaminated bodily fluids, had not previously been considered or documented and there was a lack of knowledge around the use of chemical-resistant body bags and where these could be obtained. The need for multi-agency training in responding to such incidents was highlighted. Following the debrief the local ambulance service, police and fire service produced a joint protocol for responding to chemical fatality and self-harm incidents, detailing the role and responsibilities of their respective agencies. The HPA guidance document was referred to during the production of this protocol.

Acknowledgement
Robie Kamanyire for his contribution to the guidance document.

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Review of incidents occurring at COMAH sites in England and Wales, January 2009 – June 2011

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Introduction

This report builds on the previous review of incidents at sites subject to the Control of Major Accident Hazard (COMAH) Regulations[1] logged by the Centre for Radiation, Chemical and Environmental Hazards (CRCE) between January 2005 and December 2008 (published in issue 16 of the CHaP Report[2]). It remains the case that incidents reported at COMAH sites form a very small proportion of the total number of incidents that are dealt with and logged by CRCE. For the majority of these COMAH-associated incidents direct impacts are restricted to within the boundary of the site itself; only a fraction report effects off-site. When symptoms are reported off-site these are typically ocular and respiratory irritation related to emissions to air arising from releases or fires. Nevertheless, incidents at COMAH sites have the potential to significantly impact public health and there is no room for complacency. Recent incidents could have led to more serious consequences and it is important that the Health Protection Agency (HPA) maintains its work in this area. When incidents occurred at COMAH sites, CRCE's awareness of their COMAH status appears to have improved, yet there is still room for improvement. Four pragmatic suggestions are made for future work and emphasis is placed on the importance of HPA staff ensuring that air quality cell (AQC) arrangements are detailed in off-site plans and are understood by responding organisations.

Methodology

A total of 2,227 logged incidents were extracted from CHIRP (Chemical Incidents Reporting Programme) and the predecessor Chemical Incident Surveillance System for the period 1 January 2009 – 6 June 2011. To produce a list of potential COMAH-associated incidents, incident postcodes were matched against Health and Safety Executive (HSE) and HPA lists of COMAH sites, together with a keyword search of all CHIRP data fields. Each log entry was then reviewed, and summary information was collated based on all incidents that were confirmed to have occurred at a COMAH site. Fuller details of this approach can be found within the previously published CHaP Report article[2].

Results

COMAH-associated incidents form a very low percentage of the total number of incidents logged by CRCE; 0.02% (84 of 3,899) during the earlier review period, falling to 0.01% (22 of 2,227) during the current review period. There were 22 COMAH-associated incidents identified from 01 January 2009 to 06 June 2011. This equates to 1.3 incidents per month when averaged across the reporting period, a lower rate than was found by the previous review: 2.3 per month. An additional three entries related to COMAH exercises and eight entries related to incidents that occurred at a location that shared a postcode with a COMAH site, but was not the COMAH site itself. Figure 1 presents the cumulative number of incidents over the previous and current reporting periods.

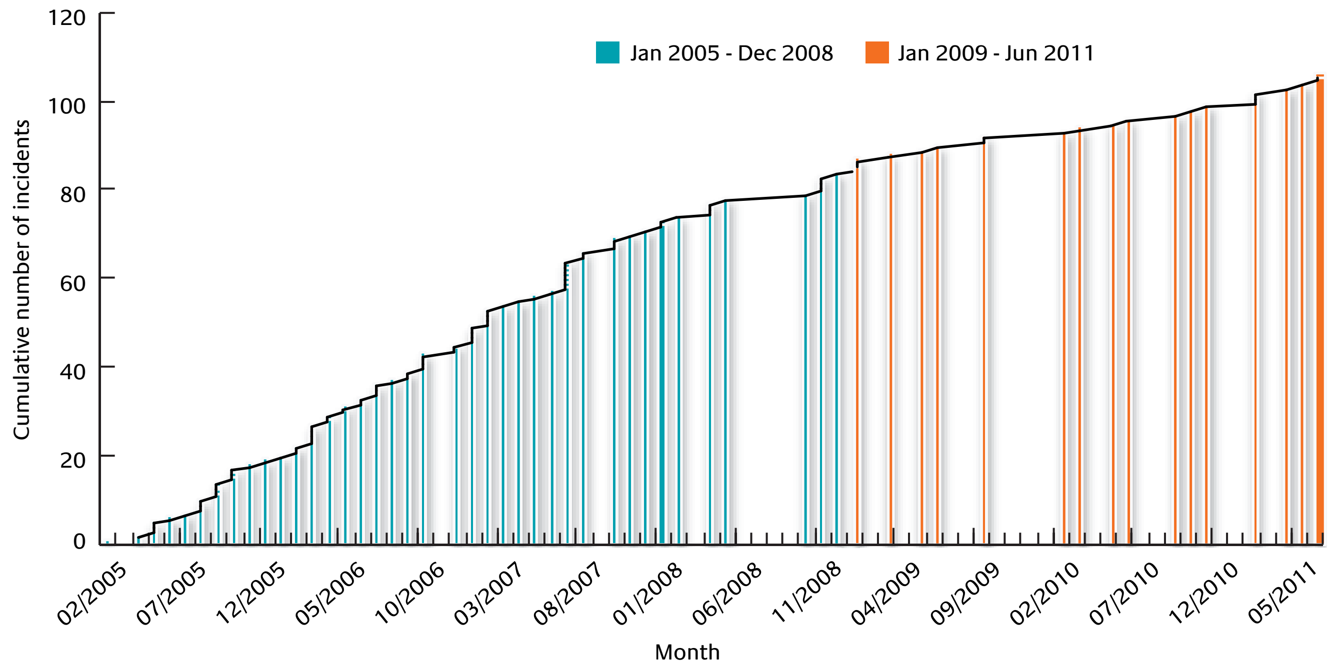

Figure 1: Cumulative number of incidents (January 2005 – June 2011)

Table 1: Impacts of incidents (percentages for the previous review period are presented in brackets for comparison)

Aspect	Jan 2009 – Jun 2011	(Jan 2005 – Dec 2008)
Upper tier	82%	(64%)
Out of hours	48%	(38%)
Flagged COMAH by CRCE	67%	(38%)
On-site effects	67%	(42%)
Decontamination advice	20%	(–%)
Shelter advice issued	25%	(15%)
Evacuation	14%	(12%)
Off-site effects	20%	(7%)
Fatalities off-site	0%	(0%)
Plan activated	5%	(0%)

Table 2: Air quality cell (AQC)

AQC involvement	Count
N/A (pre-AQC)	10
No	8
No (considered)	3
Yes	1

Table 3: Chemical involved

Chemical	Count
Products of combustion	4
Mixed solvents	2
Natural gas	2
Titanium tetrachloride	2
Boron trifluoride	1
Chlorine	1
Hydrogen sulphide	1
Lead sulphate	1
Nitric acid	1
Phosphorus pentoxide	1
Polyurethane pre-polymer	1
Sodium methylate	1
Toluene	1
Turpentine	1
Waste hydrocarbons	1
Unknown	1

The findings of the review of COMAH-associated incidents from the past 18 months differ in some areas when compared with the preceding 36 months, but caution must be employed in interpretation, due to the low number of incidents on which these percentages are based.

When incidents occurred at COMAH sites, CRCE's awareness of their COMAH status has improved, with a greater percentage of log entries demonstrating that staff were aware that the incident they were dealing with was occurring at a COMAH site. This may be due to ongoing CRCE work to map upper-tier sites and to provide central access to off-site plans for on-call staff, together with a raised profile for COMAH as a consideration when gathering information during incidents.

The latest review showed a greater proportion of reported incidents occurring at upper-tier, rather than lower-tier, sites. The fact that both reviews reported a higher proportion of incidents at upper-tier sites is likely to reflect the higher level of multi-agency preparedness and awareness of these higher hazard sites rather than their relative numbers; there are many more lower-tier sites in the UK than upper-tier sites (648 lower-tier compared with 363 upper-tier, according to HSE data from May 2011). It is likely that CRCE surveillance under-reports incidents at lower-tier sites, compared to upper-tier sites, as incidents at lower-tier sites are only likely to be notified to the HPA in the event of likely, or actual, impacts on public health. From 2009 there were only four entries related to lower-tier sites; two of these were not flagged by staff as being at COMAH sites. It is difficult to confidently conclude that this demonstrates that CRCE staff are less likely to be aware of sites subject to COMAH when these are lower tier, and hence do not have off-site plans, but this is plausible.

In terms of implications, a similar ratio of incidents with predominantly on-site effects was shown by both reviews. Whilst the updated review identified a higher percentage of incidents in which shelter advice was issued and in which there were off-site effects, the percentages alone do not give any inference as to the seriousness of potential or actual effects on public health. It remains the case that, of all logged COMAH-associated incidents, it is a relatively small proportion that leads to off-site effects and the majority are incidents in which impacts are restricted to within the area of the site boundary. It is often the case that when incidents lead to evacuation this is due to the risk of explosion or fire rather than the risk of exposure to a chemical.

CRCE remains unaware of any COMAH-associated incidents that have led to off-site fatalities since 2005, which is the earliest time from which data has been reviewed.

In common with the previous review, Figure 2 reflects the national distribution of upper-tier sites (as detailed in the previous review[2]), with the greatest number of incidents occurring in those regions with the most sites (the North West, the North East, and Yorkshire and Humber). Relatively fewer incidents were reported in Wales during this reporting period; Wales had a higher proportion of incidents during 2005 to 2008, due to repeat incidents related to a steelworks site.

Notification routes were not examined during the previous review. Figure 3 indicates that the most common alerting mechanism for CRCE was indirect alerting through the issue of a CHEMET[3]. When a CHEMET dispersion model prediction is issued by the Met Office, this is automatically forwarded to CRCE. Together with direct notification by HPA colleagues based in health protection units (HPUs), these routes formed the bulk of CRCE alerting to COMAH-associated incidents.

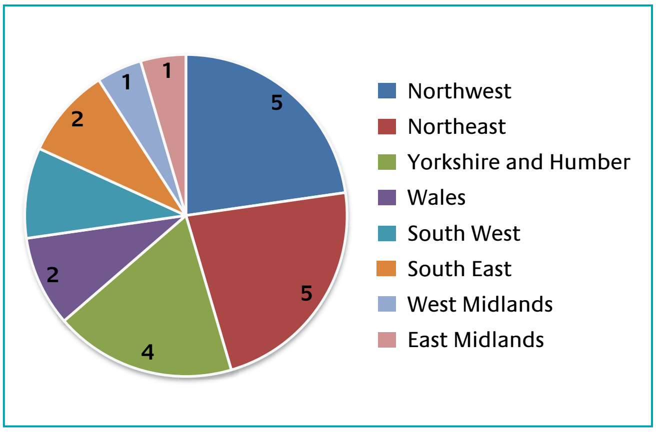

Figure 2: Incidents by region

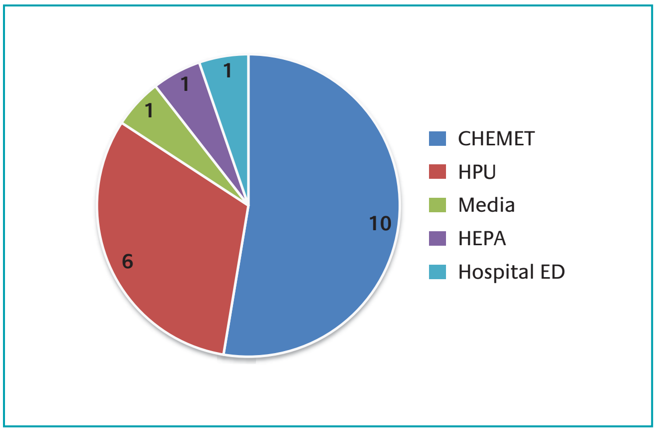

Figure 3: Incidents by CRCE notifier

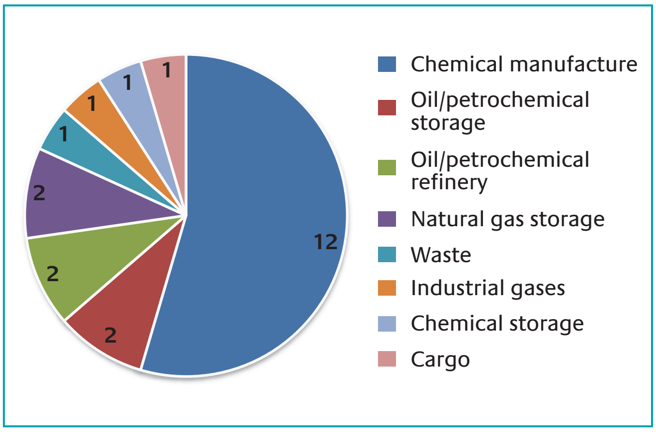

Figure 4: Incidents by industry type

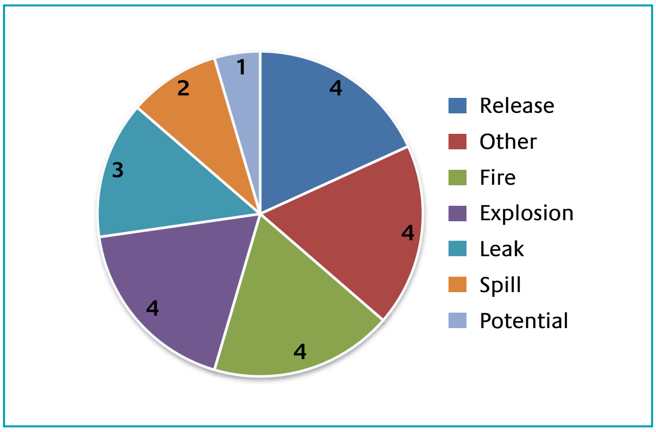

Figure 5: Incidents by incident type

The incidents attributable to different industry types (Figure 4) are consistent with the proportion of these industry types subject to the COMAH regime, i.e. COMAH installations include a large proportion of chemical manufacturers and handlers of petrochemicals and natural gas, so it follows that these industries are the ones most often reported in incidents. A notable change from the previous review is the absence of logged incidents related to steelworks. The previous review had reported a number of separate incidents related to two particular sites yet none was reported during the current period for those sites, which were operational over that time.

Leaks, spills and releases together form the predominant incident type in this reporting period (Figure 5), as was found by the previous review. The attributable share fell during the current reporting period, when there were comparably more explosion-type incidents reported. One 'potential' incident was reported in which there was no subsequent chemical release. CRCE was alerted to a number of 'other' incidents: these were predominantly odour complaints from members of the public or issues related to occupational exposures and decontamination by the health service.

Discussion

The qualitative information given within log entries is invaluable when examining impacts on health and weighing up the implications of COMAH-associated incidents for health organisations. Broad types of incident impact are summarised below, illustrated using examples from logged incidents identified in the review.

Incidents that resulted in no significant health impacts on or off-site (5/21)

- Most commonly associated with small leaks, releases of volatile materials and short-lived fires. A faulty valve at one site meant that toluene had to be decanted from one container to another; vapour was released and the emergency services were on standby
- During one incident a strong odour was reported that was linked to material on-site, yet there were no complaints or other off-site impacts
- A gas leak at a lower-tier gasholder was notified to the HPA but it did not result in evacuation or off-site impacts.

Incidents that resulted in on-site health impacts (5/21)

- An on-site explosion led to four fatalities on-site and was accompanied by media reporting that alerted CRCE prior to formal notification by the emergency services. The resulting fire was quickly controlled and there were no off-site impacts
- A night-time release of a toxic, denser-than-air gas led to employees self-evacuating but the operator did not alert the emergency services to the fact that a release had taken place. Off-site impacts were possible yet none was reported in this case
- Chlorine was released at a site, resulting in four staff showing respiratory symptoms
- Two crew members of a berthed ship were overcome by turpentine fumes and taken to hospital.

Incidents that resulted in on-site health impacts and indirect off-site health impacts (2/21)

- An explosion at a chemical manufacturing site injured two staff who were taken to hospital without decontamination. The hospital closed its emergency department whilst the site workers were decontaminated and treated. Advice on decontamination was sought from the HPA.

Incidents that resulted in evacuation or sheltering but for which there were no reported off-site health impacts (5/21)

- A fire occurred at a gasholder site that led to 600 people being evacuated as a precaution due to the risk of explosion. The HPA was not formally informed and found out about the incident via the media
- An explosion and prolonged fire led to the issuing of shelter advice and a school being asked not to open. An AQC was discussed but was considered unnecessary. There were no reported off-site effects
- A spill of fuming nitric acid and the potential for fumes travelling off-site led to the evacuation of a nearby school being considered. Preventative action at the site helped to mitigate the release; a shelter message was issued and no effects were reported
- A significant leak of mixed solvents at a waste company led to a 300 m exclusion zone being set-up. Residents and nearby workers were evacuated whilst the spill was cleaned up.

Incidents that resulted in complaints or the reporting of health impacts off-site (4/21)

- Plant shut-down and flaring of gas at a refinery was associated with widespread complaints of a sulphurous odour, with residents reporting headaches and respiratory irritation. The incident became a chronic issue involving multi-agency meetings and was resolved in time once the plant was repaired
- A large fire at a chemical manufacturing site led to the evacuation of two houses and two people presenting at hospital with respiratory symptoms. An AQC was called and local schools were advised not to open. After the fire was extinguished there were follow-up queries regarding fugitive emissions of powder from the site
- An explosion led to a chemical release from a site on the bank of an estuary. Three employees were exposed and taken to hospital, where hospital staff reported symptoms linked with secondary exposure and sought advice on decontamination. An off-site emergency was declared and the off-site plan was activated. Shipping was closed on the estuary and a ship that had passed through the chemical plume subsequently docked so that crew could be checked by paramedics
- A fire involving sodium metaperiodate at a chemical manufacturing site resulted in eye and respiratory irritation being suffered by five workers at a nearby industrial site due to exposure to products of combustion. The workers were treated at hospital.

It is important to bear in mind that this review examines the reported impacts of incidents rather than the potential impacts. From the examples above it can be seen that there have been a number of occasions where incidents had the potential to result in far more serious consequences.

Activation of the off-site plan

Two incident logs revealed situations where operators had not notified the emergency services of a release with the potential to lead to off-site impacts and that is clearly an issue of concern. Based on the incidents that were logged by CRCE during both review periods it appears that, whilst a number of small-scale incidents occurred at upper-tier sites during which one would not expect off-site plan activation, there have been a significant number of incidents that have resulted in off-site impacts for which there is no indication in the CRCE log that the off-site plan was activated, even though there were reported off-site public health impacts. In some of these cases the off-site plan could have been activated but this was either not communicated to the HPA or not made clear on the CRCE log. However, it appears that there have been a number of incidents at upper-tier sites where the plan has not been formally invoked, despite the formation of multi-agency tactical and strategic coordinating groups. This is an area that warrants more detailed consideration in future reviews. CRCE will work with HPUs and partners to examine such eventualities after incidents and during multi-agency debriefs.

Repeat incidents at a single site

Repeat incidents at a single site were again identified during the latest review period, in which two incidents were reported at one chemicals manufacturing site. In both cases material was released off-site and there was a potential risk to public health. The first was an incident with no reported on- or off-site impacts and the emergency services were not initially notified by the company. The second was a serious accident that led to the death of one employee and injury to two others. These incidents illustrate the importance of early notification (by operators) of the emergency services and HPA of incidents, and of COMAH operators fully participating in emergency planning and response.

Transport

In common with the previous review, transport remains a factor in a number of incidents, with one associated with loading/unloading of a berthed ship at the jetty of a COMAH site and another involving the driver of a tanker falling ill whilst on-site (although this latter case was found to be unrelated to a chemical exposure). Transport infrastructure can be impacted by incidents, as well as being associated with an incident's cause; in two other incidents, shipping traffic in the Humber estuary was disrupted due to chemical releases from a site on the bank of the Humber.

Air quality cell (AQC)

Since the inception of the AQC arrangements, one COMAH-associated incident has resulted in an AQC activation, with activation considered during a further three incidents, where trigger criteria were not met. Although AQC consideration and activation is taking place in response to incidents at COMAH sites, older off-site plans may contain little or no detail regarding AQC arrangements, which went live in April 2010. It is important that organisations with a role in incident response are aware of the AQC's role and remit.

Incidents in proximity to COMAH sites

Eight log entries were related to incidents that occurred at a location that shared a postcode with a COMAH site, but was not at the COMAH site itself. Only one of these entries showed an awareness of the incident's proximity to a COMAH site. These incidents could have affected the COMAH sites nearby to varying degrees: they ranged from small, short-lived fires to controlled burns and a fire near to a fireworks depot, for which a 600 m exclusion zone was set up in which there was an adjoining upper-tier site. It is important for staff to consider the location of COMAH sites when dealing with unrelated incidents in the vicinity, as there could potentially be knock-on effects. HPA geographical information system mapping can be used to identify the locations of upper-tier sites.

Conclusions and proposals

The updated review reports results consistent with those of its predecessor. Both reviews may under-report the actual number of COMAH-associated incidents. This is because there may have been logged incidents for which the postcode was incorrect or absent, or for which no part of the log made reference to the fact that the incident location was a COMAH site. Omissions from site lists held by the HPA will also contribute to under-reporting of incidents.

For the majority of these COMAH-associated incidents direct impacts are restricted to within the boundary of the site itself; only one-quarter report off-site effects. When symptoms are reported off-site these are typically ocular and respiratory irritation related to emissions to air arising from releases or fires. When incidents lead to evacuation this is more commonly associated with the risk of explosion or fire rather than exposure to a chemical.

Whilst incidents at COMAH sites form a very small proportion of the total number of incidents that are dealt with and logged by CRCE, they have the potential to significantly impact public health and there is no room for complacency. Recent incidents could have led to more serious consequences and it is important for the HPA to maintain its work in this area. Incidents are just as likely to occur in and out of hours and it is important that the HPA response to either is equally robust.

Four pragmatic proposals for future work

1. There is room for improvement in terms of HPA awareness of the COMAH status of sites when incidents occur at a site or close by. HPA incident logging systems should be integrated with COMAH site location data held by the HPA so that site proximity is automatically highlighted when acute and chronic environmental issues are logged. Incidents can also occur in the vicinity of COMAH sites that have the potential to lead to domino effects and flagging of nearby sites when entering logs would improve awareness of this.
2. Both reviews have shown that repeat incidents do occur at individual sites, although they are rare. It is advisable for routine surveillance to include regular checks to identify problem sites where there may be the potential for future incidents and for which proactive engagement with stakeholders and preventative action could be beneficial.
3. Although AQC consideration and activation is taking place in response to incidents at COMAH sites, older off-site plans contain little or no detail regarding AQC arrangements, which went live in April 2010. It is therefore important that this is considered when plans are reviewed and updated. Staff should ensure that partner organisations are aware of the AQC's role and remit. Sites may have their own modelling and monitoring capabilities and it is important that these are detailed within the off-site plan together with an explanation of how the operator will communicate this information to responding organisations.
4. Future incident review papers should widen their scope to identify the time between the start of an incident and notification of the HPA, and to canvass HPA staff to establish more clearly whether off-site plans should have been activated and whether they were activated during each incident.

References

1 The Control of Major Accident Hazards Regulations 1999. Available at http://www.legislation.gov.uk/uksi/1999/743/made

2 Stewart-Evans J. A review of Health Protection Agency involvement in incidents occurring at sites regulated under the Control of Major Accident Hazards (COMAH) Regulations. CHaP Report 2010; 16: 8–11. Available at http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1263812796194

3 Met Office. Chemical Meteorology (CHEMET). Available at http://www.metoffice.gov.uk/publicsector/CHEMET

Emergency Planning and Preparedness

Public health response to chemical incident emergencies

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Introduction

The public health response to chemical incident emergencies toolkit (CIE Toolkit) is a European Union (EU) part-funded project, which involves a collaborative effort between partners from Poland, Greece, Sweden, the Netherlands and the United Kingdom. The main objective of the project is to reduce the burden of disease relating to chemical emergencies through an improved public health response. This is to be achieved by facilitating a rapid and efficacious response to acute chemical incidents by providing a source of relevant material and expert guidance, in the form of a toolkit and a training manual, enabling member states to address specific training needs.

The importance of developing training material for the public health management of chemical incidents was highlighted through a project survey, which sought the views of public health practitioners from across member states in relation to their educational training and personal experience in managing chemical incidents. This survey indicated that a lack of formal training had been undertaken by many public officials involved in managing chemical incidents. Further information about this survey and the other project outputs can be found on the websites created for the project. These sites can be accessed at www.hpa.org/cietoolkit and http://cietoolkit.fs-server.com/ (Figure 1).

Overview of the CIE Toolkit

The development of the toolkit comprised five key activities, which are briefly summarised below.

1 Development of a set of exercise cards

A suite of exercise cards for chemical incident scenario training has been developed. These training cards are designed for table-top exercises, whereby an exercise director facilitates discussion on a scenario, from the planning and preparedness stages, through to the response and recovery stages of an incident. The exercises are designed to be undertaken by multi-agency public health professionals and to be followed by an evaluation or 'debrief' to ensure that issues identified by the exercise can be resolved: for example, through improving emergency response plans or for input into future training.

2 Environmental epidemiology and monitoring follow-up

The CIE Toolkit aims to provide a source of epidemiological information and guidance for public health professionals who are required to use their public health expertise in the investigation of environmental exposures caused by chemical incidents. As producing individual questionnaires for the thousands of known chemical substances in conjunction with various incident scenarios is not a realistic goal, the project team decided to target the identification of possible generic scenarios of a chemical release which could be applicable to the most

Figure 1: CIE Toolkit website presenting the outputs of the manual: more features are given to registered members through the topics and forum tabs

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CHEMICAL INCIDENTS EMERGENCIES TOOLKIT

likely situations where public health professionals are asked to provide advice following a chemical incident in a timely and effective manner. The project team concluded on the following four scenarios:

- Chemical release to air or land from an industrial accident or a natural incident, e.g. arising from accidents at Seveso II industrial sites, large-scale fires, natural occurrences (e.g. volcanic ash plume) and deliberate release of a chemical agent
- Chemical release to water sources and water supplies, e.g. industrial accident leading to contamination by fire-fighting run-off water, deliberate poisoning of drinking water supplies
- Chemical contamination of food and drink, e.g. dioxins in meat, benzene in bottled mineral water, melamine in powdered milk
- Chemical contamination of consumer goods, e.g. lead content of toys, fungicide-treated furniture.

More information on this subject is available in the members' login area of the CIE Toolkit website at http://cietoolkit.fs-server.com/.

3 Risk and crisis communication

The public perception of risk can often be inappropriate and inconsistent. The objective of this work area therefore is to improve the reliability of messages communicated between health care responders and affected populations following a chemical incident or emergency, in order to increase public confidence and promote behavioural compliance. Thus, risk communication is aimed at helping people make more informed decisions about threats to their health and safety. This work was conducted in four stages:

- A literature review exploring risk perceptions and current behavioural responses to health impacts of chemical incidents (planned and accidental), the impact of risk communication messages on these variables, and existing programmes for responding to chemical incidents
- Focus groups with health care responders to determine their information needs and concerns through the course and aftermath of a chemical incident, as well as their knowledge of existing plans for responding to the event and communicating with members of the public
- Survey of members of the public – to complement the work of the focus groups, a survey has been conducted amongst members of the public in order to ascertain their information needs and concerns through the course and aftermath of a chemical incident, as well as their levels of trust of and predicted behavioural response to existing emergency response plans and messages identified during the focus groups. The survey obtained feedback from the general public regarding the type of information and support they feel needs to be provided in the event of a chemical incident. The survey was conducted in the UK and in Poland, thus addressing the differences between Western and Eastern Europe as well as social and cultural differences within individual countries
- Guidance for risk communication provided in a series of mini-risk-fora group discussions with emergency responders from across a range of emergency services such as the police, fire and ambulance services. The purpose of these meetings was to convey to these public health officials the information needs of members of the public, and how that information could be communicated.

4 Psychological consequences and care of affected populations

There is an urgent need to provide guidance and training to cover the psychosocial provisions required during and after a chemical incident (i.e. the provision of general welfare support) and to manage the potential post-traumatic effects of an incident. Training material and exercise scenarios addressing the psychosocial aspects of chemical incidents and disasters have been developed to improve preparedness and response to the psychosocial needs of those affected. In addition, a practical handbook for public health managers and mental health managers has been developed that provides an overview of the current knowledge on preparedness and post-disaster health care (Figure 2). The manual discusses how to manage the psychosocial aspects of a crisis.

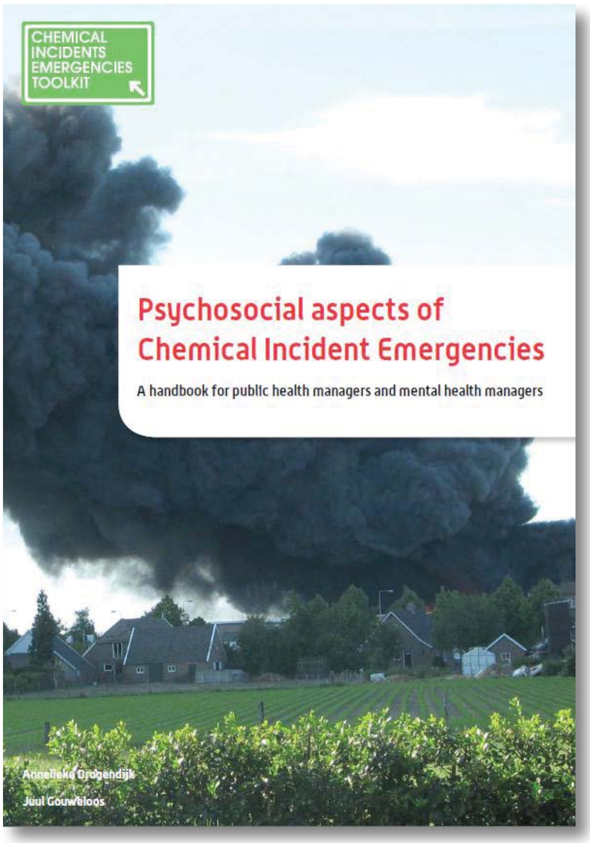

Figure 2: Handbook for public health managers for psychosocial aspects of chemical incidents, produced as part of the CIE Toolkit

5 Guidelines for conducting exercises

A workbook consisting of 10 topics, along with accompanying documents, has been produced to help public health professionals design exercises that test emergency response plans for chemical incidents. After working through each of the 10 workbook topics, participants provide the equivalent of an exercise planning report, which can be used by exercise planners to define the aims, objectives, participants, scenario and events of their exercise. This workbook would therefore be appropriate for professionals designing an emergency preparedness exercise, as a useful guide in the early stages of exercise planning and development.

Work presentation and availability

The project partnership has presented the outcomes of this project at a number of conferences including the 3rd Joint European Public Health Conference (October 2010) hosted by the European Public Health Association and Association of Schools of Public Health in Europe, which were attended by an audience of public health professionals. A subsequent workshop was held in Greece in April 2011, where delegates from 10 European countries were able to view and evaluate the CIE Toolkit. The presentations from this workshop, along with comments on the available lecture notes, have been made available on the CIE Toolkit webpage at www.hpa.org/cietoolkit.

Conclusions

The outputs of this project have been the production of a toolkit and manual which contains guidance documents and further information to help users, through the:

1. Development of a set of exercise cards using scenarios which can be used in table-top training exercises involving multidisciplinary and multi-agency groups for scenario training
2. Development of model protocols and questionnaires to promote a common approach across Europe to deal with environmental epidemiology and monitoring follow-up requirements after an acute chemical incident
3. Increased understanding of risk and crisis communication requirements across Europe to help the communication process following an acute chemical incident
4. Increased understanding of psychological consequences and care of affected populations following a chemical disaster, to include communicating with the public regarding their needs
5. Provision of generic guidelines for conducting exercises involving major chemical incidents.

The basis for a network of experts has also been created by the project team. The network of experts will consist of a variety of public health experts with specialist knowledge of chemical incident emergency planning, preparedness, response and recovery. This network will be available to deliver advice and guidance and to assist with the delivery of training courses, including courses to meet the needs of individual member states and 'train the trainer' courses. Guidance will also be provided on how to access international assistance in the event of a major chemical incident. For more information about the network or the project, please send an email to the CIE Toolkit mailbox at cietoolkit@hpa.org.uk or, alternatively, contact Mark Griffiths or Raquel Duarte-Davidson.

Chemical and Radiation Risk Assessment Network (CARRA-Net): coordinating the international response to European transboundary incidents

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Background

Should a similar incident to the large fire at Buncefield (UK, 2005) occur in the future in mainland Europe at a location close to several national borders, then a cross-border public health response would have to be activated in the affected neighbouring countries. This immediately raises a number of questions. How would the multinational public health response to such an incident be dealt with? Additionally, how would risk assessments be conducted and risk mitigation measures be agreed and implemented? How would follow-up investigations be conducted and coordinated?

Currently, the procedures across the European Union for a coordinated multinational response to chemical incidents with cross-border impacts are very limited (although a response network known as European Community Urgent Radiological Information Exchange Network (ECURIE) exists for radiological incidents). The Chemical and Radiation Risk Assessment Network (CARRA-Net) project was funded by the European Commission to address the questions above. The objective was to draw on existing resources and schemes and develop these into a response system for both chemical and radiological incidents, although this article considers only the chemical aspects of this work.

The stakeholders and wider European context of the CARRA-Net project are explained further in the box.

CARRA-Net – European context

Health Security Committee-Network (HSC-Network)
This is a network of senior representatives of public health bodies, with representation from all EU member states, who would act as risk managers should there be a chemical incident that has the potential to have cross-border significance. The UK is represented by the Department of Health. The 'risk managers' are assisted in their work by 'risk assessors' in member states. Senior staff at the HPA (as well as other relevant experts) provide this role

Rapid Alerting System for Chemical incidents (RAS-CHEM)
RAS-CHEM is an IT platform which, once implemented, will enable poisons centres (and, with time, other public health chemical responders) across Europe to communicate and share information on interesting and/or potentially cross-border chemical incidents. It is also used as an alerting system for the HSC-Network of risk managers and risk assessors. RAS-CHEM has five alert levels, corresponding to the level of risk, with levels 3 to 5 relating to the more serious chemical incidents

International Health Regulations (IHR)[1]
The International Health Regulations (2005) provide a basis for the notification of major incidents with international implications via the network of WHO national focal points (NFPs). While primarily aimed at infectious disease incidents, it will also be used for the notification of major chemical and other types of incident

DG SANCO
This is the EU directorate with responsibility for the health of consumers (SANté et COnsommateurs). It has a broad remit to ensure that laws on food, product safety and wider public health issues are applied. It sponsors a number of projects in the area of public health security and is particularly concerned with serious cross-border health threats

Introduction

There is a variable response to chemical and radio-nuclear* incidents across the EU, especially where those incidents have the potential to be of cross-border significance. For events affecting or with the potential to affect public health, a number of legal requirements are in place for the notification of neighbouring countries of incidents that could affect them and to facilitate mutual sharing of information, such as the International Health Regulations (IHR) and the United Nations Economic Commission for Europe Convention on the Transboundary Effects of Industrial Accidents[2].

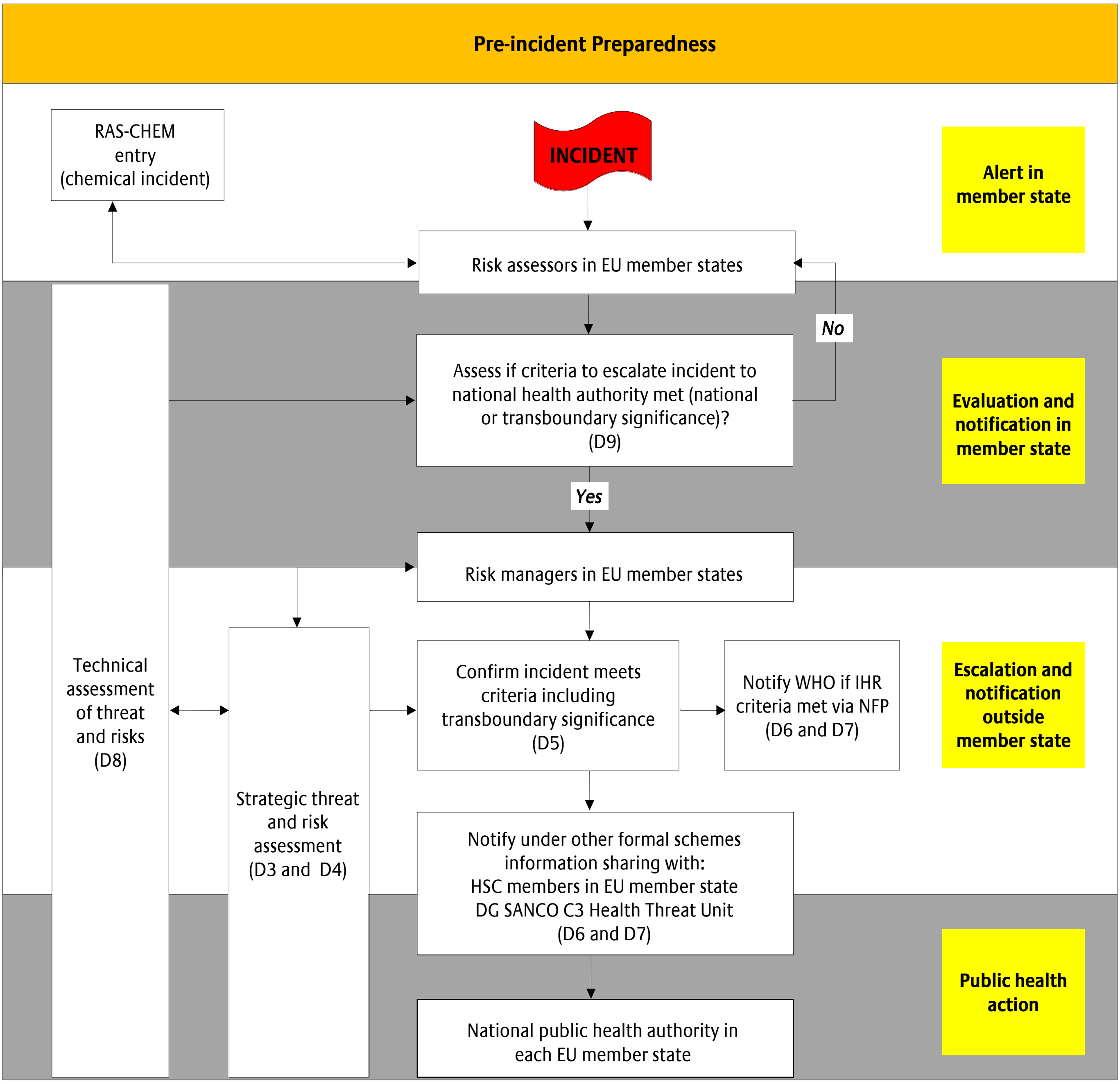
Efforts to develop European notification systems to promote a rapid response to either radiological or chemical events have been successful, with the European Community Urgent Radiological Information Exchange (ECURIE) Network, and the Rapid Alerting System for Chemical Incidents (RAS-CHEM). In the latter case, whilst the RAS-CHEM application has been developed, it has not yet gone live and requires a set of standard operating procedures (SOPs) and guidelines to govern its implementation and management. There remains a need to strengthen a shared approach to the risk assessment and management of chemical and radio-nuclear incidents, and one means to achieve this is through the establishment of an EU network of member state risk managers† and risk assessors‡ (HSC-Network).

Once implemented, the primary public health risk assessment is performed by risk assessors within a member state. Risk assessors determine if criteria for notification to the national public health authority are met, as well as whether or not the incident meets the definition of a cross-boundary incident (see the figure and Table 1).

* A radio-nuclear event is defined as a radiological emergency or incident involving the release of radioactivity into the environment from an accidental or deliberate event, including the movement of radioactively contaminated products and foodstuffs within and between countries.

† European Union member state national public health authorities are represented by risk managers who are responsible for sharing information with other risk managers and who collectively comprise the HSC-Network. The HSC-Network members are charged with strategic management of risks with cross-border significance and following up public health events flagged up by national health risk assessors.

‡ Risk assessors are defined as persons who support the risk manager by notifying events that have national and cross-border public health significance. They provide ongoing technical assessment of public health risks.



CARRA-Net deliverables for chemical incident response (abbreviations D3 to D9 above relate to separate delivered outputs from the project)

If so, they liaise with and inform risk managers, who are the national representatives of the Health Security Committee (HSC), and prepare risk and threat assessments to support discussion and decision-making at member state level.

The principal responsibility of risk managers is the validation, evaluation and, where appropriate, escalation of the incident outside their member state (e.g. through the HSC-Network or the World Health Organization, WHO), along with implementation of public health protection measures within their own country.

Through the CARRA-Net project, incident risk assessment templates and supporting technical information have been prepared for risk managers and risk assessors. The main objectives of the CARRA-Net project were to implement a consistent approach to the risk assessment and management of transboundary chemical incidents. These encompassed:

- Development of standard operational procedures (SOPs), protocols, criteria and guidelines to:
  - trigger a threat assessment for an incident
  - share information within the appropriate network(s) responsible for public health during chemical events
  - trigger the risk management process by activating the appropriate authorities
- Consolidation and provision of risk assessment tools and information for the response to cross-boundary chemical threats
- Facilitation of information sharing between EU member states through their existing risk assessment and risk management networks.

Deliverables are detailed in the figure. Deliverables D3 to D9 refer to separate delivered outputs from the project.

Table 1: Proposed criteria for the notification of a chemical incident to the national public health authorities and examples

Seriousness of the public health impact: an incident involving a release of a chemical substance which directly results in any of the following consequences	Examples
1 Two or more fatalities among members of the public	Ruptured vessel on board a tanker travelling to a European destination releasing a volatile solvent affecting members of the public passing by with three fatalities
2 Six members of the public hospitalised for 24 hours	Children on holiday from several member states overcome by chlorine in a swimming pool – evacuated to hospital for observation
3 The evacuation or sheltering of 250 or more members of the public for more than two hours or for longer periods where the product of people and time (hours) exceeds 500	Large-scale tyre fire, close to a national border persisting for several days and potentially exposing a nearby population to products of combustion (i.e. particulates, PAHs, irritant gases)
4 The interruption of drinking water supplies, or utility services (such as electricity, gas or telephone services) to more than 500 people for more than two hours or for longer periods where the product of people and time (hours) exceeds 1000	Overdosing of aluminium sulphate flocculant resulting in acidified water supply and leaching of metals from plumbing into drinking water supplying more than one member state. 'Do not drink' notice issued for 24 hour period to a population of several hundred
5 An incident logged on RAS-CHEM at level 3, 4 or 5 and where the seriousness of the incident has been verified by the national public health authority	Ajka aluminium plant accident in Hungary: alkali sludge spill resulting in nine deaths and 122 injuries along the River Danube. RAS-CHEM level 4
6 An incident considered by the national public health authority as having potentially serious public health implications (e.g. UK chemical incidents identified on the Incident Emergency Response Plan at level 3, 4 or 5)	Mercury contamination of skin lightening creams in products sold across the EU
7 A notification under RASFF (the EU Rapid Alert System for Food and Feed) in which a member state 'considers the existence of a serious direct or indirect risk to human health deriving from food or feed'	Dioxin contamination of German feed and its presence in exported eggs
Unusualness of the incident	
8 An incident logged on RAS-CHEM at level 2 which has been verified by the national public health authority as constituting an incident that is sufficiently unusual to warrant national public health attention	Icelandic volcanic eruption reported on RAS-CHEM on 21 April 2010 at alert level 2
9 A consumer product logged onto RAPEX (the EU Rapid Alert System for Non-Food Consumer Products) database for a chemical reason where there is at least one incident involving one member of the public	In March 2006 the German poisons centres raised an alert about the potential public health threat posed by the 'Magic-Nano-Incident': 97 incidents were reported to poisons centres in Germany over three days, with symptoms including respiratory distress and in some cases pulmonary oedema following the use of two similar 'nano' sealing sprays from the same manufacturer. The suspected cause was identified and the product withdrawn from the market in Germany (within 36 hours). Consumers were warned not to use these products in press releases and very few incidents were reported after March 2006
Risk of international spread	
10 Epidemiological evidence, case history information, media reports etc of similar occurrences/poisonings leading to impacts in other member states	Hydrogen sulphide fatalities reported in more than one EU country as a result of self-harm information published on the internet
11 Possibility of cross-border migration of a chemical agent, either through air (e.g. smoke plume), water (e.g. contaminated rivers), movement of people (e.g. contaminated casualties) or goods (e.g. contaminated consumer goods)	Release into the environment of chemically contaminated toxic mud from a burst lagoon in Hungary: alkali sludge spill resulting in nine deaths and 122 injuries along the River Danube
Significant risk of international travel or trade restrictions	
12 A similar chemical event in the past has resulted in international restriction in trade (e.g. withdrawal of contaminated consumer goods) and/or travel (e.g. large smoke plume/volcanic ash cloud)	Dimethylformamide contamination of leather sofas imported from China
13 The source of the chemical incident is a food or drink, or any other goods that might be chemically contaminated, and has been exported/imported to/from other member states	Benzene in Perrier water (1990): this was thought to be an isolated incident where a worker made a mistake in the filtering procedure
14 The event occurred in association with an international gathering or in an area of intense international tourism	CBRN incident at a major sporting final
15 The event caused requests for information by foreign officials or the international media	EU nationals on holiday in an active volcanic region being contaminated with volcanic ash dust after a surprise eruption, and expressing health concerns

Examples of the types of chemical incidents that could have trans-boundary impacts are shown in Table 2. Whilst chemical contamination incidents of food and feedstuffs and chemical contamination incidents involving consumer products have their own formal EU procedures – known as the Rapid Alert System for Food and Feed (RASFF) and the Rapid Alert System for Non-Food Consumer Products (RAPEX) – these schemes lack cross-boundary public health engagement procedures as they are aimed more at recalling contaminated items. The CARRA-Net project provides a specialist addition to these schemes.

Table 2: Scenarios and chemical groups considered

Scenarios	Examples
Releases of chemicals/ by-products from fixed or mobile sites	Incidents occurring at a chemical plant or fixed installation (e.g. explosion, large-scale fire, release of pressurised liquids or gases), large-scale chemical spillages or chemical leaks on transport routes, natural occurrences (e.g. volcanic ash plume) and deliberate releases
Contamination of drinking water supplies	Lagoon failures, contamination by fire-fighting run-off water, deliberate or accidental poisoning of drinking water supplies or drinking water resources such as rivers used for abstraction
Chemical contamination of food and drink	Dioxins in meat, benzene in bottled mineral waters, melamine in powdered milk
Chemical contamination of consumer goods	Lead content of toys, fungicide-treated furniture

The project has developed criteria that define 'serious' chemical incidents and incidents that have 'transboundary potential'. These identify which chemical events need to be flagged to national public health authorities. The proposed criteria take into account notification criteria and requirements under the IHR as well as acknowledging existing notification and alerting networks (e.g. RAS-CHEM and UNECE). One recognised difficulty with applying IHR criteria to chemical incidents is that they have been derived for infectious disease outbreaks, and therefore some of the terminology requires re-interpretation for chemical events*. Table 1 shows the criteria proposed for chemical incidents, in each of the four main areas flagged by IHR, namely 'seriousness', 'unusualness', 'international spread', and 'travel and trade restrictions'. Under IHR, meeting specified criteria within two of these four areas constitutes a need for notification; the relevant IHR national focal point (NFP) must make an appropriate notification to WHO and other WHO NFPs in other states will also be notified. However, within the context of this project, if a risk assessor considers that any one of the criteria in Table 1 has been met, they have the responsibility to notify the national risk manager. Once an incident meeting any of these criteria is notified to the national public health authority/risk manager, an assessment needs to be carried out to confirm whether notification to other member states is required. A chemical incident is considered to have transboundary significance if one of the following incident descriptions apply and one of the three considerations below is also met.

* This was examined during 2011, when a number of multinational exercises involving transboundary chemical incidents were carried out under the code word IRIDIUM. Elements of the CARRA-Net project were tested in these exercises and found to perform well.

Incident descriptions

- If a verified entry on RAS-CHEM at alert levels 3, 4 or 5 meets either point 3 and/or point 4 (i.e. international spread and/or travel or trade restrictions) of the qualifying criteria in Table 5.1 (Annex 2 of the IHR 2005 notification criteria)
- If under the UNECE Convention on transboundary accidents a chemical incident is reported under an 'Assistance Request Report' on the Industrial Accident Notification Scheme
- If an alert on the RASFF system concerns a chemical contamination incident which concerns a food or drink commodity which has been on sale and consumed in several member states
- If an alert on the RAPEX system concerns a chemical contamination incident which concerns a consumer product which has been on sale and has the potential for the public to be exposed to the contaminant in several member states.

Considerations for cross-border significance

Consideration 1: Geographical location of the incident

- Within 1 km of a border
- Within 1 km of a major water course, crossing a national border
- Within 1 km of a water course used as an abstraction point for water supplies to a neighbouring country
- Within 1 km of a major transport route (road or rail) between countries, and so potentially affecting cross-border movement
- Within 1 km of a major airport, so potentially affecting air traffic movements.

Consideration 2: Evidence or suspicion of cross-boundary spread

- Results from predictive modelling of plume movement or dispersion via water
- Monitoring results from neighbouring countries indicating potential cross-boundary impacts
- Visual observations, e.g. direction of plume movement
- Media reports/internet reports of concerns in more than one member state
- Unusual clinical symptoms or occurrences in more than one member state, which may be linked to a chemical incident.

Consideration 3: Potential for movement between member states

- Contamination detected in a food product which could be or has been exported to or imported into a member state
- Contamination detected in consumer goods which could be or have been exported to or imported into a member state
- Contamination of a vehicle used for transportation between member states (e.g. airplane, ship, boat, train, bus or lorry) where people may potentially have been exposed.

What next?

The EC plans to take the CARRA-Net outputs forward by developing more formalised notification and response procedures to chemical incidents across the EU. To facilitate this, a call for proposals for a 'Decision on serious cross-border health threats to human health'[3] was published in December 2011 aiming to:

- Streamline and strengthen the EU capacities for responding to serious cross-border threats to health

- Ensure coordination between member states
- Require consultation between member states in their preparedness and response planning
- Expand the remit of the early warning systems, risk assessments and surveillance and monitoring systems beyond just communicable diseases, to include health threats from biological, chemical, environmental and other unknown origins.

Acknowledgements

We would like to thank Vicky Silvey for developing the CARRA-Net database of risk assessors and risk managers. We would also like to thank Sam Watson, Jamie Bond, Stacey Wyke-Sanders and Naima Bradley for peer reviewing the reports prepared for the European Commission. We also gratefully acknowledge the European Commission for funding this specific contract (SC 2010 61 21, implementing Framework Contract No. 2009 61 05).

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Developing a health risk assessment training scheme in Europe: the Risk ASSETs™ project

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Introduction

Health risk assessment is an essential public health tool widely used in health protection and regulatory contexts to inform risk management decisions and to help protect public health. However, in recent years, concerns have been expressed over the apparent shortage of trained risk assessors in Europe, the effects this may have on the sustainability of risk assessment advice at European Union, national and private sector levels[1], and the lack of suitable training opportunities available for scientists to gain expertise and qualifications in risk assessment[2]. With this in mind, the European Commission recently supported the Risk Assessment and Management – European Training (Risk ASSETs™) Programme project to assess training needs and develop a proposal for a European health risk assessment training programme. The project comprised:

- Assessment of the profile and training needs of health risk assessors
- Development of a learning, knowledge and skills framework
- Development of health risk assessment training material
- Development of a proposed administrative framework for the training programme.

This report summarises the main results of the project.

Health risk assessors and their training needs

The profile of health risk assessors was established through a survey of over 300 risk assessors from across Europe[3]. In Europe, a majority of health risk assessors are in full-time employment in academia, industry, a national government department or agency, or consultancy, and tend to work in a professional or supervisory/managerial role. A proportion (approximately 10%) of health risk assessors are studying full-time at doctoral level. Health risk assessors come from a wide variety of professional backgrounds, with the majority holding post-graduate qualifications in subjects such as the biosciences, chemistry, environmental science, engineering, public health and toxicology. As such, the majority of health risk assessors tend to acquire their health risk assessment expertise whilst employed, through on-the-job experience, self-directed study and attendance at short courses. The principal drivers for undertaking health risk assessments are European and/or national legislation, public health protection, research and product safety.

The training needs of health risk assessors can be broadly divided into technical and non-technical training needs[3]. The technical training needs of health risk assessors entail the knowledge and skills they need to acquire to meet the technical requirements of their individual jobs, to comply with legislative health risk assessment requirements and to ensure a high level of public health protection. A review of relevant European legislation and surveys of health risk assessors identified that the technical knowledge and skills required to carry out their roles comprised eight broad areas:

- Underlying science involved in health risk assessment (e.g. chemistry, environmental science, epidemiology or toxicology)
- Data gathering, evaluation and presentation skills
- Hazard classification
- Dose-response assessment
- Exposure assessment
- Risk characterisation
- Overall assessment of risks
- Reporting and communicating risk assessments.

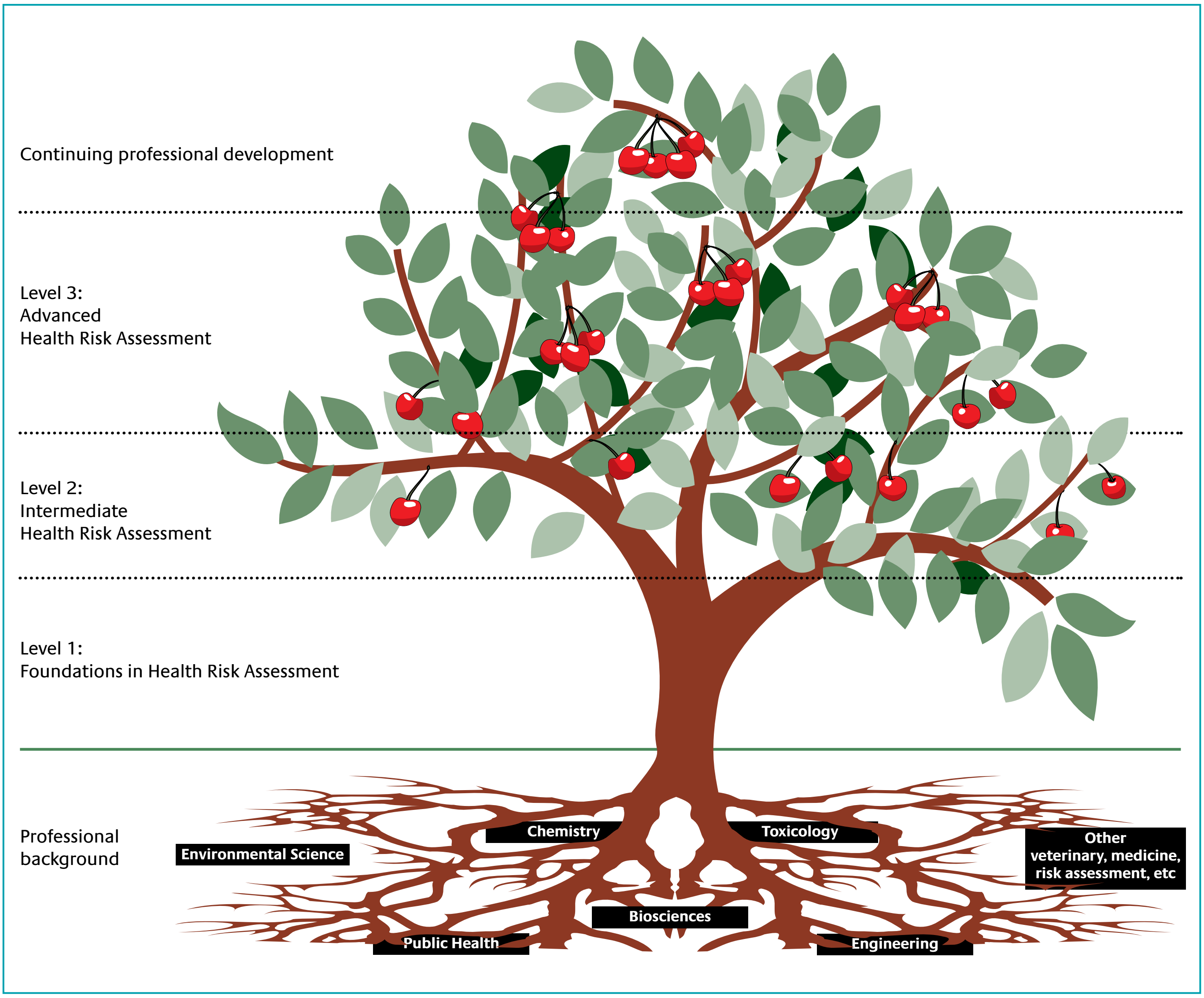
The non-technical training needs and preferences of health risk assessors were mostly related to the general profile of health risk assessors and were:

- Structured European training programme
- Formal recognition of training undertaken
- Training delivered via short courses
- Training that is available throughout Europe
- Training focused at the practitioner level
- Training delivered by reputable training providers
- Good publicity of courses
- Funding or scholarships available to attend training
- Opportunities for mentorship and networking
- Opportunities to gain wider experience of health risk assessment (e.g. via placements).

Learning, knowledge and skills framework

A learning framework for the Risk ASSETs™ Programme was developed (see the figure) to reflect the intended training audience and their needs, and was based on the expert input from two international workshops (Utrecht, May 2010, and Oxford, December 2010)[4].

The overall learning framework consists of a core training in health risk assessment, in order that health risk assessors from a variety of backgrounds have a common foundation-level understanding of health risk assessment principles and practice. Trainees then have the opportunity to specialise in different areas of health risk assessment, thereby tailoring their training to their specific job requirements and career development aspirations.



Learning framework of the Risk Assessment and Management – European Training (Risk ASSETs™) Programme

A knowledge and skills framework (KSF) was also developed to define the knowledge and skills an assessor of chemical and/or electromagnetic health risks would be expected to have to be a proficient practitioner, and to act as a basis for curriculum development[4]. The KSF was initially based on the outcomes of the assessment of training needs and then further developed through a process of the two international workshops (Utrecht, May 2010, and Oxford, December 2010) and a Europe-wide public consultation (August to October 2010). The final KSF for health risk assessors consists of statements of the knowledge and skills a health risk assessor may need to acquire in ten principal domains:

- General health risk assessment principles
- Advanced health risk assessment principles
- Professional attitudes, ethics and quality control
- Toxicology
- Epidemiology
- Exposure assessment and monitoring
- Electromagnetic fields
- Risk characterisation
- Risk management
- Risk communication.

The 'general health risk assessment principles' domain represents the knowledge and skills that all health risk assessors would be expected to have in common. Within the other domains, the knowledge and skills are divided into 'intermediate' and 'advanced' levels. A health risk assessor would seek to develop knowledge and skills in these areas depending on their job requirements, specialisation and career aspirations.

Health risk assessment training material

The training curriculum is based on the KSF and consists of a core set of 12 modules covering different aspects of health risk assessment methodology and the underlying science of health risk assessment[4]. The modules are:

- Health risk assessment, management and communication – principles and practice (1) and (2)
- Advanced principles in health risk assessment
- Fundamentals of toxicology for health risk assessment
- Advanced principles of toxicology for health risk assessment
- Fundamentals of epidemiology for health risk assessment
- Advanced principles of epidemiology for health risk assessment
- Fundamentals of human exposure assessment

- Advanced principles of human exposure assessment
- Health risk assessment of electromagnetic fields
- Implication for risk management and communication
- Risk characterisation.

The format of the modules is based on the training needs and preferences of health risk assessors. As a result, each module is a one-week course, with pre- and post-course assessments, and involves work on case studies to provide participants with an opportunity to gain experience of applying the taught material. Each module is equivalent to three European Credit Transfer and Accumulation Scheme (ECTS) credits (75–90 hours of learning). By awarding ECTS credits, a trainee can work towards a masters in health risk assessment, by taking 10 modules (30 ECTS credits) and completing a thesis (30 ECTS credits).

Administrative framework

A Europe-wide health risk assessment training programme would require central administration and coordination. As such, a proposed administrative framework for the programme was developed[5]. The principal roles and responsibilities within the programme would be:

- Programme board – responsible for the overall operation and development of the Risk ASSETs™ Programme
- Academic committee – responsible for the technical and scientific content of the training programme
- Quality control and assurance committee – responsible for operating a quality control and assurance system and ensuring common standards across the programme
- Risk ASSETs™ office – responsible for the day-to-day operation of the training programme
- Training providers – responsible for the delivery of individual modules
- Core universities – responsible for awarding ECTS credits for all training providers.

Quality control and assurance would be a key element of the training programme in order to ensure the quality of training, develop the reputation of Risk ASSETs™ and ensure that the training meets the educational standards of the core universities awarding the ECTS credits. Adequate quality control and assurance would be achieved principally via a quality policy and standard operating procedures, which all training providers would be required to implement and follow. Additional activities to ensure adequate quality control and assurance would include:

- Evaluation of training materials by the academic committee prior to training delivery
- Trainee evaluation of module delivery
- Double marking of a sample of assignments
- A system of internal and external audit.

Awareness, recognition and reputation of the Risk ASSETs™ Programme will be a key element in its success and uptake. As such, a high level of awareness, recognition and a reputation for high-quality training would need to be established from the outset. This would involve engaging key stakeholder groups, maintaining the quality of the curriculum and training materials, and raising awareness of the training programme.

A number of other considerations would need to be addressed in the development of the training programme. These would include ensuring equity in access to all potential trainees from across Europe, and developing a language policy and copyright and intellectual property arrangements under which the programme would operate.

Conclusions

A structured European health risk assessment training programme, such as Risk ASSETs™, has considerable potential to improve the availability of health risk assessment training in Europe and deliver a number of substantial benefits, including ensuring the availability of well-trained assessors of health risks and improving public health protection. However, for these benefits to be realised, a number of challenges will need to be addressed including developing a collaborative framework between selected European universities to award ECTS credits, identifying and developing a suitable funding mechanism, engaging stakeholders, and ensuring that a high level of quality control and assurance is applied by all training providers.

Acknowledgements and further information

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Further information about the Risk ASSETs™ project can be found on the project website at http://www.hpa.org.uk/riskassets or by contacting the project team at riskassets@hpa.org.uk.

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UK Recovery Handbook for Chemical Incidents: evaluating the evidence base for recovery, remediation and decontamination methods

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General introduction to the UK Recovery Handbook for Chemical Incidents (UKRHCI)

The Health Protection Agency (HPA), in collaboration with the Department for Environment, Food and Rural Affairs (Defra), the Food Standards Agency (FSA), the Home Office, Northern Ireland Environment Agency and the Scottish Government, has developed a UK Recovery Handbook for Chemical Incidents (UKRHCI). The UKRHCI project commenced in June 2009 and the handbook is available on the HPA website at http://www.hpa.org.uk/Publications/RemediationAndEnvironmentalDecontamination/. In addition, an e-learning module to accompany the handbook will shortly be available on the website.

The aim of the handbook is to provide a framework for choosing an effective recovery strategy following a chemical incident, and a compendium of practicable, evidence-based recovery options for inhabited areas, food production systems and water environments[1].

Developing the handbook has involved extensive consultation with stakeholders and technical experts from a range of disciplines who have experience of managing chemical incidents and/or insight into the work of recovery coordination groups. A series of workshops (see the table) has been crucial in the development of the handbook.

UKRHCI stakeholder workshops

Handbook section	Location, date
Pilot workshop	Nottingham, April 2010
Inhabited areas (1st workshop)	London, May 2010
Water environments	London, July 2010
Food production systems	London, September 2010
Inhabited areas (2nd workshop)	Edinburgh, January 2011
Food production systems (2nd workshop)	London, October 2011
Water environments (2nd workshop)	London, November 2011
Inhabited areas (3rd and 4th workshops)	London, February 2012

Evaluation of the evidence base

Remediation, recovery or decontamination is the process of removing or neutralising a hazardous substance from: structures, articles and equipment; the environment; and people following exposure to that substance. Understanding the issues associated with decontamination, remediation and recovery of inhabited areas, food production systems and water environments has been the focus of an evaluation of the evidence base for the recovery options recommended for consideration in the UKRHCI project, and has comprised a literature review, and retrospective and prospective studies.

The main objective of the evaluation of the evidence base was to examine and evaluate historical and recent chemical incidents that have involved decontamination, remediation and recovery, in order to gain a better understanding of:

- What procedures and protocols are used for decontamination, remediation and recovery
- Problems or constraints associated with the recovery options including:
  - ◊ public health/health protection (including psychological effects)
  - ◊ technical (i.e. specialist equipment)
  - ◊ waste
  - ◊ social (i.e. disruption)
  - ◊ cost.

Methods

Three techniques were used to evaluate the evidence base of remediation and recovery techniques, including:

- A literature review of chemical incidents that have involved decontamination, remediation or recovery
- A retrospective study to capture incident recovery experience from internal (i.e. HPA) and external stakeholders (i.e. Food Standards Agency/Government Decontamination Services). The retrospective study initially required participants to complete a short online questionnaire[1], which was followed by a structured interview, conducted by a member of the project team
- A prospective study of chemical incidents reported to the HPA (i.e. Chemical Incidents Reporting Programme, CHIRP) that involved remediation, recovery or decontamination.

As reported previously[2,3], a recovery options database was developed to capture and extract information from the literature review, and retrospective and prospective studies.

Results

The UKRHCI recommends the use of 88 potential recovery options, which are relevant to each environment (see Figure 1).

To date, the recovery and remediation strategies from 117 chemical incidents (historical and recent) have been evaluated in order to gain a better understanding of problems and constraints associated with implementing recovery techniques. This evaluation included consideration of constraints relating to: public health (e.g. psychosocial effects); social aspects (e.g. disruption); technical requirements

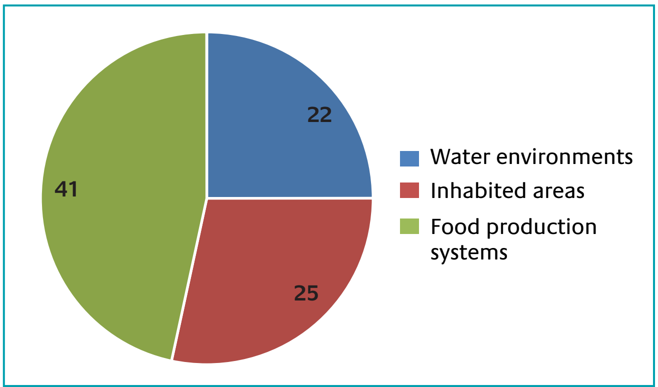

Figure 1: Number of recovery options relating to each environment, within the UKRHCI

(e.g. specialist equipment and expert guidance); waste considerations; and cost.

Chemical incidents often impact upon more than one environment or media (i.e. inhabited areas, food production systems or water environments). The recovery strategies implemented to deal with such incidents have been referred to when developing the recovery options recommended within the handbook.

The following is an example of an incident captured by the retrospective study[4,5,6]. In summary, on 10 July 1976 an accident occurred at a chemical plant near the town of Seveso (Northern Italy). A reactor vessel used in the production of 2,4,5-tricholorophenol (TCP) suffered a safety plate rupture, causing the release of a toxic vapour cloud composed of several toxic chemicals and by-products including TCP, ethylene glycol, chlorinated phenols and 2,3,7,8-tetracholoro-dibenzo-para-dioxin (TCDD). Estimates of TCDD released varied significantly from 300 g to 120 kg. The toxic plume spread over a large area contaminating several thousand people; many animals, buildings and crops and much soil in the vicinity of the plant were contaminated. Significant remediation of contaminated soil, buildings and the factory plant itself was required. In severely contaminated inhabited areas the decision was made to permanently relocate the population and demolish their homes. The recovery options implemented during the remediation of the Seveso incident are illustrated in Figure 2 below, compared to the number of times they have been implemented in the remediation of other chemical incidents contained on the UKRHCI database.

The project has demonstrated the importance of collating and evaluating the evidence base for recovery options, to improve practice and inform decision-making. The UKRHCI provides the user with a six-step decision framework, identifying relevant recovery options that could be considered to remediate specific environments (i.e. food production systems, inhabited areas or water environments) or surface types (i.e. external buildings or internal surfaces). The six-step decision framework provides the user with an overview of the key aspects that should be considered when developing a recovery strategy.

There are historical and recent examples where the clean-up strategies for the remediation of chemical incidents were not subject to the same rigorous evaluation that the handbook leads the user through, and as

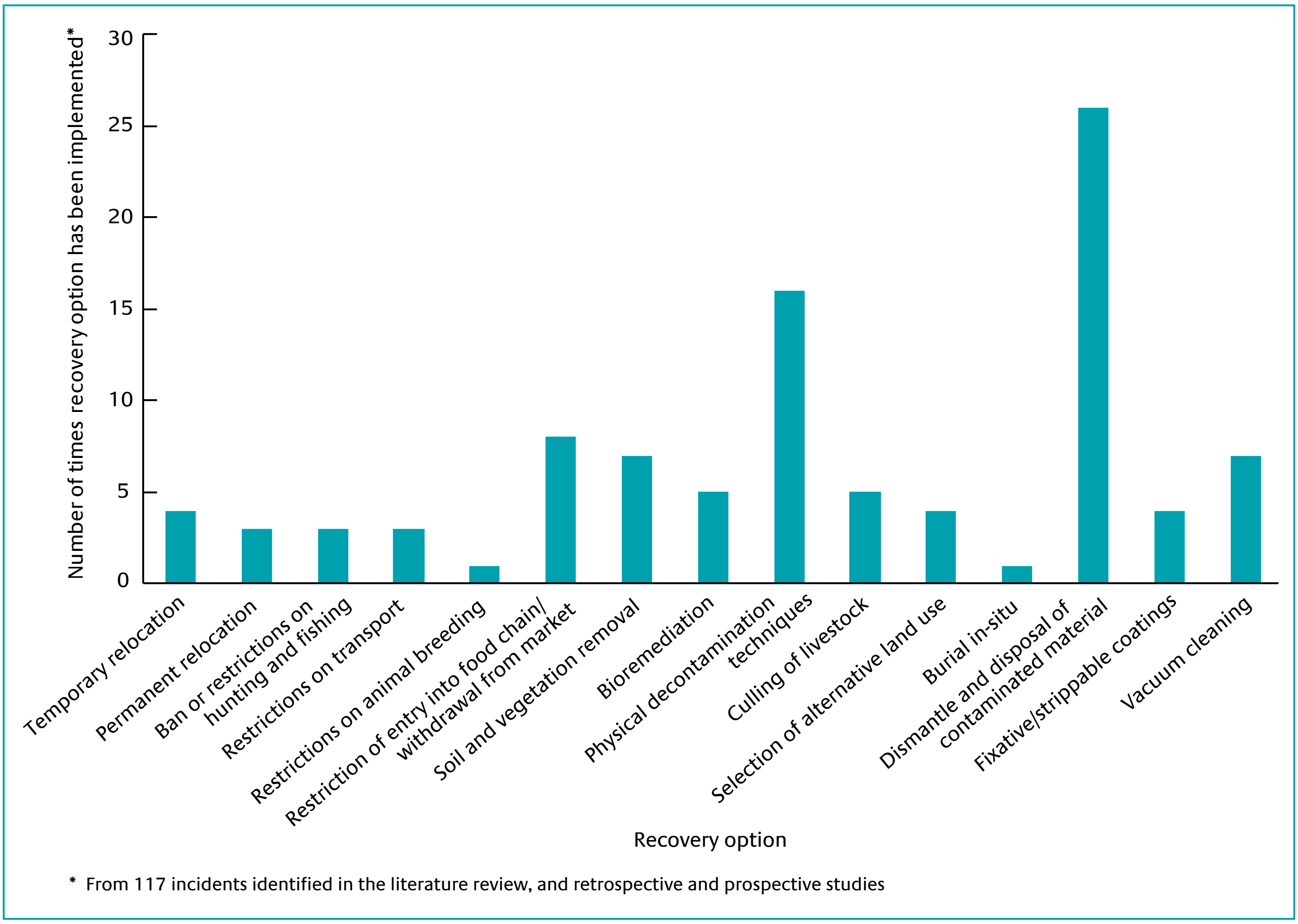

Figure 2: Recovery options implemented to remediate the Seveso (dioxin) incident and frequency of use in other chemical incidents

a result the remediation methods employed had a detrimental effect on people or the affected environment. A recent example of bad practice was when workers reported negative health effects following occupational exposure to hydrofluoric acid, which was inappropriately used by a small brick cleaning company at a dilution of 15% from 60% concentrate to clean bricks[7].

A historical example is of the oil tanker 'Torrey Canyon', carrying 119,000 tonnes of crude oil, which ran aground near Lands End, contaminating the French and Cornish coasts (in 1966). A quick decision was made to burn (by bombing) the remaining 20,000 tonnes of crude oil as a remediation method, which was ineffective and the detrimental environmental impacts of this strategy had repercussions for decades[8,9].

Conclusions

The project has evaluated the evidence base for recovery and remediation techniques implemented during the clean-up phase of a chemical incident, to ensure guidance within the UKRHCI is robust and practicable.

Evidence from the review has been incorporated into the recovery options recommended for consideration in the UKRHCI. The evaluation of the evidence base for recovery options has also identified gaps in knowledge and issues to be taken forward through future research.

The UKRHCI is a user-friendly guidance document to aid the decision-making process for the implementation of a recovery strategy in the aftermath of a chemical incident. The handbook is available on the HPA website at http://www.hpa.org.uk/Publications/RemediationAndEnvironmentalDecontamination/.

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Exercise Bucephalus: testing Health Protection Agency procedures

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Introduction

The Civil Contingency Act of 2004 was introduced to modernise local civil protection activities and to introduce special legislative measures to deal with incidents on a larger scale. This meant that the Act introduced a new definition of 'emergency' appropriate for the type of threats and risks that the UK faces in the 21st century. The Act is separated into two parts: local arrangements for civil protection (Part 1) and emergency powers (Part 2) but across both the definition is almost identical. The new definition defines an emergency as:

> 'an event or situation which threatens serious damage to human welfare in a place in the United Kingdom; the environment of a place in the United Kingdom; or the security of the United Kingdom or of a place in the United Kingdom'[1]

In Part 1 of the Act, the emergency responders are divided into two categories, Category 1 and Category 2 responders. Category 1 responders are known as core responders, they include the emergency services (police, fire and ambulance services, British Transport Police, Coastguard), local authorities, NHS primary care trusts, NHS hospital trusts, NHS foundation trusts, the Health Protection Agency, the Environment Agency and port health authorities. Category 1 responders have a primary role in the response to an incident and have the following duties placed upon them:

- Risk assessment
- Develop emergency plans
- Develop business continuity plans
- Arrange to make information available to the public about civil protection matters and maintain arrangements to warn, inform and advise the public in the event of an emergency
- Share information with other local responders to enable greater coordination
- Co-operate with other local responders to enhance coordination and efficiency.

The Department of Health (DH) developed guidance for the NHS which specifies that NHS organisations should plan and participate in a live exercise every three years, a table-top exercise every year and test communication cascades every six months[2]. To help meet these requirements, Exercise Bucephalus (named after the beloved horse of Alexander the Great) was developed by an HPA exercise planning team including representatives from different departments and centres within the HPA, such as the Centre for Radiation, Chemical and Environmental

Exercise Control (Excon), HPA Victoria

Hazards (CRCE) and HPA Colindale, as well as London and North East Health Protection Services. The exercise was coordinated and delivered by the Emergency Response Department (ERD) and was an internal HPA exercise with no participation by external partners or agencies.

The scenario required one-day participation from all divisions and centres across the HPA and was a command post format (CPX). Participants in CPX exercises are expected to play from their own offices or emergency operation centres (EOC) but not to be briefed about the scenarios, i.e. as per a normal incident response. The exercise primarily tested communications between specialist centres and regional offices, as well demonstrating resilience by asking some specialist centres or regions to provide additional resource to assist the HPA's overall response. Although this was an internal HPA exercise, multi-agency involvement was simulated through injects to create a more realistic scenario. There were two incident scenarios being played simultaneously, to test different responses within the HPA.

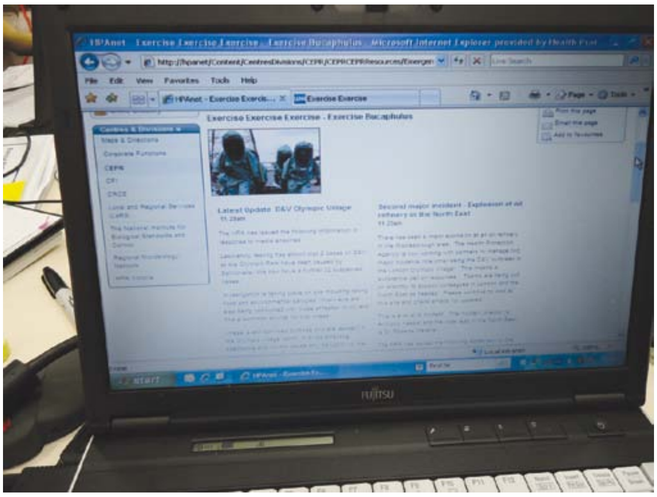
Exercise Master Events List (MEL)

Aim

The aims of Exercise Bucephalus were to exercise the HPA's Incident and Emergency and Response Plan (IERP), the HPA Olympic Concept of Operations (CONOPS), and to explore the capability of the HPA to respond to two concurrent serious incidents during the 2012 Olympic Games. The exercise also aimed to test a new role within the IERP, namely a national incident commander, to help coordinate the overall response to the two separate incidents.

Scenario

The exercise was set during the 2012 Olympic Games with the scenarios being introduced by mock news broadcasts. The first scenario involved an outbreak of salmonella at the London Olympic Village affecting high-profile athletes and sporting events and generating much media interest. The second scenario involved a large explosion at a chemical manufacturing site in the North East region resulting in a low plume of dense toxic smoke which affected the North East and Yorkshire and Humber regions. Due to the nature of the second scenario, which in reality would be ongoing for a substantial period of time (over eight hours), the nature of the release and the potential public health impact, an air quality cell (AQC) was required to assist the public health risk assessment. An AQC is set up by CRCE and the Environment Agency, therefore injects were used to simulate the EA's involvement.



HPANet Exercise Bucephalus 'news' information

Environmental incidents

CRCE provides advice on the effects of radiation and chemicals on health, which can assist in the management of uncontrolled releases of hazardous substances into the environment. There are five units in England and Wales which have expertise on emergency response to chemical incidents, all of which were involved with this exercise. CRCE used this scenario to practice mutual aid between units and management of separate parts of incident response by different units, as well as managing the daily CRCE input for the HPA's Olympic SitRep and business as usual. During the Olympics, CRCE will be required to provide daily air quality information within the public health briefings and situation reports that the HPA will be required to submit to the LOCOG Chief Medical Officer. Air quality has been identified as a concern by the International Olympic Committee, campaign groups and the media. It is therefore important that the HPA is able to inform LOCOG at the earliest point of any potential air quality issues.

Table 1 shows how the tasks were divided between the different teams. In addition, CRCE had representation at the National Emergency Coordination Centre of the HPA in London.

Table 1: Tasks for the different units within the Centre for Radiation, Chemical and Environmental Hazards

Unit	Tasks
Nottingham/ Newcastle	Exercise incident response Support scientific, technical and advice cell (STAC) Coordinate chemical advice into public health risk assessment
Birmingham/ Manchester	Manage the air quality cell Data analysis to feed into Nottingham/Newcastle response
Chilton/ Gloucester	Open the Emergency Operating Centre Manage input to Olympics office CRCE Daily Olympic SitRep production Coordinate CRCE input to incident response
London and Wales	Provide surge capacity to deal with other incidents and daily business

This type of arrangement between units has been instigated both in exercises and during real protracted incidents, and demonstrates the resilience of being able to provide mutual aid between teams to ensure business continuity.

Air quality cell (AQC)

Since 2010, sixteen AQCs have been set up around the country with the Environment Agency and CRCE as the lead organisations. The AQCs deployed monitoring teams with real-time air monitoring capability to the vicinity of incidents with a potential impact on air quality. The data generated and air dispersion modelling is subsequently used to advise on air quality impacts on public health.

The AQC is operational during the response phase of a major incident, usually between one and two days. Once the incident has stabilised, then the AQC hands over to a recovery coordination group, which is usually led by the local authority. Further information on the AQC process and procedures can be found on the Environment Agency website: http://www.environment-agency.gov.uk/homeandleisure/pollution/air/125091.aspx.

Media briefings, with exercise 'news' on screens in background

National Emergency Coordination Centre (NECC), HPA Victoria

Aims of an air quality cell

- Improve air quality monitoring capabilities to provide 24/7 response
- Improve modelling capabilities to provide 24/7 response with partner organisations
- Multi-agency AQC will coordinate provision of interpreted air quality data to assist with public health risk assessment
- AQC will link to STAC (CRCE representative on AQC to HPU representative on STAC or multi-agency meeting)
- EA and CRCE decide when the AQC is to stand-down or hand over to the local authority recovery group
- CRCE and HPU to continue to liaise with the local authority for continuity.

Exercise evaluation

Feedback from players suggested that the exercise was very well received and identified important lessons. The exercise involved 130 people participating as players, evaluators or exercise control staff. Exercise participants entered into the spirit of the exercise and played as realistically as possible and their feedback, along with reports from evaluators and feedback from debrief sessions, informed a full exercise report outlining lessons and recommendations for action[3].

Olympic Coordination Centre (OCC), HPA Victoria

Lessons and follow-up actions

An action plan was developed using the feedback from the exercise; some of the actions identified are outlined in Table 2. The main lessons identified during the exercise were that procedures and policies need either to be developed or to be modified to encompass the HPA's role within the Olympics Games. An HPA Olympic preparedness programme will be in place to prepare adequate numbers of staff in all identified roles, including a cadre of staff accredited to enter Olympics sites. The Emergency Response Development Group (ERDG) will ensure, when developing its new training strategy, that it takes account of any training gaps identified in Exercise Bucephalus.

Table 2: Lessons identified and actions following Exercise Bucephalus
Note: a number of these actions have now been completed

Lesson identified	Actions
IERP revision and testing	Ensure IERP has national HPA coordinating functions incorporated Consider a formal briefing cell with details of draft membership Perform further tests of IERP once revised
EOCs across the HPA	EOC training to include: • familiarisation • set-up and operation Regular IT and testing
HPA protocols	Highlight HPA teleconference protocol Email protocol to be developed
Olympic Coordination Centre (OCC)	Develop an operational plan from the CONOPS and re-test Identify and train staff for roles within the OCC and for London Olympics Operation Cell (LOOC) roles Develop business continuity plans in case the HPA Victoria office is not accessible and test
Air quality cell	Include roles and responsibilities within the IERP

Summary

Exercise Bucephalus was an ideal opportunity for the HPA to explore the flow of information across the agency and test the IERP, the HPA Olympic CONOPS, and to explore the capability of HPA to respond to two concurrent serious incidents during the 2012 Olympic Games.

The consensus from those participating and observing the exercise, was that the HPA is in a strong position to respond to more than one serious incident during the Olympic period in much the same way as the HPA performed admirably during the pandemic (H1N1) 2009 response. The full copy of the exercise report is available from hilary.moulsdale@hpa.org.uk.

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Environmental Science and Toxicology

Preventing carbon monoxide poisoning

A report by the All Party Parliamentary Gas Safety Group (APPGSG)

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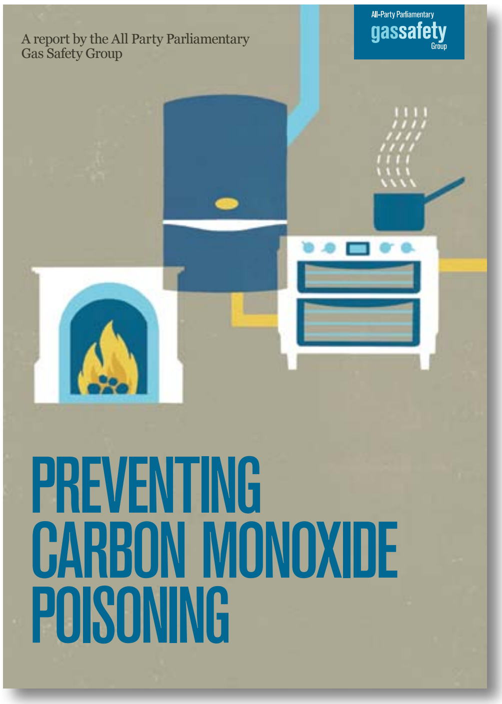

Hidden dangers

Carbon monoxide poisoning is hard to identify. Carbon monoxide cannot be seen, smelled or tasted and it is difficult to diagnose as it mimics the symptoms of other common illnesses such as influenza and headaches. Low level exposure can persist undetected for long periods of time, resulting in people living at constant risk. Although the Department of Health reports as many as 4,000 people each year are diagnosed with low level carbon monoxide exposure requiring treatment, on top of 50 fatalities and 200 admittances[1] to hospital with serious injury, it is feared that the true numbers exposed may be considerably higher. Alongside the cost of the human suffering caused by carbon monoxide poisoning, it has been estimated (based on these figures) that preventing carbon monoxide poisoning could save the UK £178 million each year (see the box).

Estimated cost of carbon monoxide poisoning in the UK

This figure is indicative, based on the latest available, estimated statistics. It was calculated as follows:

Number of carbon monoxide incidents per annum *(Department of Health)* x Value of preventing an incident *(Department of Transport)*

Fatalities:	50	x	£1,585,510	=	£79,275,500
Serious injury:	200	x	£193,677	=	£38,735,400
Minor injury:	4,000	x	£14,932	=	£59,728,000
Total:					**£177,738,900**

Despite progress having been made in recent years, oral evidence received throughout the inquiry process found there is consensus that a lack of awareness and under-reporting masks the true number of incidents and fatalities. It is this lack of awareness, recognition of the symptoms and prevention of the dangers which the APPGSG report *Preventing Carbon Monoxide Poisoning*[1] aimed to tackle.

Our approach

The APPGSG initiated a parliamentary inquiry into how to better detect and improve awareness of the risks of carbon monoxide. The group carried out the parliamentary inquiry between May and July 2011. Five formal sessions were held in parliament, drawing together a range of industry representatives, policy makers, medical professionals, engineers, charities and other key stakeholders who are involved in protecting people from the dangers of carbon monoxide poisoning.

The findings and policy recommendations in the report were based on witness statements heard in the inquiry sessions, through in-depth follow-up policy interviews and written submissions. A steering group of senior industry, public health professionals and charity representatives supported the inquiry and helped inform its direction. The inquiry was chaired by Baroness Finlay of Llandaff.

Findings

Throughout the inquiry it became evident that the best way to prevent death and reduce injury is through the development of a well-trained and suitably equipped workforce. This includes ensuring engineering staff are correctly installing and maintaining appliances, combined with a high level of awareness of the symptoms and dangers of carbon monoxide poisoning amongst both the general public and medical professionals.

The report's findings fell into the categories of improving detection, raising awareness and improving regulation. This article focuses on those recommendations which have implications for health professionals.

Improving detection

There is no agreed 'safe' level of exposure to carbon monoxide. Susceptibility to poisoning varies from person to person, with the young and old typically being most vulnerable.

There are various ways of detecting carbon monoxide – environmentally (in the atmosphere) and biologically (in the blood and exhaled breath). Early detection is an essential part of diagnosis, prevention and treatment of any poisoning. This will involve ensuring access to appropriate equipment and training which will be the cornerstone of minimising injuries and fatalities.

The inquiry heard that there is a significant lack of awareness and access to equipment amongst health care professionals and coroners. There is a need to ensure resources are targeted where they are required most. Doing so will not only improve identification of the presence of carbon monoxide, thus helping to avoid injuries and fatalities, but will also build a more precise account of the true number of people affected.

A London Ambulance Service study, in which five ambulance crews used pulse co-oximeters to test for and measure levels of carbon monoxide in patients, identified 83 cases of suspected carbon monoxide poisoning during the year-long programme[3]. These incidents demonstrated that during clinical assessment and treatment, ambulance personnel had frequently and unknowingly been exposed to elevated carbon monoxide concentrations. Therefore the report recommended that carbon monoxide detection equipment should be provided to paramedics, even in areas which have a hazardous area response team (HART). This would work best if paramedics were issued with monitors which could record carbon monoxide levels over time, with results fed into a central recording system so that worker exposure could be monitored.

Raising awareness

To this end the report makes a series of recommendations to improve the capability of health services in dealing with carbon monoxide poisoning. For example, the report recommends that the government should ensure that under the NHS contracts for services, general practitioner (GP) surgeries and hospital emergency departments (EDs) are trained both to recognise the symptoms of carbon monoxide poisoning and to monitor for it, using the appropriate equipment, whenever carbon monoxide exposure is suspected.

A previous report published by the APPGSG, *Raising Medical Professionals Awareness of Carbon Monoxide Poisoning*[4], called for a study to be carried out in EDs to determine the extent to which carbon monoxide poisoning at low levels is taking place. As a result, Dr Simon Clarke, Emergency Physician at Frimley Park Hospital in Surrey and Steering Group member, completed an observational study[5]. Dr Clarke's study targeted patients with a predetermined set of symptoms and assessed a total of 1,758 patients.

The Health Protection Agency has produced an algorithm for use by GPs and emergency physicians to check for the signs and symptoms of carbon monoxide poisoning in patients who present with symptoms of non-acute poisoning[6].

The APPGSG's latest inquiry heard evidence from Dr Ed Walker, medical adviser to the charity 'CO Awareness', who stressed the importance of providing suitable diagnostic equipment for medical staff. Dr Walker suggested that GPs and medical staff should be trained to ask the following questions:

- Where are your symptoms worse? Are they bad at home and do they get better when you go out?
- Does anyone else at home have the same symptoms?

Improving awareness of identification strategies among medical professionals, be it through the use of the HPA's algorithm or Dr Walker's suggested questioning, would increase crucial awareness of carbon monoxide poisoning.

The inquiry heard that there is a lack of information about the impact of long-term exposure to carbon monoxide – in particular, any associated neurological effects that may occur. To develop treatments, respondents to the inquiry made it clear that further studies are needed to investigate the effects of carbon monoxide poisoning on human health – in particular, the mechanisms through which these effects are caused. A greater understanding of how carbon monoxide affects the body will allow resources to be guided to where they are needed most. Therefore the report recommended more research be urgently undertaken to improve understanding of the consequences of low level exposure to carbon monoxide. The report recommends that industry should collaborate with the Medical Research Council and other research funding bodies to:

- Support studies that attempt to evaluate the prevalence of carbon monoxide poisoning across different population groups
- Set up a longitudinal study to assess the sequelae of acute and low level exposure to carbon monoxide poisoning
- Facilitate a study of the neurological effects of repeated exposure to carbon monoxide at low levels.

The inquiry also heard suggestions that GPs should be able to 'prescribe' a gas appliance check for suspected carbon monoxide poisoned patients. The report recommended that this should be implemented.

In France, around 400 deaths resulting from carbon monoxide poisoning are recorded every year. The level of carboxyhaemoglobin in the blood is measured in every case where carbon monoxide poisoning is suspected. Given the lack of distinct indicators for pathologists to identify a case of carbon monoxide poisoning, the report suggests that the government should routinely test all deaths for carbon monoxide poisoning at post mortem. The report recommends that where carbon monoxide is found to be the cause of death a distinct category should be used to record the incident on a central register. The report also recommends the need for a central collation point for data relating to carbon monoxide incidents.

Better regulation

The inquiry identified the need for a number of regulations safeguarding consumers to be updated. This included the need for the government to bring regulation of the whole fossil fuel sector in line with the gas industry.

Taking the report forward

The APPGSG inquiry identified a number of interventions that present a real opportunity to tackle carbon monoxide poisoning through improved detection, increased awareness and better regulation. Taking forward the recommendations of this report will be far less expensive than the cost of lives damaged and lost each year by avoidable carbon monoxide poisoning. The APPGSG shall continue to work closely with the relevant industry and governmental bodies to ensure these changes are brought about.

The inquiry identified 17 suggested recommendations. These can be found in the full report which is available at http://www.policyconnect.org.uk/appgsg/node/494.

Acknowledgements

- Thank you to the Parliamentary Inquiry Sponsors: Energy Networks Association, Energy UK and the Gas Industry Safety Group
- Baroness Finlay of Llandaff for Chairing the Parliamentary Inquiry
- David Kidney of the Chartered Institute for Environmental Health for chairing the victims' charities evidence session.

1

Patient presenting with:
Headache, nausea/vomiting, drowsiness, dizziness, dyspnoea, chest pain
COULD THIS BE A CASE OF CO POISONING?

2

Ask the patient:
- Do you feel better away from your house or place of work?
- Is anybody else in your family or house experiencing the same symptoms as you?
- Have you recently had a heating or cooking appliance installed?
- Have all gas, coke/coal, wood or oil fired appliances, eg, cookers, fires, boilers at your home been serviced within the last year?
- Do you ever use your oven or gas stove for heating purposes as well as for cooking?
- Has there been any change in ventilation in your home recently, eg, fitting double glazing?
- Have you noticed any sooty stains around appliances or an increase in condensation?
- Does your work involve possible exposure to smoke, fumes or motor vehicle exhaust?
- Is your home detached, semi-detached, terraced, flat, bedsit or hostel?

You are suspicious:
Could this be a case of CO poisoning?

You are confident:
This is **NOT** a case of CO poisoning?

3

Action to take: GP - General Practice ED - Emergency Department

1 Test for CO
GP - breath test for exhaled CO if device is available. (Note: Only indicates recent exposure; interpretation diffi cult in smokers. For interpretation of results see TOXBASE).
ED - heparinized venous blood sample for COHb estimation. For interpretation of results see TOXBASE and contact the National Poisons Information Service (NPIS).

2 Management - Commence oxygen therapy
GP - follow advice on TOXBASE; refer to ED if required.
ED - follow advice on TOXBASE. Contact NPIS for severe poisoning.
(See CMO/CNO letter November 2008: www.dh.gov.uk/cmo).

3 Protect your patient and others - Contact your local Health Protection Unit (HPU)
They will co-ordinate services for your patient and provide further CO guidance. Telephone gas, oil or solid fuel helpline (see Notes).

4 DO NOT allow patient home without a warning NOT to use the suspect appliances.

5 Follow up
GP - note that symptoms may persist or develop later.
ED - advise patient to see GP for follow-up. Note this advice in discharge letter.

4

If patient does not improve
- Contact NPIS for advice.
- Contact local HPU for advice.
- Reconsider diagnosis.

Notes

Box 1: Carbon monoxide is a mimic Carbon monoxide poisoning is notorious for simulating other more common conditions, including flu-like illnesses, migraine, food-poisoning, tension headaches and depression. Headache is the commonest symptom - think CO!

Box 2: Carbon monoxide sources are multiple The source of CO may be in the home, in the car due to a leaking exhaust system, or in the workplace. Gas, oil, coal, coke and wood heating appliances are the commonest sources in the home. Malfunctioning heating appliances may be indicated by there being yellow rather than blue flames (if it is not a 'decorative flame' fire) and by the deposition of soot on radiants or on the wall adjacent to the fire. There may be more than one source of carbon monoxide. Poisoning is not limited to those from lower income groups. Carbon monoxide can leak into a semidetached or terraced house/flat from neighbouring premises. It is unlikely that a patient will know about servicing of appliances at his/her workplace, but it is worth asking about the sort of heating devices in use. It is also worth asking: "Have you recently started to re-use heating appliances/boilers after the summer break/during an unexpected cold spell?"

Box 3: Stopping further exposure is essential Preventing further exposure is the most important thing you can do. Breath tests and blood samples may prove inconclusive some hours after exposure has ended: CO levels in the blood decline with a half-life of about 6 hours. Note that a normal concentration of carboxyhaemoglobin (COHb) does not disprove CO poisoning unless the sample has been taken soon after exposure ended. A heparinized venous blood sample should however, always be taken and sent to the local Clinical Chemistry Laboratory for analysis. For interpretation of results and detailed advice on CO poisoning see TOXBASE and call NPIS. If you strongly suspect CO poisoning do not wait for the result of the analysis before taking the other steps listed in Box 3. Contacting the gas (0800 111999), oil (0845 6585080) or solid fuel (0845 6014406) safety services is essential. Contacting your local HPU is essential as they will co-ordinate Environmental Health, Safety, Social and other services to protect your patient and others. Follow-up is important as further consequences of chronic exposure to CO may be delayed, or mild symptoms may persist, multiply or intensify. Recommend the purchase of an audible carbon monoxide alarm for installation in the home.

Box 4 Links and contact details for information on carbon monoxide
- TOXBASE: www.toxbase.org.
- National Poisons Information Service (NPIS) 24 h hotline: 0844 892 0111
- Health Protection Agency: www.hpa.org.uk/chemicals/compendium/carbon_monoxide/default.htm
- NHS Direct: www.nhsdirect.nhs.uk
- Department of Health: www.direct.gov.uk/keepwarmkeepwell
- Carbon monoxide – Are you at risk?: www.dh.gov.uk
- Information in joint CMO/CNO letter of November 2008: www.dh.gov.uk/cmo
- Local HPU contacts: www.hpa.org.uk/hpucontactdetails. 24 h Chemicals hotline: 0844 892 0555

HPA diagnosing carbon monoxide poisoning algorithm

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Natural Disasters and Climate Change

Health information and climate change: getting the message across

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This evening discussion meeting was organised by the Catastrophes & Conflict Forum of the Royal Society of Medicine (RSM) on 28 September 2011, in conjunction with Medact and the UK Climate Health Council. The meeting's objectives centred on 'getting the message across' about the health implications of climate change.

As Chair, I opened the session by outlining the challenges in interpreting climate change information, accessing reliable data and communicating risks. While recognising the controversy, I proposed that the impact of climate change is measurable, getting worse, and arguably reaching a 'tipping point' that necessitates collective attention and action. In highlighting the awesome scope of the issue, I suggested that '... people find this hard to communicate, and hard to absorb, not least because there are inherent uncertainties. However, the outcomes will have non-negotiable impacts on our global population'.

Professor Hugh Montgomery discussed **'The predicted consequences for health'**, describing the ways in which climate change poses an immediate threat to human health and survival worldwide, through a variety of direct and indirect impacts. These included:

- Extreme weather events
- Loss of habitat and ecosystem impacts
- Changes in bacterial disease and vector-borne disease
- Mass migration and conflict.

By showing the impact of climatic changes on life on Earth over hundreds of millions of years, Hugh was able to demonstrate that current climatic changes are dramatic, man-made and require urgent attention to mitigate disastrous impacts to human health.

Dr Judith Anderson presented on **'Absorbing the implications of climate change for health: too much to bear?'**, highlighting the traumatic threat posed by climate change. She proposed that when traumatised we cannot construct a narrative, restricting constructive action and stewardship of the future. Thus she proposed that we should not simply focus on behaviour change but must consider issues of values, meanings, identity and our relationship to the ecosystem on which we depend and which depends on us.

Judith's presentation was refreshing in its approach, thought-provoking, and provided an insightful new angle on the issues of absorbing and motivating action on climate change 'fears'.

The final speaker, Mr Asher Minns, presented on **'Communicating uncertain climate change science'**. He delivered a lively, alternative look at how concepts of risk are delivered in the media, and exposed the dangers of exaggerated reports – 'climate porn'. The limitations of some 'consensus' documents coupled with the importance of communicating uncertainty were areas highlighted for attention.

The audience participated in a rich and informed discussion. It explored issues such as value systems, developments in inter-generational narratives and tips for non-materialistic presents.

A selection of thoughts and learning issues generated at the event follow.

1. What five words come to your mind when you think of climate change? In discussing these with our neighbours we gain insight into our own interpretation and feelings. Words such as *fear, motivated, loss, destabilised, protective, energised* and *future* were given at the event. This demonstrates the breadth of personal narratives in regard to climate change even within a select group. We must recognise that underlying assumptions need to be managed before we can successfully facilitate behaviour change within ourselves, populations and politicians in implementing policy.
2. Three approaches to policy-making were outlined:
   - Wait and see
   - Adjust and act now
   - The precautionary approach.

   It was proposed that it's not possible to 'adapt' to climate change, as no amount of money will prevent the devastation caused by ecosystems reaching their 'breaking point'. The 'precautionary approach' was considered essential.
3. It was proposed that climate modelling has always been wrong – it has historically *underestimated* the severity due to not incorporating the positive feedback loop. We cannot foresee all consequences, however good our current information.
4. Key issues to influence policy include:
   - Development of the economic argument
   - Climate change posing serious threats to human security by increasing civil unrest (due to water, food and health security), migration and ultimately conflict
   - Social justice as a strong motivator – populations in developing countries being most detrimentally affected by climate change. Inter-generational justice may be less of a motivator, though resonates strongly with some individuals.
5. Health professionals have a particular role in advocating climate change issues. They are trusted to get the message across and can legitimately highlight the co-benefits between health and environmental sustainability (active transport, reduction in meat consumption, and so on).

The Catastrophes & Conflict Forum would like to thank all participants, panel and audience members for their generous contributions at the event.

Further information is available at http://www.rsm.ac.uk/academ/forcc.php.

Built Infrastructure for Older People's Care in Conditions of Climate Change (BIOPICCC)

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Background

While the impact of extreme weather on older people's health is well documented[1,2], less attention has been paid to the impact of these weather events on the *infrastructure* supporting older people's health and social care delivery. Health protection strategies need to consider continuity of service delivery for vulnerable groups in the population who are most dependent on care services. This infrastructure includes, for example, buildings, utilities, transport systems and medical equipment, all of which may be impacted by events related to extreme weather (e.g. coldwaves with heavy snow, heatwaves and floods). Concerns surround problems such as: snow and ice restricting road and footpath access for professional or family carers, or deliveries of medicine and food; extreme heat increasing the electricity demand for air conditioning or water for showering; and flooding of an electricity substation supplying the nearby hospital and older people's homes in the area. As the Intergovernmental Panel on Climate Change's report on extreme events[3] reminds us, weather-related hazards such as floods and heatwaves are projected to increase in both frequency and severity with climate change worldwide. While winters are projected to become warmer and wetter on average, coldwaves will still occur. Furthermore, in the UK, the older population aged 65 years and over is projected to increase to 22% of the total population by 2031[4], with the fastest growth in the older age groups most likely to need care services. Protecting the health and wellbeing of older people, and ensuring we meet their health and social care needs during extreme weather events, is vitally important.

The BIOPICCC project is funded by the Engineering and Physical Sciences Research Council as part of a major research network on 'Adaptation and Resilience in a Changing Climate' (ARCC). The team is researching strategies to make the infrastructure systems supporting health and social care for older people more resilient to the harmful impacts of climate change up to 2050. The project involves a multidisciplinary team at Durham University and Heriot-Watt University, with expertise in engineering, climate modelling, social and geographical sciences, and health and health care research. The team recently published key findings[5] from a hazard and vulnerability mapping exercise focusing on variation across England.

Methods: national-scale hazard and vulnerability mapping

The research began with a review of the literature from the UK and elsewhere to identify weather-related hazards likely to place particular pressure on the infrastructure supporting older people's health and social care. From this review, a series of working definitions was produced. For example, our working definition for a heatwave relates to prolonged temperature levels that are high relative to prevailing average temperatures. This makes allowance for future adaptation to heat among the older population in terms of physiological habituation, behaviour changes and modification of built infrastructure that may mitigate the climate change effects on health. Coldwaves and flooding events are defined in relation to infrastructure risks due to prolonged freezing, snowy weather or flood-related inundation.

Using the latest climate projections from the UK Climate Impacts Programme (UKCP09) (http://ukclimateprojections.defra.gov.uk/), heatwaves and coldwaves were mapped for the 2030s for the 'medium emissions scenario' across England. River and coastal flooding was also included, based on the outputs from the UK government's Foresight Flood and Coastal Defence Project[6]. Demographic projections for the older age groups were then mapped at the local authority level for the period 2006–2031. Indicators on local populations including ethnicity, deprivation and rural-urban location were devised and mapped to identify local social factors that may make residents particularly vulnerable. BIOPICCC is particularly interested in areas where, compared with the present, projections predict the greatest increases both in extreme weather events and in the numbers of older people. These are areas where rapid adaptation may be especially challenging.

Results: regional variation in vulnerability

The findings, published in *Applied Geography*[5], suggest heatwaves are most likely in the South and South West of England, while areas such as the East of England, North West and Yorkshire and Humber are projected to experience the greatest *increase* in heatwave events in comparison to current conditions (see Figure 1). Although coldwaves will become less common nationally, they will continue to challenge systems of health and social care, especially in more northern and central areas. Some areas are expected to experience increased susceptibility to flooding (both fluvial and coastal) – in particular, some coastal areas in the South East, the East of England and the Yorkshire and Humber regions.

Areas experiencing the most rapidly changing hazards often also have large and growing numbers of older people, especially in the oldest age groups (85 years and over), e.g. parts of the South East, outside central London, and the East of England (see Figure 2). Many of these are rural or semi-rural areas outside the major urban agglomerations, emphasising the importance of climate change and demographic trends for rural populations.

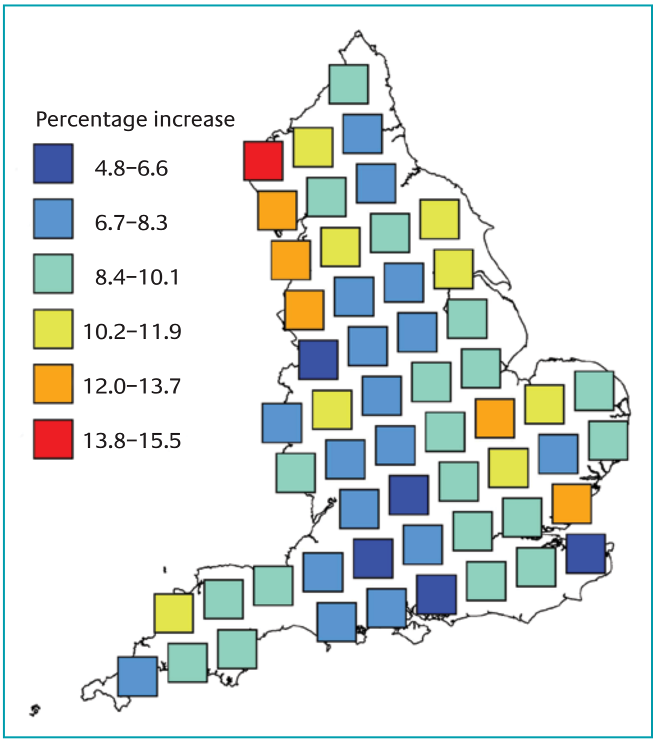

Figure 1: Percentage increase in the number of heatwave events per year in England between the baseline period (1961–1990) and the 2030s (2020–2049)
We define a heatwave as an event where the daily maximum temperature is equal to, or greater than, the locally defined threshold (the 95th percentile value of the prevailing daily maximum temperature distribution) for three or more consecutive days. Data derived from the UKCP09 Weather Generator (Version 2) under the medium emissions scenario

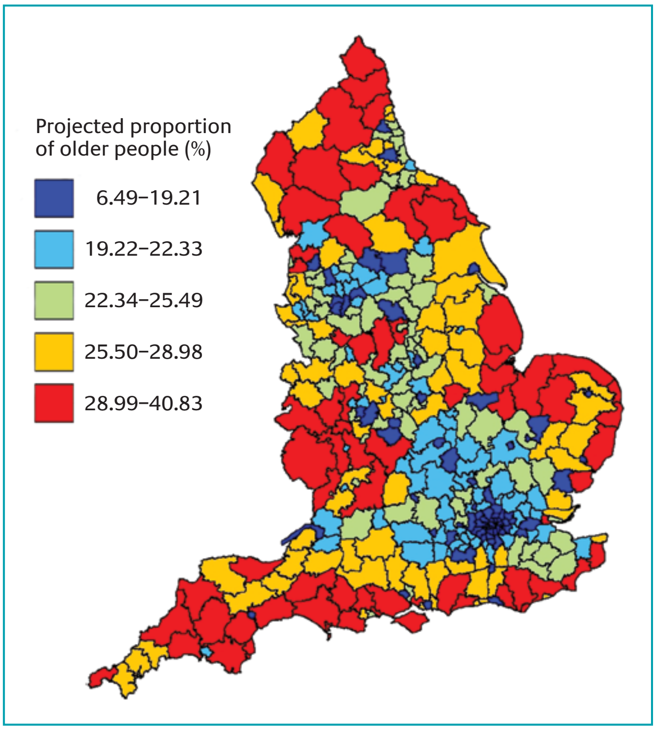

Figure 2: Projected proportion of the population aged 65 years and over in local authority districts in England in 2031
Analysis based on 2006 sub-national population projections by age group at local authority level[4]

Turning research into action for health protection: local level consultation

While these national-scale hazard and vulnerability maps can inform resilience planning at the national scale, it is also important to consider what data can inform local planning for resilience to climate change. We are undertaking in-depth consultations in two local authorities, one in the north and one in the south of England. We are holding discussions, at the scale of local authorities and in local settlements, with various stakeholders (including older people and their carers and service providers). We are identifying the key infrastructures important for the delivery of health and social care for older people at the local scale, how they have been affected by extreme weather in the past and how they may be affected in the future. Conditions vary from one area to another so it is important to help local communities and agencies build capacity to assess what will work best in their own area. In terms of adaptation and resilience measures, local resources, as well as regional or national support, can be brought to bear to tackle climate change impacts on an ageing population.

Protecting the health of older people from the effects of extreme weather is a very important concern. The scientific findings from the BIOPICCC study, and the research in progress, emphasise the need for a 'joined-up' approach, both for understanding what resilience is and how to implement more resilient local health and social care systems, now and in the future.

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Conferences and Workshop Updates

National Cold Weather Plan Voluntary and Community Sector Workshop

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Introduction

Cold weather is an important public health issue in England. It caused 25,700 extra deaths during the 2010/2011 winter compared to the rest of this time period[1]. Cold weather is also an important cause of morbidity[2]. This is not a problem unique to England, and other countries such as Spain and Portugal also suffer from excess winter deaths[3]. However, countries such as Finland have achieved far lower rates of excess winter deaths. The Eurowinter study demonstrated that European countries with warmer climates and lower levels of bedroom and living room heating were associated with higher increases in cold-temperature-related mortality[4].

In 2009 the Chief Medical Officer drew attention to this issue and called for a national cold weather plan. The Cold Weather Plan for England was subsequently developed as a public health plan, by the Extreme Events and Health Protection Section of the Health Protection Agency (HPA) Centre for Radiation, Chemical and Environmental Hazards (CRCE) and the Department of Health (DH).

Cold Weather Plan for England

The plan aims to:

- Reduce excess winter deaths by ensuring health, social care and voluntary organisations, alongside individuals, take appropriate actions when cold weather occurs
- Avoid excess seasonal pressures on health and social care services.

A system of cold weather alert levels will be issued each year by the Met Office between 1 November and 31 March and is summarised in the figure.

This summary focuses on the workshop held on 5 September 2011 for the voluntary and community sector and its role in the national cold weather plan. A full report of the event is published on the HPA website[5]. An earlier workshop for health care professionals was held in July 2011[6].

This figure is an excerpt from the Department of Health *Cold Weather Plan for England: Protecting Health and Reducing Harm from Severe Cold*[7].

COLD WEATHER PLAN LEVELS	
Level 1	**Long-term planning** All year **Winter preparedness programme** 1 November – 31 March
Level 2	**Extreme winter weather is forecast – alert and readiness** 60% risk of extreme cold in the following days
Level 3	**Response to extreme winter weather – severe weather action**
Level 4	**Major incident – emergency response** Exceptionally severe weather or threshold temperatures breached for more than 6 days

Cold weather plan levels

Aims and objectives of the workshop

The aim of the workshop was to engage voluntary and community sector organisations in the development of the plan.

The objectives were to:

- Inform the voluntary and community sector about the public health impact of cold weather and the development of the plan
- Provide a forum for consideration of the plan
- Learn how best to disseminate and implement the plan.

Workshop presentations

The workshop opened with several presentations including the public health burden of cold weather and the need for the plan, an introduction to the alerts system, an overview of the health effects of cold weather and a presentation on current research in this field.

Outcomes from the workshop

The active discussion between delegates covered a number of themes and generated various points for consideration. These are summarised in the table.

Conclusions

This workshop identified significant interest among voluntary and community sector organisations and a willingness by them to discuss cold weather and public health issues. Valuable contributions were made on a number of diverse themes and following the workshop, the Cold Weather Plan for England was launched on 1 November 2011[7].

Themes and points for consideration discussed during the workshop

Theme discussed	Points for consideration
Voluntary and community sector (VCS) actions	The VCS is very useful but differs across the country and is often fragmented. Each community will need to mobilise differently and will have its own networks. There needs to be the freedom for variation Actions should be appropriate for individuals and there should be sufficient resources to implement these Smaller, informal groups should also be targeted alongside faith groups and voluntary sector organisations
Health services role	Health professionals should take a lead by giving information about cold weather to vulnerable groups (e.g. vaccination appointments are an opportunity to provide advice and signpost to other organisations) The cold weather plan should recognise individual choices in how people use healthcare
Role of central and local government	Cross-linking between government departments, websites and initiatives like direct.gov.uk and Winterwatch Local authorities could provide coordination for local communities with leadership from health and wellbeing boards The cold weather plan should focus on preparedness over response Links to the insurance industry could be explored
Specific actions within the cold weather plan	Level 1 needs to be included in long-term planning During Level 2, checking of room temperatures might be difficult for visiting social care staff Identification of vulnerable persons for Level 2 and higher was identified as a challenge Checking on the vulnerable needed to be coordinated and could potentially include tele-monitoring Level 3 actions require long-term planning and could be led by the local authority
Cold weather plan dissemination	Strategically, information could be disseminated to local health and wellbeing boards Involve existing organisations that target vulnerable groups such as Age UK, and consumer organisations Involve local people who are trusted sources of information (e.g. post offices) Official services (e.g. energy suppliers and other schemes) could aid contact with vulnerable groups Inform VCS organisations of where to find the plan so they can disseminate it and mobilise their resources Actions should be relevant to individuals and communicated in simple language The plan should encourage discussions about actions at a local level due to regional differences

Acknowledgements

On behalf of the HPA and DH, we would like to thank all those who contributed, attended and/or presented at this workshop.

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HPA Updates

Environmental permitting: Health Protection Agency and Environment Agency working together

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Improving health consultation in environmental permitting

The Environmental Permitting (EP) Regulations[1] came into force in April 2008. They bring a number of different environmental regulatory regimes (and their individual consultation mechanisms) under one umbrella. Initially they combined the Pollution Prevention and Control (PPC) and Waste Management Licensing (WML) Regulations, before the addition of industries dealing with waste from extractive industries (Mining Waste Directive). The current Environmental Permitting (England and Wales) Regulations 2010 (the Regulations) came into force on 6 April 2010 and added water discharge consents, groundwater authorisations, radioactive substances registrations (RSR) and authorisations under the scope of the Regulations. The Regulations aim to reduce the administrative burden of regulation on industry and regulators without compromising the environmental and human health standards previously delivered by the separate regimes. The Environment Agency (EA) is the statutory regulator in England and Wales.

Under the Regulations, certain industrial processes and activities require a standard or bespoke environmental permit before being allowed to operate. The permit, if granted, specifies conditions that the operator must comply with, including the application of 'best available techniques' (BAT) which prescribes that the process must ensure a high level of protection for the environment as a whole (including human health).

Since the advent of the pollution prevention and control regime, the EA and the Health Protection Agency (HPA) have worked closely to ensure that public health is a fundamental consideration in the regulation and permitting of process industries and waste management activities. In early 2010, the EA and the HPA entered into a Working Together Agreement for Environmental Permitting[2] (the Agreement). The Agreement was signed by the EA and the HPA on 30 September 2011.

One of the benefits of this new Agreement is that the EA now consults with the HPA directly, as well as with directors of public health (in primary care trusts). Approaching each health consultee directly assists a coordinated response within the statutory consultation periods, allowing for more efficient processing and determination of industry applications for permits.

A closer working relationship

The Agreement cements a closer working relationship between the two agencies, and joint working and information sharing ensures that public health is considered around regulated installations. This is particularly important in light of the organisational changes that are currently taking place within both agencies and across the health services. This working relationship will help both organisations to work together effectively during the creation of Public Health England and a single body for Wales (Environment Agency Wales, Forestry Commission Wales and Countryside Council for Wales) to ensure, as far as possible, a seamless transition for customers and stakeholders.

The EA and the HPA have also established a joint operational liaison group that meets every four months to discuss areas of mutual interest and to improve the service that both organisations provide to their stakeholders. The group provides a forum to discuss new and emerging industrial issues in environmental public health, such as novel waste treatment technologies and shale gas extraction.

This group has set objectives for 2012 to improve the integration of public health within the environmental permitting regime. Existing guidance to public health professionals[3] will be updated and short statements will be produced to give advice on specific industries such as intensive farms, novel waste technologies and composting sites.

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Graduate environmental health practitioners in a multi-agency training placement

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Introduction

Environmental health is a fundamental, frontline, specialism of public health and a key stakeholder in the wider public health workforce. Environmental health practitioners (EHPs) employed in local authorities hold the regulatory powers to protect the public's health, and they are also regularly involved in identifying and providing key interventions to protect health and reduce health inequalities. With the move towards Public Health England (PHE), perhaps now more than ever, it is essential for the various specialisms in public health to work together, to fully understand each other's roles and responsibilities, and share expertise to develop and foster closer working practices.

Since 2010, the Health Protection Agency (HPA), Sandwell Primary Care Trust (PCT) and Sandwell Metropolitan Borough Council (MBC) have been leading the way with a unique multi-agency partnership to broaden and provide work place experience for some of the new generation EHPs. This article identifies the benefits the placements afford to these students as well as to the host organisations, hopefully encouraging other organisations to offer similar placement in the future.

Pathway to qualifying as an environmental health practitioner

Similar to the process involved in the established public health training scheme (see the UK Faculty of Public Health website at http://www.fph.org.uk/), for EHPs to practice they must go through a rigorous training and registration process overseen by the Chartered Institute of Environmental Health (CIEH) registration board. As well as completing a CIEH accredited university degree at undergraduate (full-time three years) or master's (full-time one year) level, they must also undertake professional written examinations, attend an interview and complete a portfolio of professional practice (PPP) on their practical experiences from work placements. For the student EHP usually this work placement is undertaken within a local authority for a period of one year. Historically, students were paid during their placements, but these placements are usually now offered as unpaid appointments. In addition, the number of training placements offered by local authorities has decreased, but there are new opportunities including internships and specific short-term training opportunities with government organisations and private companies relevant to environmental health.

The public sector economic downturn has changed the landscape for EHP employment resulting in more employment opportunities arising in the private sector for qualified EHPs. The CIEH actively encourages a range of training and employment opportunities as it recognises their diverse membership, which is utilised in a range of public and commercial organisations.

Sandwell environmental health multi-agency placement

There are recent examples where local offices of the HPA and PCTs have offered a short-term training placement, generally consisting of a few days, to a student EHP. Often these placements will have been arranged through agreements with a local authority, but this only provides a taste of a particular public health specialism.

The Sandwell environmental health multi-agency placement is an agreement between the Birmingham office of the HPA Centre for Radiation, Chemical and Environment Hazards (CRCE), Sandwell PCT and, crucially, Sandwell MBC. The local authority takes a lead for the placement and provides a student training coordinator for the year. The placement year comprises eight months at Sandwell MBC, three months at the HPA and one month at the PCT. Previously the placement has been offered to two student EHPs per year on an unpaid basis. All three organisations are committed to providing the placement and all are involved in interviewing, identifying projects and also providing support to the students throughout the year. Additionally the training leads in all three organisations have an environmental health background and can tailor the placement to the student's particular needs, based on their own experience.

Student environmental health practitioners' training needs

The student's placement is structured to fulfil competencies required for the portfolio of professional practice (PPP). The fundamental requirement of the PPP is to show experience in the principal domains of environmental health practice:

- Food safety
- Health and safety
- Environmental protection
- Housing and health
- Public health.

Whilst public health is a principal domain of the PPP, it also underpins all of the other domains listed above. Therefore, the PPP provides a solid public health foundation for students specialising in environmental health.

During the time spent with the HPA and the PCT, students have supported day-to-day operations and have been involved in the following projects:

- Support of the West Midlands region in developing carbon monoxide surveillance, improving understanding of alerting mechanisms with other organisations when carbon monoxide poisoning/incidents occur
- Examination of the CRCE chemical incident database to look at the distribution and frequency of chemical incidents in the West Midlands region during 2011
- Identification of hazardous waste disposal legislation and responsibilities for collection and West Midlands contacts
- Review of the local authority annex of the Large Fires Involving Asbestos Containing Materials Toolkit
- Identification of landfill sites with potential for mining of valuable materials such as metals
- Use of statistical control charts to highlight areas of excessive public nuisances
- Systematic review of the evidence of adverse environmental and public health effects of decreasing the frequency of domestic refuse collection.

Benefits of a multi-agency placement

Involvement in the placement scheme offers many benefits to both the host organisation and the students, including:

- A unique and valuable experience for the student providing a solid public health foundation for their future environmental health career
- Multi-agency partnership working between host organisations
- Development of contacts in other organisations, benefiting both the host organisations and the students involved
- Development of partnership projects for the students to lead on, benefitting both the host organisation and the students
- Sharing knowledge and expertise with students and between organisations
- Reputational benefits to all organisations involved through the demonstration of commitment to training and working with key stakeholders.

Example timetable for a multi-agency placement

Jan/Feb	Advertise and interview for student(s): this process is encouraged to happen as early as possible in the year
Sept	Student(s) start the placement: 1 week introduction with the local authority
Sept/Oct	6 weeks with food safety at the local authority
Nov/Dec	6 weeks with environmental protection at the local authority
Jan/Feb/ Mar	3 months at the Health Protection Agency, which is divided into 10 weeks with CRCE and 2 weeks with Health Protection Services
April/May	6 weeks in housing at the local authority
June	1 month at the primary care trust
July/Aug	6 weeks in health and safety at the local authority
Aug	2 weeks consolidation/review period

Annual leave is by mutual agreement between the host organisations and the students

Is your organisation able to offer a placement opportunity?

Environmental health students require dedicated and motivated training supervisors and teams to gain broad experience. In the Sandwell multi-agency placement, both the HPA and the PCT supervisors have an environmental health background, and have gone through a similar training process so can assist in guiding the student.

Here are some suggestions on how to set up a multi-agency placement scheme:

1. Speak to a student EHP training coordinator in the environmental health department of a local authority to initiate discussions
2. Contact a university which delivers the environmental health degree at either a BSc or MSc level. Universities support their students in obtaining training placements. Universities which offer courses can be found on the CIEH website: http://www.ehcareers.org/where_what_study.html
3. Contact your local branch of the CIEH for assistance. Details of local CIEH branches can be found on the CIEH website: http://www.cieh.org/members/regional_network.html
4. If you are unable to offer a multi-agency placement but your organisation can offer experience to a student independently, the CIEH has developed a 'student directory' where placement opportunities are collated by specialism. Further details can be found at http://www.cieh-cymruwales.org/professional_development/student_training_opportunities.html
5. On a final note, if you are based in the HPA, you will need to obtain centre/division approval. In CRCE the visiting workers policy was used to provide human resource guidance on recruiting students into the HPA.

Future of placements in Public Health England

Whilst the future of where each public health specialism will sit is still undecided, there will be an increase in the delivery of public health at a local level. The role of the EHP will be essential and multi-agency placements such as the Sandwell environmental health placement will form a key developmental requirement for student EHPs.

Maurice Brennan, Head of Teaching in Environmental Health, University of Birmingham, stated that:

> 'The model developed in Sandwell is an excellent example of the approach that will lead to greater integration of the professionals skills needed in the new era of public health delivery in England. The feedback from students on this placement has been excellent. Well done all concerned.'

Given our positive experiences from taking part in the Sandwell environmental health multi-agency placement, we would encourage other organisations regularly involved with environmental health to look into adopting a similar training commitment, which will work towards providing EHPs with a broad range of experience and thus improve their public health knowledge.

Acknowledgments

We would like to thank all the EPH students who have taken part in the placement, in addition to all the departments and professionals who have assisted with their training.

Training Days for 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 2012 programme has been developed to offer basic and more detailed training for HPA staff as well as for those in allied professions, such as local authorities, the NHS and the emergency services.

Calendar of chemicals training courses for 2012

Date	Title	Level	Length	Venue
Autumn 2012	**Essentials of Environmental Science**	3	Five days	King's College, London
Dates to be announced	**Carbon Monoxide Workshop**	2/3	One day	To be confirmed
Dates to be announced	**Understanding Public Health Risks from Contaminated Land**	2/3	One day	To be confirmed
Dates to be announced	**UK Recovery Handbook for Chemical Incidents: Interactive Training Sessions**	3	One day	To be confirmed

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 at 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 courses, please contact Karen Hogan

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