Chemical Hazards and Poisons Report

From the Chemical Hazards and Poisons Division
May 2008 Issue 12

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Editorial

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In this issue the Oak Processionary Moth is reported as causing public health concern: in 2006 a series of cases were identified in South West London and the Forestry Commission are now anxious about wider spread of this moth. Advice about who to call if the caterpillars or related cases are identified is provided for this summer's possible infestation.

In addition, recent incidents are summarised in this issue: a fire in Corby resulting in significant concern for fire fighters and a Bangladeshi family in East London with possible mercury poisoning. We also offer further information about the environmental sampling undertaken after the 7th July 2005 London Bombings - this work showed how important such sampling is to reassure those working in the environment of the incidents and those who now use the London Underground. In a continuing series on carbon monoxide incidents, two cases studies are reported. For the first time, we include a paper on health economics, addressing the economics of carbon monoxide strategies and options.

Two articles related to emergency preparedness are included. One reflects a recent Gold level exercise on flooding, a most topical exercise after the summer flooding of 2007. The other looks at the development of a draft framework for managing influx into community health facilities following chemical incidents. Currently Primary Care Trusts, along with the Health Protection Agency, are Category 1 responders under the Civil Contingencies Act 2004, but General Practitioners are not identified under the act as being either Category 1 or 2 responders. Thus, this article considers the issue of the concerns that such services may have on how to respond further.

Environmental issues are, as always, of significance, and in this issue, the Environment Agency and Chemical Hazards and Poisons Division joint horizon scanning pilot is presented. This joint project is of particular importance to us as the HPA is increasingly involved in complex learning, which has been highlighted by last summer's floods. Two articles reflect our concerns to improve our understanding in this area. One article addresses the development of a risk assessment framework for potential chemical contamination during flood events. The other reviews the Health Protection Agency guidance for flooding using the flooding in England & Wales 2007 as a case study. This reports that the advice and guidance provided nationally and locally during the flooding event of summer 2007 were generally accurate and consistent. However, a number of recurring issues were identified where the evidence-base for the advice given was less than ideal. Proposals of how to address this are offered.

A series of conference and workshop reports are included in this issue, covering a wide range of topics: health effects of climate change; behavioural sciences in the Health Protection Agency; and the Small Area Health Statistics Unit Jubilee Scientific Meeting, 18 December 2007.

The next issue of the Chemical Hazards and Poisons Report is planned for September 2008. The deadline for submissions for this issue is 1st August 2008. Please do not hesitate to contact us about any papers you may wish to submit. Please contact us on chapreport@hpa.org.uk, or call us on 0207 759 2871.

We are very grateful to Professor Gary Coleman for his support in preparing this issue.

In addition the editor wishes to report that before leaving the Health Protection Agency in April 2008, Professor Pat Troop, the Chief Executive Officer, HPA, visited the West Midlands in order to participate in the first ever West Midlands HPA Staff Awards. This event was held in late February in Birmingham. Dr Toby Smith from CHaPD Birmingham shared the award of Employee of the Year for the HPA West Midlands Region.

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Incident Response

Oak Processionary Moth

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A non-native species of toxin-producing caterpillar which can affect the health of humans and plants was first found breeding in England in 2006. The larvae of the Oak Processionary Moth (*T. processionea*) are hairy caterpillars (see figure 1), and the third to sixth larval instars, found in late spring and early summer, produce a toxin which can affect humans and animals. They bear urticating hairs or setae, 5-10 micrometres in diameter, which contain a mixture of proteins including a histamine-liberating toxin[1]. The organism is named for the caterpillars' tendency to form long lines or processions as they move from their nest (see figure 2) on the trunk of an oak tree towards the leaves on which they feed; the resultant defoliation is a threat to the oak trees on which they live[2] (see figure 3).

Figure 1: Oak Processionary Moth larvae, © Crown copyright, Forestry Commission

Humans exposed to the setae most commonly develop intensely itchy rashes but eye symptoms, pharyngitis, malaise and respiratory problems are also described, and outbreaks occur[1;3-6]. There are no reported deaths. The clinical picture is similar to that seen with brown tail moth (*Euproctis chrysorrea*) which also causes itchy rash[7] and in the UK[8] and globally[9] there are many species of caterpillar which can cause dermatitis. The rash may include weal and flare reaction, toxic irritant dermatitis and persistent itchy papules[1].

Exposure to the toxin of *T processionea* may result from direct contact with its caterpillars as their striking appearance can invite people to handle them, but airborne spread of the toxin-containing setae is known to occur over at least 20m, and setae can also persist in the ground for months or years[1;10]. Thus individuals can develop symptoms without known contact with the caterpillars.
T processionea can cause outbreaks or single cases of itchy rash, but as the rash is non-specific, the cause may not be identified if the individual did not have or report direct contact with the caterpillars.

Figure 2: Oak Processionary Moth larval nest, © L Moraal, Wageningen URC, The Netherlands

Oak processionary moth (see figure 4) was originally a Southern European pest, but its range has been extending northwards for decades, probably associated with climate change[11;12]. The first breeding colony in the UK was found in South West London in 2006, and is thought to have arrived on imported trees[11] and a number of other infestations have been identified subsequently. Concerted efforts to eradicate the pest and prevent further importation have been undertaken by the Forestry Commission, including the introduction of emergency legislation to prevent further importation, and ongoing identification and destruction of nests. The aim is to identify and destroy existing colonies in the UK as larvae, so as to prevent further breeding in this country[13]. The Health Protection Agency is working with the Forestry Commission, the Department for Environment Food and Rural Affairs, and local authorities to maximise the chances of identifying and destroying existing colonies of this pest in the UK. Health professionals in the affected areas will be contacted as the season for the caterpillars begins with advice on diagnosis, management and reporting.

Anyone who believes they have found one of the caterpillars or nests in an oak tree should not touch them but should contact one of the following:

- to report sightings in Ealing Borough, call 020 8825 5000 or e-mail trees@ealing.gov.uk;
- to report sightings in Richmond Upon Thames Borough, call 0845 612 2660 or e-mail trees@richmond.gov.uk;
- sightings can also be reported to the Forestry Commission's Forest Research agency, telephone 01420 22255 or e-mail christine.tilbury@forestry.gsi.gov.uk.

Figure 3: Oak Processionary Moth caterpillars on oak tree
© Crown copyright, Forestry Commission

Figure 4:
Oak Processionary Moth adult © Paul Harris

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Fire at an adhesives factory: lessons identified from both occupational and public health practitioner perspectives

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Introduction

On May 8th 2007, a fire started at Caswell Adhesives factory in Corby. This resulted in a number of fire appliances being mobilised to the fire from Northampton Fire and Rescue Service, and two retained crews were mobilised to cross the Northamptonshire border to assist at the incident.

The incident led to health concerns for both firefighters and members of the public. In this article, the response to the incident is presented from both occupational and public perspectives, along with lessons identified.

Incident Response

Occupational Health Perspective

Following the return of the crews to their respective stations at approximately 17:00 hours, the Leicestershire Fire and Rescue Service (LFRS) Occupational Health (OH) and Safety team were advised by a telephone call from Northampton Fire Safety Department that the crews had been exposed to 'gases given off' during the incident, possibly phosgene. Immediately after we received this information we informed our control of the exposure, and requested a list of names of the individuals involved.

The safety information received by the OH and Safety unit suggested that the chemicals involved had the potential to harm human health and that the individuals involved might require hospitalisation. As much information was collected regarding the exposure as possible; however, details and specifics were limited.

Whilst LFRS occupational health were aware of the incident, the sequence of events was initially unclear. LFRS crews had returned to their station and had since gone back to their own employment and families. Subsequently (about an hour later), we were advised that the Northamptonshire crews who had been exposed to what was now being described as 'phosgene' were attending their local hospitals for 'check-ups'. All were later discharged as fit.

As the LFRS crews were unaware of their exposure, we had to find the individuals involved in the incident, which caused a delay in assessing their health status. Once we had informed and collected the 10 firefighters, they were taken to the Emergency Department and all were admitted for observation for 48 hours. This followed the advice that the physician coordinating their admission decided was appropriate in light of their potential exposure to phosgene. A more accurate clinical assessment was hindered by the poor medical histories from the firefighters regarding the extent of the exposure experienced. There was no formal incident information at this time to assist the assessment.

The firefighters were discharged from hospital after approximately 24 hours but were advised not to return to their full time employment for a further day. All were symptom free, no ill health effects were experienced at the time or since the incident. No further follow up has been advised. The health exposure has been recorded in each individual's occupational health record.

Public Health Perspective

The East Midlands (South) Health Protection Unit (HPU) was notified of the fire at 9.05 hours by the East Midlands Chemicals and Environmental Team – CET (now Chemical Hazards and Poisons Division, Nottingham).

The local HPU duty person then liaised with the fire and ambulance personnel dealing with the incident to obtain more information. There was also close liaison between the Chemical Hazards and Poisons Division (CHaPD) and the HPU about the possible chemicals implicated in the incident.

A media statement had already been issued to the public to 'Go In, Stay In (close windows), Tune In', which was going out on local radio stations. A decision was also made by the emergency services to evacuate the factories within the area as there may be a risk of explosion.

The initial information on the chemicals showed the presence of acetone, toluene and dichloromethane. Chemical fact sheets for these substances (including their effects on health) of these chemicals were sent by CHaPD to the fire and rescue services on site.

The Duty person from the HPU communicated with various people from different organisations, including the County Council and the Primary Care Trust (PCT) department of public health. The HPU set up a dialogue with Northamptonshire PCT and the appropriate communications managers for the representative organisations.

At 11:00 hours, the HPU was informed that a silver command meeting had already taken place one hour previously. This gave the HPU some concerns as messages regarding public health were being given out without advice from the HPA. The HPU was assured by silver command that they would be contacted if their presence was required at further meetings.

The continued message of 'Go In, Stay In, Tune In' was repeatedly given throughout the morning.

On the advice of the HPU, a public health meeting was set up for 14:30 hours at the PCT headquarters to ensure all the public health issues were being addressed. At this time, the HPU was informed that the acute phase of the incident was over. A representative from the Environment Agency (EA) also attended this meeting as there were concerns about the surrounding area which was mainly farming land with some livestock and crops. The EA and Food Standards Agency (FSA) were advising on the risks around this as well as the possible risks caused by the 'run off' water from the fire site.

A HPU representative planned to attend an on site silver command meeting at 16:00 hours and would advise the PCT whether there was any further public health risk following this meeting.

The meeting at 16:00 hours was to discuss the opening of the roads and allowing the factories to open later that evening at 18:00 hours. The movement restrictions for the public were lifted, and appropriate messages were to go out on local radio stations.

No further meetings were planned and acute incident closed.

At 20:15 hours, HPU received a call from CHaPD informing us that 10 fire-fighters had been advised to attend the local Emergency Department for investigation following possible exposure to phosgene (which may be produced by the combustion of chlorinated organic compounds).

CHaPD had taken the enquiry from the Emergency Department regarding the possible health risks to these fire-fighters. This resulted in a number of telephone conversations between HPU on-call, CHaPD on-call and local hospitals. A total of 26 fire-fighters presented at four different Emergency Departments that covered Kettering, Leicester, Northampton and Peterborough. The consultant in Leicester Royal Infirmary made the clinical decision to admit 10 self-presenting fire-fighters for observation. All other Emergency Departments discharged the fire-fighters who presented there.

The admission of the 10 fire-fighters at LRI led to great confusion among the fire and rescue services as to why different decisions were made at different Emergency Departments. HPU on-call spoke to the fire officers managing this situation that evening to try to reassure and explain the reasons for the confusion and it was decided that the HPU was to contact the appropriate (OH) departments of the fire brigades the following morning.

Lessons identified

Occupational Health

A breakdown in communication occurred when LFRS was informed on a casual basis between safety departments that firefighters may have been exposed to chemicals.

There was some confusion regarding the specific chemicals involved. This confusion was compounded by the lack of clarification from both those giving the advice and those receiving advice, with particular issues arising due to the cross-border nature of the incident. These issues highlight the need for good communication. Operationally, these issues have been addressed and systems have been developed and improved.

By not being actively aware at an early stage, OH and safety professionals were unable to establish good health or incident histories regarding exposure and were subsequently criticised by the hospital physician that the histories taken from individuals were poor: individuals had reported a range of exposure levels from 'eating smoke' to 'minimal' / 'if any' exposure, yet all 10 were admitted as a precaution. This lack of good information potentially wasted medical time and resources. The firefighters were hospitalised thus losing time from their whole time employment resulting in additional cost to LFRS as they were reimbursed for their retained duties and lost time.

Stress and anxiety to both individuals and their families could not be discounted and the potential for litigation is ever present in these situations. LFRS OH and Safety have since developed an assessment tool as part of the chemical exposure documentation that is completed at these incidents. This will enable better quality of information to be available if further health intervention or surveillance is required.

Public Health

On 9th May a teleconference was held between the HPU and CHaPD (London and Nottingham Units) to discuss lessons identified from this incident and possible ways to improve public health response to similar incidents.

The HPU contacted the OH departments of the fire brigades involved to discuss the incident and also to put them in contact with CHaPD for further advice.

One of the positive outcomes of this incident around lessons learnt is that the local HPU now has closer links with the OH service to the fire brigades in the region.

Unusual clinical presentation in four siblings from a large Bangladeshi family

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This report focuses on a family of Bangladeshi origin, including 14 siblings, living in one household in north-east London. The children lived with their biological parents who had no medical problems and there was no history of consanguinity, social problems, or of recent foreign travel. Over a six month period, four siblings had presented to the same hospital with symptoms initially suggestive of an infectious aetiology. All of the children then developed behavioural and speech abnormalities that resolved spontaneously. No conclusive diagnosis or source of infection was identified at this time.

The Chemical Hazards and Poisons Division (CHaPD), London, were alerted to a possible environmental cause of illness in a number of the children. Heavy metal or carbon monoxide poisoning were raised as possible aetiologies. Following a multidisciplinary case conference, further investigations were requested from all family members, including stool specimens for virology and blood for toxicology (lead and mercury). Detailed history from the father revealed no obvious environmental or dietary sources of heavy metal exposure. A site visit was made by CHaPD with the local authority partners, where environmental assessment and sampling was undertaken.

Clinical presentation and investigation

The first family member to be investigated (case 1: age 9 years) presented in July 2006, and was initially managed as a presumed head injury after falling from a bicycle. At the hospital the Glasgow Coma Scale (GCS) score was reduced (12/15) with no obvious external injury. A computerised tomography (CT) of the brain was normal and the case was admitted for observation. The GCS soon resolved to normal (15/15). This child later developed headaches, extra pyramidal signs and unusual behavioural patterns including persistent tongue protrusion, infantile mannerisms and dysarthria. The initial diagnosis of head injury was re-evaluated and this was treated as presumed encephalitis.

In December 2006, three further siblings (cases 2, 3 and 4: ages 17, 11 and 8 years respectively) were admitted to hospital over a period of five days with headache, neck pain, vomiting and extra pyramidal signs. Each child displayed the same behavioural characteristics as the first sibling affected, including tongue protrusion and infantile mannerisms. Only one of the four siblings was noted to have mild pyrexia. Case 1 continued to exhibit abnormal behaviour problems when last seen, while in the other three children, symptoms and signs resolved over three weeks.

Environmental investigation: site visit and sampling

A site visit was agreed with the property owner and arranged in conjunction with the local authority environmental health team. Following a preliminary risk assessment, full personal protective equipment was considered unnecessary. Previous land use around the residence was ascertained through historical records. Initial overview (visual inspection) of the property was made to identify possible environmental sources. The local authority conducted a detailed assessment of the property to ascertain its overall suitability for habitation. Environmental sampling was arranged by the local authority- all samples were placed in appropriate containers, labelled with the sampling location and a unique reference number, and sent to accredited laboratories for analysis.

Surface swab sampling: thirteen swab samples were collected throughout the property, one from each room, from representative areas of flat surfaces. Each swab was taken from an area of $0.01m^2$ using a plastic sampling template.

Garden soil sampling: five surface soil samples were taken from the back garden, one towards each corner and one in the centre.

Mercury vapour monitoring: the entire property was assessed for mercury vapour using a hand held instrument capable of reading from 1 to 2000 $\mu g/m^3$. Following completion of all of the above monitoring and sampling, SKC 520 series passive/diffusion samplers were placed at four locations in order to monitor mercury vapour over an extended period (120 hours). This would allow a lower limit of detection to be achieved than for the direct reading instrument.

Biological findings

Routine investigations on the cases, including blood, microbiology, radiology, and tests for carbon monoxide poisoning, were normal. All family members had blood and stool samples taken, as well as rectal and throat swabs. All these were sent for virology analysis while blood and urine samples were sent for toxicology screening.

Stool sample findings for four of the children were as follows:

- Cases 1 and 4 – enterovirus detected (inadequate quantity for typing)
- Siblings 6 and 7 - enterovirus detected, VP1 genotyping: echovirus type 6

Results of urine toxicity testing in the family were negative for lead but showed slightly elevated mercury levels in eight of the 14 children (Table 1). Case 1, who had initially presented in July 2006, had normal lead and mercury blood levels.

Table 1: results for lead and mercury screening.

Case ID (date taken if not 06/01/07)	Age (years)	Blood lead level (μmol/L) (normal <0.50)	Blood mercury level (nmol/L) (normal <50)
Case 2 (26/12/06)	17	0.10	170
Case 2	17	0.18	92
Case 3 (29/12/06)	12		45
Case 3	12	0.23	68
Case 4	8	0.28	53
Sibling 1	20	0.22	68
Sibling 2	19	0.15	83
Sibling 3	14	0.42	54
Sibling 4	7	0.14	84
Sibling 5	6	0.29	54

Environmental findings

The site was first developed as housing between 1896 and 1915, previously it was farmland. There was very little in terms of historic industrial use in the area: an electroplater was located 50m away and a refuse destructor or power station 300 - 400m away. It is possible that the site could have been subjected to dumping as both this and adjacent properties were the last to be developed.

Surface swab sampling: slightly elevated mercury concentrations were detected in surface wipes from three locations in the house:

- second floor kitchen, worktop (12 ng , figure 1)
- first floor, middle bedroom, wall below light switch (11 ng)
- basement, front, wall adjacent to light switch (16 ng)

Mercury was not detected in any of the bedrooms (less than 10 ng), or in the rear basement that had suffered fire damage.

Figure 1: surface swab sampling in the kitchen © HPA

Garden soil sampling: all individual soil analysis results were below the Contaminated Land Exposure Assessment (CLEA) Soil Guideline Value (SGV) for inorganic mercury of 15 mg/kg for gardens without uptake[1] by vegetables (table 2). If the upper 95th percentile bound mean value of the results is calculated in accordance with the methodology given in CLR7[2], then the SGV of 8mg/kg for gardens with the plant uptake route included is not exceeded (note that the SGV is intended to protect the health of a young female child).

Table 2: Results of soil sampling in rear garden of property

Site location reference (depth 0.0 – 0.15m)	NE	SE	Centre	NW	SW
Mercury (mg/kg)* *Limit of detection = 0.5 mg/kg	2.3	1.5	1.4	8.6	1.2

The condition of the garden was such that the growing of vegetables, except possibly in containers, would appear to be highly unlikely (figure 2). The calculated 95th percentile for the concentration of total mercury in the five soil samples is 6.0 mg/kg.

Figure 2: inspection of garden © HPA

Mercury vapour monitoring: no concentrations differing from background or ambient values were recorded at any location during direct monitoring. The result from the passive monitor on the second floor was slightly positive for mercury. Although this was above background levels it was not considered to be significant. The other three passive samples were negative for any traces of mercury.

Interpretation and conclusions

The clinical findings were inconclusive, but suggest the possibility of an infectious aetiology. Enterovirus levels were extremely low in the children, but can give rise to neurological symptoms, and may occur in a large family living in crowded and possible unhygienic conditions (figure 3).[3]

Figure 3: unhygienic living conditions © HPA

Elevated mercury levels did not fully explain all of the children's symptoms but required further investigation as to a potential source.[4] Immediate management in this case was to remove the children from the possible source of exposure. Following assessment by the social work team the family was requested to leave their home, as it was deemed unsafe for habitation, and move to temporary accommodation.

Overall, environmental findings showed that no contamination was present in the garden. Vapour tests in the house were below background levels with the exception of one slightly elevated sample; and wipe tests showed non-significant elevated concentrations of mercury. The most likely source of this mercury contamination (particularly on walls adjacent to light switches) is from skin transfer during hand contact, rather than from deposits due to spillage of elemental mercury (for example from a thermometer see Box 1). Similarly, if volatilisation during a fire, or from damage of fluorescent tubes etc, had occurred, then the slightly elevated concentrations would be expected to be more widespread.

The outcome of the local authority assessment was that a number of hazards were identified in the home which would need to be dealt with. As the property was owner occupied, improvement notices could not be served (Section 11, Housing Act 2004). However, the LA served a hazard awareness notice and the property owner is currently in negotiation with the local authority over remediation of the property. This case reflects the importance of considering a wide range of infectious and environmental causes in case management, and involving the appropriate health and local authority partners.

Box 1: Possible sources of environmental mercury exposure

Thermometers and barometers
Fluorescent lights and electrical switches
Batteries[5]
Cooking utensils
Food such as contaminated fish[6]
Traditional medicines[7]
Paint
Toys
Chemicals such as pest control or timber treatment[8]
Dental amalgam

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Acknowledgements

The authors would like to thank:

Johnathen Ruder, Richard Robinson and Ian McConnel (London Borough of Hackney)

David Gerrie and Ivan House (Medical Toxicology Unit, Guys and St Thomas' Hospital Trust)

Dr Rajiv Sood (Consultant Paediatrician, Homerton Hospital)

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The July 2005 London Bombings: environmental monitoring for non-infectious materials release, and initial health risk assessment.

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Introduction

The multi-agency response to the July 7th London Bombings with regard to chemical hazard assessment and environmental/ occupational hygiene monitoring was documented in a previous issue of the Chemical Hazards and Poisons Report (Wilson et al., 2006). In this article, an update is provided in which the results of the asbestos monitoring data are summarised and an initial health risk assessment is presented.

Methods

Initial on-scene assessments of the potential for a deliberate release of chemical agents were made by the emergency services (Wilson et al., 2006). Forensic crime scene risk assessments and site control measures took account of the possible rapid change in scene dynamics during the operation and the risk of physical, biological and chemical exposures. Health and safety staff from the Metropolitan Police Service conducted scene hazard profiling. Personnel from both London Underground and Metropolitan Police Service Health and Safety in consultation with London Underground (associated infrastructure companies) identified material that may have been released from train carriages due to the explosions by inspection of train carriage schematics.

Health and Safety personnel from the Metropolitan Police Service and London Underground primarily directed the occupational hygiene monitoring which was undertaken on the London Underground after evacuation of the uninjured, walking wounded, and after the rescue of casualties. Much of the work was undertaken after the Strategic Coordinating Group (SCG) had stood down. However, a multi-agency group was established outside of the SCG (initially calling itself an 'environment group') that included personnel from London Underground/Transport for London (including Tubelines and Metronet), Health Protection Agency (HPA), the Department for Environment, Food and Rural Affairs (Defra) Government Decontamination Service) and the Metropolitan Police Service. At the first meeting of the group (19.07.05), the initial occupational hygiene sampling data, scene hazard profiling, risk assessments and mitigation controls (including safe systems of work) were reviewed, and plans for ongoing recovery efforts discussed (Wilson et al., 2006).

Due to initial concerns surrounding potential health risks posed by asbestos, airborne fibre monitoring was instigated. (Wilson et al. 2006). Airborne fibre monitoring was undertaken at Kings Cross, Russell Square, Aldgate and Edgware Road stations. The airborne asbestos fibre monitoring programme was started at 16:44 hours on the 7/7/05 at Kings Cross. Initially, static and personal airborne fibre monitoring was undertaken on all three parts of the London Underground network where the explosions occurred by UKAS accredited (United Kingdom Accreditation Service) services. Additional reassurance monitoring was undertaken on the platforms at Covent Garden underground station.

Concentrations of airborne asbestos fibres (Health and Safety Executive (HSE), 2005) were measured using the phase contrast microscopic (PCM) method recommended by the HSE (2005) using both personal and static samplers. PCM is commonly used for occupational health and safety purposes (for example when asbestos materials are being stripped from buildings). Concentrations of airborne fibres are measured that are >5µm in length, <3µm in width with an aspect ratio of at least 3:1.

Results and Discussion

Airborne Fibre Monitoring

Initial scene hazard profiling included a consideration of the possibility that a significant number of asbestos fibres could have been released into the air. However, inspection of the damaged train carriages subsequently confirmed that this was very unlikely. Results of airborne fibre monitoring are summarised in Table 1. The concentrations measured were below the limits of detection for the methods used and in agreement with visual inspection of train components, suggest that a significant release of fibres to air did not occur.

Preliminary Health Risk Assessment

On the basis of visual inspection of the damaged train carriages and airborne fibre measurements, the risk associated the potential release of hazardous materials from train carriages were assessed to be negligible. With respect to the health of the emergency responders present on scene during the forensic investigation, the health risks related to airborne fibres was negated by the adopted working practices (including use of appropriate personal protective equipment (PPE), such as P3 respiratory protection). The use of PPE by those present after the stations were evacuated and casualties rescued, reflected a precautionary approach in the event that on scene hazard profiles changed.

Table 1 Summary of measured airborne fibre concentrations

Station (dates of sampling)	**Airborne Fibre Conc. (f/ml)**	**Test Type**	**Method (see HSE 2005)**
Kings Cross (07.07.05 - 25.07.05)			
Tunnels (proximal and distal)	<0.01 to <0.02	Static Reassurance	MDHS39/4
Platforms and other publicly accessible areas	<0.01 to <0.04	Static Reassurance	MDHS39/4
Personnel in vicinity of damaged carriages	<0.02 to <0.08	Personal 4-hour control limit	MDHS39/4
Covent Garden (08-10.07.05)			
Platforms	<0.01	Static Reassurance	MDHS39/4
Russell Square (07-25.07.05)			
Tunnels (near and distal to damaged carriages)	<0.01 to <0.02	Static Reassurance	MDHS39/4
Platforms and other publicly accessible areas	<0.01 to <0.02	Static Reassurance	MDHS39/4
Personnel in vicinity of damaged carriages	<0.04 to <0.16	Personal 4-hour control limit	MDHS39/4
Aldgate (07-08.07.05)			
Platforms	<0.01	Static Reassurance	MDHS39/4
Ramp (25m from end of damaged carriage)	<0.01	Static Reassurance	MDHS39/4
Edgware Road (07.07.05)			
Platform (50m to rear carriage of damaged train)	<0.01	Static Reassurance	MDHS39/4
Open carriage opposite blast damaged carriage	<0.01	Static Reassurance	MDHS39/4

The health implications associated with exposure to tunnel dust on the London Underground under normal operating conditions has been previously assessed (Hurley et al., 2003; Seaton et al., 2005). In considering the possible risks to health due to exposure to tunnel dust, this group characterized the material, considered the evidence available on adverse health effects in workers exposed to similar substances, estimated likely maximal exposures of staff and passengers, and performed *in-vitro* toxicological testing of sample dusts (Hurley et al., 2003; Seaton et al., 2005). *In-vitro* toxicity testing showed that on a weight for weight basis, the toxicity of tunnel dust is comparable to welding dust, is less than quartz, but greater than titanium dioxide, a material generally considered to be inert (Hurley et al., 2005). These assessments indicated that tunnel dust is unlikely to represent a cumulative risk to the health of workers or commuters under normal operating conditions (Hurley et al., 2003; Seaton et al., 2005).

There are a lack of environmental monitoring data with which to assess potential exposure to respirable dust in the aftermath of the bombings on the London Underground. However, the exposure duration and inherent toxicological properties of the tunnel dust components were considered in order to make a qualitative assessment of long-term health risks.

Studies on the toxicological properties of tunnel dust have focused on quartz and iron oxide components (Hurley et al., 2003; Seaton et al., 2005). The International Agency for Research on Cancer (IARC) has classified inhaled crystalline silica as a Group 1 carcinogen based on sufficient evidence of carcinogenicity in humans and experimental animals (IPCS, 2000). Silicosis, lung cancer, and pulmonary tuberculosis are quite clearly associated with (predominantly) chronic occupational exposure to quartz dust. Non-occupational silicosis is not widely reported (although there is one example from the Himalayas that may be an exception, Saiyed et al., 1991). Studies have also documented statistically significant increases in several diseases being associated with quartz inhalation, but uncertainties exist in the evaluation of epidemiological studies and the risk assessments (IPCS, 2000).

The possibly reduced toxicity of quartz in tunnel dust due to surface activity effects (Cullen et al., 2005) in conjunction with the apparent lack of quartz-related conditions such as silicosis in London Underground workers who are chronically exposed to tunnel dust (Carlton et al., 2003), suggests that the silica component of the tunnel dust poses a very low long-term risk to health for those present on the London Underground immediately after the blasts.

With regard to the iron oxide component of tunnel dust, previous risk assessments examined evidence of health effects in individuals that are exposed to iron in respirable forms through their occupation (Hurley et al., 2003). The occupational groups identified included: haematite miners, fettlers, welders and silver polishers (Hurley et al., 2003). It was suggested that the only group of workers who are likely to be exposed to pure ferric oxide is silver polishers who have been shown to accumulate iron in the lung without serious consequences (Barrie and Harding, 1947).

Welders have been identified as the occupational group that is likely to have the greatest exposure to iron (Hurley et al., 2003) Welding fume has been considered as an analogue for the iron-bearing component of tunnel in previous health-risk assessment, although it is likely to be more toxic than abrasion-generated dusts (Hurley et al., 2003). Exposure to welding fumes has been associated with an increased (reversible) risk of pneumonia (Coggon et al., 1994; Palmer et al., 2003, 2006). However, it contains several compounds in additional to those containing iron. The inhalation of significant amounts of iron may also result in pulmonary siderosis, which has generally been regarded to be an essentially benign condition (Morgan, 1995). An assessment of the risk of developing haemochromatosis from inhaling iron dust suggested that welders do not have an increased risk of developing haemochromatosis (Hurley et al., 2003), although one paper presents three cases where occupational exposure to iron during welding was suggested as a possible cause of systematic iron overload (Doherty et al., 2004). However, it should be remembered that welding fume is likely to be much more reactive than metal dusts generated by abrasion.

The long-term risk to the health of members of the public and emergency responders posed by the iron oxide component of tunnel dust was qualitatively assessed to be very low given that ill-health attributable to iron particle inhalation in chronically exposed occupational groups does not appear to be common and that the potential exposure duration in the aftermath of the bombings was comparatively short. It is also clear that the use of PPE by those conducting the forensic examinations after the clearance of the stations further reduced any long term risks to responders' health.

Conclusions

The evidence available suggests that long-term adverse effects in emergency responders and members of the public caused by hazardous materials release by the July 7 explosions on the London Underground are very unlikely. The response to the London Bombings highlighted that the initiation of environmental and occupational hygiene monitoring strategies is essential to support both public and occupational health risk assessments during incidents which may have involved hazardous materials release. These monitoring strategies should be underpinned and supported by a multi-agency approach involving key health, safety, engineering and scientific stakeholders.

Acknowledgements

The authors would like to thank London Underground infrastructure companies (Metronet, 4-Rail) and Casella for their assistance. The authors would also like to thank the members of the 'environment group' set up during the London Bombings for their co-operation and support.

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Carbon monoxide poisoning: lessons in communication and risks to first responders

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Introduction

There have been fourteen incidents involving carbon monoxide (CO) reported to CHaPD London from November 2007 to the end of February 2008. Two have involved fatalities, and in one, exposure of attending emergency workers was confirmed. Use of personal protective equipment (PPE) provides protection for some specialised emergency teams, but significant CO exposures in first responders is well recognised. A CO action card has been developed to guide Health Protection Units (HPUs) in the management of CO incidents[1]. It sets out the respective roles of the relevant agencies and the communication between them necessary to manage the incident. During and after a CO incident, there may be significant media interest, particularly when a death occurs or there is evacuation of large numbers of people, and press communication is required.

We describe two incidents, one fatal, one near fatal, to highlight the risk of exposure to first responders, and the benefits of inter-agency co-ordination and media communication.

Incident one

The Scene

On a February morning in 2008, a CO poisoning incident in a block of residential flats in London was reported to CHaPD, London. The LAS Hazardous Area Response Team (HART) put out an alert that two residents had been found unconscious in their flat and transferred to the local hospital Emergency Department (ED), and that two other flats in the building had been evacuated.

One of the two occupants of the flat had felt unwell on waking. On returning from the bathroom the person discovered the flatmate unconscious and telephoned the emergency services. London Ambulance Service (LAS) arrived and was unable to access the flat. LAS contacted the police and on forced entry, found the two residents unconscious which raised suspicion of CO poisoning. HART was therefore called and confirmed the presence of elevated CO levels at the scene.

HART members, wearing PPE for their own safety, removed and treated the casualties. In addition to the two flat occupants, three members of the first line responders, one police officer and two LAS crew were also exposed. All required transfer to hospital for further assessment and treatment. The London Fire Brigade (LFB) also attended and evacuated and secured the flats. National Grid was called and a faulty boiler in the residents' flat was identified as the CO source. The gas supply was isolated and the source decommissioned. Following gas safety checks in all the adjoining flats, the building was declared safe later that morning for evacuees to return to their homes.

The relevant HPU was informed of the incident by CHaPD London. The Consultant in Communicable Disease Control (CCDC) at the HPU contacted the ED where those affected had been being transferred.

Clinical details

At the scene, both occupants had a Glasgow Coma Scale (GCS) under 5 out of 15, with carboxyhaemoglobin (COHb) levels of over 20% (see table 1). They were resuscitated with high flow oxygen during ambulance transport and their GCS improved to over 12 by the time of their arrival at the ED. However, despite oxygen therapy, their arterial COHb levels remained elevated and their clinical features met the criteria for hyperbaric oxygen (HBO) therapy (see box 1). They were therefore transferred to the London Hyperbaric Unit and underwent HBO therapy, and were later discharged.

The two ambulance crew who were exposed had COHb levels of 10% at the scene and the policeman had a higher level of 19%. On arrival in ED, following supplementary oxygen, the arterial COHb of the ambulance workers had decreased to less than 5%, and the police officer's level had reduced to 10% (see box 2). Normobaric oxygen therapy (see box 1) was administered and their respective occupational health personnel attended.

Investigation and secondary prevention

Secondary prevention measures were instigated the same day: the CCDC contacted the local authority Emergency Planning Officer (EPO) to ensure there was liaison with their designated Environmental Health Officer (EHO) and the Health and Safety Executive (HSE). The EPO promptly ascertained that the flat was privately owned and liaised with the flat management company to ensure that National Grid CORGI-registered engineers were contracted to repair or replace the faulty boiler before the occupants were permitted to return to the flat.

Incident two

The Scene

A week later, HART alerted CHaPD to a CO incident involving a fatality in London. The alarm had been raised by parents unable to establish contact with an adult resident. Police forced entry into the flat and found one person dead and another unconscious. The police were not equipped with PPE at that time. HART and LFB were called as CO poisoning was suspected. The unconscious casualty was transferred to a local hospital. The local authority EPO, the HSE and the local HPU were promptly notified.

The implicated flat was in a large new-build complex comprising three blocks of flats. The gas supply to those blocks was immediately isolated and disconnected. The police evacuated approximately 150

SAVED FROM POISON DEATH

GIRLFRIEND'S LAST-MINUTE CALL BEFORE PASSING OUT

BY JULIET EYSENCK

LUCKY: Emma and Christopher

CO

Figure 1: Headline from local paper © Paddington, Marylebone and Pimlico Mercury

residents in the same block as that of the casualty whilst safety checks were conducted. Most evacuees dispersed to friends and relatives or sought private accommodation. The police arranged temporary shelter nearby for the remaining ten evacuees.

Clinical details

LAS found the collapsed person with a GCS of 6/15 and high flow oxygen was administered. During the ambulance journey the patient's condition deteriorated and intubation was required. On arrival at ED, the casualty's COHb level was >25% despite high flow oxygen therapy. The patient was transferred to the Intensive Care Unit for further treatment.

Investigation and secondary prevention

Within two hours of the HART alert, evacuees were allowed to return home since CO was not detected in adjoining flats in the same building. However the gas supply remained disconnected. The Police, with assistance from HAZMAT teams and National Grid issued warning notices advising the occupants in each residential unit not to switch on their meter until permitted by their gas provider.

In view of the fatality, a joint criminal investigation was launched by the police and the HSE which is ongoing. It emerged that the construction of the development was recently completed and owned by a housing trust. The local authority EHO liaised with the housing trust to ensure residents whose gas supply was interrupted received practical assistance for heating, hot water or alternative accommodation. Residents noted that none of the flats had CO monitors. These were ordered by the police commanding officer and were subsequently installed by the housing trust.

Learning points

1. Risks to first responders

Safety Triggers for Emergency Personnel (STEP 1 2 3) (Box 3) was developed by London's blue light services as a simple scene assessment tool for use primarily by front line staff who arrive first at the scene of an incident but do not have PPE or specialised training in CBRN or hazardous materials incident management.
CO poisoning may not initially be suspected, highlighting the need for raising awareness among members of the public, dynamic risk assessment by front line services, and simple precautionary measures such as ventilating the premises. Pilot studies are in progress on the validity and utility of CO oximetry (Rad-57™, see box 2) for first responders, with the aim of rapid diagnosis at the scene.

2. Inter-agency communication

In the early stages of a fatal or potentially fatal accidental CO poisoning, there is the need to urgently obtain information to confirm diagnosis and rapidly communicate with local authorities so that swift action is taken to prevent others from exposure. Investigation with or without HSE involvement can then identify the causal factors. The CO action card[1] indicates that division of responsibilities between local authority Environmental Health and the HSE is complex. In the two incidents we report, there was close liaison with the local authority, even when the HSE was involved. This was particularly important in incident two which involved a new-build: it was likely that all flats had boilers and other appliances of similar specification, installation and ventilation. HPA coordination with the HSE, local authority and housing trust was needed to ensure proper scrutiny of the safety checks before allowing residents to return, and appropriate assistance to those who remained without gas supply.

It is critical that the HPU can access a key contact in the LA for accidental CO poisoning both in and out of hours. This allows for rapid communication when incidents occur. The HPU can then, as far as possible, be informed that ongoing risk to the public is urgently removed and future poisoning prevented.

3. Media communication

The need for raising awareness of the recognition of CO poisoning, immediate action and prevention is clear[2]. The HPA had issued a CO press release at the end of 2007 to raise awareness and give key prevention messages. (This information is available on the HPA website[3]). The second incident received coverage in the London press the day after the event.

With two serious incidents having occurred within a week, the HPA took the opportunity to approach the two people poisoned in the first incident and prepared a further CO press release, again highlighting primary and secondary prevention messages. The affected individuals were keen to facilitate any coverage that could increase public awareness. Subsequently, local London newspapers picked up on the press release and the individuals fully co-operated in offering them interviews.

A further newspaper article was published which highlighted key messages on how to identify, and what to do in the event of CO poisoning.[5] In terms of primary prevention, the main message of the proper installation and maintenance of appliances was missed. However, the incident went on to receive more comprehensive coverage in a local paper which ran a personal story with interview quotes, and a complete summary of detection and prevention messages[6] (see figure 1).

Summary

Accidental CO poisoning is a significant public health problem and emergency service workers may be put at risk. The burden of such incidents falls on the private rented sector so legal rights and responsibilities should be stressed to tenants and landlords alike. Rapid and effective inter-agency communication and coordination is required to confirm and manage CO incidents effectively. Timely press communication can be used to improve public awareness of CO poisoning and convey prevention measures.

Table 1 Summary of toxic effects flowing carbon monoxide exposure[3]

Carboxyhaemoglobin in blood (%)	Signs and symptoms
<2	No significant health effects
2.5-4.0	Decreased short-term maximal exercise duration in young healthy men
2.7-5.2	Decreased exercise duration due to increased chest pain (angina) in patients with ischaemic heart disease
2.0 - 20.0	Equivocal effects on visual perception, audition, motor and sensorimotor performance, vigilance and other measures of neurobehavioural performance
4.0-33.0	Decreased maximal oxygen consumption with short-term strenuous exercise in young healthy men
20-30	Throbbing headache
30-50	Dyspnoea, dizziness, nausea, weakness, collapse, coma
> 50	Convulsions, unconsciousness, respiratory arrest, death

Box 1. Oxygen therapy in carbon monoxide poisoning

Oxygen competes with CO for haemoglobin binding sites and reduces the half-life of COHb from about 320 to 80 minutes. High concentrations are essential because carbon monoxide has an affinity for haemoglobin 240 times greater than oxygen. Oxygen is administered through different systems depending on the clinical picture and setting:

1. **Pre-hospital treatment: high flow oxygen**
   Supplementary oxygen given by the ambulance crew is delivered at high concentrations via a mask and venturi valve system. The port size of the valve determines the airflow rate to ensure an accurately controlled inspired concentration of oxygen.
2. **In-hospital treatment: normobaric oxygen therapy**
   100% oxygen is delivered at normal atmospheric pressure (101 kPa at sea-level) through a non-rebreathing mask.
3. **Hyperbaric medicine centre: hyperbaric oxygen (HBO) therapy:**
   Oxygen is delivered at an increased pressure of 1.2-3 times that of normal atmospheric. This increases the amount of oxygen dissolved in the blood, displaces CO from haemoglobin and increases oxygen delivery to tissue.

Referral criteria for hyperbaric oxygen therapy in London[4]

- Loss of consciousness at any time
- Neurological abnormalities
- Cardiovascular symptoms (e.g. chest pain) or signs (eg. arrythmias)
- Pregnant and COHb level >20% (or probably was at peak)
- COHb level >25% (or probably was at peak)
- Ingestion of drugs /alcohol

If one or more criteria are present, HBO therapy may be considered. The aim of HBO is to prevent permanent damage to brain and heart. The use of HBO therapy in CO poisoning is widely debated.

Box 2. Measuring COHb levels: pulse oximetry versus blood sampling

At the incident scene conventional pulse oximetry is available to ambulance crews to monitor oxygen saturation from which COHb levels are derived. The accuracy of the sensor (placed on finger, toe, ear or nose) is affected by many factors such as poor perfusion and nail polish. Therefore the gold standard measurement of COHb is by arterial blood gas, the equipment for which is usually only available in hospitals. A new sensitive CO oximetry device, Rad-57™, is currently being piloted by first responders. The manufacturers claim its accuracy combined with its light weight, portability and robust design is ideal for the field setting[7].

Box 3. Key points of Safety Triggers for Emergency Personnel

STEP 1	ONE casualty	Approach using normal procedures
STEP 2	TWO casualties	Approach with caution, consider all options, report on arrival & update control
STEP 3	THREE casualties OR more	Do NOT approach the scene Withdraw Contain Report Isolate yourself SEND FOR SPECIALIST HELP

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7 Masimo Rad-57™ Signal Extraction Pulse CO Oximeter with Rainbow Technology™. http://www.masimo.com/rad-57/

Economic assessment of carbon monoxide poisoning: strategies and options

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Background

The growing number of CO poisonings and deaths is of concern to the HPA who must respond to such incidents effectively to reduce impacts to victims, susceptible individuals and the wider community. Economics is concerned with obtaining maximum benefits from the resources being committed for a particular purpose. But could these resources be used differently to produce bigger health benefits and/or free up resources for other things?

Little is known about the epidemiology of CO poisoning. Many cases of mild poisoning may remain undiagnosed and under-reported (Krenzelok et al, 1996). The economics of CO defensive purchases among the population is under-researched too. In a largely unregulated free-market for CO detectors, where standards of manufacture and levels of awareness are variable, little is known about consumer choice. Although effective at reducing CO levels in homes which use them (ibid) audible detectors are not widely used. Analogous to the cheaper and much more publicised smoke alarm, CO detectors have not yet been universally adopted mainly due to lack of awareness of householders (Hendrie et al, 2008).

Additionally, a strong social inequality gradient may exist in CO incidents. CO poisoning is associated with overcrowding, faulty gas heating systems, mobile heater use, rented accommodation (personal correspondence Ruggles, 2008) and guest-houses - features of lower socio-economic residences (Sam-Lai et al, 2003; Weaver, 2007).

Economic evaluation

The approach taken by economists is to compare the costs and benefits of feasible options that address a common problem in order to make efficient use of finite resources. Costs are defined as the total amount of resources used, not necessarily prices paid. So for example, redeployment of staff already employed by the HPA to a new area will still count as a cost in economics. Costs and benefits are compared to the current way of managing a problem, so that all costs and benefits are incremental in nature. The incremental costs are the additional resources that are needed, whilst incremental benefits are the additional benefits associated with the programme.

In every evaluation the incremental benefits must be defined very carefully. They are most easily captured in ways that are naturally measured, but they must also have some meaning in the practical sense to policy makers. So in *cost-effectiveness analysis* this might include for example, the number of lives saved, the number of additional cases detected or the response time.

In theory the economist is looking for the option which gives the highest return per £ expended - this might of course be the option of 'staying-put', sometimes called the 'do-nothing' option. Benefits or outcomes are measured in other forms - such as monetary benefits (*cost-benefit analysis*) or in terms of quality of life impact (*cost-utility analysis*). It is not always easy to measure health benefits in monetary terms, but in areas like hearing aids, smoke detectors and over-the-counter drugs the value of benefit can be revealed by the amount of money the consumer is willing-to-pay through personal expenditure. At other times we may have to ask people how much they *might* be willing-to-pay hypothetically (*contingent valuation*), say in terms of extra tax per year.

In practice a more realistic approach to finding new and more efficient solutions is often taken using a technique known as *'option appraisal'*. This approach is used in many health care settings to brain-storm, derive new ideas, create new solutions and then rank them in terms of each option's cost-effectiveness. It allows for more than one criteria to be considered simultaneously. Unlike the methods mentioned above the effectiveness measure is usually a composite of several different objectives. These are weighted to reflect relative the importance of each objective to give a *weighted benefit score*. This is done through a consultative process involving relevant stakeholders - it should never be done just by economists inventing a new index!

In the example below, possible options to tackle CO poisoning in a defined population are explored. There are bound to be more, some only variants of each other - but the ones shown below are just for illustration. To illustrate the cost-effective analysis method it is assumed that the only outcome of importance is one that is straightforwardto measure - that of 'lives saved'. Cost-effectiveness is necessarily one-dimensional, relying as it does on a single indicator, whereas both cost-benefit and cost-utility encapsulate several, if not multi-dimensional goals. A quality of life score for example would capture dimensions of improvement from physical to psychological well-being.

A hypothetical cost-effectiveness analysis of new CO measures is shown below.

Table 1 lays out the various costs and benefits. All new options are an improvement on lives saved but unfortunately they all cost more.

Table 1 Total costs and benefits

Option	Total cost	Total benefit (lives saved)
1.Respond & investigate individual cases (current policy)	£50k	8
2. LA inspection of rented premises etc.	£130k (£50 + £80k)	30
3. Awareness raising campaign via household leafleting	£65k (£50k + £15k)	18
4. Free provision of CO detectors	£100k (£50k + £50k)	14

Each new option must still include the cost (£50k) of Option 1 - the requirement to investigate and limit further damage by HPA staff. Some involve more cost than others too.

The way the new options are assessed economically is to compare them with current Option 1 - in terms of their additional or incremental cost and benefit as shown in Table 2.

Table 2 Incremental costs and benefits

Option	Incremental cost	Incremental benefit
1. Respond & investigate individual cases (current policy)	n/a	n/a
2. LA inspection of rented premises etc.	£80k	22
3. Awareness raising campaign via household leafleting	£15k	10
4. Free provision of CO detectors	£50k	6

Finally, the incremental cost effectiveness ratio (ICER) for each option is calculated compared to present practice and ranked in order of cost-effectiveness in Table 3.

Table 3 Incremental cost-effectiveness ratio of proposed option

Option (rank order compared to current policy)	Incremental cost-effectiveness ratio ICER (Cost per life saved)
1. Respond & investigate individual cases (current policy)	n/a
3. Awareness raising campaign via household leafleting	£1,500
2. LA inspection of rented premises etc.	£3,636
4. Free provision of CO detectors	£8,333

Cost-effectiveness and budgetary impact

In this hypothetical example the leafleting campaign is more than twice as cost-effective at saving lives as inspecting properties and 5.5 times more cost-effective than making CO detectors freely available to the public. The rational decision-maker should select Option 3 first if there were limited funds available, saving an extra 10 lives. However, the budgetary impact and distribution of costs in different agencies also needs to be taken into consideration. Finally, if more money was made available Option 2 would also be selected saving a further 22 lives etc.

However, it is not so easy in practice! Cost-effectiveness may only be one criterion - the implementation of these other options may depend on feasibility, access, equity and many other desiderata. This is where a more complex technique such as 'option appraisal' would be used. Also, efficiency may not be the only consideration. We may wish to 'equity proof' our economic decisions too. Some options are better at reaching more vulnerable groups/those at greater risk of CO poisoning than others. Table 4 assesses the same cost-effective ranking only through the lens of an equity audit.

With equity now informing efficiency, it might be deemed more worthwhile to adopt another of these approaches but at greater expense. Looked at another way, the price of greater equity will be the additional price paid (e.g. £80k for Option 2).

Conclusion

Economics is concerned with improving efficiency of resource use through techniques such as cost-effectiveness analysis. This in turns means laying out the full costs and benefits of competing options and using incremental analysis to determine relative cost-effectiveness. However, in the real world much uncertainty surrounds every option (eg incorrect use of detectors, different calibration of equipment etc.) and so more sophisticated probabilistic modelling will be required. Such models can take a lot of time to build but are ultimately more cost-effective than making the wrong initial policy decision!

However, as a first step towards better use of limited resources, basic economic evaluation is a useful and transparent tool that will stimulate thinking and debate about goals and objectives - and the different means of achieving them.

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Table 4 Cost-effectiveness and equity

Option	Incremental cost-effectiveness ratio ICER (cost per life saved)	Equity audit
1. Respond & investigate individual cases (current policy)	n/a	Neutral or possibly even equity damaging
3. Awareness raising campaign via household leafleting	£1,500	Alerts everyone - but may be disregarded by those with lower educational attainment or without English as a first language
2. LA inspection of rented premises etc.	£3,636	Could target some of the highest risk individuals with lowest incomes (saving most lives) but may have civil liberties implications
4. Free provision of CO detectors	£8,333	May be only taken up by the concerned middle-classes!

Emergency Planning and Preparedness

Exercise Capital Ingot

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Exercise scenario

A notional scenario of fluvial and surface water flooding across the Greater London area was developed for the exercise, concurrent scenarios involving a potential avian 'flu outbreak and a winter 'flu epidemic were also included.

Aims and objectives

The aim of the exercise was to test the regional multi-agency response in London, including the implementation of the Strategic Command Centre (SCC), thus satisfying the requirements of the Civic Contingency Act (CCA, 2004) for planning and testing emergency response arrangements.

The objectives set out by the exercise planning team were to:

- Demonstrate an understanding of London resilience Partnership's Plans and Procedures
- Exercise strategic decision making processes
- Demonstrate effective handover procedures
- Exercise the integration of Scientific and Technical Advisory Cell (STAC)
- Exercise existing logistical arrangements within SCC to inform further development of the SCC
- Test external communications arrangements and the effectiveness of the Media cell

HPA Aims and Objectives

The aim for the Health Protection Agency (HPA) in participating in the exercise was to exercise the HPA contribution to the multi-agency response to a regional emergency that requires the implementation of the SCC arrangements.

The HPA objectives for the exercise were:

- To exercise the HPA elements of the mechanisms for the provision and dissemination of Public Health advice for the London Strategic and Tactical command structures.
- To test arrangements for multi-agency working with key partners in London, specifically London NHS for this particular scenario, The Environment Agency was also included.
- To validate interoperability of HPA and NHS Emergency Plans with regard to Public Health information, advice and guidance within STAC.
- To test HPA allocation of appropriate resources to the STAC and Recovery Working Group (RWG).
- To test the provision and dissemination of Public Health messages through involvement of HPA Communications staff in the Media Cell.
- To gain an appreciation of where the response to a London event may differ from one elsewhere in UK.

Exercise planning

Players met at the London Fire Brigade (LFB) Training Centre at Southwark a couple of weeks prior to the exercise to prepare for the scenario. In the days preceding the exercise, players received a number of media 'injects' in the form of newsletters, some with attached simulated radio broadcasts. The scenarios described in the media injects included:

- Water courses and reservoirs at or near capacity due to high rainfall throughout the preceding winter and autumn, prompting concern about flooding. Heavy rain predicted over the Oxfordshire area, some local flooding already reported
- Bad weather conditions disrupting road and rail transport in the Oxford area
- Primary health services at capacity under the strain of responding to an outbreak of winter flu
- Dead swans found at Hyde Park being tested for avian 'flu; a 3km protection zone and a 10km surveillance zone causing significant disruption to traffic in central London

Running the exercise

The LFB were the lead agency for the exercise, with support from the Emergency Planning College. The exercise was held in the Strategic Command Centre (SCC) of the police training centre in Hendon. The LFB commissioned the development of a software programme for the SCC to provide automatic injects to players and to allow them to enter their key decisions on the log. The aim of this computer system was to coordinate the running of the exercise, provide a platform for documenting the responses from various players, and to provide a real-time log of actions and decisions made.

The following organisations participated within the SCC:

- Police
- London Ambulance Service
- London Fire Brigade
- Local Authority
- Environment Agency
- NHS London
- Transport for London
- Utilities
- STAC
- Military
- Government Liaison Team / Local Resilience Team
- Media

Various scenarios affecting south and north London were involved in the exercise:

- Fluvial and surface flooding
- Cold weather
- Transport chaos – road gridlock and rail disruption
- Threat to strategic power network
- Impairment of waste water treatment service
- Environmental contamination
- Damage to Olympic construction site
- Widespread community flooding and isolated communities
- Impacts on businesses and other local services

STAC

The STAC consisted of a Chair and Deputy Chair, and representatives from CHaPD, Local and Regional Services (LaRS), the Environment Agency (EA), and the Met Office. There was also administrative support within the STAC, with one individual assigned to monitoring injects and log decisions made by the STAC. The Chair of the STAC liaised with Gold, bringing back specific questions to the team and reporting back the STAC response.

The STAC was asked to provide advice on:

- Identifying vulnerable infrastructure most likely to be affected if flooding were to worsen, with a view to assigning resources for flood prevention
- Identifying any sites on the flood plain with the potential to release chemicals should they be immersed, e.g. Control of Major Hazards (COMAH) and Integrated Pollution Prevention and Control (IPPC) sites
- Risk from high security laboratories on the flood plain should these become flooded
- Advice for the public should drinking water supplies be disrupted
- Advice for the public should power supplies be disrupted
- Advice for the public on preparing and disposing of food where there is disruption of the power supply
- Advice for the public on the potential health risks from microbial and chemical contamination of flood water.

Recovery Working Group

The purpose of a Recovery Working Group (RWG) is to ensure that all agencies involved in the follow-up of an incident liaise with each other in order to provide a coordinated and effective response. In this instance, the RWG largely focused on logistical issues related to insurance and waste management.

Outcomes

The ability of the STAC to respond to specific questions from Gold command was tested and proved to be a success. Multi-agency working within the STAC was also effective, supported by an experienced and effective Chair; specific tasks were identified, prioritised and assigned with a clear emphasis on the limited time available before reporting back to Gold Command. Provision and dissemination of Public Health messages through HPA Communications was generally successful, however, there were occasions when the scientists providing advice were not consulted on the final document released. This has implications for the accuracy of the advice disseminated and has been highlighted as a learning point. The exercise identified a number of issues specifically relevant to the London setting that have also been highlighted as learning points, including flooding of underground stations, difficulties associated with multiple impacts on transport in and around the capital, and the implications of already stretched primary services in responding to acute events.

In addition to testing the regional response mechanisms, the exercise highlighted a number of issues specifically related to flooding incidents. Potential sources of chemical contamination were identified as low risk; the only IPPC and COMAH sites in the area were Transco stations, with a minimal risk of explosion due to misplaced items banging into the gas tanks and a low risk of hydrocarbon contamination due to the release of relatively small quantity of fuel. The most significant potential risks to public health were identified as the disruption of the power and water supplies, access to services, and exposure to carbon monoxide (CO) due to the potential for people to use generators and cooking appliances to keep them warm. It was noted that during flooding incidents, the most significant risks may be those indirectly related to health, e.g. flooding of an electricity substation. It is important that any HPA staff likely to be part of a STAC responding to a flooding event are aware of some of these indirect risks and other health aspects specific to flooding.

The STAC is not encouraged to pre-emptively provide advice to Gold. However, due to the expertise in the STAC, they were able to predict issues likely to arise as the scenario progressed, such as potential disruption of the drinking water supply. There may be a role for the STAC in providing suggestions to the Gold as to the sorts of issues that they may need to start thinking about during the different phases of incidence response.

It was felt that the exercise was a somewhat missed opportunity to test the skills and working of the STAC; the scenarios did not include any chemical contamination, disruption of wider services was limited to transport and primary health care, and there was no actual disruption of drinking water supplies. An overarching aim of conducting exercises is to improve the working relationships between individuals in the various agencies that will be involved when a real incident occurs. The absence of representatives from the FSA, Local Authority and the Drinking Water Inspectorate ensured that the STAC did not have access to expertise that would ordinarily be represented in a real incident but it was also felt that this was a missed opportunity to improve the links between multi-agency responders.

Despite the many health impacts associated with the clean-up phase of flooding, these were not given much consideration at the RWG. Although the RWG were informed about the documented risks from CO specifically, including the two suspected deaths from CO exposure in Tewkesbury, it was felt by the health representatives that these issues were not adequately prioritised. Discussions were dominated by logistic issues around insurance and waste collection. While acknowledging the importance of these issues, which also have their own direct and indirect impacts on health, it was felt that the health agenda should have been given more weight.

In the initial phase of a flooding event, i.e. days 1 and 2, the main risks to the public are drowning and concealed hazards. However, in the extended aftermath of a flood event, other risks to public health should be considered once the flood water has receded. These include exposure to microbial and chemically contaminated flood water, standing water and furniture during clean up, exposure to mould, and potential hygiene issues related to longer term disruption of water supplies.[1] However, among the most significant and preventable risks during the clean-up phase is exposure to CO from the use of generators and dryers in the home with a number of deaths reported from flooding events in the US and elsewhere.[2] There is also a significant health burden from the long-term psychosocial impacts of flooding. While the health burden of these longer-term impacts is more difficult, initial evidence suggests that it is significant.

Key lessons identified

In order for an exercise to fully test the abilities of the agencies involved, it must include scenarios that test their skills.

The importance of attending and/or participating in these exercises must be stressed and agencies must be committed to supporting them.

It is important that the members of the HPA likely to be called to represent health on a STAC are aware of those issues specifically related to flooding events.

Health issues may not be an implicit priority for the RWG; it falls to those representing public health to make the case for it be included as a priority, using examples from previous flooding incidents (e.g., two suspected deaths from CO poisoning in Tewkesbury) may be useful

It is essential that the time scale under consideration is explicit (i.e. two days, two weeks and two months post-flooding), particularly in the RWG. The shifting health issues related to different periods after a flooding event have been identified in the literature and in other flooding events.

The role of the STAC in pre-emptively identifying likely health issues is not clear and should be clarified.

The protocol between the communications team and the science team must be followed at all times, with all press releases reviewed before they are signed off

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Development of a draft framework for managing influx into community health facilities following chemical incidents

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Introduction

Planning and resource allocation for major incidents, including those involving chemical agents, are usually focused on preparedness of first responders in hospital emergency departments, ambulance services, police and fire departments. However, during the initial phases of a chemical incident, the nearby community health facilities may be the first to receive an influx of individuals seeking medical help, as was the case in the Tokyo sarin subway attack and the Bhopal disaster in 1984.[1,2] Recently, in a chemical incident exercise hosted by NHS London Emergency Planning named 'Exercise Tamino', a simulated terrorist release of sulphur mustard gas led to large numbers of people leaving the scene and seeking medical assistance at GP practices, walk-in centres and other community healthcare facilities.[3] An influx of individuals from a chemical incident to community health facilities is potentially associated with significant problems because of the limitations of both staff trained in chemical incident management and provision of personal protection and decontamination equipment.

The Chemical Hazards and Poisons Division, London [CHaPD(L)] was asked to develop a draft framework for managing the influx of people to a community healthcare facilities following a chemical incident.

Aims and objectives

The draft framework aims to assist those working in community health facilities such as GP practices in primary care, community walk-in centres and pharmacies. It provides generic guidance for clinicians, managers and emergency planners to develop practical chemical incident plans specific to their own practice or healthcare facility. The framework assumes that a generic major incident or business continuity emergency plan is already in place. Specific chemical incident plans can then be used as an adjunct to them.

Methods

The methods used to develop this draft framework were:

1. Identification of key points and lessons from a review of the published literature available on casualty influx following chemical incidents, especially the Tokyo sarin subway attack;
2. Development of draft measures for managing people affected by chemical incidents, tailored to the limited capacity in community healthcare facilities, based on the themes identified in the literature.

Literature searches were undertaken using PubMed. The search terms included: 'tokyo sarin', 'sarin matsumoto' and 'primary care chemical incident' and revealed 95, 28 and 74 citations, respectively - these were reviewed for relevance using online abstracts. All languages were included in the search. Papers without abstracts were not considered further. The references included within relevant papers identified were also reviewed, where possible.

In order to identify national guidance and internal papers concerning mass decontamination and chemical incident management plans, searches were performed on United Kingdom (UK)-based relevant websites namely, Department of Health, Health Protection Agency, Chemical Hazards and Poisons Division (CHaPD) intranet and the Home Office. The US Centres for Disease Control and Prevention website was also searched.

A Google search was also performed looking for 'grey literature' using the terms 'primary care chemical incident', 'community chemical incident' and 'community preparedness'. Finally, 20 references were selected from the above literature sources. The opinion of experts in the field of chemical incident response from the CHaPD was also consulted in drafting this framework.

Results (1): Literature Search

No peer-reviewed literature was found on the management of chemical incidents specifically in community healthcare facilities. The existing literature is focused on ambulance services and emergency departments. Most literature on chemical incident preparedness recommends significant capacity and staff investment to bring any setting, including community health facilities, to a higher level of preparedness.

The targeted literature search identified four key themes associated with chemical incident casualties in healthcare facilities, namely:

1. *Containment.*[1,4-11] There was significant secondary contamination from affected casualties to responders, including medical staff, during the Tokyo sarin subway attack.
2. *'Self presenter' management.*[1,5,12,13] The ratio of real casualties needing medical help to 'worried well' who do not need medical help is estimated to be in the ratio of 1:4 in a chemical incident.
3. *Decontamination.*[1,3,5,6,8,11-16] The majority of contamination may be on patients clothing and the removal of clothing is thought to remove 70-80% of contamination.
4. *Treatment.* [1,4,12,14,17-20] Responders must avoid being the next casualty.

(further details of literature findings are given in Appendix 1).

Results (2): Development of Draft Framework

The literature review was used to develop the draft framework based on the four key themes listed above. Each theme highlights practical action points adapted from the literature to community health facilities for consideration. The emphasis is on ensuring that community health facilities are able to contribute efficiently and effectively to the management of an influx of individuals from a chemical incident while at the same time balancing the risk of secondary contamination of staff and other patients.

As previously stated, the draft framework is an adjunct and not a replacement for the community health setting's established generic major incident or business continuity emergency plans. During a chemical incident, those plans should already be activated to establish standardised communication lines with other agencies including the Health Protectiion Agency (represented locally by Health Protection Units -'HPUs'), Primary Care Trusts (PCTs) and the emergency services to ensure information is flowing as quickly as possible to develop a coordinated response.

(1) Containment

The objectives of containment are:

- to minimise secondary contamination of medical facilities, staff and regular patients, especially where a persistent agent is involved;
- to allow time for staff to initiate their generic emergency plans, which includes establishing appropriate communication lines especially with the HPU and PCT; and
- to allow time for staff to perform risk assessment of situation based on available information and guidance from other agencies, especially the HPU and PCT

Containment can be approached in the following way:

i) 'Lockdown'

Lockdown is securing the medical facility with controlled entry and exit points[6,9-11]. Support from the police may be needed in order to achieve lockdown, although it must be recognised that their resources may be stretched during a major incident. If police assistance is needed, it is important to use the communication lines in the local HPU and PCT, as per the healthcare facility emergency plan.

ii) Switch off Ventilation

Air conditioning systems should be switched off to prevent gases or vapours from spreading to other areas of the building.[9]

iii) Safe entry/exit points for urgent regular cases

The benefit of maintaining a service for urgent 'regular' cases will reduce pressures on emergency departments as well as helping the business continuity of primary care. This can only be done if the regular cases can be separated from those that may be contaminated and there is no significant of exposure to airborne agents. Separate entrances for urgent 'regular' patients can be provided with clear instructions/directions as to where to enter the.

iv) Freeing of existing capacity

Consider ceasing all elective activity by cancelling appointments or any elective activity planned for the day in order to manage the workload generated by the incident. This will depend on the numbers of people presenting, the complexity of the incident, and the staff needed to manage the incident.

(2) 'Self-presenter' management

'Self-presenter' is the term used to describe individuals who have arrived at the health care facility by their own means from the scene of the chemical incident. They may comprise both real casualties needing medical assistance as well as 'worried-well' who do not need medical assistance.

The objectives of 'self-presenter' management are:

- to prevent secondary contamination by minimising physical contact between those at high risk of contamination and those at low risk of contamination
- to reduce the strain on health services by sending 'worried-well' home

'Self-presenter' management can be improved by identifying in advance those areas in and around the health facility which could be used to segregate the high risk 'self-presenters' from the low risk 'self-presenters'.

Early intelligence obtained from individuals can be used to develop a segregation protocol. For example, if an incident occurred in a train station, those who were in the station and thus potentially exposed, should be separated from those who were outside the station.

The segregation protocol should constantly be updated as more information and advice come in from the PCT/HPU or other responders.

(3) Decontamination

The objectives of decontamination are:

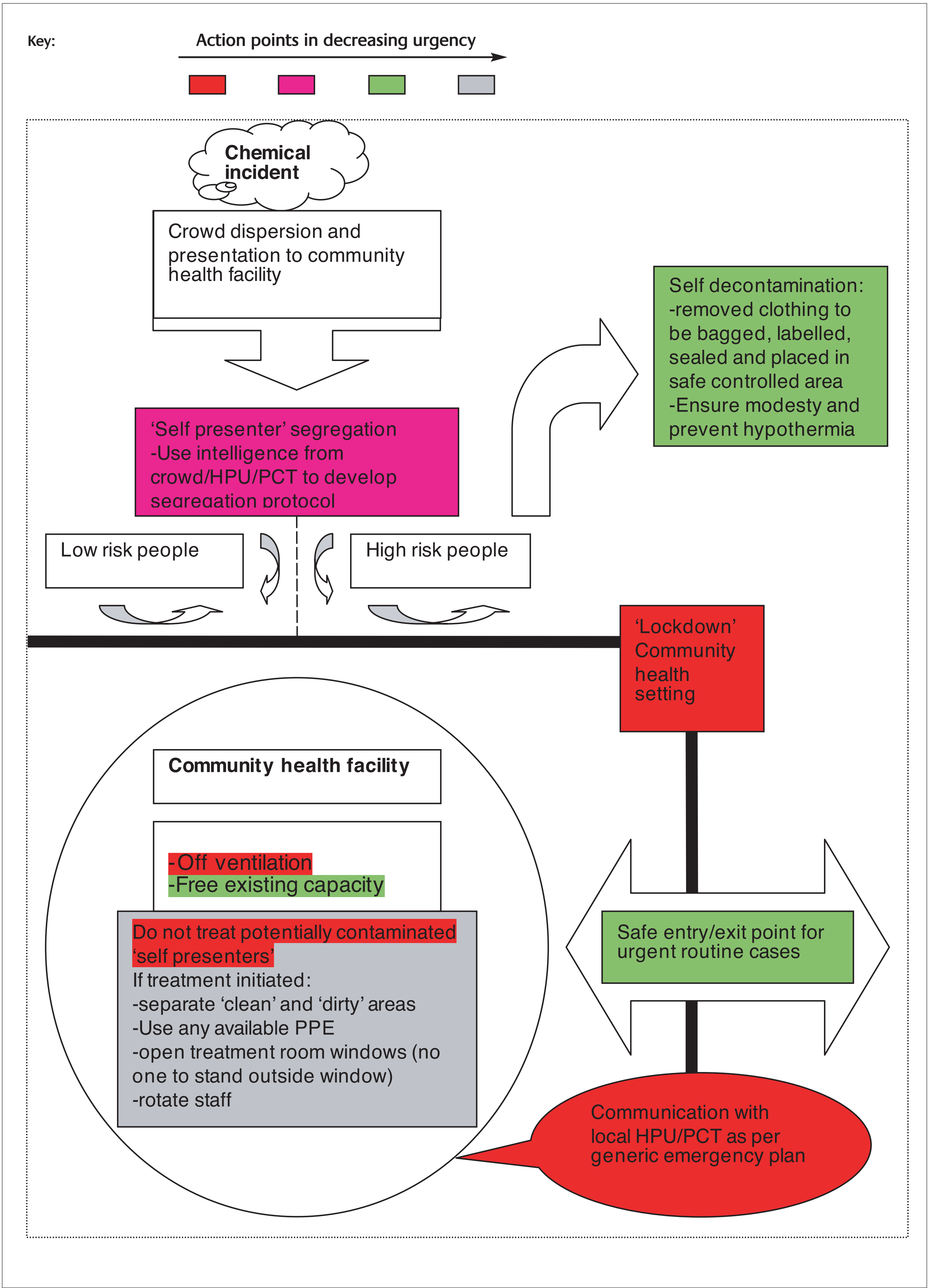
- to reduce exposure to chemical(s) in affected individuals
- to minimise secondary contamination of medical facilities, staff and regular patients especially where a persistent agent has been released;
- to minimise risk to poorly equipped staff if treatment is initiated.

Note that mass casualty decontamination is ideally carried out at the scene of an incident using dedicated fire service facilities under the direction of the ambulance service.

If 'self – decontamination' is required, community health facilities need to ensure that:

a) removed clothing is treated as hazardous waste with the potential to cause secondary contamination[4]. All removed clothing must be double bagged (minimal permeability bag), labelled and placed in a pre-planned controlled safe area.
b) a source of spare temporary clothing for patients is identified to maintain modesty and prevent hypothermia in cold weather.[8,15]

Summary of draft framework for planning influx into community health facilities following chemical incidents:



c) adequate privacy is provided for disrobing. It is particularly important that empathy towards the cultural, religious and diversity issues associated with removal of clothing is considered.[15]

(4) Treatment

The main points in treatment are:

- to ensure that medical staff in community health facilities avoid being the next casualty by NOT initiating triage or treatment of contaminated or potentially contaminated patients[12,20]
- to ensure that community health facilities have already initiated their emergency plans with clear communication lines established with other agencies (specifically local HPU and PCT to develop a coordinated response);
- to acknowledge that individual ethical views may make advice NOT to treat difficult to follow. However, medical staff ought to be aware of the risk they are taking both to themselves and the public if they allow potential contamination to spread;
- to ensure that if treatment is initiated, the appropriate steps are taken to minimise risk of secondary contamination

Treatment can be approached in the following way:

i) 'If you cannot be the solution, avoid becoming the problem' [12]
Responders should not start treatment unless they are aware of risk to personal, staff and regular patient safety.

ii) Good communication with HPU and PCT
This reduces delays in receiving information on identity of chemical and treatment method[17]. Information will also facilitate the dynamic risk assessment process to change action or protocol if appropriate.

iii) Use any available Personal Protective Equipment (PPE)
Extreme caution must be taken before coming into contact with patients who have not been fully decontaminated without adequate PPE[1]. If a high-risk decision to treat patients is made whilst adequate PPE (e.g. chemical suit with air filter) is not available, it is advisable to use any available level of PPE (gloves, aprons, mask, eye protection, etc) rather than standard work clothing. Note that respiratory protection is the most important factor when there is a gas or vapour hazard.

iv) Separate 'clean' and 'dirty' areas
If treatment is initiated, try to ensure that potentially contaminated patients are kept separate from uncontaminated staff and routine patients.

v) Open windows in treatment rooms
This should help dilute any potential risks to medical staff.[1,4] It is important to ensure that patients are not marshalled outside these windows.

vi) Rotation of staff
This has been suggested to reduce secondary contamination of workers involved in treating patients. [1,6]

Discussion

Chemical incident management may not be perceived to be a high priority for community health facilities. However, the literature and recent events have shown it is possible that they may be called upon to deal with an influx of individuals from a chemical incident, either accidental or deliberate. The consequences of having no preparation for such an incident could potentially be very significant.

Community health facilities are now required to develop business continuity and pandemic flu emergency plans. Incidents involving a chemical agent release may obviously present different challenges to those associated with outbreak of an infectious disease (e.g. pandemic influenza) or radiological release, but to a certain degree many points will be relevant in the planning and preparation of all events involving 'self-presenters'. Community health facilities could use this framework to augment their development of routine emergency plans to ensure they are better prepared to deal with an influx from chemical incidents.

The framework discussed in this article is not comprehensive and is still in its early draft stages. Any comments on how it could be improved and further developed to assist colleagues in community health settings is very much welcomed.

Acknowledgements

The authors would like to thank Edmund Checkley for the comments and advice on this paper.

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Appendix 1

Findings from literature review

The key points identified from the literature search are:

1 During the Tokyo Subway Sarin Attack, about 10% (135 of 1364 emergency medical technicians) of the frontline medical staff attending to patients showed acute symptoms and received medical treatment[1].

2 All medical staff wore standard clothing when attending to patient without any respiratory protection[1].

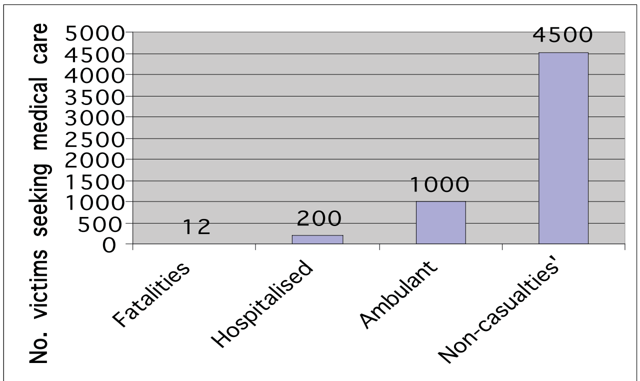
3 In Keio University Hospital Emergency Department, which received 113 patients, the majority of emergency medical staff suffered symptoms while treating patients; dim vision (73%), rhinorrhoea (53%), tight chest (27%), cough (13%), salivation (7%) and sore throat (7%) [4].

4 Fire and police personnel at the scene were also exposed and affected while rescuing and caring for victims[5].

5 In total, approximately 20% of all responders at the scene developed symptoms in Tokyo while the figure is as high as 37% during the Matsumoto attacks[6,7].

6 More than 4000 victims walked, used taxis, or private vehicles of good samaritans to access medical assistance during the Tokyo Sarin subway attack[1]. They made their way not only to hospitals, but to private outpatient clinics as well[5].

Figure 1



7 Poor communication and lack of coordination led to a concentration of victims at St. Luke's Hospital, not necessarily the closest Emergency Department resulting in a major overload for the department[1].

8 Figure 1 shows the different categories of individuals presenting to medical centres during the Tokyo Subway Sarin incident. (modified from 12).

9 The ratio of 'real patients' needing medical help versus 'worried well' (individuals who may not be directly affected by the incident but will still seek medical attention) is estimated at a ratio of 1:4 in chemical incidents[12].

10 Secondary contamination of health workers in the Tokyo sarin subway attack occurred in enclosed areas such as during transportation and treatment in ambulances with poor ventilation or in Emergency departments where the windows were shut. Identification of this problem led to orders being transmitted to open windows of ambulances and Emergency department treatment rooms to minimise risk[1,4].

11 Clothes of victims removed during treatment were also identified as potential sources of secondary contamination. Double bagging the clothes prevented further contamination of staff[4].

12 During the Tokyo Sarin subway attack, at 1100 hours (3 hours after the incident) the police made a television announcement that the chemical involved was Sarin. This was the first information that 145 (73%) of the hospitals/clinics had about the chemical[17].

13 Treatment and management advice was difficult to come by during the Tokyo Sarin subway attack as the Japanese poisons information centre lines were overwhelmed. Approximately 35% of hospitals were unable to get through to the Japanese poisons centre for advice[17].

14 Current national policy is to have decontamination carried out before transporting patients to medical facilities [8,15]. This is usually operated by the local Fire service based on standard hazardous material (Hazmat) procedures.

15 Although the main consideration in chemical incidents is the health and safety of people affected by chemical incidents, it must be remembered that some will find the process of clothing removal distressing[15].

16 Responders must continue to be sensitive to the dignity, cultural and religious concerns and requirements of different communities and social groups[15].

17 The majority of contamination may be contained on clothing. Removal of clothing is believed to remove 70 to 80% of contaminants[6,12-14].

18 The standard advice for medical workers during a chemical incident is 'If you cannot be the solution, avoid becoming the problem'[12].

19 Responders must avoid being the next casualty [20].

20 In the London area, a Hazardous Area Response Team (HART) has just been set up. The aim of HART is to provide a high level of clinical care to patients in hazardous environments at the same time as rescue and (as required) decontamination is effected, whilst ensuring the safety of responding ambulance and medical personnel[18]. The dangers of treating potentially contaminated patients is highlighted by the high level of PPE used by HART personnel.

21 During Exercise Tamino, the response of most Primary Care Trusts to the influx of walking wounded and worried well to their community health centres was to close them down[3]. As a result, patients not directly related to the incident had to access urgent health care via the nearest Emergency Department. This placed more pressure on acute services[3].

Summary

The literature findings can be summarised into 4 key themes:

- **Containment**[1,4-11]- There was significant secondary contamination from affected casualties to responders including medical staff during the Tokyo sarin subway attack.
- **'Self presenter' management**[1,5,12,13]- The ratio of real casualties needing medical help to 'worried well' who do not need medical help is estimated to be in the ratio of 1:4 in a chemical incident.
- **Decontamination**[1,3,5,6,8,11-16]- The majority of contamination will be contained on clothing and removal of clothing is believed to remove 70-80% of contaminants.
- **Treatment** [1,4,12,14,17-20]- Responders must avoid being the next casualty.

The draft framework for planning chemical incidents in community health facilities was then developed using these 4 key themes.

Environmental/toxicology

Environment Agency and Chemical Hazards and Poisons Division joint horizon scanning pilot

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" It is not the strongest of the species who survive, nor the most intelligent; rather it is those most responsive to change"
- *Charles Darwin*

Introduction

Great achievements start with great visions. How many times have you thought *'if only I had thought of that'*? How easy it is in retrospect and how often are the best ideas the simplest? That is why the development of a horizon scanning collaboration between the Environment Agency and the Chemical Hazards and Poisons Division is so exciting - *great vision based on simple ideas.*

So what is horizon scanning? Horizon scanning is the systematic examination of potential threats, opportunities and likely developments including, but not restricted to, those at the margins of current thinking and planning. Horizon scanning may explore novel and unexpected issues as well as persistent problems or trends.[1] Horizon scanning is one tool that contributes to Futures Work, gathering the evidence that might hint at what is to come, and how new technology might change the world. The Foresight website[2] contains useful background information on Science and Technology Futures Work, including detailed guidance on best practice and how to plan new forward looking projects.

There are many reasons to scan the horizon, with various reports highlighting the benefits of 'getting ahead of the curve' and thinking 'outside the box'. Because the horizon is vast, many horizon scanning projects focus their 'binoculars' on a small section. Such detailed scanning helps provide warning of emerging issues in many fields, and underpins much future work. However, modern advances in information technology have not only led to vast amounts of information becoming publicly available but also to alternative methods of gathering this information. These advances have allowed the Environment Agency to broaden the scope of their horizon scanning. The rate at which new information enters the public domain is also ever increasing and in order to keep up automatic data harvesting tools will be needed. Such developments need to have well thought out foundations to build upon, and this joint project aims to build on the work already carried out by the Environment Agency.

Horizon scanning at the Environment Agency

The Environment Agency Horizon Scanning team looks for new and emerging science and technology developments which may have an impact on the work of the Environment Agency in the future. The four step horizon scanning process used by the Environment Agency is summarised in figure 1. The first step, scanning, is continuous and web-based, uses a free access aggregator website to collect Really Simple Syndication (RSS) feeds from a wide variety of sources including (but not limited to) newspapers, scientific journals, academic institutions, governmental bodies, NGOs, newsgroups and blogs. This approach is in contrast to most Futures Work, where issues are targeted. Continuous scanning (bottom-up) allows the information to define the issues rather than topic driven (top-down) approaches which rely more on expertise in a given field. The top-down approach is important, but by definition will fail to identify as-yet-unknown trends and therefore needs to be complimented by a broad sweep or bottom-up scanning process. When evidence of new science and technology developments are identified – in the form of on-line articles - they are assessed for relevance to the objectives of the Environment Agency and importance to the environment in general.

Relevant articles from the feeds are entered into a customised database - the Horizon Scanning Interactive Database (HSdBi) - that has been developed by the Environment Agency's technology team. Information about the article, including date, source, copyright information, URL, a summary of the information and the relevance to the Environment Agency - is stored. The item is also scored for relevance to the Environment Agency's remit, the maturity of the science, and the credibility of the source. This database forms the foundation for an evidence base (currently containing over 6,500 records) used to identify trends which offer opportunities or threats

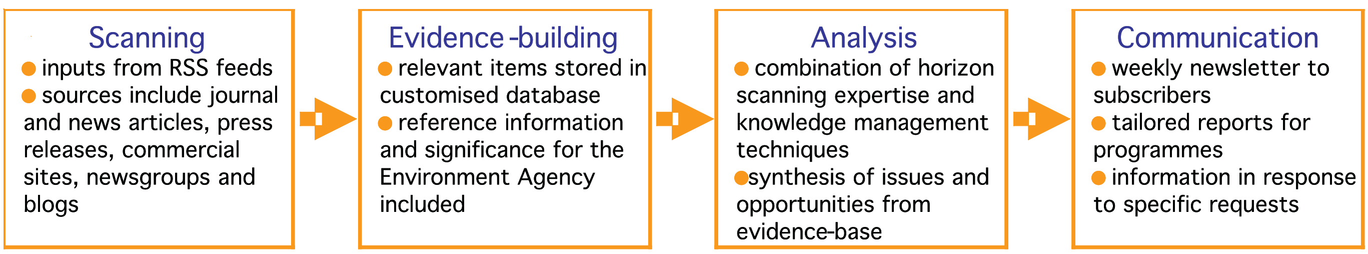

Figure 1: Summary of horizon scanning process

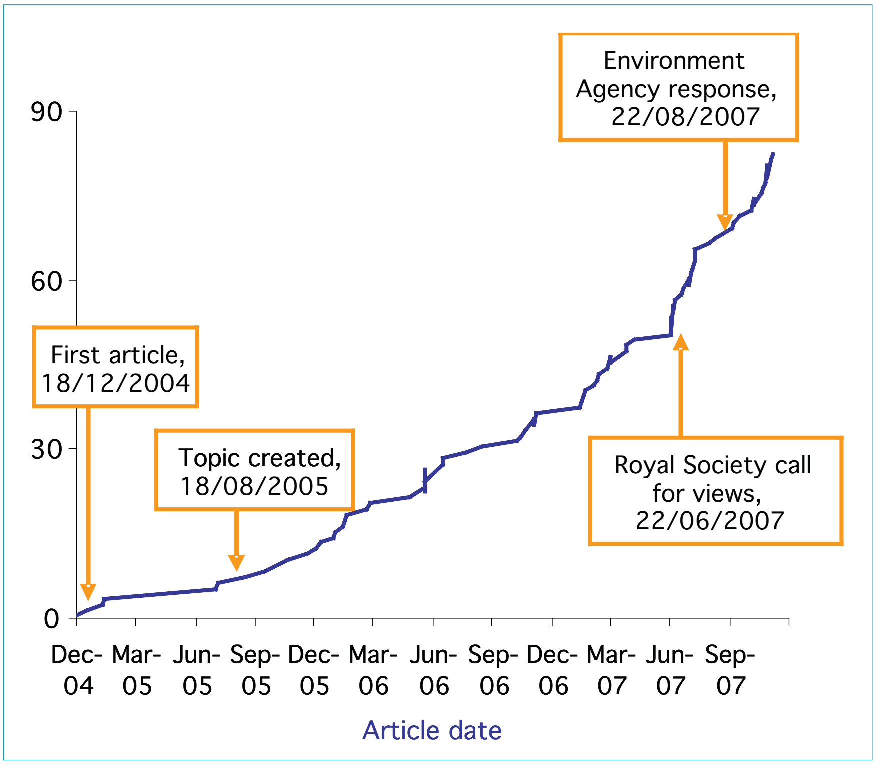

Figure 2: Number of articles on synthetic genomics in the HSdBi

for the Environment Agency. Knowledge management tools as well as the expertise of the Horizon Scanners are used in this analysis. Issues that are identified can differ in timescale; at one end of the spectrum there is new research improving on existing techniques and at the other end there are conceptual developments whose impact will not be felt for a decade or more but which may require changes within Environment Agency policy or operations.

The information derived by the Horizon Scanning team is then communicated to scientists, policy makers and operations staff within the Environment Agency in a variety of ways. A weekly newsletter containing new items from that week is sent to approximately 350 subscribers within the Environment Agency. More targeted fortnightly or monthly newsletters that concentrate on a single field, or issue, are also produced to meet the needs of different departments within the Environment Agency. Reports or summaries can also be created if requested to provide background into emerging issues as the need arises.

Synthetic genomics - the idea of designing and creating novel organisms engineered for medical, commercial, or environmental applications - provides a good example of how the Horizon Scanning process works at the Environment Agency. Figure 2 provides a timeline illustrating the accumulation of records relating to synthetic genomics in the database. The first record was entered into the HSdBi in December 2004.[3] At this time the field was new but the Horizon Scanners recognised its potential to have a large impact upon the environment. Other items on the subject followed and it was assigned a topic in August 2005. In June 2007, the Royal Society called for comments as they had identified synthetic genomics as being an emerging issue and wished to get views from other interested parties.[4] The Horizon Scanning team had accumulated 30 months worth of evidence on the subject so were able to quickly respond to the Royal Society on behalf of the Environment Agency. As a result of this response, the Environment Agency was invited to be part of a Royal Society working group set up to monitor developments in synthetic genomics, meaning that environmental viewpoints on this technology will be represented in the future.

The Environment Agency and Chemical Hazards and Poisons Division joint horizon scanning pilot

The Chemical Hazards and Poisons Division (CHaPD) is committed to developing a joint collaborative service, building on the Environment Agency horizon scanning expertise. Staff from CHaPD regularly spend time with the Environment Agency and contribute articles of public health relevance (initially concentrating on chemical issues) into the Environment Agency HSdBi. Twice a month, extracts are taken from the database, which includes articles entered by the Environment Agency scanning team and the Health Protection Agency, and are circulated within CHaPD and to partners who have expressed an interest in horizon scanning. The documents will also be published on the HPAnet. An example extract of a 'CHaPD Scan' is shown below:

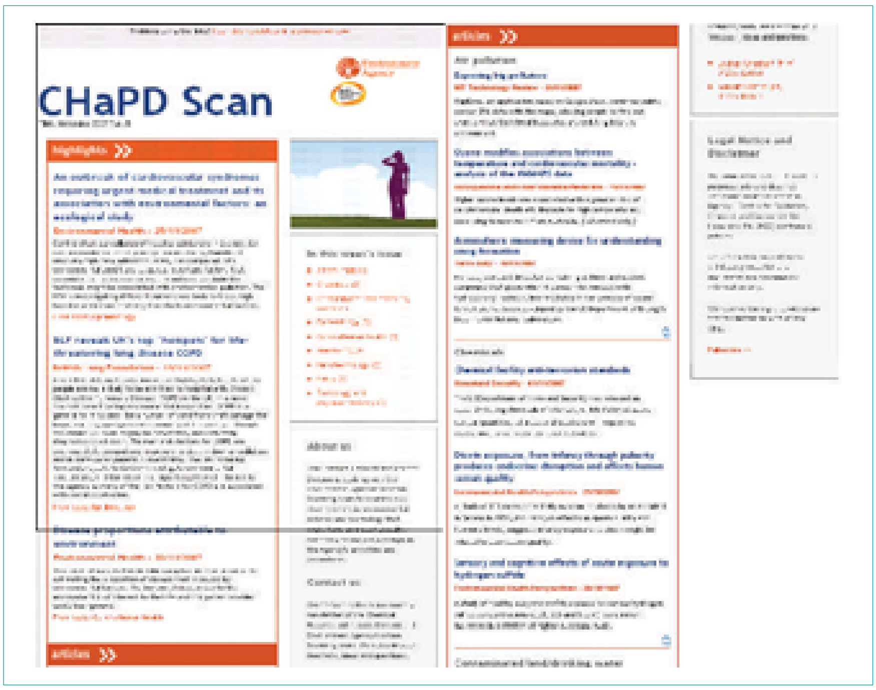

Figure 3: Extract from a CHaPD Scan

Positive feedback has been received from internal and external stakeholders including the Department of Health, Devolved Administrations and Regional Government Offices. Other departments within the HPA are also being contacted to explore how this might benefit horizon scanning activities for the whole HPA. Horizon scanning presents an excellent opportunity to develop true multidisciplinary collaboration between experts in different divisions and with different backgrounds. A formal evaluation will be conducted to inform how this work is progressed in the long term.

The regular publication helps keep people informed of new articles of interest directly relevant to their work but also, importantly, items that are indirectly relevant and might not be noticed without the horizon scanning process. The population of a bespoke database with these articles also facilitates retrospective analysis of key topics. This was demonstrated recently by the Environment Agency response to the Royal Society call for views on synthetic genomics (figure 2).

The example of synthetic genomics shown in figure 2 also demonstrates how the number of articles on a specific subject can be plotted to examine emerging trends. Another example which might be of interest to the Health Protection Agency is toxicogenomics, shown in figure 4 below.

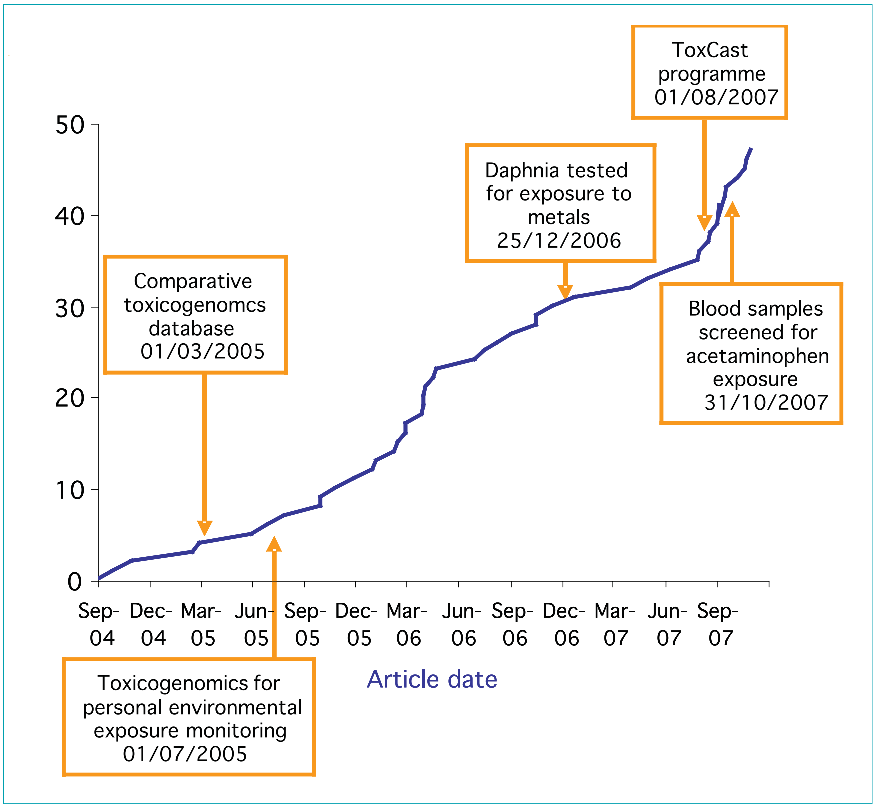

Figure 4: Number of articles on toxicogenomics in HSdBi

Toxicogenomics involves the profiling of the modulation of gene expression following exposure to toxins or other chemicals. This is an example of an emerging technology that may have impact on the way that the Health Protection Agency operates in the future. For example, it may allow profiling of specific exposures to environmental or workplace chemicals; the ultimate future application would be the attribution of illness to such exposures. It is also hoped that eventually an individual's susceptibility to hazardous chemicals will be able to be predicted based on their genetic makeup, allowing them to take appropriate precautions to avoid exposure.

Figure 4 highlights a few important developments that have occurred in this field since the Environment Agency Horizon Scanning team began to monitor it. In 2005, the Comparative Toxicogenomics Database was described.[5] It provides an ever-increasing public resource listing interactions between chemicals and genes in a range of organisms. Later in the same year, a review of new technologies for research into potentially harmful environmental chemicals highlighted the role of toxicogenomics in personal monitoring of exposure[6]. In 2006, researchers at the University of California, Berkeley, published experiments[7] that showed a correlation between gene expression in the water flea Daphnia and levels of exposure to metals such as copper, zinc and cadmium - providing evidence of the value of toxicogenomics for environmental monitoring. In 2007, the US Environment Protection Agency presented the ToxCast program[8]. By building up a library of predictive bioactivity signatures, including gene expression profiles, the program aims to develop computational models to predict potential for toxicity of chemicals. This would make the testing of new chemicals for potential environmental or health effects faster and easier. More recently, researchers showed that they could detect potentially dangerous levels of acetaminophren in rats by examining gene expression in their blood cells.[9] This offers a relatively non-invasive diagnosis of exposure that could be extended to a wide range of human applications in the future, providing a proof of principle of the value of toxicogenomics in personal monitoring of exposure to environmental chemicals.

This example demonstrates how emerging technologies can be tracked but caution is required when interpreting data, there are no clear links with the modulation of gene expression and health risks from exposure to environmental chemicals. As for our ability to screen for susceptible groups, a similar claims relating to genetic polymorphisms, disease susceptibility and preoccupation screening were made in the past but have not yet been borne out. This demonstrates the need for continual monitoring of the literature to keep up to date with advances in new technologies, interactions between new technologies and understanding of results obtained from new technologies.

Conclusions and future developments

As the rate of information emergence is only likely to increase and data management will become more difficult. Therefore, novel tools will need to be developed to reduce the time required to manually scan articles and extract those of interest. The Environment Agency are exploring various knowledge management tools to reduce resource intensity for horizon scanning which will further improve the service.

Horizon scanning is a vital tool to prepare for future developments and should not be limited to specific issues and areas of expertise. Continuous and systematic scanning of the broad science and technology horizon is a monumental task and very resource intensive. Collaboration between agencies should improve data robustness, reduce duplication and increase efficiency. The pilot collaboration between the Environment Agency and the Chemical Hazards and Poisons Division is exploring the practical aspects of developing this work further.

If you would like to receive the pilot CHaPD Scan or require further details please contact Graham Urquhart.

References

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9 Unique pattern of gene expression can indicate acetaminophen overdose [Online]. 2007 [2007]. Available from World Wide Web: http://www.physorg.com/news113059333.html

Development of a risk assessment framework for potential chemical contamination during flood events

The South Yorkshire Flooding Working Group
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Overview

During and after flooding events chemical contamination may potentially lead to public health impacts. A multi-agency working group comprised of representatives from the Health Protection Agency, Environment Agency, and South Yorkshire Local Authorities and Primary Care Trusts has been meeting on an ongoing basis following widespread flooding events in the South Yorkshire region during the summer of 2007.

The regional working group has developed and implemented a tool which provides a risk assessment framework for potential chemical contamination during flood events. This consists of a 'traffic light system' and checklists to assess potential contamination issues from a) reports of contamination received during a flooding event and b) during routine site inspections of regulated sites following a flooding event.

It is hoped that this tool may provide an 'off-the-shelf' resource for the use of responding agencies during and after any future flooding event. The tool is intended for simple and pragmatic use and has been developed such that it should not represent an onerous additional burden on responders. It is suggested that the tool may be of particular use to emergency planners in relation to flooding emergency response plans.

Summary of work to date in South Yorkshire

In order to assess the potential impact from the 2007 floods the Environment Agency and Local Authorities were asked to retrospectively apply the checklists to their flooding response (i.e. to complete them for any historic reports of contamination and/or assessment of flooded industrial premises conducted during or after the flooding events of 2007).

This work did not identify any significant releases of chemical contaminants. One site was unable to quantify any potential loss of inventory due to the loss of records and documentation when flooded; record-keeping being one consideration when examining business continuity aspects of flooding.

In their role as Regulator, for those industrial sites that were affected by the 2007 floods, the Environment Agency and Local Authorities from South Yorkshire were asked to undertake simple risk-based assessments on an ongoing basis as part of routine site investigations of those sites that are regulated under the Pollution Prevention Control (PPC) Regulations.

Development of a risk assessment tool

The South Yorkshire tool has developed from national[2] and regional multi-agency work undertaken following the 2007 floods to provide a standardised approach to assessing risk. It reflects the fact that risk assessments are best carried out at a local level and require a multi-agency approach (e.g. involving Local Authorities, Environment Agency, Health Protection Units and Primary Care Trusts).

The tool uses a 'traffic light system' to identify any potential contamination issues (risk assessed as '**red**', '**amber**' or '**green**'); with '**green**' issues requiring no further action and '**amber**' and 'red' issues requiring investigation and a more detailed risk assessment; with '**red**' issues the immediate priority for consideration of the multi-agency group.

The 'report' checklist (Table 1) was developed to provide a means for responders to assess the risk of chemical flood contamination from ad-hoc complaints, information and reports received by responders from those 'on the ground' and provides a practical means for assessing chemical contamination risks both during and after the busy response phase of a flooding event.[3]

The 'point source' checklist (Table 2) was developed to provide a means to assess the risk of chemical flood contamination during the post-flooding follow-up phase, once floodwaters had receded. In discussion with the Environment Agency and Local Authorities it was recognised that the scope should be achievable and not pose an undue additional burden on resources. The South Yorkshire working group set the scope of post-flooding assessment to those flooded sites subject to routine PPC inspections by the Environment Agency or Local Authority so as to limit the impact on those organisations' resources and provide an achievable and pragmatic audit. This has been implemented by appending a short 'point source' checklist to existing documentation and completing the assessment during the routine inspections related to any given installation's PPC permit.

There is an extremely broad range of potential sources of chemical contamination during flooding events. It is recognised that sources which are not sites regulated under the PPC Regulations present a potential further source of chemical contamination and are likely to be many in number (e.g. waste management sites; sites listed under British Agrochemical Storage and Inspection Scheme (BASIS); Control of Substances Hazardous to Health (COSHH) and Notification of Installations Handling Hazardous Substances (NIHHS) legislation; sites using or storing chemicals which may not be covered by regulatory regimes; sewage works; water company trade effluent discharges to foul sewer; active and historic landfill sites etc). In any future flooding event in which this risk assessment tool is to be used, the situation will need to be carefully considered and the scope of any post-flooding assessment agreed between the partners involved.

Together, the two checklists provide an auditable means for responders to assess both immediate and longer-term risks associated with chemical contamination during flooding events. It is recommended that in any future flooding event the process should be agreed and implemented by a multi-agency group at regional level to ensure a consistent approach to the risk assessment. Membership of such a group may include: Local Authorities, Health Protection Agency, Environment Agency, National Health Service, Food Standards Agency, and water companies.

Traffic light system & risk assessment methodology

The information gathered by the checklists is used to undertake a risk assessment using a traffic light system:

- **GREEN**: Source not released therefore no risk
- **AMBER**: Source present and released but NO housing, nursery or schools within 250m downstream or 500m downstream where one-way flow
- **RED**: Source present and released AND either housing, nursery OR school within 250m downstream or 500m downstream where one-way flow

The risk assessment is based on a source-pathway-receptor model. The source is the origin or cause of the contamination; the receptor is the person, animal, plant, or eco-system that may be harmed by the contaminant; and the pathway is the route the contaminant takes to reach the receptor. Exposure to flood water is considered to be the key pathway in the majority of flooding incidents.

Children were selected to represent the receptor considered to have the highest potential exposure to any chemically contaminated flood water due to their potential for high risk behaviour (e.g. such as playing in water and potential ingestion of soil contaminated by flood water) and their potentially higher susceptibility to the toxicological effects of chemical contaminants. Schools, nurseries or residential properties are therefore used as proxy measures for the presence of 'child receptors.'

The cordon of 250m around a source in flooded areas is a pragmatic suggestion. It is suggested that, where the source is subject to one-way flow (e.g. in or adjacent to river flow), this distance should be extended to 500m downstream. Beyond these zones, it is thought probable that the majority of contaminants will be subject to significant dilution.

South Yorkshire Flooding Working Group

Dr Wendy Phillips, Dr Rosemary McNaught, Dr Suzanna Matthew, and Julie Beech on behalf of South Yorkshire HPU; Dr Terry Matthews on behalf of Humber HPU; Dr Naima Bradley and Jim Stewart-Evans on behalf of CHaPD (Nottingham); with representatives of the Environment Agency, and South Yorkshire Local Authorities and Primary Care Trusts.

The original framework and checklists were developed by CHaPD (London, Birmingham & Nottingham) staff in partnership with the South Yorkshire and Humber HPUs, the South West HPA Region and the EA, FSA, GDS and LAs (CIEH).

References

1 **Group members are listed at the end of this document.**

2 **Original framework and checklists developed by CHaPD (London, Birmingham & Nottingham) staff in partnership with the South Yorkshire and Humber HPUs, the South West HPA Region and the EA, FSA, GDS and LAs (CIEH).**

3 **Note that information and advice on what measures should be taken to reduce health risks from flooding can be found at http://www.hpa.org.uk/flooding Detailed guidance for public health professionals dealing with acute flooding chemical events can be found at http://www.hpa.org.uk/chemicals/checklists**

Source/receptor risk assessment checklist for chemical flood contamination

Instructions:

1 Please use correct table

2 Complete table and return to *[insert agreed point of contact for collation e.g. regional flooding Strategic Coordinating Group, multi-agency working group, etc]*

[insert address and contact details e.g.

Contact name

Organisation

Street

Town

Postcode

Tel: #### ### ####

Fax: #### ### ####

Email: agreed.contact@organisation]

Table 1: Report of potential chemical flooding contamination

All reports of potential chemical contamination (e.g. from members of the public, industry, emergency services etc) should be logged here by responders

Table 2: Follow-up phase: Point sources (known storage)

This can be informed by flood and point source maps from the Strategic Coordinating Group or multi-agency working group and with assistance from the Environment Agency/Local Authorities. The scope of necessary follow-up to be agreed by local flooding group.

Where sites have been flooded - Regulator (e.g. LA, EA) to carry out assessment at the industrial sites that it regulates during routine site inspections in order to identify potential pollution incidents associated with flooding

Initial risk assessment is based on a 'Traffic light system' defined as follows:

GREEN: Source not released therefore no risk

AMBER: Source present and released but **NO** housing, nursery or schools within 250m downstream or 500m downstream where one-way flow

RED: Source present and released **AND** either housing, nursery **OR** school within 250m downstream or 500m downstream where one-way flow

If possible this will be made at the time of assessment or report.

If this is not possible then leave this section of the checklist blank.

Table 1: Report of potential chemical contamination from flooding

REPORT OF POTENTIAL CHEMICAL CONTAMINATION	
Date and time report received	Date Time
Date and time of potential contamination	
Exact location of observation / observed effect	
CONTACT DETAILS	
Name of reporter	
Contact details (telephone/mobile/e-mail address)	
Address	
Postcode	
Reason for report	
FLOOD issues	
Site flooded (Yes/No)	
If yes when were you flooded?	
How long were you flooded?	
When did the flood water go?	
Visual description of source (container, petrol film, colour, texture, etc)	
Description of any visible labels	
Possible location of source of chemical contamination	
RECEPTOR IDENTIFICATION	
Any receptor i.e. housing, nursery or school within 250m? Yes/No	
If yes, is the receptor downstream or upstream?	
Any reported health effects associated with flooding? (Yes/No) If yes please specify	
Name and contact of person receiving report	
INITIAL RISK ASSESSMENT	
Initial 'Traffic light' risk assessment (Green, Amber, Red)	
Name and contact of person undertaking initial risk assessment of REPORT	

Table 2: Post-flooding site inspection checklist for Regulators (sites with known storage of chemicals)

Date and time of assessment	Date Time
Name of site or company	
Address	
Post code	
Contact name	
Type of site (nature of installation)	
FLOOD issues	
Was site flooded (Yes/No)	
If yes when was the site flooded?	
How long was it flooded for?	
Any visual evidence of contamination from flooding (container, petrol film, colour, texture, etc)?	
POSSIBLE CHEMICAL CONTAMINATION	
Possible location of source of chemical contamination	
Any known or potential chemical released or lost (Yes/No)	
If Yes, give following details for each chemical released or lost (please add data under the following headings and repeat as required):	
1. a) Name of chemical (product) b) Concentration c) Quantity d) Can we have copy of Material Safety Data Sheet MSDS? e) Description of any visible labels f) Date of possible release	
2. a) Name of chemical (product) b) Concentration c) Quantity d) Can we have copy of Material Safety Data Sheet MSDS? e) Description of any visible labels f) Date of possible release	
3. a) Name of chemical (product) b) Concentration c) Quantity d) Can we have copy of Material Safety Data Sheet MSDS? e) Description of any visible labels f) Date of possible release	
RECEPTOR IDENTIFICATION	
Any receptor i.e. housing, nursery or school within 250m? Yes/No	
If Yes, receptor is Downstream or Upstream	
Any reported health effects associated with flooding? (Yes/No) If yes please specify	
INITIAL RISK ASSESSMENT	
Initial ‘Traffic light’ risk assessment (Green, Amber, Red)	
Name and contact of person undertaking assessment of POINT SOURCE	

Review of Health Protection Agency guidance for flooding: Flooding in England & Wales 2007 used as a case study

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Introduction

Consistently wet weather throughout the early months of summer 2007 filled watercourses and saturated soils. These weather conditions were due to a slight shift in the jet stream, which flowed further south and stronger than usual, causing more rain-bearing depressions crossing southern and central parts of the UK while warmer sea temperatures created more rain clouds. In mid-June, following a period of particularly heavy rain, flooding occurred in Yorkshire. Extensive flooding was also experienced in the South West and West Midlands following another period of heavy rain in mid July. Over the course of the summer, more than 55,000 homes and businesses were flooded. Insurance claims from homes and businesses are approaching £3milllion while the real costs are likely to be much greater than this (Environment Agency (EA), 2007); the cost of recovery in Gloucestershire alone is likely to be over £50million.

During these floods, the Health Protection Agency (HPA) was called upon to respond at both the local and the regional level through providing advice to professionals and to the public about the potential health risks involved and how best to avoid and/or minimise these. Due to the range of advice and guidance disseminated by various HPA departments during the event, and acknowledging the difficulties encountered in trying to obtain advice regarding a number of specific health issues, it was decided to conduct a review of the HPA advice and guidance for flooding events. The review also aimed to support the development of a single set of advice and guidance for health during and after flooding events, as recommended by the interim Pitt Report (The Cabinet Office, 2007).

Approach used

As a first step, a review of the HPA response to the flooding events in the summer 2007 was conducted. All likely sources of information used during the flooding were trawled in order to identify advice and guidance used, and specific questions raised by the media, the public and the Cabinet Office. The documentation included;

- emails (external and internal)
- Situation Reports (SITREPS) from the Health Protection Units (HPUs)
- Government Office reports
- The rolling brief produced by the Scientific and Advisory Cells (STACs)

Local HPA staff were also emailed and asked to forward any advice or guidance they used during the event. Any additional national and local advice and guidance were collated and evaluated for consistency. A non-systematic review of the advice and guidance available from other agencies was conducted, including reports and guidance from the Environment Agency (EA), Food Standards Agency (FSA), Centres for Disease Control and Prevention (CDC), and the World Health Organisation (WHO). These were also reviewed for consistency with the advice and guidance provided by the HPA. A non-systematic review of the evidence-base around the health impacts of flooding was conducted, along with an evaluation of the evidence upon which the HPA guidance is based, and the identification of specific areas where the evidence is strong, weak or absent.

An important aspect of this review was to identify recurring issues that arose throughout the duration of the flooding event, and to identify areas where there was difficulty in providing appropriate and/or timely advice. This involved:

- Identifying recurring issues/questions that arose during the flooding
- Identifying specific questions from Gold command, the Cabinet Office Briefing Rooms (COBR), the media, the pubic and public health professionals
- Identifying those issues/questions where the evidence-base and/or knowledge was not available at the time of the flooding
- Identifying issues where the evidence-base is absent/weak and where it may be improved, by the HPA or by other agencies

Outcomes

The review highlighted some inconsistencies in the local and national guidance; these consistencies were generally not inaccuracies but slight variations in the advice, with the potential to cause confusion.

A number of recurring issues were identified:

1 There were concerns about the potential risks to health from exposure to microbial and chemical contamination of flood water through direct contact with the flood water and contact with residues once the flood waters receded - for example from eating food from allotments that had been submerged.

2 Disruption of mains water supplies can affect a large number of people for a prolonged period of time during and in the aftermath of a flooding event. Following the flooding of the Mythe water treatment works in summer 2007, 140,000 people were without access to mains water for up to two weeks (EA, 2007). In the short-term, disruption of the water supply will not just affect health through the absence of readily available drinking water but will also impinge on numerous other aspects, such as the hygienic preparation of food and the adherence to usual personal hygiene practices. Those with small children will be particularly vulnerable; especially those with bottle-fed babies as some commercially available mineral waters are not suitable for children, due to their high salt content. The disruption of mains water supply has serious implications for sanitation and it may be necessary to evacuate people from their homes if there is no

alternative access to toilet facilities through temporary facilities or at nearby rest centres. The decision to evacuate will be made at a local-level. However, the experience of the summer 2007 flooding indicates that this decision may be supported through the provision of some advice and guidance such as the use of commercial sanitation products and likely triggers for evacuation. Longer-term disruption of mains water will also interfere with clean-up after the floodwater has receded and this can cause considerable distress for those who want to return to their homes.

3 Disruption of power can often occur during flooding events when power stations or electrical sub stations become flooded. This can have a direct impact on health as people may find it difficult to stay warm or keep cool. In the absence of power, other risks include carbon monoxide (CO) poisoning from the use of generators indoors and fire hazard from the use of candles. More indirect impacts are those resulting from the difficulties in preparing food - especially the elderly and those with young children - and the dangers of eating food which has not been preserved properly as fridges and freezers will not work. A number of recurring issues related to the disruption of power arose during the summer 2007 events and there was some contradictory advice given about the amount of time different food stuffs can be stored. The review has identified these as issues to be discussed with the Environment Agency (EA), the Food Standards Agency (FSA) and the local authorities so that in the future, the advice from each agency is consistent.

For some of these issues, the existing HPA advice and guidance is based on a clear and robust evidence base. However, for some other issues outstanding questions remain, for example:

- What is the most effective approach to basic hygiene procedures where there is no mains water supply, especially where young children are involved?
- How do you conduct an adequate clean up in the absence of mains supply?
- How long after the flooding recedes is it safe to play on sports pitches/playing fields? Is this period dependent on whether the weather is wet or dry?

These identified gaps will be reported to the various groups and individuals working on flood-related health issues with the request that they identify potential ways of improving the evidence and the confidence with which decisions can be made. In some cases, the most appropriate response may be for the HPA to conduct the work required to fill the gap. In other cases, it may be reasonable to commission other agencies or individuals to conduct the work.

The review identified a number of issues that were not considered a priority in the flooding 2007 event, but that have been significant during flooding incidents elsewhere and are therefore likely to arise in future flooding incidents. For a number of these, it may be possible to pre-emptively produce off the shelf guidance:

- The HPA advice and guidance includes a short reference to mould, however, it was a major concern for the Centres of Disease Control and Prevention (CDC) following the Hurricane Katrina floods in New Orleans, USA. This may have been due to the humid conditions experienced in New Orleans but mould is also likely to be an issue during clean-up for homes in the UK.
- The issue of whether tetanus booster shots should be administered to those involved in the clean-up, either professionally or in their own homes, was not considered a priority in the UK flooding event. However, the CDC recommended that those involved in the clean up had up-to-date boosters.
- Hepatitis A (Hep A) vaccination was also raised as a potential issue in the aftermath of Hurricane Katrina due to the large numbers of people staying in rest centres for prolonged periods of time. Hep A was mentioned briefly at a SITREP of the flooding 2007 but generally was not considered a priority. During this flooding event, people were not in rest centres for a long time but this may not be the same in other flooding incidents. It may be useful to consider this possibility and the likely triggers for decision-making should these circumstances arise

Gaps in the evidence for risk assessment

Much of the guidance used during the flooding aimed to reduce the risk of exposure to chemicals and infectious agents and was based on basic hygiene procedures, the efficacy of which is well established. However, the evidence-base for more specific advice related to the health impacts from flooding events was found to be relatively limited - for example, the risk associated with flooding of allotments. The gaps in the evidence-base make risk assessment during flooding events difficult. However, certain risks which have been identified as significant, such as carbon monoxide poisoning, and it is important that those responding to flooding events are aware of these and prioritise them in a risk assessment. For other less well-documented risks, a systematic review of the evidence for risks from chemical and microbial contamination during the acute and recovery phases of flooding events would be useful. A risk assessment tool has already been developed by the HPA Yorkshire and Humber Group; this tool facilitates the identification of sources of pollution, likely pathways and potential receptors, and uses a 'traffic light' system to inform local decision-making of issues with high risk. This tool is useful for rapid crude initial risk assessment but could be more effective if supported by a review of the evidence-base, potential quantification of the causal links between flooding risk and health impacts; including estimates of the magnitude of uncertainty involved.

Most of the available studies on the health impacts of flooding focus on the acute impacts from drowning and flood-related vehicle accidents; however, there is limited evidence which suggests that the health burden from long term psychosocial impacts such as stress and Post-Traumatic Stress Disorder (PTSD) is also significant. Additionally, there is evidence to suggest that those in lower socio-economic strata are more likely to be affected by flooding, while also being less resilient to the impacts of flooding (McMahon, 2007); therefore, inequalities in the health burden from flooding must also be considered.

In response to the flooding events of summer 2007, and subsequent directions to the HPA in the Pitt Review (The Cabinet Office, 2007), a Flooding Coordination Group was established within the HPA. This high-ranking Group has been tasked by the Chief Executive to coordinate the HPA work on flooding and to ensure that the HPA carries out the tasks assigned to it by the Pitt Review. This review forms part of the initial work commissioned by this group. This review, along with a number of related pieces of work, will continue to contribute to improving the ability of the HPA to prepare for flooding events, through improving resilience and response capability. This includes a number of future actions:

1 For those issues where the advice and guidance from the HPA was found to be consistent, and where the evidence-base is sound, advice and guidance will be made available for both professional and public end-users for a range of media, e.g. messages for radio and television, flyers, etc. These will be developed through collaboration with the HPA communications team and experts from the HPA, who will also ensure that it is the best-available evidence as used by experts in other agencies. This work is currently on-going.

2 The review of existing advice and guidance, along with the review of the evidence-base, will inform the development of off-the-shelf guidance for recurring issues during flooding events. These will include, where possible, an indication of where local knowledge needs to also be applied and the magnitude of the uncertainty in the evidence-base.

3 For those issues identified by the review as having a weak/absent evidence-base, the HPA will evaluate whether it is possible to improve the evidence, whether through additional work conducted by the HPA or through supporting work conducted by other agencies.

4 The review will be used to support the risk assessment tool currently being developed by identifying uncertainties in likely decision-making scenarios. The review of the evidence-base will ensure that the advice given and decisions taken are based on the 'best available' evidence.

5 Developing a quantified estimate of the health burden associated with flooding events has been identified as a priority by both the HPA and the EA, particularly for the long-term health impacts that have rarely been considered in previous studies; the HPA is in discussion with the London School of Hygiene and the Environment Agency on a proposal for a study to evaluate the health impacts of flooding events in the UK, including both acute and chronic health outcomes.

6 The review of the advice and guidance for responding to flooding events also identified some training needs. There is a need for some institutional knowledge about the health effects that are specific to flooding, particularly those potential risks that have a proven evidence-base, such as mortality from exposure to carbon monoxide. There also needs to be awareness at the local level about the specific health effects associated with flooding so that generic skills can be appropriately applied. This is especially true for those areas that are prone to flooding.

Conclusions

The advice and guidance provided nationally and locally during the flooding event of summer 2007 were generally accurate and consistent. However, a number of recurring issues were identified where the evidence-base for the advice given was less than ideal. Where the evidence is robust, the HPA will collaborate with other relevant agencies to develop consistent off-the-shelf advice and guidance for use in future flooding events. Where the evidence-base as been identified as weak, gaps will be identified and recommendations will be made for closing these gaps. The HPA will continue to work alongside the EA in building resilience and improving the response to flooding.

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Developing a Children's Environment and Health Strategy for the United Kingdom – a progress update

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Summary

The Children's Environment and Health Strategy for the UK is now out for public consultation and will be revised in due course in light of the comments received. As a wide range of initiatives and existing policies are already in place that address many environments and health concerns relevant to children, the strategy builds on and complements policies and activities already undertaken by government departments, devolved administrations, local and regional authorities and the National Health Service. The strategy makes recommendations on the measures necessary to improve children's environmental health and should help encourage a comprehensive strategic approach to protecting and improving children's health and well-being in the UK.

Introduction

Children and young people can be particularly vulnerable to the adverse health consequences arising from exposure to environmental hazards (WHO, 2005).This is because they

- are still growing and developing, which can mean that certain biological systems may be more susceptible to harm from environmental hazards than adults and that immunity to disease is not as well developed
- often experience different patterns and levels of exposure to environmental hazards because they take in more food, water and air relative to their body weight than adults, consume a different diet (particularly when very young) and can absorb some chemicals more readily than adults and
- can be more vulnerable to unintentional injuries due to their tendency for exploratory behaviour, play and their maturity and ability to judge risks

To address children's vulnerability from environmental hazards, the European Environment and Health Process, led by the World Health Organization (WHO) Regional Office for Europe, provides support to the 53 WHO Europe member states (including the United Kingdom; UK) as they plan and implement national and international environment and health policies. In 2004, WHO member states signed the Children's Environment and Health Action Plan for Europe (CEHAPE; WHO, 2004) which commits them to the development of national plans to address four Regional Priority Goals covering (i) water, sanitation and health; (ii) injuries, obesity and physical activity; (iii) indoor and outdoor air pollution; and (iv) chemical, physical and biological hazards.

The Health Protection Agency has been commissioned by the Department of Health, on behalf of the Interdepartmental Steering Group on Environment and Health to develop a Children's Environment and Health Strategy for the UK. This article provides an update on progress and outlines some of the areas highlighted in the strategy. An earlier paper (Duarte-Davidson *et al*., 2007) provides further background material on the project.

The burden of disease in children and young people in the UK

The impact that the environment has on children's health should be considered as part of the broader burden of disease in children. Children and young people (aged 0 to 19 years) represent about a quarter of the population in the UK and generally experience a high standard of health. Currently, there are about 5,000 deaths each year amongst children under 14 years of age (out of approximately 750,000 births) and the main causes of death are due to congenital malformations, neoplasms, injuries and poisonings (HPA, 2008). The main causes for admission to hospital and visits to General Practitioners include respiratory tract infections and asthma, injuries, poisonings and intestinal infectious disease (HPA, 2008). Whilst the burden of disease attributable to environmental factors amongst children and young people is difficult to quantify, environmental factors can have an influence on many of the causes of ill health and therefore provide an opportunity to further protect and improve children's health.

Progress to date

An in-depth assessment of the current status of children's environment and health in the UK was undertaken during 2006/7 (HPA, 2007). The assessment aimed to identify areas where further action may be necessary to better protect children's health from environmental hazards. This was used as a basis for developing the Children's Environment and Health Strategy for the UK (HPA, 2008). The strategy aims to provide recommendations on the measures necessary to improve children's health by effectively managing environment-related influences on child health and provide a coherent and coordinated cross-government approach. Some of the areas for improvement highlighted in the strategy are summarised in Box 1.

This strategy will work alongside other policies and initiatives (see HPA, 2007 and 2008 for further details) with the aim to provide a comprehensive and coordinated approach to ensuring children in the UK experience the highest attainable levels of health. Within England and the Devolved Administrations, the strategy will help set an overarching context whilst allowing a degree of flexibility within each administrative region.

Box 1 Areas for improvement highlighted in the strategy

The challenge for the UK is that, whilst the legislative base on public health has been well developed and the baseline in most Regional Priority Goals is very good, there are specific areas that could still benefit from improvement. Examples include:

- Counteracting the increasing number of overweight and obese children and young adults, coupled with improving the amount of physical activity they undertake.
- Addressing concerns regarding the number of children whose asthma is affected by air pollution and the effects of air pollution on the long-term lung function of children.
- Promoting good sun protection behaviour amongst children to prevent skin cancer.
- Reducing unintentional poisonings amongst children.
- Gaining a better understanding of environmental inequalities and the disproportionate burden of disease experienced by children in lower socioeconomic groups so that appropriate interventions can be effectively targeted to ensure the needs of these children are adequately addressed.

The Consultation process

The Children's Environment and Health Strategy is currently out for public consultation (see figure 1). The aim of the consultation process is to seek feedback from interested parties on the proposed recommendations, areas for further action and identify other areas that may require action in order to meet the UK's commitment to the Children's Environment and Health Action Plan for Europe. The consultation document and questionnaire can be found on the HPA website (http://www.hpa.org.uk/cehape/) or are available on request from the Consultation Officer (email: cehape@hpa.org.uk). The consultation is running for a period of three months ending 13 June 2008.

Next steps

Following the consultation, responses will be collated, summarised and published. In light of the responses received, the strategy will be revised and recommendations will be made on the most appropriate measures necessary to further improve children's environmental health in the UK.

At the next WHO Regional Office for Europe Ministerial Conference on Environment and Health (to be held in Italy in 2009) the UK will have to report on the progress made towards developing and implementing our national children's environment and health action plan.

Acknowledgements

The Health Protection Agency gratefully acknowledges the Department of Health and the Department for Environment and Rural Affairs (Defra) for funding this work. We also gratefully acknowledge the input of the Interdepartmental Steering Group on Environment and Health for providing advice, comments and assistance throughout this project.

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Figure 1: Cover of Children's Environment and Health Strategy

Description of the Nature of the Accidental Misuse of Chemicals and Chemical Products (DeNaMiC)

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Background

In recent years there has been a change in the perception of unintentional injuries from being the result of random and unavoidable events to being largely preventable accidents. Therefore; developing and implementing effective injury prevention policy is a firm public health concern. A prerequisite to action, however, is to develop a good understanding of the nature and cause of injury. It is also important to have a means for evaluating the effectiveness of preventive measures.

In the case of household consumer chemical products a number of preventive (risk management) measures have been introduced either via regulations, or as part of the manufacturers' commitment to promote stewardship and responsible care when using their products. However, in spite of these efforts, exposure to household consumer chemical products continues to occur and there is a need to better understand the nature and extent of these exposures.

The information currently available regarding the burden of injury following accidental poisonings and exposures to household consumer products is incomplete and varies throughout Europe. Sources of data include poisons centres, national morbidity and mortality statistics, and injury statistics collected through specific national or regional schemes. These data are not, however, always readily accessible and there are differences in the ways that they are organised and reported.

Introduction

The DeNaMiC project aims to identify what data is available to characterise the nature and extent of injury from household consumer chemicals and chemical products within Europe, and to find out what conclusions can be drawn from these data sources. It also aims to explore the feasibility of using poisons centre data for the same purpose, both retrospectively and prospectively. The project work is divided into five subcomponents.

The partners in the project are the Health Protection Agency, the poisons centres of Lille, Göttingen, Prague and London, as well as the World Health Organisation and the German Federal Bureau for Risk Assessment.

This report provides a summary of the first subcomponent of this project, which has recently been completed. The focus of this subcomponent was to assess the availability of published statistical data and data from poisons centres on the nature and frequency of accidental exposures to chemical products, and to analyse these data where possible. The lead partner for this work was the Guy's & St Thomas' Poisons Unit (London, UK).

Method

The first step in the process was to define the limits of the events for which data would be sought. This involved agreeing the definitions for consumer products and circumstances of exposure, and the scope of products and circumstances that would be considered for inclusion in the project. In deciding on the scope of products that should be included, the product classification schemes used by the Göttingen, Lille and London poisons centres were compared and mapped to identify a core group of product categories.

A search of the published literature and the Internet was then carried out to find relevant data. In addition, a sample of poisons centre annual reports was obtained and studied. An Excel-based tool was developed to assist in the literature analysis. A ten year time span was searched; publications and reports were restricted to the English language.

Outcomes

Comparison of the product classification schemes used by the poisons centres of Göttingen, Lille and London showed that no centre's scheme incorporated definitions for product categories. There was some degree of compatibility between the three schemes. In some instances there was 100% successful matching at the higher tier (broader product category) of some typical household consumer chemical products such as drain cleaner, oven cleaner and descaler (as in the Lille and Göttingen schemes). However, there were significant differences with the more detailed product specific categories (at a deeper level e.g. product brand name and composition). These differences limited the degree of mapping that could be carried out between poisons centres since the higher level tier could encompass a significantly different group of products in the three database schemes.

The literature search identified 156 publications. However, only 58 contained relevant statistics on poisoning with household products. The data presented in these selected papers was too heterogeneous to allow data pooling or statistical analysis, therefore only descriptive conclusions could be drawn.

Fifty nine English-language annual reports from 8 countries (UK, France, Germany, Switzerland, Sweden, Slovakia, Ireland and New Zealand) were examined. General information could be found on the agents or products involved in exposures, but detailed information was generally unavailable e.g. the concentration of chemicals within product preparations, or packaging and labelling information. Each poisons centre categorises products in its own way and as a result these data was not necessarily comparable between centres. The presentation of data within the reports was highly variable, not only between poisons centres but, also in some cases, between years for an individual poisons centre's reports. Once again it was not possible to do a statistical analysis.

Conclusions

This review has highlighted the difficulties in comparing published and poisons centre statistics on exposures to household consumer products. The product classification schemes used by poisons centres are living schemes that adapt to the changing market of household products. The IPCS INTOX Use and/or Function Classification definitions were originally developed and agreed by an IPCS international working group to facilitate the collection of internationally comparable data on poisoning cases for non-pharmaceutical categories[1].

However, the majority of poison centres product category databases have subsequently diverged to the point where comparisons are difficult. This is well illustrated by the Lille and Göttingen schemes which, despite using the WHO INTOX Use/Function classification as their initial starting point, have now differentiated to a point where comparisons are difficult. The project (to date) has highlighted the importance of ensuring that appropriate definitions of product categories are established to enable effective comparisons between different schemes and the current lack of definitions for product categories greatly hindered comparison and mapping between current schemes of poisons centres involved in the DeNaMiC study. The INTOX scheme does also include definitions for product categories; however, these were not used.

Poisons centres across Europe tend to publish annual reports highlighting issues of relevance to the regions for which they collate data on poisoning events, and as such can be a valuable source of information. An attempt was made by the European Commission (EC) in 1990 to harmonise these reports between Member States[2] and thus allow for comparability of data between countries. This initiative came to a halt in the mid-1990s and as there is currently no process to encourage a move towards making data comparable. The information presented in these annual reports have diverged.

Published statistical data and literature analysis on the nature and frequency of incidents and events related to accidental exposures of chemical products could not be analysed statistically due to the heterogeneity of the data. The information commonly reported varied dramatically due to a lack of a standard reporting format. Although this review has found that statistical analysis cannot be performed on the data, a descriptive analysis can provide very useful information. Key messages and general conclusions from the descriptive analysis will be reported in due course.

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1 **IPCS INTOX Use/ Function Classification definitions available at: http://www.who.int/entity/ipcs/poisons/en/definitions_en.pdf**

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airAlert - empowering vulnerable people with directed information.

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Introduction

The Sussex Air Quality Partnership (Sussex-air) operates a service in East and West Sussex called airAlert which provides air pollution alerts to asthmatics and other people in poor respiratory health. Over the last 2 summers the service has been piloted and funded by the partnership, and from May 2008 it will be launched as a full year service, reaching out to more vulnerable groups across the region.

Sussex-air is made up from the Sussex local, county and health authorities (PCT's), in addition to the Health Protection Agency, the Environment Agency and the Sussex Universities (Brighton and Sussex). The partnership also has close ties with King's College London (Environment Research Group) and Environmental Protection UK.

Disseminating air pollution information

Air quality data in the UK has for many years been collected, validated and stored by both local and central government. However, although this data has been publicly available, it has tended to be a resource for air quality professionals rather than the wider public. In most cases, the application of the data has tended to be used to identify air pollution hotspots rather than as an informative tool to aid the management of health.

Data and forecasts are available from the national air quality monitoring network, the Automatic Urban and Rural Network (AURN), is available via government websites, such as the UK Air Quality Archive (www.airquality.co.uk) and the UK Air Pollution Forecast (http://www.airquality.co.uk/archive/uk_forecasting/apfuk_home.php). This pollution information can also be sourced via other media such as newspapers, some radio stations and television, via CEFAX and Teletext services.

Many local authorities present their data on websites. However, very few have the resource to provide a forecast service, let alone provide information that is directed at vulnerable groups through a proactive delivery method.

Advances in technology have now made it cost effective to provide information services such as airAlert (www.airalert.info) and other systems like the Swedish air information (www.luftkvalitet.info) and London-based airText service. We can now target and deliver air pollution warnings to vulnerable groups before an incidence of high pollution occurs. These systems allow important alerts to be sent direct to vulnerable individuals or groups such as schools via text/SMS (Short Message Service), voice message (to home phones) RSS (Really Simple Syndication) or email.

Air pollution forecasts to air Alerts

Sussex-air developed airAlert from its existing air quality forecasting service, which had been in operation across Sussex since 2002. airAlerts are linked into the air pollution forecasts in Sussex, provided by King's College London (Environmental Research Group). These are based on the most recent air quality data, collected twice daily from the automated Sussex Air Quality Monitoring Network and regional meteorological forecasts. The network is made up of 16 automated air quality monitoring stations spread across Sussex, that continuously sample air for various pollutants including: nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulates/dust (PM_{10}), ozone (O_3) and carbon monoxide (CO). King's College London also utilise data from surrounding counties and the London Air Quality Networks, in addition to data from Europe.

An air quality forecast is produced each day in Sussex and if there is a predicted breach of the UK air quality standards/objectives, an airAlert is sent out to those persons vulnerable to the effects of air pollution. These alerts may be sent direct to recipients by text message/SMS (mobile phones), voice-message (home-phones) or email and are available as an RSS feed to PC's.

airAlert – the air pollution warning service for vulnerable people

airAlert is a free service for people with asthma and other respiratory conditions in Sussex. Clients for the service join up through local health care networks, such as the British Lung Foundation (BLF) 'Breatheasy Groups', and through GP surgeries and clinics. Over the last two summer pilot periods, the service has provided alerts to over 300 vulnerable people with asthma and Chronic Obstructive Pulmonary Disease (COPD). Anyone with asthma or a respiratory complaint can register free on-line at www.airalert.info or by post (using a free-post response form in airAlert leaflets).

Once registered, clients receive an airAlert information pack and airAlert card, to give further information on airAlert and to explain the messages they receive. The airAlert website (to be relaunched in May 2008) will allow clients to register, get airAlert updates and cancel or take holidays from the service.

The service is still in development; last summer it included email airAlerts for schools (airAlert-4-schools) and the media (e-Alerts). The airAlert-4-schools pilot in 2007, provided airAlerts to 16 schools across Sussex to inform staff and pupils of any predicted air pollution episodes. Southern FM radio station also received and broadcast e-Alerts potentially reaching in excess of 100,000 people. It is expected that in 2008 (with promotion and marketing) airAlert will reach directly to 700-1000 people in Sussex.

airAlert provides preventative health care information for key target client groups who are vulnerable to the effects of air pollution episodes:

- Persons with asthma and other respiratory sensitive groups

Other groups overlap into the key target groups, including:

- Young and older people
- Carers
- People with limited access to services or living remotely
- Vulnerable groups in the community
- Schools and nurseries
- Health professionals

Aims of the airAlert service

The key aims of the service provided by Sussex-air are to:

1. Provide air quality alerts warning of an air pollution episode that has the potential to affect the health and well-being of vulnerable individuals or groups.
2. Provide clear understandable messages and an informative, helpful service.
3. Provide the service free to clients.
4. Provide support and information direct to vulnerable persons via message services such as SMS/text, telephone voice message, email, RSS and the web.
5. Support the public health system by supplying preventative healthcare information to aid patient health care, help reduce health service burden and costs. In particular targeted towards: vulnerable groups in the community, and young children in schools and nurseries

airAlert service information (2006 & 2007 summer services)

During the summers of 2006 and 2007 airAlert provided pollution forecast services to 160 and 304 clients, respectively. During this period airAlert issued 36 alerts in 2006 and 17 alerts in 2007, resulting a total of over 10,000 airAlert messages being sent.

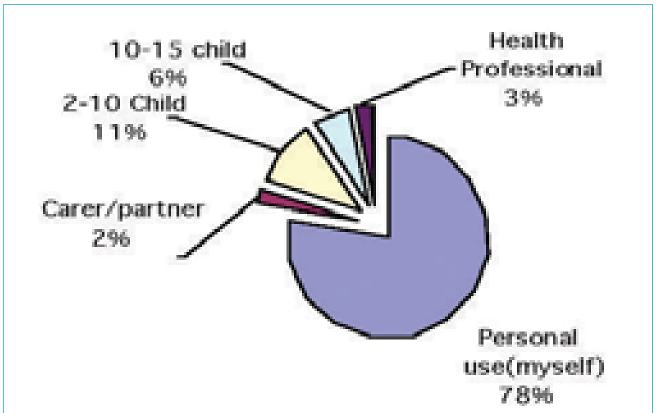

Figure 1: 2007 service users/clients

2007 data shows that the users of the service are predominantly women (65%) who are likely to be the carers of younger children and their older partners.

The majority of clients received the service for their personal use (78%), with people caring for others (young and old) receiving 19% of the alerts and health professionals 3% (see Figure 1).

Text messages to mobile phones were the most popular (79%) when compared to land-line/home phone voice message deliveries (21%). Mobile phone technology was not a deterrent to older people, over 55 year olds are the predominant user group (41%). This was reflected in the dominance of the recruitment Breatheasy-Group-cohort, which is anecdotally observed to be made up of mainly older people.

Sussex-air, in association with Dr Kirsty Smallbone at the University of Brighton, undertook interviews and questionnaire surveys with service clients of airAlert in 2006 and 2007. This showed that the intervention provided by airAlert gave clients the opportunity to take preventative action to minimise their risk of feeling ill or avoiding a visit or admission to Emergency Departments (EDs) or their GP.

On receipt of the airAlert message, many took precautionary measures such as using inhalers (24%) or preventative doses of medicines (19%) and extra doses due to symptoms (9%). As the alerts informed clients of the pollutant level and the locations where these were likely to occur (such as at roadside or rural locations), some preferred to avoid the areas specified in the alert (15%), undertake less exercise (outdoors) (16%) or stay indoors for the duration (13%) or all day (see Figure 2). Results from 2006 showed that 67% of the clients modified their behaviour due to airAlert and the majority made a link with their symptoms to air pollution.

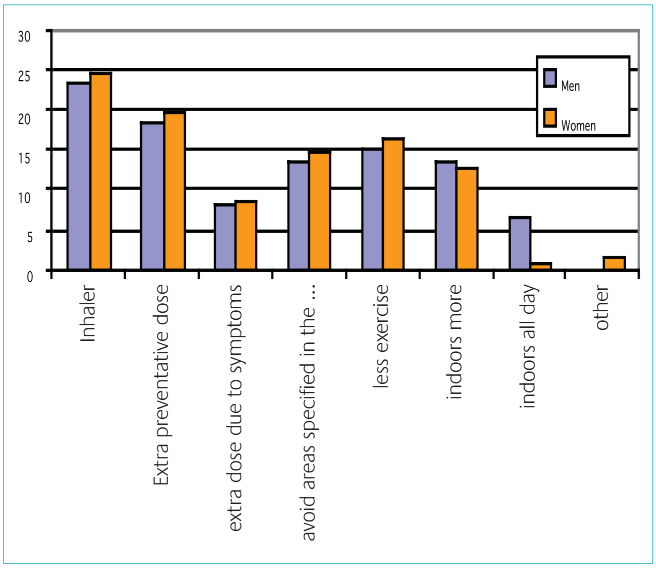

Figure 2: Percentage Client response to airAlert messages when asked what they did after receiving an airAlert message during 2007

Clients were asked to assess whether airAlert helped them manage their symptoms, with the majority (73%) agreeing that airAlert did. 5% did not think airAlert coincided with their symptoms and 22% did not know (see Figure 3).

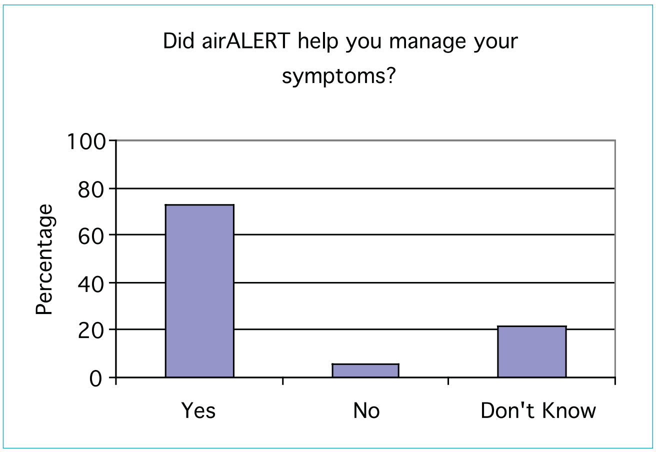

Figure 3: Self management of symptoms during 2007

These types of service empower vulnerable persons, by providing information which allows them to make decisions to better manage their health.

The service, by default, also provides resource savings to primary, secondary and tertiary care authorities by likely reduced admission rates through early intervention. Potential resource savings from airAlert can be made from likely non-admissions to hospitals and GP surgeries. For example, as an asthma hospital admission cost to the NHS is estimated to be £861 per day, and if airAlert prevented an estimated 1 in 30 admissions in 2007, the potential savings for local Sussex PCTs could have been £24,000. airAlert provided this service to over 300 client users in 2007, at a cost of £600.00 for messages.

The future of intervention systems

airAlert has the potential to be used to deliver information to a wider cohort across Sussex and other counties in the UK and EU. The delivery technology allows information to be sent direct to the clients. If well- managed, airAlert has the potential to provide other useful services to vulnerable people. These can be directed at patients, health professionals, hospitals and carers of the vulnerable, older and younger people. Such services could include:

- Chronic Obstructive Pulmonary Disease (COPD) in association with other providers.
- Pollen
- Heat-wave and cold alerts

airAlert and similar systems have great potential to provide information to persons to aid in the management of respiratory illnesses. This sits well with the preventative health care agenda and should reduce hospital admissions and GP visits. The existing technology could be utilised to deliver a wide range of additional environmental information to assist in the better self-management of health.

The Clara cell: an enigma

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The Committee on the Medical Effects of Air Pollutants (COMEAP) recently considered the suggestion that the increasing use of chlorinated swimming pools was a cause of the rise in asthma prevalence: a statement can be found on the COMEAP website http://www.advisorybodies.doh.gov.uk/comeap/statementsreports/swimasthma2007.pdf. During this discussion, changes in the human Clara cell marker protein CC16 were discussed. The significance of changes in blood levels of CC16 has been discussed (La Kind *et al*, 2007). This article focuses not on CC16 but on Clara cells themselves. These cells are perhaps not as well known as they should be and are certainly not well understood: indeed, the differences in Clara cell phenotypes between species suggest that there is not just one type of Clara cell but several.

Descriptions of Clara cells

Clara cells were described by the American anatomist Max Clara in 1937. It is accepted that they had already been described, but not named, by the great Swiss histologist, Albert von Kölliker in 1881. von Kölliker's name is not now much known except to histologists but his *"Handbook of Human Histology"* (1852) was the first great work on the subject and was translated into English by T H Huxley. Clara was himself a distinguished histologist whose work just preceded development of the electron microscope. In the pre electron microscope era, resolution of small objects was inevitably limited by the wavelength of visible light and interpretation of high magnification images was open to debate. Baker was critical of some of Clara's interpretations, commenting on Clara's description of the fine structure of microvilli (from avian intestinal cells) as "We are here in the realms of fancy" (Baker, 1942). But Clara cells from the distal airways certainly exist and have, since their discovery, aroused considerable controversy. Clara described the cells that now bear his name in two species: rabbit and man (Clara, 1937). That they could be readily identified in the rabbit is certain but in man they are less easily distinguishable. Clara described the cells as non-ciliated, low cuboidal cells with their apices projecting into the airway lumen. This is an accurate description in the rabbit, mouse, rat, hamster and guinea pig and also in the sheep, horse and llama. But in man and other primates, the cells do not project far into the airway lumen and in terms of ultrastructure, as revealed by electron microscopy, are very different from those of the common laboratory species.

Ultrastructural features of Clara cells

In the common laboratory species the cells, which are cuboidal in shape, are characterised by many ovoid, membrane bound, electron dense secretory granules. These are also found in some primates, including man, but not in the rhesus monkey. In laboratory animals agranular, or smooth, endoplasmic reticulum is plentiful; this is not the case in primates. On the contrary, extensive granular endoplasmic reticulum characterises the primate Clara cell. Glycogen granules are uncommon in both groups. In carnivores, dog, cat and ferret, and in cattle, the Clara cells are different again: the cytoplasm is filled with glycogen granules and secretory granules are rare, in fact absent in the cat. In nearly all species studied, except the llama, the cells show interdigitating lateral extensions of their cytoplasm. Unusually large mitochondria are common in the laboratory species and the cat, but not in others.

In terms of ultrastructure, then, the mammalian Clara cell displays a range of phenotypes and one could be forgiven for thinking that more than one cell type was actually being described. Interestingly, the appearance of fetal Clara cells differs from that seen in adults: in all species glycogen is common. The Clara cells of adult carnivores look much more like fetal cells than do those of common laboratory animals. Clara cells are not fully differentiated at birth: in some species post-natal differentiation seems not to occur (Plopper, 1983).

Location of Clara cells in the airways

Clara described the cells in the bronchioles. The cells are most commonly seen in the terminal bronchioles (the last branch of the conducting airways) and in the respiratory or transitional bronchioles where alveolar budding from the bronchiolar wall is seen. Ciliated epithelial cells but hardly any goblet cells are found in this part of the airways. In the cat, all the epithelial cells in this region are Clara cells. In the mouse, about 50% are Clara cells but in the rat only 25% are of this type (Plopper and Hyde, 1992). In the mouse, hamster and rabbit, Clara cells are found throughout the airways from the trachea to the bronchioles; this is not the case in all other species studied – in these, Clara cells are limited to the bronchiole.

Numbers of Clara cells

Clara cells are average sized cuboidal epithelial cells, about 7 µm in diameter. In the cat, some 19,500 such cells are found per mm^2 of the bronchial surface. Even in the rat, with a similar total cell density per mm^2 of about 17,000 there are 4,336 ± 201 Clara cells per mm^2 of surface (Plopper and Hyde, 1992).

Functions of Clara cells

Given the very distinct inter-species variation in Clara cell morphology, it would not be difficult to believe that their function also varies from species to species. Most work has been done in laboratory species and the uncertainties inherent in extrapolating from such work to man should be carefully noted.

Oreffo *et al* (1990) reported a method for isolating Clara cells from the mouse lung. Such preparations lend themselves to biochemical studies of cell function. Work from the same group (Richards *et al*, 1990) has described the response of Clara cells to toxic materials.

(a) Xenobiotic metabolism by Clara cells

The cytochrome P450 monoxygenase isozyme family is a characteristic feature of Clara cells. This is a large family of iso-enzymes and only some members have been described in these cells. Some appear to be constitutively expressed in some species (CYP1A1 in the rat); but is inducible in the mouse in which it seems not to be expressed constitutively. CYP2F2, on the other hand is expressed in large amounts by the mouse – but not in any other species. The P450 isoenzyme family plays an important part in the metabolism of toxic chemicals but, in the case of some compounds, eg the furan 4-ipomeanol, metabolites of significant toxicity are produced. Furans, indoles, chlorinated hydrocarbons, aromatic hydrocarbons, N-nitroso compounds, trialkyl phosphates and paraquat all cause damage to Clara cells. Damage is characterised, in laboratory species, by swelling of the plentiful agranular endoplasmic reticulum, where the monooxygenase enzymes are located, leading to swelling and casting off of the projecting "heads" of the cells. Interestingly, Clara cells can develop resistance (or tolerance) to toxic chemicals: in the case of naphthalene, P450 metabolism is suppressed during the tolerant period. Block of P450 metabolism with, for example, piperonyl butoxide induces tolerance to 4-ipomeanol and to naphthalene. Ozone (and nitrogen dioxide) damages Clara cells and prolonged exposure of rodents to these gases leads to Clara cell hyperplasia and to conversion of alveolar ducts into respiratory bronchioles. It should be recalled that respiratory bronchioles are not normally found in these species. The hyperplastic response is long lasting (6 months after termination of prolonged exposure to ozone) but not, apparently, permanent (Plopper *et al*, 1997).

(b) Contribution to bronchiolar secretions

Secretory cells of the airway epithelium include: goblet cells and serous cells in the larger airways and Clara cells in the bronchioles. Clara cells secrete a range of proteins (from < 10 kDa to 200 kDa). It was at one time believed that an apocrine process, involving loss of a part of the cytoplasm, was typical – this is doubted: a merocrine process seems more likely. The protein CC16, also known as CC10 and uteroglobin, is a marker for Clara cells. The exact functions of this protein and similar forms found in a variety of species, are unknown but anti-protease (inhibiting proteases produced by neutrophils) activity seems to be important. It is possible that one of the surfactant-associated apoproteins (SP-A) is produced though this seems less certain. Surfactant itself seems not be produced by Clara cells – the laminar bodies so characteristic of alveolar type II cells are not seen in Clara cells. But it is likely that Clara cells are involved in arachidonic acid metabolism and secrete an inhibitor for phospholipase A2. The homology between CC16 and uteroglobin is interesting. Uteroglobin is produced by cells of the rat uterus and appears to have a wide range of functions including: progesterone binding; protease inhibition; phospholipase A2 inhibition; antinflammatory activity; and immunosuppressive activity (Plopper *et al*, 1997).

(c) Progenitor cell functions

Clara cells are the progenitor cells both for themselves and for ciliated bronchiolar cells. The belief that basal cells are the key progenitor cells in the airway epithelium has been challenged: it now seems likely that the basal cells are a rather special self-replicating group mainly involved in anchorage of other cells to the basal lamina (Shami and Evans, 1992).

(d) Fluid balance in bronchioles

Sodium ions are transported across Clara cells from the mucosal surface to the serosal surface. This is thought to be the basis of fluid reabsorption in the distal airways. Adjustment of the composition of fluid passing up the airways may well be an important function of Clara cells (Plopper *et al*, 1997).

Conclusions

Clara cells have been identified in a wide range of mammalian species - they show a considerable range of species specific phenotypes. It is becoming increasingly clear that they play a range of roles in controlling conditions in the distal airways: detoxification of chemicals and control of inflammatory and, perhaps, of immunological processes. They are also the progenitor cells of the ciliated cells in this part of the lung. Such a range of functions suggests great complexity: there is much yet to be discovered about these enigmatic cells.

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Conference and Workshop Reports

Health Effects of Climate Change

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Global warming is likely to pose a significant threat to the United Kingdom's health during the rest of the century. With temperatures predicted to increase by 2.5 – 3 degrees centigrade by the year 2100, it is estimated that that by 2012 there will be a one-in-forty per year chance of a heatwave causing 3,000 immediate deaths.

Tick-borne diseases such as Lyme disease are likely to become more common as people spend more leisure time in woodland areas. There is even a small chance that malaria will return to the UK, although outbreaks are likely to remain small and easily controlled. In addition, skin cancers are set to rise as people spend more time in the sun. There will also be up to 14.8% more cases of stomach upsets - including salmonella - causing up to 14,000 extra food poisonings a year.

The number of people at high risk of flooding is also set to rise from 1.5 to 3.5 million by 2100 and sea levels are expected to rise by between 20 and 80 centimetres by the end of the century. The chance of the West Antarctic Ice Sheet collapsing is, however, thought to be very low - although its impact would be dramatic with sea levels rising by up to eight metres over several centuries.

However, climate change is not all bad news for the people of Great Britain and Northern Ireland. Winter deaths from cold weather have dropped dramatically in recent decades and are likely to continue their decline. From 1971 - 2003, the number of cold weather deaths in the South East of England plummeted from 9,174 to 5,903 per million people aged over 65 while deaths in the rest of England and Wales similarly dropped from 9,222 to 6,088 per million. Scotland also saw falls from 9,751 to 6,166.

Despite steady temperature increases from 1971 to 2003, the number of warm weather related deaths also declined. The South East of England saw deaths fall from 258 to 193 per million people aged over 65 while the rest of England and Wales saw them drop from 188 to 93 per million. The most dramatic improvements, however, came in Scotland where warm weather related deaths fell from 125 to just eight. This suggests that people have been able to acclimatise to the 1°C temperature increase experienced in the UK since 1960.

Despite these benefits, Health Authorities need to prepare for the potential adverse effects of climate change, which were set out in *The Health Effects of Climate Change*, a joint Health Protection Agency and Department of Health report published in February (see figure 1). The report, which was written to help the decision making process of the UK Government, looked at the health consequences if no action is taken to avoid significant climate change this century.

While outbreaks of malaria are likely to remain rare in Britain, health authorities need to remain alert to the possibility of larger outbreaks in continental Europe and the emergence of disease-carrying species of mosquitoes in wetland areas of Britain. Malaria was once common in southern Britain but declined as people started to sleep in separate rooms, making it more difficult for mosquitoes to find a human meal. Drainage schemes in marshlands from the 1820s also shrank mosquito breeding sites. Although outbreaks continued into the 20th century, there has not been a major scare since 1917 – 1918, when 330 servicemen were infected after being stationed near salt marshes in the Thames Estuary. The disease is passed from infected person to new victim by certain strains of mosquitoes. As two thirds of malaria cases brought into Britain in 2003 were from people visiting India, the greatest risk of a future British outbreak is thought to be in urban areas where many British Asians live. However, seven out of ten cases of one strain of malaria had infected Britons on trips to West Africa. Many of these Britons, who were mainly of Nigerian and Ghanan heritage, live in London and Southern England, which is a known breeding ground for a species of malaria-transmitting mosquito which breeds in tree holes. Its larvae have even been found in water in old tyres. At present, there are only a few months a year in the South of England where malaria could be transmitted by mosquitoes. If the climate becomes warmer, the conditions will become more favourable for transmission but it is likely that further improvements in living conditions will prevent a return of malaria in all but the most high risk areas.

Heatwaves pose the greatest threat to the elderly and the ill. The Health Protection Agency recommends that the first average daily forecast of 17°C at the start of the summer should trigger press and broadcast warnings. The warnings should be repeated when an average daily temperature of 25°C is forecast. Vulnerable people and carers should make sure they have an electric fan available and check that windows are open. Windows should be opened in the morning but shut if the outdoor temperature rises above that indoors. Water can be sprinkled on the face, arms and clothing to help cool the body. In emergencies, a cool bath or shower will help with rapid cooling. It is also important that people continue to eat meals and have at least normal levels of salt. Several of these points are already included in the *Heatwave Plan for England*. The largest temperature rises in the UK are expected in the South. Temperatures in Kent, Surrey and Hampshire are expected to rise by between 3 – 4.5°C by the 2080s. Summer temperature increases are likely to be greater than those in the winter. Almost all the South of England is expected to experience summer temperature rises of between 3.5 - 4°C by the end of the century, while winter increases are likely to be less than 2.2°C.

Sea level rises and tidal surge flooding are already threatening coastal lowlands including the Wash, Norfolk, Suffolk and the Humber. Coastal flood risk also weighs most heavily on those with lower incomes including those people living in the East of England, Yorkshire, the Humber and London regions. River flood risk is more equally distributed. The Thames Barrier, which protects 150 square kilometres of London that lie below the high tide level, was closed 55 times between 1983 and 2004 to protect against tidal surges. However, more than 50% of these closures happened in the last five years. An estimated 1.25 million people live in the defended Thames tidal floodplain. After the Thames, the Humber River has the greatest number of people in its floodplain. The tidal barrier in Hull and other flood defences in the area protect 300,000 people. More effective land use management will reduce the effects of flooding in most cases, but in the worst scenarios better use of flood defences and coastal realignment will be needed.

Figure 1: Cover of Health Effects of Climate Change in the UK 2008

References

The Health Effects of Climate Change in the UK 2008 can be accessed at:
http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_080702

The heatwave plan for England can be accessed at:
http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4109508

Environment Agency and Health Protection Agency Flooding and Health Discussion Forum

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Background

Responding to the widespread floods of summer 2007 required a huge amount of work from dozens of organisations across the UK, including health, environment and government agencies, industry, scientists, charities and non-governmental organisations, at both local and national levels.

The Environment Agency (EA) is the primary agency with responsibility for managing flood risk and warning about flooding from 'main' rivers and the sea. However, they rely on the Health Protection Agency (HPA) for health advice. Both the EA and HPA formed part of the STAC – the Scientific and Technical Advisory Cell – which advised the Gold Command units and the Government during the emergency. This required a complicated, coordinated response between agencies, and after the acute phase of the flooding was over, it was agreed that the EA and HPA should meet in order to review the successes and failures of inter-agency working and discuss how this could be improved in the future.

Overview of the day

On 30th January, 30 members of the EA and HPA convened at Holborn Gate, London. The aims of the day were to develop a better understanding of each agency's role in relation to flooding and to agree areas for improvement, and to discuss future areas of joint working and research. The group were given a chance to get to know members of staff and their roles within each other's agency, discuss their respective agencies' objectives, and consider the lessons identified from the summer floods. The outcome of these discussions is described in the following sections.

Improving working between the EA and HPA

The EA and HPA have a shared objective: to minimise the impact of flooding on people and infrastructure. Reports from the summer 2007 floods suggest that aspects of inter-agency working worked relatively well and this improved as events unfolded. However, a number of areas for improvement were noted:

Understanding roles and responsibilities
Delegates indicated that knowledge of each other's agency was not good, which resulted in some confusion during the floods on who to approach for advice and which agency was responsible for decisions such as signing off joint communications. It was felt that the roles and responsibilities of each agency should be clarified and disseminated to all staff. In addition, the different regional structures of the agencies were found to be confusing. It was considered important to develop staff relationships between the EA and HPA - especially at a local level. Local Resilience Fora (LRFs) could be utilised to help coordinate local level communication.

Flood-specific work
Consistent messages should be communicated to the media and the public by both agencies, and it was suggested a dedicated 'one-stop-shop' flood website could be established. Flooding advice should be prepared jointly in advance, designed for both local and national dissemination. An effort should be made to integrate health into the EA's strategy for flood preparation and response. A mechanism should be developed to share data and research, both in the time between floods and in a timely manner during floods. In particular, flood maps should be made available to the appropriate persons within the HPA so that they can be disseminated to relevant staff in order to prepare for future events and provide exposure data for epidemiological studies. It was considered especially important that sharing arrangements for emergency incident procedures should be developed further, as well as practical aspects like the potential for sharing incident rooms.

Actions for both agencies:
- A Working Group of both agencies will be established to coordinate meeting inter-agency goals and clarify working procedures.
- The Working Group will develop a Memorandum of Understanding between the EA and HPA specifically for flooding incidents, highlighting the roles of each organisation and the duty to respond together to floods.
- The Working Group will clarify points of contact in each agency at national and regional levels.
- Flooding leads will investigate the potential establishment of an inter-agency flooding website.

Working with other organisations

The agencies recognised that improving relationships with other organisations, such as the National Health Service, local authorities, utility companies and non-governmental organisations was important. Lines of communication should be established now in order to build relationships and determine responsibilities.

Communities
Improving work at a local level as well as nationally was an important issue raised during the meeting, and this should be done with the LRFs. More needs to be done to engage communities about flood resilience, preparation and education, and the EA has developed some strategies in this area. Individuals should also be encouraged to take responsibility for protecting themselves, their homes and their families. There may be some potential for the EA and HPA to produce 'flood packs' to help with this.

Utilities
Delegates were concerned with making public infrastructure more

resilient to floods. Currently, utility companies are not required by law to consider resilience although they are under obligation to keep supply running, although this does not have to be at normal standards. Utility companies are also not included in resilience fora. The group suggested local representatives hold discussions with utility companies to raise awareness of risk to installations, and another suggestion was that the EA/HPA should develop recommendations for minimum standards of provision.

Sharing data

A key need identified was to develop a database of flood risk maps and data from the EA, HPA and other organisations. This would need to include locations of key utilities such as water treatment plants and electricity substations, and vulnerable populations such as hospitals, nursing homes, people with mental health needs etc. This database would be of particular use to LRFs. Considerable barriers to such a database were acknowledged, including obtaining agreement and data from multiple agencies, cost, potential for misuse of sensitive data, and the need to update the database on a regular basis.

Actions for both agencies:

- The Working Group will investigate promoting community responsibility and activities.
- The Working Group and CEOs will investigate the possibility of establishing a multi-agency flood map.

Influencing policy

The group was particularly concerned that the EA and HPA should use their experience and expertise to influence policy to protect the public from floods. The following areas were discussed:

- Influence building regulations to make new properties more resilient to floods
- Influence development plans for flood plains and coastal areas (e.g. Regional Spatial Strategies, Local Development Frameworks)
- Encourage utility companies to build resilience into their service provision
- Influence surface water management plans
- Lobby for a multi-agency data sharing

Actions for both agencies:

- The CEOs will need to co-ordinate lobbying activities.

Research

A session was devoted to discussing the agencies' research needs in order to establish a good evidence base for planning and intervention strategies. These included better information on the chemical and microbiological risks of flood water, and a better understanding of the long-term health and psychological impact of flooding events. It was strongly emphasised that the health impacts should be quantified economically and that this would provide important evidence to influence policy and planning for flood risk management. The EA described how they provide advance flood warning and advice services to those at highest risk, but the public's uptake of these services can be limited and they would like to see further research into behavioural patterns. The HPA is currently setting up the Behavioural Science Research Network – see page 55 of this Report.

The EA and HPA agreed to identify and share existing evidence and research projects that they know to be underway. The EA will share data and risk maps with the HPA and the HPA will develop some health questions to include in the EA's flooding response surveys, which are conducted around 6 months after every major flooding incident.

Immediate and long-term priorities will be identified and it was recommended that the Research and Development Offices of each agency should liaise. Three tiers of research were identified: internal research, commissioned research, and influencing the research of other bodies.

Actions for both agencies:

- Establish a Research Working Group of both agencies to coordinate research sharing and requirements.

Conclusions

This was the first such meeting between the EA and the HPA. Delegates found meeting counterparts and understanding the other agency's objectives very useful. There was a positive mood to the meeting with delegates keen to work more closely together. Clear actions were delineated and the Working Group will work on taking these forward. Finally, it was reiterated throughout the meeting that the momentum should be kept up and actions should be taken now to establish procedures and improve our evidence base in preparation for the next flood.

The SAHSU Jubilee Scientific Meeting, 18 December 2007

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The SAHSU Jubilee Meeting, celebrating twenty years of the Small Area Health Statistics Unit (SAHSU), was held at Imperial College on 18th December 2007. Professor Pat Troop opened the one-day meeting, sponsored by the Health Protection Agency (HPA) and attended by an international audience, including a cross-section of HPA staff from both Local and Regional Services (LaRS) and the national centres.

The day was divided into two themed sessions: "Spatial epidemiology - state of the art and scientific achievements", before lunch and poster viewing; followed by "The role of small area studies in policy making", ending with a dinner reception and a chance to discuss the day further.

The first presentation, by Professor Paul Elliott, Director of SAHSU, gave an introduction and overview of SAHSU - its formation, aims, work during the last twenty years and current work. SAHSU, a government-funded programme based since 1996 in the Department of Epidemiology and Public Health at Imperial College, was established in 1987 following a recommendation by the Black Enquiry into the incidence of childhood leukaemia near the Sellafield nuclear waste reprocessing plant. It aims to assess public health risk from exposure to environmental factors, emphasising the use and interpretation of routine (as opposed to bespoke-collected) health statistics.

SAHSU studies (as the name suggests) use health data aggregated for small area geographies, and thus are essentially ecologic studies using spatial analysis techniques, based on population, rather than individual-level studies – although they may also integrate the results of individual-level studies. The range of routinely-collected postcode and health data collated and refined by SAHSU was summarised, together with a review of study methods and analysis techniques and how these have developed over the years. Specific examples were discussed, explaining how analysis of excess risk is subject to issues such as bias and confounding (e.g. due to geographical differences in age, gender, deprivation/lifestyle factors), migration and disease latency - together with techniques for addressing these issues. From the study results, associations between hazard and health outcome were not always as expected. Accurate exposure assessment and its application was highlighted as a key area of ongoing work.

Professor Ross Anderson of St George's Hospital Medical School then talked about air pollution and mortality – describing the historical perspective, the inherent complexities and uncertainties - and suggested that a paradigm shift may be required. Recent attention has focused on multifactorial disease causation, as the epidemiological evidence suggests that a single cause threshold concept does not apply and it seems most likely that air pollution has a contributory effect as part of a multi-causal chain. Combined with temporal effects and individual vulnerability ("loss of reserve" to deal with exposure, e.g. through illness or old age), this can explain the apparent lack of threshold, why small exposures can have clinically important effects, and why effects vary between individuals and populations. This has profound implications for abatement strategies, and may also create difficulties in risk communication.

Professor Dan Wartenberg of the University of Medicine and Dentistry of New Jersey next compared ecologic and individual studies. The historical development of both approaches - including well-known map-based correlational studies (e.g. for lung cancer and shipyards) - was summarised, together with motivations for ecologic studies and their limitations. Professor Wartenberg suggested that ecologic studies should aim to suggest potential disease aetiology based on exposure analysis - which can then be corroborated by individual-level studies – rather than focusing on characterising the spatial distribution of disease. Recent developments such as semi-ecologic studies (combining individual outcome data with grouped exposure data) were mentioned. Similarities of SAHSU work to Environmental Public Health Tracking (EPHT), which has been ongoing in the USA for five years, were highlighted. EPHT integrates environmental monitoring and public health data systems to generate new information for public health interventions.

Professor David Briggs of Imperial College London illustrated the use of Geographic Information Systems/Science (GIS) in environmental epidemiology using an array of visual examples from SAHSU and European Union projects to demonstrate the power and versatility of GIS for data integration, analysis and visualisation. In dealing explicitly with the spatial dimension, GIS appears naturally suited to epidemiology - applications were reviewed, from the apparently simple (e.g. thematic disease mapping) through to the complex (e.g. integration of GIS with models for spatio-temporal simulation and exposure assessment). The need for skilled use of GIS was emphasised, including a consideration of the limitations of GIS and the difficulties with formulating data for use in GIS. For example, data may need investigation and refinement due to errors (postcodes "wandering" over time), or fitness for purpose (administrative ward boundaries are not designed to represent land area accurately at the coastline); results of thematic mapping depend on both scale and the spatial units chosen. These can have undesirable knock-on effects, including incorrect analysis results and conclusions.

A key theme throughout the morning session was accurate exposure assessment – the need for it, inherent difficulties, and the refinement and improvement of GIS-based methods over the years. Methods have developed from using pure circular distance from source as a proxy for exposure (e.g. buffering around every landfill site in Britain!), through to complex simulation based on time-activity patterns (one example shown was the Health Effects And Risks of Transport Systems or HEARTS project). Another example, of time-activity patterns for people in a French city, demonstrated the power of combining 3D with animation for visualisation and more accurate spatio-temporal exposure assessment. Use of sophisticated methods for interpolating pollution data from fixed monitoring points, to produce more accurate individual exposure estimates, were discussed. Dynamic modelling using GIS was mentioned, by way of a noise propagation model, also the concept of a simulated city. The final question, "Whither GIS and epidemiology?", pointed to further developments in dynamic modelling to derive more realistic, individual-level exposures; modelling complex systems across different scales; and use of GIS as a hypothesis generating and exploratory tool.

Professor Sylvia Richardson of Imperial College opened after lunch with an interesting (quite technical) talk on analysis of space-time patterns of disease risk. Lack of integration of temporal aspects (despite developments such as the work mentioned by Professor Briggs) is one of the main issues of traditional spatial analysis using GIS. Incorporating case studies from England and the USA, methods for analysis of spatial patterns in combination with time trends and with space-time interaction effects were discussed – the aim being to produce a more complete and representative analysis.

Professor Nicky Best of Imperial College followed with a fascinating and in-depth introduction to Bayesian graphical models for multiple bias modelling in epidemiological studies - these models enable us to combine datasets with different, complementary strengths, to alleviate bias and answer research questions more effectively. For example, many routinely-collected datasets lack individual detail but can provide good statistical power to studies, whereas bespoke-collected datasets may have great individual detail but are smaller and lack statistical power in analysis. Bayesian graphical models can link these multiple data sources to utilise the best aspects of them all.

Dr Lars Järup, Assistant Director of SAHSU, presented the findings of two recent SAHSU studies investigating the health effects of exposure to heavy metals, illustrated with photos, mapping and exposure modelling. In some ecologic studies, particular metals could be statistically linked with excess rates of a number of adverse health outcomes, whereas there was no evidence for linkage with other adverse health outcomes. Again, associations between hazard and health outcome were not always as expected.

Sam LeFevre of the Utah Department of Health next gave a lively talk on recent work related to Environmental Public Health Tracking (EPHT) around two sites in Utah – an Air Force base and a uranium mining facility. The aim was to evaluate potential links between health outcomes and chemical/radioactive hazards that could warrant further investigation. SAHSU's Rapid Inquiry Facility (RIF) was used as an initial investigative tool. The studies uncovered interesting potential confounding in terms of who lived where - for example, certain areas associated with lower adverse health outcomes contained Mormon communities (no alcohol or tobacco consumption), whilst other neighbourhoods associated with poorer health outcomes contained people with less healthy lifestyles (a variation on the theme of deprivation). Without correcting appropriately for these lifestyle factors, significant excess risk could potentially be ascribed wrongly to other factors.

SAHSU studies addressing concerns over landfill sites causing adverse health outcomes such as cancer and birth defects were discussed by Dr Lesley Rushton of Imperial College. The nature of the landfill hazard has changed with historical improvement in design, hence variations both in potential exposure pathways and chemicals found at different sites must be considered. An interesting early finding was the ubiquity of landfill sites, with over 80% of the UK population living within 2km of a landfill (old or new) - this meant that studies unusually had more individuals in the exposed group than in the unexposed control group. Further understanding of the potential toxicity of landfill emissions and possible exposure pathways is needed to help interpret the epidemiological findings.

Professor George Morris, Scientific Policy Adviser to the Scottish Executive, gave the final presentation – a thought-provoking discussion of the current Scottish approach to environmental public health. Scotland has a long history of being "the sick man of Europe", which policy makers at the Scottish Executive are keen to turn around. With the opportunity to do things differently from England, they have broadened the environmental public health paradigm to include health, wellbeing and resilience, in line with what they see as the developing "era of ecological public health" - especially "embracing complexity" (indeed this tied in with the concepts presented by Professor Anderson relating to air pollution and multifactorial causality). The ending quote was: "If we continue to do more of the same, we are very likely to get more of the same!"

Overall the SAHSU Jubilee Meeting was a very interesting and informative day. All the presentations are available on the following web page: http://www.sahsu.org/jubilee.htm together with the agenda, a short summary and links to posters.

Behavioural Sciences in the Health Protection Agency

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Aims of the meeting

A workshop entitled *Why don't they do as we tell them? Improving health protection through behavioural research in the HPA* was held in London on 8th February 2008. The event was organised by the Health Protection Agency (HPA) and the Infectious Disease Research Network (IDRN). Delegates from all divisions of the HPA and academics attended.

The aims of the day were to provide an overview of behavioural science methodology and to identify how this research could be incorporated into the work of the HPA to improve delivery of the HPA's objectives. A further objective for the day was to establish a network of interested parties in order to take forward collaborations, funding and training for future research.

Behavioural science research

Experts experienced in a variety of disciplines in the behavioural sciences gave overviews of their work and how these research areas could be taken forward by the HPA.

Graham Hart of the Centre for Sexual Health and HIV Research, University College London, described how research into behavioural patterns can provide insight into epidemiological trends in sexually transmitted infections. He also described the differences and strengths of quantitative and qualitative research and how different behavioural science disciplines (such as psychology and sociology) can provide different but equally important perspectives on an issue, highlighting the need for the HPA to develop research links with people from a range of backgrounds.

Richard Amlôt, of the Centre for Emergency Preparedness and Response, HPA, presented some of the studies that have been conducted in collaboration with the Institute of Psychiatry (IoP) at King's College London concerning public responses during emergencies. These studies have provided insight and guidance on how the public might react to emergencies such as CBRN (Chemical Biological Radiological Nuclear) incidents, and what information they want from authorities such as the HPA.

Lisa Page from the IoP went on to describe the study being carried out in conjunction with the Chemical Hazards and Poisons Division, London. One of the aims of this study is to try to predict the impact that a chemical incident will have by testing a risk perception theory. The theory suggests that risk amplification and attenuation factors, such as pre-existing concerns, socioeconomic status and media coverage, can influence the health, social and political impact of a chemical incident. Nearly 300 incidents from across England are being examined. More details of this study can be found in previous Chemical Hazards and Poisons Reports[1,2].

James Rubin from the IoP discussed post-incident public surveys. These are useful for helping to quantify the public's health needs after an incident, assessing the success of information campaigns and identifying any potential barriers that the public might face when trying to obtain help or information. This approach can be used to develop information strategies for future incidents that take into account how the public are likely to react. The challenges of constructing surveys, logistics and ethics were described, and the need for agencies and universities to dedicate time to preparing for these surveys in advance was discussed.

Brooke Rogers, of the Centre for Risk Management at King's College, London, presented on the importance of understanding risk perceptions and developing good communication strategies for managing public health campaigns. She emphasised trust as the most important factor in risk communication and went on to describe some ways that health communication strategies could be enhanced, such as building local relationships and highlighting shared values and goals.

Bob Adak of the Centre for Infections, HPA, discussed questionnaire design for investigating disease outbreaks. He mentioned the difficulties in relying on a person's memory and how people forget the commonplace, and how this can be partially overcome by cross-referencing and re-phrasing questions. He advised using non-technical language when speaking to the public.

Discussion groups

In the afternoon, the meeting broke into four groups, each discussing how to take a suggested research question forward. The main discussion points were:

1. Practicalities of rapid response research – the need to prepare in advance for research during/immediately after an incident; new training in social research methods and survey designs for HPA staff; gaining ethics approval in advance.
2. Techniques for sustaining behaviour change – what motivates people; the success of campaigns in infection control; the requirement for more research in this area.
3. Trust in health advisors – how trust is based on perception and recognition of the advisor; the requirement for research to quantify the success of advisory campaigns.
4. New technologies and their effect on behaviour change – the need for the HPA and it's staff to better employ new technologies in order to work more efficiently.

Funding and development of future research and collaborations

Margaret Mauchline described the remit of the HPA Research and Development (R&D) Office, which includes identifying sources of funding (external and internal), providing scientific advice on proposals and assisting with applications. With regards to behavioural science, the Department of Health recently recommended that the R&D office support research in this area and encourage collaborations with external social science bodies [3]. The R&D office will be supporting the creation of a Behavioural Science Research Network, and future activities will include a scoping survey of the HPA's requirements, a follow-up workshop, and the development of a report containing recommendations for the HPA Board around June 2008.

In addition, Mike Head explained how the IDRN can support further work through organising meetings and protocol development workshops, setting up collaborator networks and assistance with proposal development and submitting research bids.

Further information

Jackie Cassell is the HPA lead on Behavioural Sciences. She is based at the Brighton and Sussex Medical School and has an Honorary Consultant in Health Protection at the Sussex and Surrey Health Protection Unit.

For further information and to join the newly formed Behavioural Science Research Network, please contact Jackie at j.cassell@bsms.ac.uk, Richard Amlôt at richard.amlot@hpa.org.uk or Margaret Mauchline at margaret.mauchline@hpa.org.uk.

To join the IDRN or to discuss how they can help your research in infectious diseases, please contact Mike Head at mhead@idrn.org.

Presentations from the day can be found at:
www.idrn.org/behavioural.php

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2. **Keshishian C, Page L, Amlôt R. Quantifying the print media's coverage of chemical incidents. *Chemical Hazards and Poisons Report*, Issue 10: 32-33, September 2007. Available at:** http://www.hpa.org.uk/chemicals/reports
3. **Department of Health. Recommendation 30 in: Review of the research and development activities of the UK Health Protection Agency. Review Panel Chairman: R Dixon. March 2007.**

An emergency department's (ED) perspective on chemical incident response: Chemical Hazard and Poisons Department (CHaPD) visit to Frimley Park Hospital, Surrey.

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Scientists and public health specialist trainees/registrars from across CHaPD were invited to Frimley Park Hospital on Wednesday, 27th February 2008, to find out about an emergency department's perspective on chemical incident response. The day was aimed towards increased understanding of the impact a chemical incident could have on an emergency department (ED), protocols that are in place to deal with such an incident and the expectations of an ED on the Health Protection Agency.

The day started with a demonstration of the NHS-specified hospital decontamination tent (from PlySu Protection Ltd), which was set up outside the emergency department entrance, as would occur in an actual incident (see figure 1). There was discussion about the benefits and limitations with using the decontamination tent (see figure 2), such as effective maintenance of the equipment, practising putting up and using the tent, and the maximum number of patients that can be treated per hour in the PlySu tent (estimated to be 12 patients/hour). The logistical problems with this system were clearly illustrated when the water supply to the unit sprung a leak!

The demonstration was followed by an introduction to military CBRN by Major Ian Gurney. As Frimley Park is both a civilian and military hospital, we were given a talk on what the military are doing to prepare for the possibility of chemicals being used against them while deployed. In particular, the need to be trained to look out for signs of chemical threats and to carry the personal protective equipment (PPE) at all times (together with all the other equipment they need), with all staff trained to a high-level on its use. There was a brief demonstration of army PPE (trousers, boots, carbon-lined jacket, helmet and breathing apparatus) as well as discussion of military use of DIM (detection, identification and monitoring) equipment, use of chemical prophylaxis (nerve agent prophylaxis - NAPS for example) and post-exposure treatment (combipen, atropine, pralidoximine and benzodiazepine).

A presentation on the principles of response was given by Dr Simon Clarke (Consultant in Emergency Medicine). Emergency departments describe a chemical incident as: *an event where an individual or individuals are exposed to non-pharmaceutical chemicals that have the potential to cause harmful effects both to the individual and others*. These may be caused by road traffic accidents, including vans containing everyday chemicals used in commerce or large-scale industrial tankers. ED staff are particularly concerned about secondary contamination of the department and the effects on staff and other patients (both from contamination and the potential for closure of the department), particularly as ED staff may be unfamiliar in both recognising and dealing with chemical incidents, as they are relatively uncommon or due to a lack of training. ED staff also need to be aware that in the case of deliberate releases, the perpetrators might be among the first few patients.

Figure 1: Demonstration of setting up the decontamination tent

Figure 2: Discussion of the benefits and limitations of using the tent

There are four principles that need to be followed during a chemical incident

1 **recognising a chemical incident.** This might be through pre-warning from the ambulance crew, being told by a patient once they are admitted to the ED vigilance by staff (Step 1-2-3 protocol, toxidromes, and hazchem ALS algorithm). Step 1-2-3 is a safety trigger for emergency personnel where; if there is one casualty, approach using normal procedures; with two casualties, approach with caution; and with three casualties do not approach the scene and seek specialist advice[1]. Toxidromes are a group of signs and symptoms that suggest the pharmacological activity of a poison or chemical. The hazchem ALS algorithm looks for (a) rapid, severe, local pain/erythema, (b) smell/odour, (c) quick look (pupils, secretions, skin changes, respiration rate), and (d) colour of blood.

2 **containing the incident.** One patient can close a whole ED, therefore it is important that only decontaminated patients get in, followed by a lock down of the hospital to prevent further contaminated individuals entering, isolating the ventilation/air conditioning systems and only allowing trained staff to work on the patient.

3 **decontamination.** This is using the PlySu tent when there are only a few patients. With larger numbers of casualties, the fire service can be employed or the new dimensions tent for mass decontamination requested.

4 **treating the patient.** This is through normal A, B, C procedure (airway, breathing, circulation), occasionally there might be an antidote or specific therapy that can be given. Dr Clarke then gave a demonstration of intubation of a dummy (see figure 3), and illustrated the difficulties ED staff would have both in terms of secondary contamination while intubating an off-gassing patient, and when wearing chemical PPE.

In the afternoon, we were given the opportunity to visit the ICU, followed by trying on Mark II chemical PPE (Respirex International Ltd), which gave an insight into the implications for using fine motor skills whilst wearing the suit (see figure 4)

The day was a great success, and allowed greater understanding of the problems that an ED experience during a chemical incident and the information that they would require from the HPA.

Figure 3 Demonstration of intubation

Figure 4 Demonstration of chemical PPE

Reference

1 http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/Browsable/DH_5449272 (Accessed March 2008).

Herbal medicines - changing attitudes

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The attitude of doctors in the UK to herbal medicines is changing. This is clearly reflected in a recent and very valuable book: *"Traditional Herbal Medicines: A Guide to their Safer Use"* by Dr Lakshman Karalliedde and Dr Indika Gawarammana which has recently been published by the Hammersmith Press, London (ISBN: 978-1-905140-04-6). This excellent account is by two doctors with experience of both Western (allopathic) and traditional herbal medicine. Dr Karalliedde is a consultant at the CHaPD London Unit, Dr Gawarammana practices as a consultant physician in Sri Lanka. The book contains a remarkable account of many (about 300) herbs used as remedies. Each account contains a note on the history of the preparation, its likely active constituents, its uses and of the precautions that should be taken especially as regards use during pregnancy and whilst breastfeeding. Valuable chapters are devoted to the toxicology of traditional remedies, especially those containing heavy metals. Interactions between allopathic and herbal medicines are also discussed. This is easily the most useful discussion of herbal medicines that I have seen. This article is not, *per se*, a book review but an exploration of attitudes to herbal medicines.

It is generally accepted that Western pharmacology and therapeutics grew from herbal medicine. All medical students are, or used to be, taught about William Withering and his description of the foxglove (*Digitalis purpura*) in 1785. Bowman and Rand describe the history of digitalis in detail and note that the drug was used both indiscriminately and often in toxic doses in the 125 years following Withering's account and that it fell into disrepute by about 1900 (Bowman and Rand, 1980). Of course, digitalis is just one of many cardiac glycosides of plant origin: squill (*Urginea maritma*) yields others as do *Strophanthus* seeds. Toad skin contains related compounds (Bufadienolides) and dried powdered toad skin was apparently used in Chinese medicine for centuries. Digitalis is itself a mixture: digitalin, gitalin, digitoxin, digoxin, and the white foxglove (*Digitalis lanata*) yields others: lanatoside C and A. Derivatives occur: acetyldigoxin and ouabain (from squill and other sources) are well known. Powdered leaves from *D. purpura* figured in the 1989 edition of Martindale's Extra Pharmacopoeia alongside pure preparations of digoxin. With so many cardiac glycosides available from so many sources it is unsurprising that these drugs have long figured in herbal medical practice. In describing digitalis, Karalliedde and Gawarammana point out that the drug is "unsafe for self medication": its toxic effects are many and include potentially fatal arrhythmias. Differences in potency between preparations of digitalis leaves (the galenical preparation of the drug) have led most, probably now all, Western physicians to prefer the pure form: digoxin. Moving away from the herbal preparations to a pharmacologically tested and assayed preparation has been a step forwards. A further point that should be noted is that the toxicity of digoxin is enhanced by low plasma potassium concentrations such as may be induced by certain diuretics. The dangers of combining a herbal preparation of digoxin with such diuretics in the absence of potassium supplements should be obvious.

Few herbal remedies, perhaps, contain such dangerous compounds as the cardiac glycosides, but Karalliedde and Gawarammana, for example, state that red clover contains more than 125 chemicals including phenolic glycosides, coumarins and salicylates: they note the diuretic action of preparations of this plant. This brings us to the criticisms levelled against herbal remedies:

(a) they can be dangerous : they may contain many (not all identical) pharmacologically active or toxic chemicals and are certainly not to be regarded as harmless on the specious grounds that they come from "natural" (or "organic") sources;

(b) the pharmacological potency of preparations can vary from batch to batch and is not always (perhaps seldom) scientifically assayed;

(c) they can delay diagnosis: patients may turn to herbal remedies for treatment of serious and potentially curable conditions. Appropriate investigations and effective treatment can be delayed;

(d) combination of herbal remedies with allopathic medicines can be dangerous: patients can hardly be expected to know of chemical incompatibilities and pharmacological interactions.

Added to these is the fact that many herbal preparations, though harmless, are likely to be useless and the advertising material associated with them may well be misleading. These objections are, it is hoped, recognised by qualified herbal practitioners in whose hands these preparations are likely to be safe.

Much less acceptable are the folk remedies described by Karalliedde and Gawarammana in their chapter on potentially harmful constituents of some herbal remedies: lead, antimony and mercury are notoriously toxic metals yet appear in some "herbal" remedies. It should be recalled that mercury and arsenic featured in Western pharmacopoeias until comparatively recently. The 12th edition of Whitla's *"Pharmacy Materia Medica and Therapeutics"* (then a standard work revised in 1933 by J A Gunn Professor of Pharmacology at Oxford) lists metallic mercury (to be given by intramuscular injection) and five "official" preparations consisting of metallic mercury rubbed up in chalk or fats. Each was used as a purgative, and some, of course, as a treatment for syphilis. Colomel comprised mercurous chloride, lanolin and paraffin. Already by 1933 practices were changing and Gunn notes:

> "*In its metallic state mercury was formerly employed in very large quantities to open the bowels in constipation and obstruction by mechanically driving the contents forwards as it gravitated towards the anus".*

All this is thankfully in the past, as far as Western practices are concerned.

In the early years of the 20th Century, the British medical profession took a strong line regarding herbal remedies or at least "Secret Remedies" which were, in large part, herbal in origin. *"Secret Remedies: What they Cost and What they Contain"* (British Medical Association, 1909) was followed by in 1912 by a second series *"More Secret Remedies: What they Cost and What they Contain"* (British Medical Association, 1912). The latter is in the authors' collection as is the riposte, of a few years later: *"The Shameless Analysis of Secret Remedies by the British Medical Association Analysed and Exposed by WH Box, 161, King Street Plymouth"*. The latter was sold for two old pence. The thrust of the British Medical Association's case was that the public was being misled by purveyors of "Secret Remedies" which did little good and which were ludicrously over priced. Box, *per contra*, argued that the British Medical Association was anxious to maintain a "closed shop" and that the preparations (including vaccines) used by the medical profession were largely useless and, worse, the cause of most illnesses in the country. Box's book adopts a remarkably biblical tone but is fair to say that the British Medical Association's authors are not always measured in their comments. Both books are now merely literary curiosities and Box's Golden Fire Ointment (Gold Medal, Paris Exhibition, 1914), Ozonia (a preparation to add to bath water to, it was claimed, release health giving ozone) and antineurasthin are gone forever. Or are they? The language used to describe the benefits of non-official preparations has changed but belief in the properties of such preparations remain and Karalliedde and Gawarammana mention preparations used to "strengthen the brain" a lead containing "herbal vitamin" used in Tibetan herbal practice to treat leprosy (sarsaparilla) and to treat breast lumps (Greater celandine). The danger of trusting to such remedies should be obvious.

The problem posed by the expanding use of herbal remedies is compounded by frequent reports in the media of yet another compound isolated from a plant (often from a remote country) which may be a cure for cancer. The public's curiosity in such matters is remarkable but perhaps understandable given the failure of Western medicine to "cure" many forms of cancer. Such reports strengthen belief in herbal remedies.

Herbal medicines, like Western medicines, can do both good and harm. Regulation of Western medicines is now rigorous, regulation of herbal medicines is not. This may be changing and requirements of demonstration of efficacy and safety are being considered. To one with a background in Western medicine this is both important and overdue.

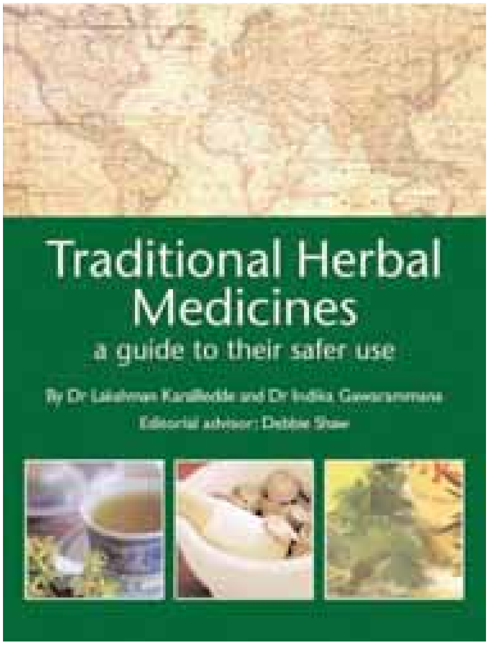

Figure 1: Cover of Traditional Herbal Medicines: A Guide to their Safer Use

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The Role of Health Systems in Chemical Safety for EECCA Countries (Minsk, Belarus 20 to 22nd February, 2008)

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Andrew Kibble and Toby Smith from the Chemical Hazards and Poisons Division (CHaPD) (see figure 1) recently attended a three day World Health Organization (WHO) workshop in Minsk, Belarus (see figure 2) which focused on the role of health systems in chemical safety for Eastern European, Caucasus and central Asian (EECCA) countries. The meeting included representatives from Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Serbia, Tajikistan, Turkey, Ukraine and Uzbekistan. International speakers included representatives from the HPA, Guy's and St Thomas' Medical Toxicology Unit, Canadian Centre for Occupational Health and Safety, German Ministry of Economic Affairs, German State Agency for Nature, United Nations Institute for Training and Research (UNITAR) and WHO.

Figure 1: Andrew Kibble and Toby Smith at the World Health Organization (WHO) workshop in Minsk

The objective of this meeting was to review the capacity of health systems of EECCA countries in the field of chemical safety and to identify the needs for international support for national and sub-regional priority actions to strengthen the health system role, especially in preparedness for and response to chemical emergencies.

Initially, EECCA participants presented feedback about the current chemical safety issues in their respective countries, with the meeting being simultaneously translated into English and Russian. Andrew presented a paper describing the work of the Health Protection Agency (HPA) in emergency planning, preparedness, response and surveillance of chemical incidents in the UK, whilst Toby was elected as the workshop's rapporteur. There was considerable interest among delegates about the work of the HPA and the UK approach to managing chemical incidents. The HPA led a wide ranging debate on the need to implement similar systems across EECCA countries and also gave a media interview to Belarusian State Television on managing chemical incidents. The final day involved splitting all participants into two working groups in order to further discuss the present situation and desired position regarding chemical management in EECCA countries.

One outcome from the workshop was the use of the HPA as a role model for developing systems in EECCA countries. It is hoped in the future that the HPA will further share its experiences in order to help to develop robust systems of chemical safety management in EECCA countries.

General observations from the workshop included that there was clearly a need to improve systems of chemical safety across EECCA countries. It was felt that EECCA countries require the development of national and regional centres of toxicology and that a good reporting system was deemed as fundamental; it was acknowledged that the number of both acute and chronic incidents is set to increase. There was consensus regarding the need to implement chemical safety programmes with a view to completely eliminating banned pesticides and obsolete chemicals. Finally, the need to develop a register of hazardous chemical sites, an inventory of dangerous chemical products and to develop public information and health promotion campaigns to target vulnerable groups and sensitive receptors was highlighted.

Figure 2: Statue of Lenin in Minsk

International Conference

Health Protection Agency

Joint working, problem sharing: Protecting the health of communities in the 21st century

20 & 21 May 2008
Hilton Manchester Deansgate

This international conference will focus on the modern environment – the health implications for its communities and the opportunities for sustainable development. It will examine the association between social deprivation and the local environment, highlighting the risks for vulnerable groups, in particular children and the workforce. It will focus on issues of historical waste, in particular contaminated land as well as contemporary waste generation and its management. The conference will lead on to debate contemporary threats – climate change and its challenges and disasters and chemical emergencies.

The conference, convened by the Health Protection Agency Chemical Hazards and Poisons Division, will appeal to all with a role to play in the environment and health, including health and occupational healthcare professionals, first line responders, environmental scientists, policy makers, environmental health officers and emergency planners.

For details please visit:

www.hpa-events.org.uk/chemicalconference

Training Days for 2008

The Chemical Hazards and Poisons Division (CHaPD) considers training in chemical incident response and environmental contamination for public health protection a priority. The 2008 programme is being developed to offer basic and more detailed training, along with the flexibility to support Local and Regional Services initiatives as requested.

Planned one day training events for 2008 include:

How to Respond to Chemical Incidents

October and November

For all on the on-call rota including Directors of Public Health and their staff at Primary Care, other generic public health practitioners, Accident and Emergency professionals, paramedics, fire and police professionals and environmental health practitioners

The general aims of these basic training days are to provide:

- An understanding of the role of public health in the management of chemical incidents.
- An awareness of the appropriate and timely response to incidents.
- An understanding of the interactions with other agencies involved in incident management.

These training days also have specific educational objectives. These are, to be aware of:

- The processes for health response to chemical incidents.
- The type of information available from CHaPD, London to help the health response.
- The resources available for understanding the principles of public health response.
- The training needs of all staff required to respond to chemical incidents.

A maximum of 40 places are available

Contaminated Land

30th September

For Consultants in Health Protection, CsCDC, CsPHM and Specialist Registrars in Public Health Medicine and Local Authority Environmental Health Officers

The Training Day will provide delegates with the tools and information to provide an appropriate and timely Public Health response to contaminated land investigations.

General aims:

- To understand the role of public health in the management of contaminated land investigations.
- Awareness of the appropriate and timely response to contaminated land investigations
- To understand the interaction with other agencies involved in the investigation and management of contaminated land.
- To review current issues relating to the management of contaminated land incidents and investigations including:
  - The Toxicology of Soil Guideline Values
  - The Local Authority Perspective on Implementing Part II A
  - Bioaccessibility in Risk Assessment
  - The Food Standards Agency (Allotments)

Specific objectives:

To understand by using incident examples the process for public health response to contaminated land issues.

To understand by using examples and case studies the type of information and the limitations of the risk assessment models provided to public health from other agencies regarding contaminated land.

To understand by using incident examples the roles and responsibilities of the different agencies involved in investigating and managing contaminated land.

A maximum of 40 places are available

Training Programme for 2008

Level 2 Chemical Incident Training

10th September, London
Other regional dates to be confirmed

For Consultants in Health Protection, CsCDC, CsPHM and Specialist Registrars/Trainees in Public Health

The chemicals training programme aims to train HPU and LaRS-regional HPA staff to achieve 'Level 2' competence for the management of chemical incidents and to meet the requirements of the Health Care Commission relevant to preparedness and response to chemical incidents (core standard 24).

The learning objectives are:
- To demonstrate an understanding of the roles and responsibilities of Health Protection in the management of chemical incidents.
- To demonstrate an understanding of the roles and responsibilities of other agencies involved in chemical incident management, and how they interact with Health Protection.
- To understand the principles of risk assessment, biomonitoring, environmental sampling and modelling, and their application in the investigation and management of a chemical incident.
- To understand the principles of communication and management where there are unresolved public concerns in environmental incidents.

Environmental and Occupational Epidemiology Spring Meeting

7th July, St Albans Centre, Holborn, London

(For the HPA Environmental Network, Consultants in Health Protection with a special interest in environmental contamination and academics working in environmental epidemiology)

This will be the 4th Environmental & Occupational Epidemiology meeting with between 75 and 100 delegates attending. The meetings were judged a great success and enabled cross fertilization between those with an interest in environmental and occupational epidemiology. To further develop these disciplines in the UK and promote collaborative working, the next meeting will take place in July 2008. The target audience is those with an interest in environmental and occupational epidemiology. The recent and rapid expansion of occupational and environmental epidemiology and health risk assessment looks set to continue in line with growing public, government and media concern about occupational and environmental health issues, and a scientific need to understand better and explain the effects of occupational and environmental pollutants on human health. The aim of the meeting is to examine various topics in a more informal environment to encourage discussion and collaborative networking.

UK trainees and PhD students have the opportunity to come to a meeting showcasing current work, and offering a forum where they can present posters of ongoing work. Members of UK Government scientific committee members charged with appraising environmental and occupational epidemiology, for risk management and standard setting, can benefit from updates on the most recent developments.

While it is primarily a forum for presenting and exchanging between UK/Irish participants, and posters are invited from research groups in the UK and Ireland, it is an open meeting and colleagues from overseas are welcome to attend.

Training Programme for 2008

Beyond the Blue Lights

(date to be confirmed)

The Health Protection Agency (HPA), Chartered Institute of Environmental Health (CIEH) and London Fire and Emergency Planning Authority (LFEPA) are pleased to host this interactive workshop and table-top scenario providing an opportunity to cement local joint working by those involved in managing the aftermath of chemical and radiological incidents in London.

Who should attend?

London HPA, Local Authority and NHS professionals with responsibility for the management of chemical, environmental and radiological incidents and emergencies including:

- **HPA** - Health Protection Unit and Chemical Hazards Division Staff, Health Emergency Planning Advisers, Regional Epidemiologists
- **LA** - Emergency Planning Officers, Environmental Health and Pollution teams
- **NHS** - PCT Public Health Directors and Consultants, Emergency Planning Liaison Officers

Topics will include

- Incident notification systems for HPA and local authorities in London
- Joint HPA-NHS-LA response to non-infectious environmental incidents after the blue lights have gone
    - Roles and responsibilities
    - Current response arrangements and assumptions
    - Understanding of ‘real-world’ response by LAs, HPA, NHS
- Recovery
- Identify gaps for further action by individual organisations and Local Resilience Forums

Training Programme for 2008

Planned training one week training courses for 2008 include:

Essentials of Toxicology for Health Protection

2nd - 6th June, King's College, London

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

The aims of this short course are to summarise the key concepts in toxicology and of toxicological risk assessment, exposure assessment and to examine the scope and uses of toxicology and the tools of toxicology in local agency response to public health and health protection issues. Sessions on toxicology will be based upon examples of incidents associated with health protection which may lead to adverse health effects. This course would provide an understanding of the limitations resulting from the lack of data on many chemicals, chemical cocktails and interactions. The course would provide an overview of all these aspects to provide an understanding of the advantages and difficulties of multi-disciplinary and multi-agency working in toxicology and the use of strategies for communicating risks associated with the investigation of toxicological hazards. The fee for this course will be around £600.

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

A maximum of 30 places are available.

Introduction to Environmental Epidemiology Short Course

16-20th June, London School of Hygiene and Tropical Medicine

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

The aims of this short course is to summarise the key concepts in environmental epidemiology, to explore the key concepts in exposure assessment and cluster investigation, to examine the scope and uses of environmental epidemiology in local agency response to public health and health protection issues. Also it will show how to explore study design and the practical consequences of choices made when planning and undertaking an environmental epidemiological study. This will include an appreciation of the influence of finance, politics and time constraints on the choice of study, to review the advantages and difficulties of multi-disciplinary and multi agency working in environmental epidemiology and to use strategies for communicating risks concerning investigation of environmental hazards. The fee for this course will be around £500.

A maximum of 20 places are available, please see the leaflet for further information.

Please see the CHaPD Training Events web page for regular updates: http://www.hpa.org.uk/chemicals/training.htm

Booking Information

Those attending CHAPD (L) courses will receive a Certificate of Attendance and CPD/CME accreditation points.

The cost of the training days are £25 for those working within the Health Protection Agency and £100 for those working in organisations outside the Health Protection Agency. Places will be confirmed as reserved upon receipt of the fees. These charges are to cover lunch, training packs and administration costs.

For booking information on these courses and further details, please contact Karen Hogan, our training administrator on 0207 759 2872 or chemicals.training@hpa.org.uk

CHAPD (L) staff are happy participate in local training programmes or if you would like training on other topics, please call Virginia Murray or Karen Hogan to discuss on 0207 759 2872.

Events organised by other HPA centres

If you would like to advertise any other training events, please contact Karen Hogan (chemicals.training@hpa.org.uk).

ISSN 1745 3763

Chemical Hazards and Poisons Division Hotline: 0844 892 0555

Available to Government Departments, allied Agencies and Organisations, First Line Responders, the NHS and other HPA Divisions