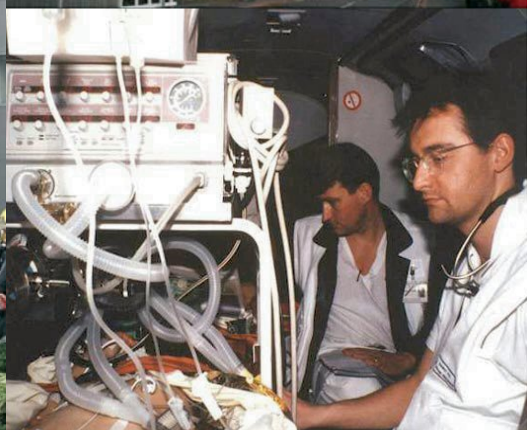
Health Protection Agency

Chemical Hazards and Poisons Report

From the Chemical Hazards and Poisons Division

February 2006 Issue 6



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Editorial

Professor Virginia Murray
Chemical Hazards and Poisons Division (London)
Editor Chemical Hazards and Poisons Report

The recent Buncefield fire of 11th December 2005 makes it apparent that health protection has a vital role. The Chemical Hazards and Poisons Division of the Health Protection Agency has been active in the incident response, by working at Gold, with a visit to Silver during the fire-fighting phase. In addition we have been working with all relevant agencies and organisations to support the recovery process. More about this fire will be reported in the May 2006 edition of the Chemical Hazards and Poisons Report.

In this Chemical Hazards and Poisons Report we report a series of recent incidents, including two fires:

- The first fire was in Southampton and the advantage of Local Health Protection Unit staff attending the Silver Command meeting is clear in this report.
- The other was a fire involving a pallet yard.

Cross-contamination of Accident and Emergency Departments always present a concern, and in this incident we show that it is possible to manage an acute chemical burn inside the department, if awareness of the potential risks is present.

Emergency preparedness issues are again identified as important. Articles cover a wide range of topics including the Civil Contingencies Act and the new NHS Guidance.

Significant developments at the Chemical Hazards and Poisons Division are reported. A new approach to hazard data sheets has been developed. These will go into use as they are developed. Comments on the structure of the new data sheet should be sent to the editor. The potential health consequences of incineration have been an issue for some years and the Division has now published its position statement on the potential impacts.

An exciting education and training programme has been developed for 2006. Full details are on the last two pages of this Chemical Hazards and Poison Report, and on our website (www.hpa.org.uk). Highlights are:

- A joint meeting organised by the Chemical Hazards and Poisons Division, Health Protection Agency, the International Society for Environmental Epidemiology and Epidemiology in Occupational Health and the International Commission of Occupational Health on environmental and occupational epidemiology on 17th February 2006 at the London School of Hygiene and Tropical Medicine following the success of the first course in April 2005.
- A joint meeting with the Environment Agency on the basic understanding of roles and responsibilities of organisations in environmental hazards management to consider how to facilitate effective local collaboration for environmental pollution and incidents on 28th February 2006.
- Special training days on contamination of air (29th June 2006), water (30th March 2006) and land (27th September 2006) have been organised.
- A new five-day course on the fundamentals in toxicology for health protection will take place on 5th to 9th June 2006 at King's College London.
- A further five-day course on an introduction to environmental epidemiology in September at the London School of Hygiene and Tropical Medicine.

The next issue of the Chemical Hazards and Poisons Report is planned for May 2006. The deadline for submissions for this issue is March 1st 2006. Please do not hesitate to contact me about any papers you may wish to submit by email to Virginia.Murray@hpa.org.uk or call me on 0207 771 5383.

I am very grateful to Professor Gary Coleman for his support in preparing this issue. I thank Dr James Wilson, Dr Charlotte Aus, Amber Groves and Karen Hogan at CHaPD for all their help in preparing this issue.

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Incidents

Fire in a Southampton University Research Laboratory

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Introduction

On Sunday morning, 30th October 2005, at around 7.00am a fire was reported in the Mountbatten Building at Southampton University's Highfield Campus. The presence of a variety of cylinders had caused a series of small explosions and the blaze involved the three-storey building. A total of 35 fire units and 200 firefighters were involved. This was the biggest incident for Hampshire Fire and Rescue Services in two years[1].

Acute phase

Following receipt of a copy of the CHEMET requested by Hampshire Fire and Rescue Service at 08.15 hours from the Met Office, the Chemical Hazards and Poisons Division (CHaPD) informed the on-call local services of the Health Protection Agency (HPA). The first on-call officer was informed at 08.53 hours. Fire and ambulance services were attending. A slow moving plume of smoke was drifting north-eastwards. The police had issued shelter warnings to the local residents and established a cordon around the site and surrounding roads.

On investigation, the Ambulance Incident Commander reported no casualties at 09.45 hours. A silver-level coordination meeting was to be convened. It was agreed an HPA representative would attend. Owing to extensive tailbacks (due to mains repairs) on the Totton causeway, he was escorted to the site by police colleagues.

The HPA was provided with an extensive list of chemicals in use in the University laboratories but individual quantities were small. Thus with this

Members of the public came out to watch the plume of black smoke which could be seen for miles (http://news.bbc.co.uk: taken by Paul Dawson-Plincke)

relatively difficult to interpret information about the chemicals within the burning building, CHaPD initially advised treating the plume as products of combustion[2]. Information on the potential health effects was passed to Hampshire NHS Direct (NHSD) for further cascade to GPs, walk-in centres, primary care centres, A&E departments and all other out-of-hours services. NHSD also reported no related complaints or casualties. The on-call lead Director of Public Health was informed of the incident.

At 11.20 hours a silver (tactical) meeting was convened by the police. It was attended by representatives from the local fire and ambulance services, the HPA, Southampton University, Southampton City Council emergency planning officers (EPO) and environmental health officers (EHO), the Environment Agency (EA) and the services' media departments.

At this meeting it was reported that the fire was by now being contained. The smoke plume was slow moving but intermittent rain was likely to reduce its area of deposition. Local media were reinforcing the sheltering advice given by the police. The University reported that there was no arsine, or biohazardous or nuclear materials on site. However, the extensive list of chemicals in use in the buildings did include phosphine, di-borane and germanium hydrides. While these were toxic substances, the known quantities within the building were small. There were still no casualties reported by the ambulance service or NHSD. It was agreed that the public health response should focus upon continuing to protect the public and advising the police as to when sheltering restrictions could be lifted. A press statement would only be released as and when restrictions were to change.

Following this meeting, there was further discussion between CHaPD and HPA Southampton. Given that quantities of chemicals were small and well dispersed, there would be no significant excess risk to public health beyond that of a large building fire. The information within the advice on products of combustion remained appropriate to provide to the emergency services and local residents. The expected risk to public health would also diminish as the plume was dissipating. In this instance, the public should therefore be advised to avoid unnecessary journeys and avoid contact with the plume. Vulnerable persons or those with an existing medical condition should also take extra precautions. To reduce inappropriate use of emergency services, members of the public would also be reminded to attend their normal out-of-hours health services, if they felt unwell.

At 12.53 hours a further CHEMET report provided an estimate of the area of coverage of the smoke plume. In this incident, there was a variable risk to health in the area under the plume. This, in a relatively compact urban setting, would make it difficult to precisely demarcate coherent and consistent boundaries between areas where sheltering advice would, and would not, apply.

At 13.00 hours another silver (tactical) meeting was convened. The fire was reported to be now under control with the smoke plume being only visible in small pockets. There were still no reported casualties by the ambulance service or NHSD. The ambulance service had informed NHSD that it was now standing down, leaving one unit on site as support. There were reports from the public of discolouration of tap water supplies. Southern Water had offered reassurance via the local media that this was a temporary 'normal' effect caused by the raising of sediment during excess water extraction that had occurred in order to fight the fire.

The Local Authority Environmental Health Department and the Environment Agency had sampled soil and water from a small stream which now contained run-off waste water from fire fighting running through the site. There would be a longer reporting time for these results but the immediate health risks from environmental sources were likely to be to wildlife, through oxygen depletion of the water, rather than direct human contact. Surface water would drain into the river Itchen. This might have implication for bioaccumulation in any shellfish beds downstream, but no immediate human risk.

Despite the existing sheltering advice, the police reported that the public were now walking around the local area. It was agreed therefore that the HPA should coordinate the public health message and press release. Following this meeting, the HPA, emergency services and the University agreed the following press statement.

Press Release from the HPA

The fire at the Mountbatten Building on the University's Highfield Campus is now under control. Based on available information there is nothing in the smoke plume that would pose a significant risk to health beyond that of the normal constituents of any other building fire.

However, we would still advise people to avoid making unnecessary journeys in the vicinity. People should also take precautions to avoid contact with the smoke plume. Those who are vulnerable or have an existing medical condition should take particular care.

If anyone experiences any health problems they are advised to contact their normal GP/out-of-hours services or call NHS Direct on 0845 4647.

At 08.40 hours on Monday 31 October 2005 the HPA was informed by the Ambulance Incident Commander that various small cylinders (chlorine, di-borane, germane, silane and phosphine) had been discovered next to damaged gas cylinders during the clean-up phase in the ruins of the laboratories. It was unclear if these had been vented. Firefighters were proposing to move these with full personal protective equipment and wanted advice on health risks if vented to air. CHaPD

Fire fighters at the scence of the fire (Source: Southampton Echo)

Part of the science block was destroyed in the fire (http://news.bbc.co.uk: taken by Stuart Heather)

sent factsheets to Hampshire Ambulance Control and confirmed that modelling a potential plume of phosphine or chlorine would be adequate. The scene was formally handed back to the University at about 14.00 hours. All gas cylinders had been located and examined. All were found to be in a safe condition.

Hampshire Fire and Rescue Services remained on site on Monday 31st October to continue 'damping down'. The scene was declared safe for ongoing salvage and inspection. An investigation into the cause of the blaze was then carried out by police and fire and rescue teams[1]. The University subsequently took responsibility to arrange the recovery and disposal of any remaining toxic material.

Lessons identified

1. The current local system of HPA on-call (providing both consultant level and second on-call support to the first on-call officer) allowed expert advice and support to the representative at the incident, while maintaining capacity to meet its other responsibilities.
2. The assistance of police colleagues allowed representatives from other agencies to promptly attend incident meetings.
3. The presence of the HPA at silver-level meetings was appreciated by colleagues from the emergency services.
4. Since a CHEMET provides a probabilistic model according to local weather information it may not be possible to apply this information precisely to provide the police with clear and consistent boundaries for applying safety restrictions.
5. The public's own perception of risk may not always follow existing advice regarding safety restrictions.

References

1 Hampshire Fire and Rescue Services. Mountbatten Building Southampton University. Over 200 firefighters from across Hampshire tackle complicated blaze. http://www3.hantsfire.gov.uk/news/stories.htm ?newsid=14358 (accessed 02/11/05).

2 Health Protection Agency: Products of Combustion – Summary Information. Chemical Hazards and Poisons Division, London, 2005

Wood Pallet Yard Fire, near Swansea

Sarah McCrea, Senior Toxicology Scientist, Chemical Hazards and Poisons Division, London
Edwin Huckle, Environmental Scientist, Chemical Hazards and Poisons Division, Cardiff

Introduction

Fires, particularly non-domestic ones, can result in significant hazards and risks. The smoke produced usually contains a mixture of soot and organic particles, carbon dioxide and carbon monoxide. Depending on the substances involved in the fire, other chemicals may be evolved, e.g. burning plastics may give off plastic monomers, acids, nitrites and in some circumstances hydrogen cyanide. The area affected by a plume of smoke may vary, sometimes rapidly, depending on meteorological conditions (wind speed and direction, atmospheric stability etc). The fabric of the building may also be important, if, for instance, it has asbestos cement roofing or construction panels, which may disintegrate at high temperatures.

Incident summary

On Friday 23rd September 2005 the National Public Health Service for Wales (NPHSW) called the Chemical Hazards and Poisons Division (CHaPD), Cardiff, at 14.45 hours to notify the unit of a fire in a wood pallet yard, which had been burning for some time (since the previous Sunday night). The deputy head of the Cardiff unit discussed the potential combustion products with the caller, considering the case of both raw and treated wood, and advised that a CHEMET be requested, as the fire was predicted to go on burning over the weekend. The evacuation of the nearby residents was also discussed, and the caller was told that this would be dependent on the meteorological conditions and plume direction and the likelihood of the fire continuing to burn. Datasheets on combustion products, sulphur dioxide, oxides of nitrogen and formaldehyde were emailed to the caller as these were considered to cover the chemicals likely to be produced by such a fire (data on formaldehyde were included because it was thought that some medium density fibreboard might be involved).

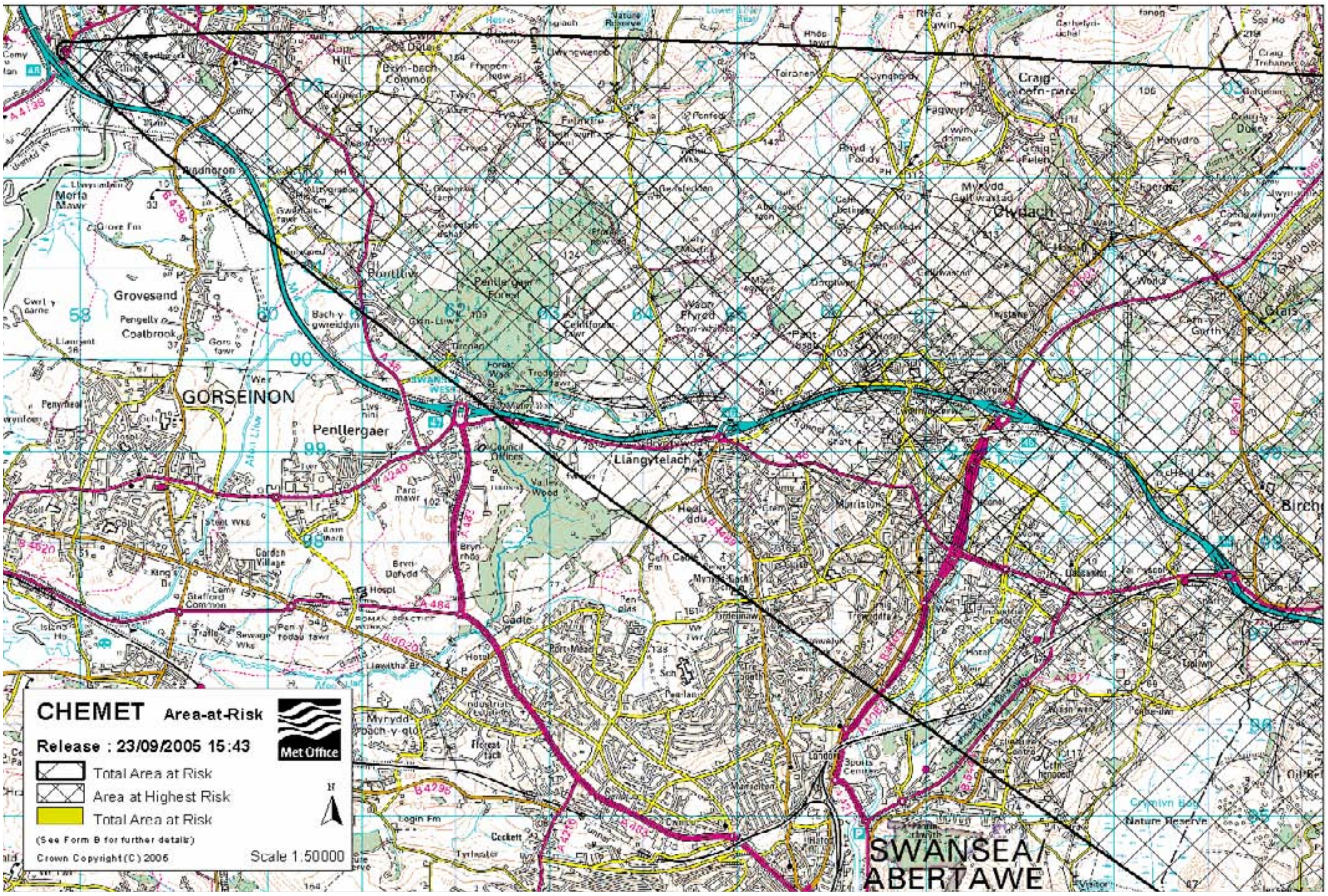
At 16.55 hours the incident was passed on to the CHaPD national on-call officer (based in London).

At 20.42 that evening the person on call for the NPHSW called the CHaPD national on-call officer as he had just been notified that 160 people were to be evacuated from the vicinity, because smoke was getting into their homes and there had been complaints of eye irritation and sore throats. A mixture of pallets, railway sleepers and sawdust were on fire, with the seat of the fire deep inside the pile. No other chemicals were involved in the fire as far as public health officials were aware. The information sheets sent by CHaPD earlier had been forwarded to him, as well as the CHEMET. The CHaPD on-call officer discussed the issues around evacuation with him (risk of moving people into plume, forgotten medications, stress, what to do with people returning home late after a night out, etc). As the NPHSW contact had not been involved in the case earlier, he was emailed the CHaPD shelter versus evacuation checklist, for information.

The CHaPD on-call officer then realised that the fire was mentioned on the BBC news website (http://news.bbc.co.uk), which said that it had been burning since the previous Sunday. After discussion, the CHaPD officer called the NPHSW contact back to check that the email had arrived and to let him know that the fire had appeared on the media and had been burning for a prolonged period (in case he didn't already know), and to confirm that the Welsh Assembly Government had been notified.

The next morning the chemical incident was handed over at 09.00 hours at the shift change to another CHaPD officer who is based in Cardiff. He was updated later by the NPHSW: the evacuation centre was still open for those who wished to use it (although only a few had done so far) and the fire service was now in control of the fire, although the service thought the fire was likely to burn and smoulder for another couple of weeks.

Blaze at the pallet yard, with a close-up on the right (http://news.bbc.co.uk)



On Tuesday 27th September, Carmarthenshire County Council and the Mid and West Wales Fire and Rescue Service issued a joint press statement about the fire, reiterating the advice which had been given by the Council's public protection officers to the public to keep doors and windows shut and stay inside their homes, and for people with breathing difficulties to see their GPs. They also announced that the Fire and Rescue Service had decided to let the fire burn itself out, to minimise the amount of smoke and steam discharged into the air, and reduce the quantity of fire water runoff from the site into nearby streams and rivers (http://www.mawwfire.gov.uk). At this stage they were distributing information leaflets to residents, and if the wind direction changed such that the smoke was likely to affect the village they would consider reopening the evacuation centre.

The fire finally burnt itself out about a month after igniting.

Points to consider

1. Large fires may continue to burn for weeks.
2. The direction of the plume may change on many occasions during that time, this can be modelled by the Met Office, in the form of a CHEMET.
3. The decisions to order either shelter in place or evacuation of nearby residents will need to be kept under continual review until the fire is pronounced extinguished (rather than just under control).
4. Regular communication with the public is important, using messages agreed by all involved agencies.

CHEMETS

CHEMETs are documents produced by the Met Office which give expected weather conditions and anticipated behaviour of any plume in the event of a chemical incident.

CHEMETS are requested and used by the emergency services and the Environment Agency.

CHEMETs do not take into account the individual nature of the chemical or the volume discharged; the initiation of a CHEMET does not necessarily imply that there is a threat to public health.

CHEMETS are automatically distributed to a number of organisations including CHaPD.

Sandon Dock: Investigation of Odour Complaints – Are They a 'Real' Health Issue?

Dr Richard Jarvis, Consultant in Health Protection
Dr Jane Richardson, Epidemiology and Surveillance Analyst
Dr Evdokia Dardamissis, Consultant in Public Health Protection
Cheshire and Merseyside Health Protection Unit

Incident summary

Sandon Dock is a wastewater treatment works serving the equivalent of a residential population of one million people. It is sited in the Mersey Docks estate about 1.5 km north of Liverpool city centre, and near to the Vauxhall area of the city. The treated water is discharged into the river Mersey.

In 2000 and particularly in 2001 there were sharp increases in the number of complaints about odour linked to the site (Figure 1). The majority of complaints were received from an area downwind of the plant, and described a 'bad egg' or 'fishy smell' consistent with sewage odour (Figures 2 and 3). Sandon Dock was considered to be the most likely source of the odour.

An investigation was undertaken on behalf of and under the direction of a multidisciplinary, multi-agency health advisory group. The group was chaired by the Director of Public Health of Central Liverpool Primary Care Trust (CLPCT). A report from this group was published in September 2005*. Members of the group were selected for specific expertise or knowledge of the incident and came from interested organisations.

Odours are rarely due to a single substance and are more often a mixture of tens or hundreds of substances. Expert advice suggested the most common and likely chemical constituents of the odour were hydrogen sulphide and mercaptans. A site visit was undertaken to understand the issues related to the odour and the abatement measures (photograph 1). The operators of the works identified likely sources of the odour and put into place abatement measures which were completed by November 2002.

A review of the literature showed that direct (toxic) health effects due to hydrogen sulphide and mercaptans in odours are very unlikely at concentrations to which local communities may have been exposed. Health effects have been noted in communities subject to bad odours, and these are likely to be mediated by the stress and psychological distress that such exposure can cause. There is no evidence to suggest the transmission of biological agents associated with odour from sewage works under the conditions encountered locally.

Local residents exposed to the odour consulted their GPs more frequently than expected for symptoms of diarrhoea, nausea, vomiting and conjunctivitis that could not be explained by other causes. Most importantly it was found that following abatement the number of complaints received dropped significantly. In addition, GP consultation rates for otherwise unexplained diarrhoea, nausea, vomiting and conjunctivitis amongst the exposed population fell significantly following abatement. Both these facts suggest that the abatement measures were successful. They also add weight to the argument that Sandon Dock was the sole source of the odour, but do not prove cause and effect.

Site visit to treatment works (© CHaPD London)

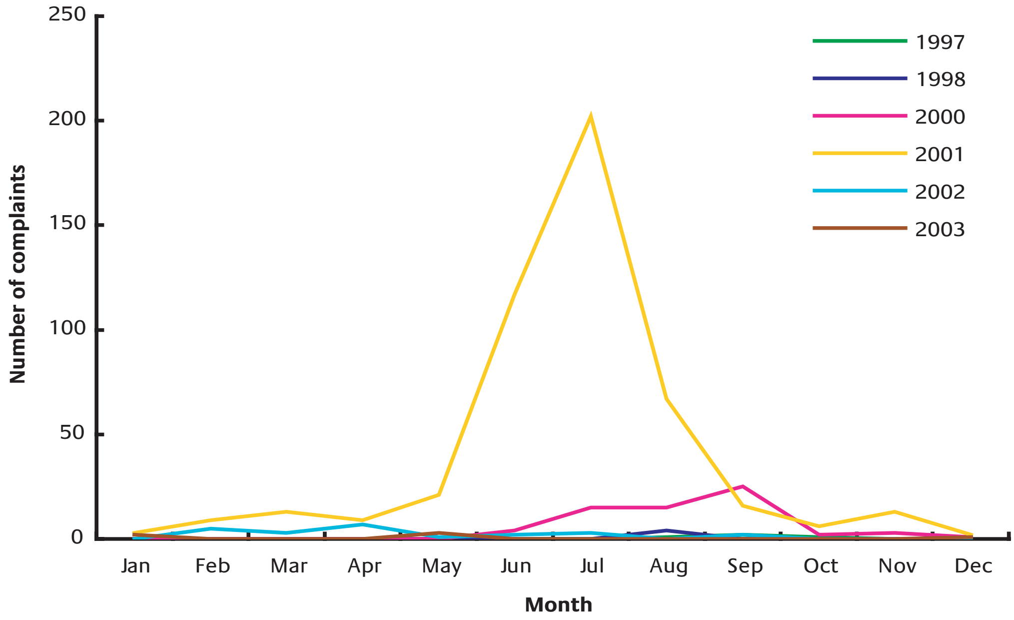


Figure 1 Distribution of complaints about the odour over time

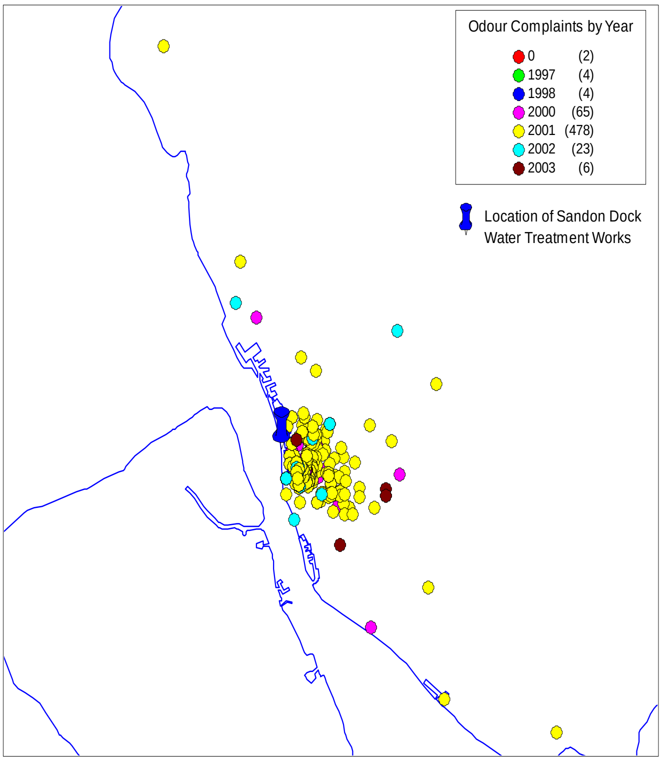


Figure 2 Complaints to the local authority by year of complaint (1997–2003)

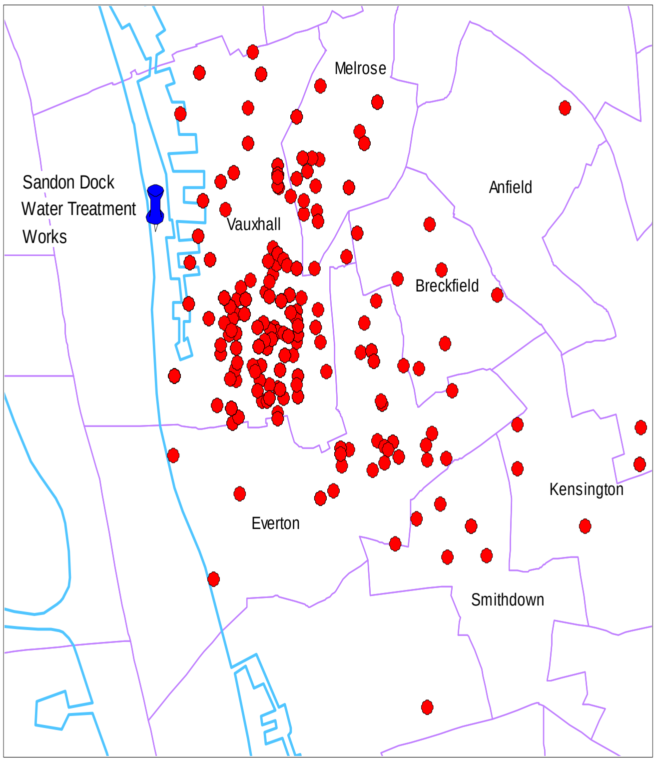


Figure 3 Complaints to the local authority close to Sandon Dock (1997–2003)

The reported health effects were significantly associated with the odour, but there was little suggestion of a direct toxicological action. A possible explanation of this observation is that the community became stressed by the presence of the odour and that the stress led to the recorded health effects.

Conclusions

A source–pathway–receptor linkage was established. Health effects were observed in a population exposed to odour from Sandon Dock. This situation required action to break the linkage and to protect health.

Measurable minor reported acute health effects were associated with exposure to the odour, but it is not possible to establish causality. There is no evidence of any sustained or chronic health effects associated with the incident. Measures were taken to permanently control the source, and this successfully broke the linkage. Therefore there is no longer a current or ongoing health protection issue.

* A copy of the full report by the Cheshire and Merseyside Health Protection Unit Environmental Incident Report on Sandon Dock Waste Water Treatment Works Odour Investigation is available from Dr Jarvis on request (richard.jarvis @centralliverpool.nhs.uk).

Outbreak of Photokeratitis after Exposure to an Unprotected Ultraviolet Light Source

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Martin Schweiger, Leeds Health Protection Unit, Leeds
Andrew Pearson, National Radiological Protection Board, Chilton (now the Radiation Protection Division of the HPA)
Clare Copley, Leeds City Council, Leeds

Main messages
Powerful sources of ultraviolet radiation are commonly used in nightclubs and other public areas.

Faulty or damaged ultraviolet bulbs may result in large numbers of people being exposed to higher than recommended levels of ultraviolet radiation, causing photokeratitis and skin erythema.

Policy implications
Similar safety limits should be adopted to those in the USA where ultraviolet lamps intended for use in public areas must self-extinguish within 15 minutes of the loss of 3 cm² or more of the outer envelope.

Summary

Ultraviolet (UV) lighting is used in many nightclubs in the UK as part of their visual effects shows. Occupational exposure to high levels of UV radiation, usually from welding torches, results in photokeratitis (known as 'arc eye' or 'welder's flash'). Here we report an incident that resulted in a number of people attending an Accident and Emergency Department with photokeratitis and skin erythema caused by excessive exposure to UV radiation from a damaged UV lamp in a nightclub. Analysis of the effective irradiance from the damaged bulb demonstrated that a person standing approximately 3 m from it would exceed the maximum permissible exposure for UV radiation after around 4 minutes. This compares to over 8 hours with the intact bulb. The mean exposure time for people in the nightclub who experienced symptoms was around 2 hours, this represents over 30 times the maximum permissible exposure time.

Introduction

The sun is the main source of UV radiation exposure for people. Exposure to artificial UV may occur in a variety of settings including cosmetic tanning, medical therapy for psoriasis, welding and industrial photoprocesses[1]. Acute exposure to high levels of UV radiation may damage the cornea and conjunctiva of the eye, resulting in photokeratitis, which fortunately usually settles after two or three days[2]. Chronic exposure to UV radiation may result in cataract, ocular melanoma and pterygium formation[3,4].

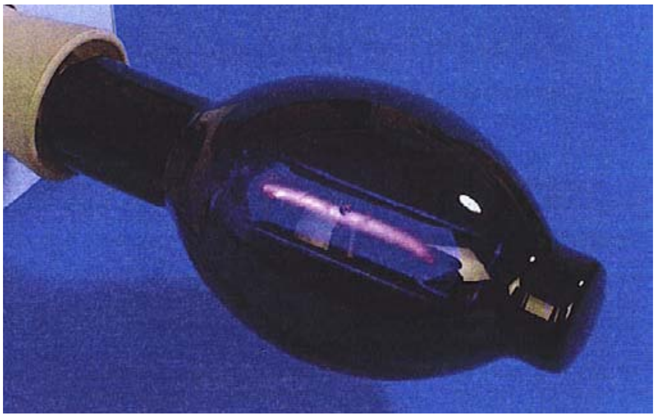
Case report

One previous incident of exposure of large numbers of people to UV radiation was reported at a cattle market in the UK[5]. We report an incident of mass exposure resulting from a damaged UV lamp in a nightclub. In January 2003, 19 people attended the Accident and Emergency Department of a hospital in the north of England complaining of sore eyes and superficially burnt skin. All reported they had attended the same nightclub the previous evening and that their symptoms had started within 12 hours of leaving the club.

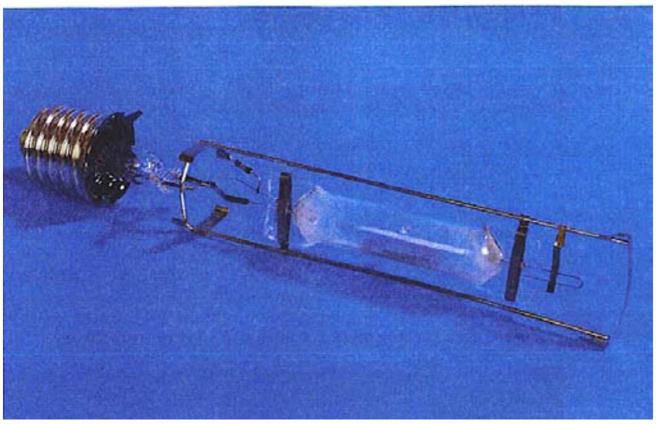
All patients were treated symptomatically for superficial keratitis and asked to attend the ophthalmology outpatient clinic in two days for review. Despite some residual corneal inflammation at that time most of their symptoms had settled.

From the case histories a number of possible causes for the symptoms were considered including:

- exposure to high levels of UV radiation
- irritation caused by visual effects smoke
- use of a chemical spray (there had been a disturbance in the club that night)
- chemical contamination of the ventilation system



Photograph 1 Intact bulb with undamaged Wood's Glass envelope



Photograph 2 Damaged bulb with a functional inner bulb but no Wood's Glass envelope

Irradiance data at 3.1 m, in mW m^{-2}		
Bulb	**UV effective irradiance (200–400 nm)**	**Maximum permissible exposure time for eyes and skin to effective UV radiation (200–400 nm)**
Intact	0.3	> 8 hours
Broken	125	3 minutes 40 seconds

The incident was reported to the nightclub owners who were advised to turn off any UV lights and not to use any visual effects smoke until a full investigation could be undertaken.

During a visit by environmental health officers to ascertain the cause of the incident it was noticed that the outer protective envelope of one UV bulb (400 W, mercury backlight) was damaged. The inner bulb was still intact and functional. The damaged lamp had been reported by the site manager to the maintenance company, but the significance of the damage was not realised and the lamp remained in operation. Staff reported that they had noticed that the light had been excessively bright on the night in question. All other UV lights in the club were inspected and found to be fully functional with intact envelopes.

The damaged lamp overlooked the club's entrance door, an adjoining seating/standing area and part of a dance floor. Measurements were taken of the distance of the lamp to the entrance door and the height of the lamp from the floor. The damaged bulb was sent to the (then) National Radiological Protection Board (NRPB) for testing.

High-powered UV lights have a Wood's Glass envelope, which provides protection from the full spectrum of emissions. This outer envelope had been smashed on the bulb in question.

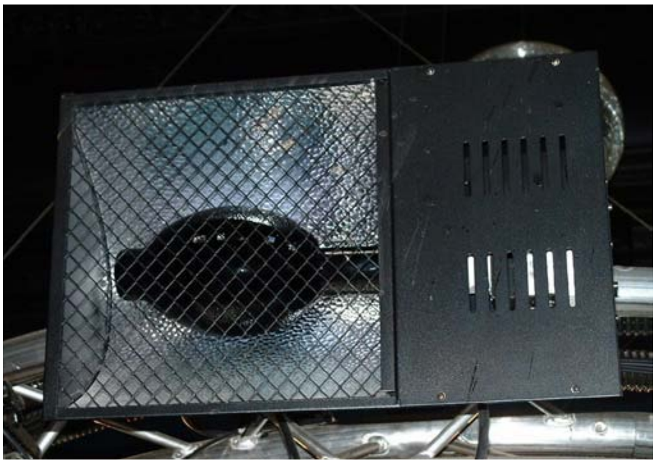
The NRPB tested the damaged bulb and an intact bulb under the same conditions. Measurements were made at a distance of 3.1 m from the source. This distance was based on measurements made at the nightclub and represents half the distance from the entrance door to the light source. The eyes of a person of average height (with eyes 1.5 m from the ground), standing halfway between the nightclub door and the light, would have been about 3 m from the source. People standing closer to the lamp would be subject to higher levels of UV radiation.

Irradiance is a measure of the rate at which energy arrives at a given point in space (unit watts per square metre). To assess exposure of unprotected eyes and skin to UV, it is necessary to spectrally weight the irradiance data to take account of varying biological effectiveness. These weighted data are referred to as effective irradiance. Maximum permissible exposure times are based on exposure limits (ELs) published by the International Commission on Non-Ionizing Radiation Protection[6].

The damaged bulb emitted higher levels of UV radiation in the 200–400 nm wavelength band than the intact bulb. From these data maximum permissible exposure times were calculated for a distance of 3.1 m from the bulb (see the table). If the distance from the bulb changed, the exposure level and therefore limit will be proportional to the inverse square of the distance.

A questionnaire was sent to 35 cases who were identified from those that attended the ophthalmology clinic and asking GPs to report any further cases. In total, 27 questionnaires were completed and returned (response rate 77%). The questionnaire asked people about their symptoms, which area of the club they had spent time in and how long they had spent there. The most frequently reported symptoms were sore eyes (89%) and burned skin (74%).

The mean exposure time for people in the area most affected by the damaged bulb was 2 hours, which represents over 30 times the maximum permissible exposure time. For those with the longest time spent in this area, their exposure is potentially over 50 times the maximum permissible exposure time. This represents significant exposure.



Photograph3 Intact lamp *in situ* at the nightclub

Discussion

Lamps of this nature have the potential to deliver high exposures of UV radiation if damaged. Although all the symptoms in the exposed settled within one week, the long-term effects are more difficult to establish. It is noteworthy that in the USA, lamps intended for use in areas where people will remain for more than a few minutes must self-extinguish within 15 minutes of the loss of 3 cm^2 or more of the outer envelope[7]. We recommend that similar safety limits are adopted in the UK and that awareness is raised regarding the potential levels of exposure from such lamps so that action is taken sooner when damage to the bulb's outer envelope is suspected.

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6 Matthes R. ICNIRP 7/99: Guidelines on limiting exposure to non-ionizing radiation. International Commission on Non-Ionizing Radiation Protection 1999

7 Food and Drug Administration Center for Devices and Radiological Health. High pressure mercury vapour discharge lamps. Code of Federal Regulations. 2002;8

Acute Sulphuric Acid Exposure – Don’t Delay Decontamination

Dr Simon Clarke, Consultant Emergency Physician, St Thomas’ Hospital, London.

Clinical report

A 31 year old man had been unblocking a sink in the toilets of a local restaurant and had tipped 98% sulphuric acid solution down the sink. Unfortunately, the sink contained residual water that reacted violently with the acid which sprayed his chest, arms, and lower face. He suffered immediate pain so removed his T-shirt and washed his face in an adjacent sink; his colleague brought him straight to the Emergency Department where he walked into the triage area.

The triage nurse asked the duty consultant to review the patient and, in particular, to decide whether the patient should be taken outside for formal external decontamination using the standard NHS-specified decontamination unit and personal protective equipment. It was decided to take the patient straight through to the Clinical Decision Unit (CDU) for a shower rather than wait for the PlySu tent to be erected because:

- the patient’s skin had started to blister in the 15–20 minutes since the accident and it was apparent that his skin would deteriorate if there was further delay in decontamination
- the risk of off-gassing was thought to be minimal because the sulphuric acid was in the liquid rather than vapour state and the heavily-contaminated T-shirt had been discarded at the scene and replaced with a jacket.

The patient showered himself for 15 minutes after which the pH of his skin was normal; he was clinically assessed further and found to have no respiratory or ocular involvement. He had a confluent area of erythema on his anterior neck and chest wall, and small splash marks on his chin, lower maxilla, and upper arms. After a further 30 minutes, his skin pH was retested and found to have remained at 7.0. After consulting the CHaPD factsheet on sulphuric acid, the patient was admitted to the CDU for overnight observation, in view of the small risk of late-onset pulmonary oedema.

It was also ascertained from the patient’s colleague that the sink had been successfully unblocked and rinsed out and the room cleaned. No-one else had been affected at the scene.

After four hours, the patient requested to leave; his skin was found to be unchanged, his chest remained clear, so he was discharged against medical advice. He was advised not to smoke and arrangements were made for him to be followed up by his primary care team; he was also told that if he developed any respiratory symptoms he should return to the department immediately.

Discussion

The current counsel of perfection is for patients presenting from chemical incidents to be kept out of the Emergency Department for decontamination. This process not only reduces the risk of secondary contamination of the healthcare staff and facility, but also reduces the dose of toxin to which the patient is exposed. However, it is imperative that a risk assessment is made to determine which of these factors is more important in each scenario: in this case, it was felt that the risk to the department was minimal, whereas the risk to the patient from delaying decontamination was considerable. Just occasionally, clinical judgement needs to override clinical guidelines with minimal impact to staff and other patients.

Natural Disasters

A Brief Introduction to the Health Consequences of Natural Disasters

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Introduction

Natural disasters have caused significant mortality and morbidity in 2004 and 2005. Whilst many of these disasters are initiated by a natural hazard event they are nonetheless associated with chemical contamination from both natural and technological sources. Few have yet been investigated from the chemical hazards and risk assessment aspects.

It is important to stress from the outset that a natural disaster is the conjunction of a natural hazard with a vulnerable human community, at any scale, and that the risk thereby generated constitutes the cause of the disaster. The natural hazard alone is not the disaster – it is its impact on the community that gives rise to the disaster itself. Thus studies of societal vulnerability and coping strategies need to sit side-by-side with meteorological and geophysical studies of hazard events if we are to develop workable strategies for disaster mitigation. Thus the term natural disasters may be a misnomer if it is accepted by the public to mean only 'environmental hazards', which refer to geophysical hazard events such as earthquakes, volcanic eruptions, drought, flooding, lightning and high winds that can potentially cause large-scale economic damage and physical injury or death[1].

Data from the UN International Strategy for Disaster Reduction (ISDR) reported in the media in 2004[2] stated that there had been:

- an increase in recorded deaths in 2003 of 83,000 in comparison to 53,000 in 1990
- the numbers of events had increased to 337 in 2003 in comparison to 261 in 1990
- risk factors contributing to this increase were thought to be related to the increase in societal vulnerability due to urban growth and the increasing number of megacities, the increasing use of marginal land, climate change and environmental degradation

This paper considers some of the issues relating to natural disasters including their identification and examples of such events, together with measures for mitigation and preparedness as well as the response and recovery processes from natural disasters.

Natural disaster incidence

Evidence from such diverse sources as the International Federation of the Red Cross (IFRC) and major commercial re-insurance companies (SwissRe, for example) is that natural and man-made disasters have been affecting increasing numbers of people throughout the world. Efforts to establish better mitigation of and preparedness for, and prevention of, disasters is now becoming an increasing priority in the concerns of donor agencies, implementing agencies (such as non-governmental organisations) and affected countries. For this reason, demand for complete and verified

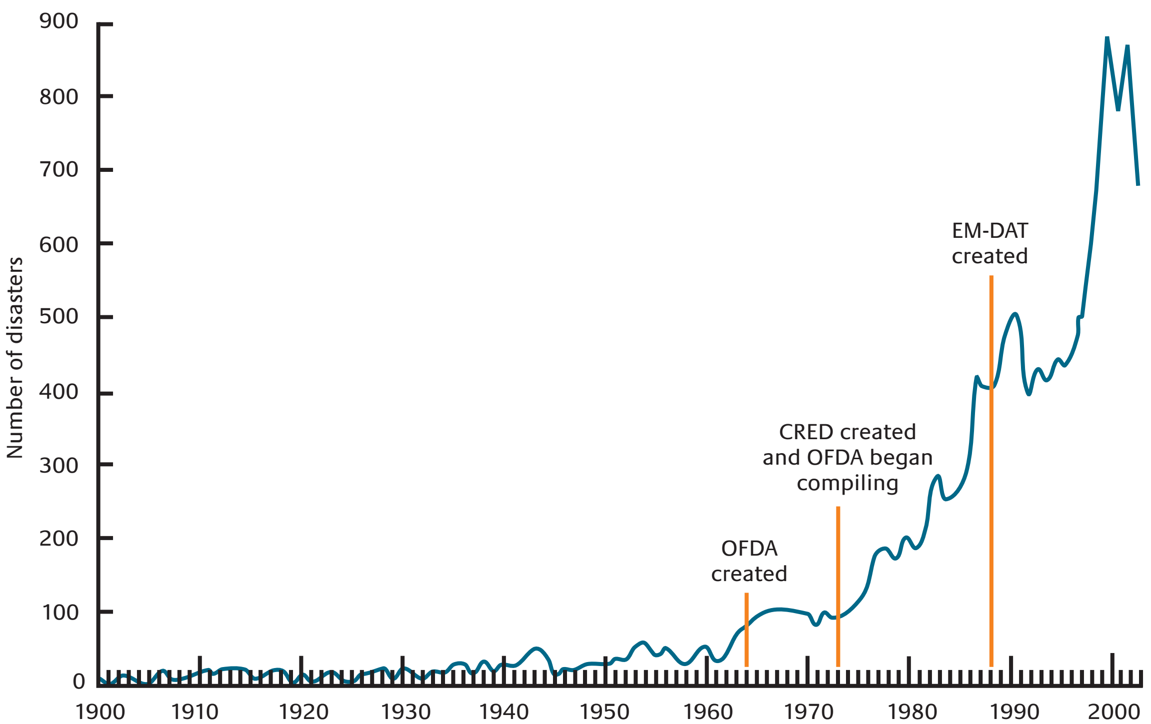


Figure 1 Total number of natural and technological disasters registered in EM-DAT (1900–2003)[5]

data on disasters and their human and economic impact, by country and type of disaster has been growing. EM-DAT is one source of such information[3].

The definition of a natural disaster is difficult. The ISDR states that for a disaster to be entered into the database at least one of the following criteria must be fulfilled:

- 10 or more people reported killed
- 100 people reported affected
- declaration of a state of emergency
- call for international assistance[4]

Figure 1 shows the reported increase in the total number of natural and technological disasters between 1900 and 2003 and registered in EM-DAT. This figure does log issues such as the start of the Office of Foreign Disaster Assistance (OFDA) of USAID; these developments are thought to have impacted on the ability to identify events.

For the production of its tables and figures, the ISDR divide natural disasters into three specific groups based on hazard type:

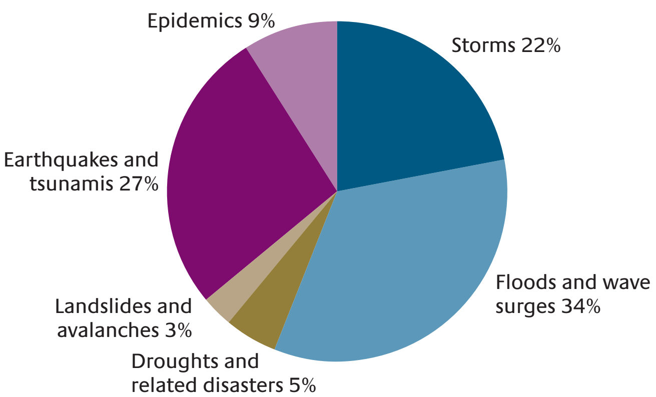
- hydro-meteorological disasters: including floods and wave surges, storms, droughts and related disasters (extreme temperatures and forest/scrub fires), and landslides and avalanches
- geophysical disasters: divided into earthquakes and tsunamis and volcanic eruptions
- biological disasters: covering epidemics and insect infestations[5]

Table 1 describes the EM-DAT information for the distribution of disasters by origin and decade. Hydro-meteorological disasters are most common. Data for the current decade only includes the first four years.

Information on the types of disaster becomes particularly important for separating those that kill (Figure 2) and those that adversely affect populations (Figure 3) with the level of development within countries. Although fatality data are often available, completeness of these data is

Table 1 Distribution of natural disasters by type of event (1900–2003, by decades)[5]

	1900–09	1910–19	1920–29	1930–39	1940–49	1950–59	1960–69	1970–79	1980–89	1990–99	2000–03	Total
Hydro-meteorological	28	75	56	74	128	280	511	795	1575	2139	1444	7105
Geological	36	26	32	38	53	58	94	128	234	283	152	1134
Biological	5	12	10	3	3	3	40	65	167	351	297	956
Total	**69**	**113**	**98**	**115**	**184**	**341**	**645**	**988**	**1976**	**2773**	**1893**	**9195**



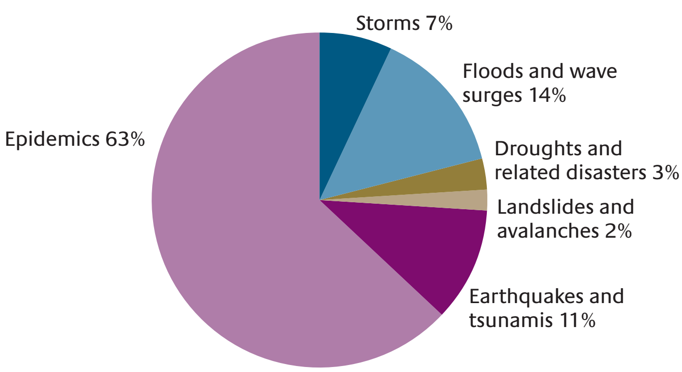
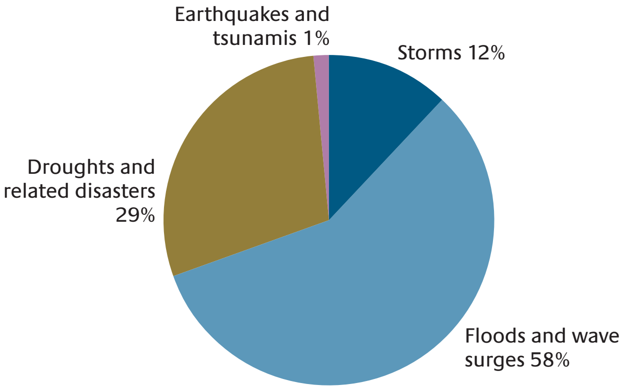


Figure 2 Types of disasters resulting in death in developing countries and least developed countries (1994–2003)[6]



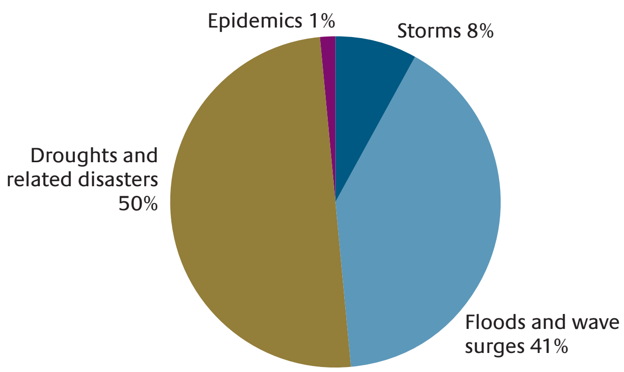


Figure 3 Types of disasters resulting in adverse effects on people in developing and least developed countries (1994–2003)[6]

difficult, particularly as there may not be long-term follow up. Indeed, the ISDR states that data on the numbers of people affected by a disaster can be very useful for risk assessment, but are often poorly reported[6]. Moreover, the ISDR reports that the definition of 'affected' remains always open to interpretation, political or otherwise. However, this information can be valuable to show the impact of different disasters. Thus droughts have an even greater adverse health impact (50%) on least developed countries, whereas they kill fewer (5%) in developing countries.

Data for 1995 to 2004 have just been published[7]. The 26th December 2004 tsunami in South East Asia resulted in 224,495 deaths, which represented 90% of all deaths due to natural disasters in that year.

In comparison to this international data, the USA keeps information on the number of major disaster declarations. In comparison to 1994 when 38 were declared, in 2004 a total of 68 were declared[8].

Examples of recent incidents

A relatively small number of these incidents are well remembered from the media coverage they attracted but many more have occurred and have received little national or international attention. In order to try to facilitate a better understanding, Table 2 (overleaf) provides a list of some recent natural disasters and natural adverse events.

Preparedness, response and recovery for natural disasters

The World Health Organization addresses health action in crises and provides excellent technical guidance, some of which concerns the dangers of inappropriate response, examples of which are included in the box[9]. Extensive information is available on internationally regarded websites. Examples of such sites include

- organisations such as the World Health Organization (http://www.who.int/en/) and the Pan American Health Organization (http://www.paho.org/)
- associations such as the World Association of Disaster and Emergency Medicine (http://wadem.medicine.wisc.edu/)
- non-governmental organisations such as the International Commission of the Red Cross (http://www.icrc.org/eng), St John Ambulance (http://www.sja.org.uk/) and Merlin (http://www.merlin.org.uk/)

Conclusion

The UN International Strategy for Disaster Reduction (ISDR) aims at building disaster-resilient communities by promoting increased awareness of the importance of disaster risk reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters[12]. Information on training and preparedness is published on the ISDR website, as well as on the other websites referred to above.

Glossary

IFRC	International Federation of the Red Cross
ISDR	UN International Strategy for Disaster Reduction
OFDA	Office of Foreign Disaster Assistance, USA
EM-DAT	EMergency Disasters DATa Base, Belgium
CRED	Centre for Research on the Epidemiology of Disasters, Belgium
USAID	US Agency for International Development
WHO	World Health Organization
PAHO	Pan American Health Organization

Box Inappropriate response guidance (Source: World Health Organization[10,11])

Emergency evacuation of whole populations to other geographical locations is not recommended.

Do not send household foods or food items unless explicitly requested. Donate money to purchase large amount of food locally/regionally.

Do not send household medicines or prescriptions. These items can be medically and legally inappropriate. Consult the WHO guidelines on essential drugs and the local authority of the beneficiary country first.

Blood and blood derivatives: Do not send! Even if there are a lot of injured victims, there is much less need for blood than the public commonly believes. Local blood donors in the affected country will cover the victim's needs. This type of donation is unsuitable because it requires time-consuming and labour-intensive quality and safety controls, such as refrigeration or screening for detection of HIV

Medical or paramedical personnel or teams. Do not send them! They would arrive too late. Local and neighbouring health services are best placed to handle emergency medical care to disaster victims.

Field hospitals, modular medical units. Do not send them! Considering that this type of equipment is justified only when it meets medium-term needs, it should not be accepted unless it is donated.

Unilateral decision on resource allocation. Do not take it without evidence of needs!

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3 EM-DAT (EMergency disaster DATtabase): The OFDA/CRED International Disaster Database - www.em-dat.net - Université Catholique de Louvain - Brussels - Belgium http://www.em-dat.net/ (Accessed 22.10.05)

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7 Hoyois P, Below R, Guha-Sapir D International Federation of Red Cross and Red Crescent Societies WORLD DISASTERS REPORT 2005, Annex 1, Disaster Data. Center for Research on the Epidemiology of Disasters, Catholic University of Louvain, http://www.em-dat.net/documents/tablesWDR2005.pdf (Accessed 22.10.05)

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10 World Health Organisation Earthquakes. Technical Hazard Sheet. Natural Disaster Profiles. http://www.who.int/hac/techguidance/ems/earthquakes/en/index.html (Accessed 01.11.05)

11 World Health Organisation. Vegetation Fires. Technical Hazard Sheet, Natural Disaster profiles http://www.who.int/hac/techguidance/ems/vegetation_fires/en/index.html (Accessed 01.11.05)

12 International Strategy for Disaster Reduction Mission and objectives http://www.unisdr.org/eng/about_isdr/isdr-mission-objectives-eng.htm (Accessed 22.10.05)

Table 2 Examples of some recent natural disasters and adverse events from January to October 2005 (some pre-2005 events are included, depending on significance) (from various online news media sources)

Type of event	UK	Rest of Europe	Rest of World
Hydro-meteorological disasters			
Floods	Floods in Carlisle in January 2005 resulted in over 3,000 people and an industrial estate at risk	Floods in Switzerland, Romania, Germany, Austria, Bulgaria and Poland resulted in 43 deaths in August 2005	Floods following A typhoon caused at least 35 deaths in Vietnam, China, the Philippines and Thailand in September 2005
Storms	19 people injured – 3 seriously – as a tornado ripped through Birmingham in July 2005	Storms in Finland killed 3 and cut power supplies to over 40,000 in December 2004	Hurricane Katrina in August 2005 with 1,281 confirmed dead, caused chemical contamination and more than $200 billion damage
Droughts	Drought tightened its grip on the whole of the South – and particularly in Kent and Sussex – after 10 consecutive months of low rainfall, September 2005	Searing heat and drought in the summer of 2005 affected large swathes of southern Europe and North Africa including Portugal, Spain, France, Italy and Greece	A severe, protracted drought threatened over a million people in Somalia and the Horn of Africa (August 2005) In October 2005 a state of emergency was declared in Brazil because the worst drought for half a century dried up rivers and lakes in the Amazon basin
Extreme temperatures	A heat wave occurred in August 2003, with Kent registering 38.5°C (101.3°F). An estimated 2,091 deaths were attributable to the heat wave in England	In Spain's southern region temperatures rose to 40°C (104°F) in some areas in June 2005, an alert to the elderly, infirm and those with young children was sent by text message	At least 37 people died in a severe heat wave that spread eastwards across the USA in July 2005
Forest/scrub fires	Many small forest or woodland fires mostly associated with arson, in 2005	In August 2005 fires destroyed 140,000 hectares of forest in Portugal and left at least 15 people dead, including 11 firefighters	In February 2005, Malaysia's emergency services tackled hundreds of fires that sprang up across the country following a prolonged dry spell. More than 2,000 firefighters tried to put out flames in six states. In some cases the fires took hold in the peat soil, proving particularly hard to put out
Landslides and avalanches	In January 1999 warnings of avalanches were issued to climbers and hill walkers in the Scottish Highlands five days after 4 people died when they were buried under tons of snow near Ben Nevis	In June 2005 a landslide hit a beach in southern Ukraine killing a Russian teenager and trapping several other people. The incident happened near the city of Sevastopol in Crimea	In February 2005 at least 170 people were killed and hundreds more were missing in Indian-administered Kashmir following the worst snowfalls in two decades, with more than 100 people killed by the avalanche in the village of Viltengnar
Geophysical disasters			
Earthquakes and tsunamis	A few small events are recorded but none is recorded as having caused significant damage in the last few years	In 2002 an earthquake struck a school in Southern Italy where at least 26 children were killed	Tsunami, December 2004 – more detailed report from Sri Lanka (page 17) An earthquake on 8 October 2005 in Pakistan and Kashmir resulted in over 73,000 deaths
Volcanic eruptions	Not applicable	In 2002 the Italian Government declared a state of emergency in parts of Sicily, after a series of earthquakes accompanying the eruption of Mount Etna forced about 1,000 people to flee their homes	El Salvador's highest volcano, Ilamatepec, erupted in October 2005, killing 2 people and forcing thousands to flee the area. The ground shook as plumes of smoke and ash rose from the volcano, and burning rocks were hurled into the air. People were treated for smoke inhalation
Biological disasters			
Epidemics	In 2001, foot-and-mouth led to the slaughter of more than 6 million animals and is estimated to have cost the UK as much as £4 billion	In October 2005 Britain called for a blanket ban on imports of wild birds after the potentially lethal H5N1 strain of avian influenza was detected in a quarantined parrot. Outbreaks of the H5N1 virus have occurred in Romania, Russia and Turkey	Sudden Acute Respiratory Syndrome in June 2003 resulted in 812 deaths across the world, with 348 in mainland China, 298 in Hong Kong, 84 in Taiwan, 32 in Singapore and 38 in Canada

Health Protection Issues associated with the Tsunami in Sri Lanka

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Introduction

In Sri Lanka, the immediate impact of the tsunami of 26th December 2004 was displacement of 850,000 people from their homes, a death toll of 31,141 and injuries to 23,000. To date, 4,200 people are reported to be missing. The damage was mainly in the coastal area extending from the Jaffna District in the north, along the east coast affecting Kilinochchi, Mullaitivu, Trincomalee, Batticaloa, and Ampara Districts, Hambantota, Matara and Galle districts in the south and Kalutara, Colombo, Gampaha and Puttalam Districts in the west (see the map). The destruction of infrastructures associated with industries such as fishing, tourism and agriculture led to the loss of livelihood and economic hardship for the majority of the population in the coastal regions affected.

Several hospitals and health centres were severely damaged and health workers were amongst the victims. Water supplies were disrupted and consequent contamination resulted in an acute shortage of clean drinking water. Sanitation facilities and sewage treatment works were damaged, increasing the risk of outbreaks of diarrhoeal diseases. Diseases such as salmonellosis, typhoid, hepatitis, and shigellosis were a major concern, particularly in the temporary camps which were used to accommodate the displaced as adequate sanitation was lacking. Outbreaks of acute respiratory and skin infections were also a major concern.

Initially, prevention of injury-associated complications was a priority. Subsequently, mosquito-borne diseases such as malaria, Japanese Encephalitis and dengue, due to the numerous pools of stagnant water caused by both the tsunami and the flooding that took place a few days later in some districts, necessitated immediate and aggressive preventive measures.

The Government of Sri Lanka took immediate steps to distribute essential items including food and medicines to the affected areas under the supervision of the district administration and established three task forces responsible for rescue and relief (TAFRER), logistics, law and order (TAFLOL), and rebuilding and reconstruction (TAFREN). The international community mobilised all resources maximally to support the planning and implementation of relief operations.

Coordinated international and local finance, expertise, personnel and equipment enabled a successful immediate relief phase to achieve prevention of further deaths, control of communicable diseases, and the provision of food, water and shelter along with emergency medical care. These activities enabled the return of children to school within four months.

The World Health Organization (WHO) was the main partner of the Ministry of Health in coordinating the health sector response. The overall purpose of the WHO Sri Lanka's emergency strategy was to support national, local and other allied health sector partners in protecting the health of the survivors and other vulnerable groups.

The major activities of the WHO Sri Lanka in association with the Sri Lankan Ministry of Health were:

- disease surveillance and control
- control of vector borne diseases
- strengthening information systems
- provision and maintenance of safe water supplies and sanitary facilities
- reinforcing and expanding psychosocial and psychological support services
- assessment of the care provided for compromised children

Flooding and the aftermath of the tsunami in Sri Lanka

Disease surveillance and control

The WHO immediately activated the Global Outbreak Alert and Response Network (GOARN). As a result, disease surveillance and response experts were posted to Sri Lanka to strengthen existing disease surveillance and early warning systems

Outbreak warning and surveillance systems areas were established and strengthened in tsunami-affected areas. The epidemiological information on diseases with the potential to cause infections in tsunami-affected areas was collected, collated, analysed and disseminated. Appropriate rapid response mechanisms to epidemics or unusual health events were established and strengthened.

The WHO supported the Epidemiology Unit in Sri Lanka to update the existing facilities for drafting, publishing and disseminating early warning surveillance protocols to personnel working within the surveillance system in tsunami-affected districts. Ten diseases – namely leptospirosis, dengue, dengue haemorrhagic fever, acute flaccid paralysis (AFP), tetanus, viral hepatitis, pertussis (whooping cough), rabies, rubella, and measles – were selected for notification purposes and documentation facilities were developed. The surveillance system was also supported by geographical information systems (GIS) for health mapping and health-related databases.

No major disease outbreaks have occurred. The WHO credits this to the resilience of the public health systems and response capabilities of the health sector in Sri Lanka, supported by dedicated and committed work of local and international communities.

Control of vector borne diseases

The areas that were affected by the tidal wave – the north, south and east of Sri Lanka – have different vector compositions and thus differing risks of vector borne diseases. Thus each district needed to be addressed individually.

The adult and larval vector density had decreased in tsunami-affected districts. Personal protection was facilitated by increasing knowledge and education among the tsunami-affected population and by the provision of the necessary equipment. The capability to diagnose and treat malaria and dengue in tsunami-affected districts was increased.

Dengue and malaria vector control activities in the camps were continuously promoted. The WHO facilitated the control activities with provision of technical assistance, insecticides, necessary spraying and fogging equipment, personnel to clean the camps, garbage collection bins and sanitation supplies (i.e. provision of gully-suckers to empty the temporary latrines). Local health staff were trained on the operation and maintenance of essential equipment.

Provision of insecticides, spraying and safety equipment along with durable mosquito nets contributed to the control of the spread of vector borne diseases. Furthermore, the COMBI programme for filariasis control was assisted by improving compliance to Mass Drug Administration.

Vector surveillance was facilitated by enhancing local capacity through the provision of technical guidance and training. The WHO facilitated a rapid survey with the Entomological Assistance Team in Galle district and this survey revealed that 70% of breeding places were positive, infested with several varieties of mosquito larvae. The WHO facilitated a sand fly survey, in conjunction with the Anti-Malaria Campaign in Jaffna, and the Department of Zoology, University of Jaffna, in Delft Island. The local health authorities were advised on the importance of regular vector surveillance on Lieshmaniasis and the necessary recommendations were implemented to prevent an outbreak.

Strengthening information systems

An adequate response to disease states amongst vulnerable population groups is highly dependent on a well-functioning health information system. The current status of the health information system in Sri Lanka is based on a manual system. The Ministry of Health was able to develop a health facility connectivity project document with technical assistance from the WHO. The project focused on building a unified architecture for the information and communication technology infrastructure and information system. This facilitated the establishment of a health information system, which included a hospital information system, a multi-disease surveillance system, a health telemedicine system and a supply chain management system, which was implemented in the tsunami-affected areas.

Provision and maintenance of safe water supplies and sanitary facilities

The provision of clean water and sanitation at a district level in Sri Lanka is the responsibility of the local administrative councils, Medical Officers of Health and the Water Board. The supply of water and sanitation services at the transit camps, temporary housing and affected areas of the tsunami emerged as a critical issue, which was supported by the WHO.

The water and sanitation team of the WHO Sri Lanka, with the Ministry of Health and the other partners, conducted a rapid assessment of the situation at campsites and the coastal areas of affected districts. Approximately 12,000 shallow wells in the coastal villages had been contaminated with salt and this created an urgent need to chlorinate the recharged water. The assessments of the sanitation requirements of the camps revealed a need for effective behaviour-change communication programmes focusing on personal hygiene habits.

A guideline for water quality standards was made and distributed to all relevant departments and agencies. The National Water Board conducted national level workshops and regional workshops for water quality surveillance, with the technical assistance of the WHO. Demonstrations and training in well-cleaning and chlorination were conducted. Necessary steps were also taken by the Medical Research Institute of the Ministry of Health, and regional laboratories of the Water Board for ongoing surveillance activities. The key objectives were to improve water quality and basic sanitation in the affected areas to prevent water- and sanitation-related diseases.

Good sanitary and hygiene practices were promoted in the communities living in transit camps. Water quality surveillance systems for rural water supplies were established and strengthened. Further enhancement of the local capacity to deliver and manage water and sanitation services to rural and small urban areas are taking place.

In collaboration with Merlin*, improvement of hospital water, sanitation and biomedical waste disposal services are in process.

Reinforcing and expanding psychosocial and psychological support services

An essential component of the rehabilitation and recovery efforts recognised was the need to meet the psychosocial and mental health needs of the survivors. The psychosocial support programme launched jointly by the Ministry of Health and the WHO, with other partners, aimed at reaching each and every survivor of the tsunami, and providing them with the appropriate services.

The activities necessary were

- mobilisation of community action
- development of competencies on psychosocial and mental health support at primary health care level
- supported development of mental health professionals,
- training of existing nurses in psychiatric hospitals in rehabilitation and related techniques
- development of local psychiatric services – local acute and intermediate stay wards, day care and resource centres in all districts
- advocacy of the Ministry of Health for Mental Health Policy and new legislation.

The emphasis was not to 'medicalise' the distress of the community. The optimum way of reaching every affected person was through a properly trained community level worker (CLW), who was from the community and understood the culture, beliefs and the values of the people. Each CLW was assigned to a fixed number of families and was to be supported by mental health professionals. Their duties were to provide social support (meeting the needs of day-to-day life, obtaining aid, etc), providing psychological first aid and identifying those who needed specialised or supplementary mental health services. Sri Lanka has one of the highest suicide rates in the world. Training to identify those requiring referral to the psychiatric services care was implemented.

* Merlin (http://www.merlin.org.uk)

Assessment of the care provided for compromised children

The preventive health measures for control of communicable diseases implemented by the Ministry of Health in collaboration with the WHO Sri Lanka were well coordinated and effective. Registers were maintained of the numbers of pregnant women and children in the affected areas – particularly of children aged 1–5 years who had lost one or both parents. Pre-school facilities provided by the Social Services and Education Departments were functioning in the refugee camps.

Plans or programmes for participating relief agencies to share information and work together in the best interest of children were not available. This resulted in a relative lack of awareness of the roles and responsibilities for workers in relation to prevention and detection of abuse. An important deficiency was the unavailability of a register or information on offenders – convictions, molesters, paedophiles, sexual offenders – i.e. people who should not be involved in the provision of care to compromised children.

A need for training and appointment of named professionals (paediatricians, nurses) for child protection in health institutions and health districts appeared to be an urgent requirement to develop ongoing services related to child sexual abuse, which could then be expanded in times of crisis such as the tsunami.

Conclusions

The post-tsunami strategies implemented in Sri Lanka to provide comfort and relief to those affected are documented with a view to stimulating discussion and review. A developing country such as Sri Lanka encountered difficulties and shortcomings which would be common to many countries of a similar socioeconomic status. The ability to prevent an increase of vector borne diseases and the total prevention of outbreaks of water borne diseases are the notable achievements of the health services in Sri Lanka. Many health professionals and their families were also traumatised by the tsunami and when providing care and support to victims under very demanding conditions with limited facilities. The need for such health workers to receive support must not be underestimated.

A significant difference between disaster planning and relief work in Sri Lanka when compared to developed countries is the relative lack of emphasis on chemical pollution. Being a predominantly agricultural country, pesticides and chemicals associated with agriculture are widely used, albeit minimally in the coastal areas where the main industry is fishing. However, there was no monitoring or sampling carried out for chemicals. Despite the shortcomings associated with reporting ill health after the tsunami, it is noteworthy that there were no reports of ill health due to chemical contamination.

Preventive and curative health care and rehabilitation activities have been greatly facilitated by the generosity and the expertise of the international community and the selfless efforts of all grades of health professionals and the public of Sri Lanka. However, the long-term wellbeing of the affected people would require continued dedicated, committed and coordinated activity of the Sri Lankan health workers and the populace of the global village.

Acknowledgement
This paper is based on the WHO publication on tsunami relief in Sri Lanka, 2005.

Emergency Planning

Civil Contingencies Act

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Introduction

The Civil Contingencies Act came into force on 1st April 2005. The major regulations supporting the Act came into force on 14 November 2005 but local authorities have an extra duty – that of advising and assisting businesses and voluntary organisations about business continuity management. This duty will come into force on 15 May 2006 (Cabinet Office Civil Contingencies Secretariat, letter dated 28 July 2005)

The Act is divided into two distinct parts: local arrangements for civil protection (part one) and emergency powers (part two). Its accompanying regulations and non-legislative measures deliver a single framework for civil protection in the United Kingdom. While it is primarily focused at civil emergencies, Part 1 will improve the ability of the UK to deal with the consequences of a wide range of disruptions by improving the planning process at local level, building better contacts between organisations and ensuring that what goes on at the local level is consistent with efforts at the regional and national levels. The key to the act and its legislation is the updating of the definition of what constitutes an emergency.

Civil Contingencies Act Definition of an Emergency

An emergency is:

- an event or situation which threatens serious damage to human welfare in a place in the United Kingdom
- an event or situation which threatens serious damage to the environment of a place in the United Kingdom
- war, or terrorism, which threatens serious damage to the security of the United Kingdom (Civil Contingencies Act 2004)

It is worthy of note that under the 'Emergency Powers' Part 2 of the Act, the Government will be able to utilise significant powers to deal with emergencies. For example, the Act will permit the Government, without seeking Parliament's immediate consent, to:

- order the evacuation and cordoning off of dangerous sites
- ban public access to sensitive areas
- impose curfews to prevent people travelling at certain times
- take over, or confiscate property, animal or plant life, with or without compensation
- outlaw public gatherings
- take control of financial institutions
- deploy troops to assist in an emergency
- set up special courts/tribunal to handle compensation following a terrorist attack

The Act imposes a series of legal duties on relevant bodies known as Category 1 and 2 responders, with the duties on Category 1 being the more onerous. The table summarises those who are Category 1 and 2 responders. The Health Protection Agency is a Category 1 responder.

Duties of a Category 1 responder

These duties include:

- development of risk assessments to contribute to the emergency planning and response process
- monitoring and evaluating current plans and putting in place new contingency and emergency plans (emergency planning)
- preparation and maintenance of a risk register
- preparation and maintenance of business continuity (continuity of service) plans
- development of robust communication links
- ensuring that arrangements are in place to make information available to the public; additionally, maintain procedures to warn, inform and advise the public in the event of an emergency

Civil Contingencies Act 2004

2004 Chapter 36

Category 1 and 2 responders	
Category 1 responders	**Category 2 responders ('cooperating responders')**
Emergencies services Police forces British Transport Police Fire authorities Ambulance services Maritime and Coastguard Agency **Local authorities** All principal local authorities (i.e. metropolitan districts, shire counties, shire districts, shire unitaries) Port Health Authorities **Health bodies** Primary care trusts Acute trusts Foundation trusts Local health boards (in Wales) Any Welsh NHS trust which provides public health services Health Protection Agency **Government agencies** Environment Agency Scottish Environment Protection Agency	**Utilities** Electricity distributors and transmitters Gas distributors Water and sewerage undertakers Telephone service providers (fixed and mobile) **Transport** Network Rail Train operating companies (passenger and freight) London Underground Transport for London Airport operators Harbour authorities Highways Agency **Health bodies** Strategic Health Authorities **Government agencies** Health and Safety Executive

- liaison with other Category 1 responders
- liaison with Category 2 responders
- collaboration in training, exercising and planning, including information sharing – notably, the sharing of information is a crucial element of the Act and underpins all forms of co-operation
- inclusion and participation with Regional and Local Resilience Forums (RRF and LRF), as appropriate
- development of a robust and effective planning, training and exercise cycle

For the HPA, many aspects of the requirements of the Act are being addressed within the programmes of work to meet the HPA corporate goals. Significant progress has been made in developing emergency operations centres, a strategic emergency response plan, threat-specific plans and supporting guidance. These have been tested through a series of regional multi-agency exercises run by the HPA (largely on behalf of the Department of Health), with involvement ranging from local HPA and NHS units, blue-light services, the Cabinet Office and other government departments. In parallel, an extensive training programme targeted at the health sector has been provided. Underpinning this has been significant collaboration at all levels with local organisations, Government and many of the Category 1 responders. Even so, work remains to be done to comply with the Act. Details of these activities are available on the HPA website (http://www.hpa.org.uk/cepr).

Requirements of the Act and regulations

All Category 1 responders have a duty to comply with the Act and regulations and must cooperate with each other. The principle mechanism for this cooperation is the Local Resilience Forum (LRF). The HPA must be represented independently of other health service representation at the LRF.

The LRF itself is a strategic coordinating group that reflects the key principles of the Act at the local level. The purpose of the LRF process is to ensure effective delivery of those duties under the Act that need to be developed in a multi-agency environment – for example, compilation of risk profiles for a community risk register. The LRF needs to develop a systematic planned and coordinated approach to encourage responder bodies according to their functions to address all aspects of policy in relation to:

- risk
- planning for emergencies
- planning for business continuity management
- publishing information about risk assessments and plans
- arrangements to warn and inform the public
- other aspects of civil protection

All Category 1 responders must ensure they are adequately represented at LRF meetings including the subgroups – the Regional Health Emergency Planning Adviser through Local and Regional Services HPA representation at RRF, LRF, health and other relevant subgroup meetings, as appropriate. Information on how to contact your Regional Health Emergency Planning Adviser is available on the HPA website (http://www.hpa.org.uk/lars).

NHS Emergency Planning Guidance 2005

Verity Kemp, project manager for the review of the NHS Emergency Planning Guidance, email:verity@healthplanning.co.uk

Introduction

The purpose of the revised NHS Emergency Planning Guidance[1] is to describe a set of general principles to guide all NHS organisations in developing their ability to respond to a major incident or incidents, and to manage recovery whether the incident or incidents has effects locally, regionally or nationally within the context of the requirements of the Civil Contingencies Act 2004.

The guidance contains principles for effective health emergency planning that have been developed in consultation with the Health Departments of the Devolved Administrations. It is strategic national guidance for all NHS organisations in England, and equivalent guidance will be provided by the Health Departments of the Devolved Administrations.

Evolution of the guidance

The new guidance document replaces the NHS Emergency Planning Guidance 1998 and all other material previously included in or associated with that guidance. It has been revised to take account of changes made to NHS organisation since the creation of the Health Protection Agency (HPA) and the changes in the type and nature of threat posed following the terrorist attacks of September 11, 2001, in New York.

It links to existing national guidance, including 'Beyond a Major Incident'[2], and 'National Guidance on Pandemics'[3]. It is built on the principles of cooperation, information sharing, risk assessment, emergency planning, business continuity management and communicating with the public.

Target audience

The guidance is based on best practice and shared knowledge. It is intended to provide a platform for all NHS organisations (including foundation trusts) to undertake major incident and emergency planning and associated activities.

Basis of the guidance

The guidance is based on the work of a multidisciplinary steering group drawn from the NHS, Regional Public Health Groups and the HPA. Interviews were also conducted with partner organisations that included the Association of Chief Police Officers, the fire service, and various professional organisations including the Faculty of Accident and Emergency Medicine and the British Association for Immediate Care (BASICS).

Dissemination

The guidance is entirely web based and available at www.dh.gov.uk/emergency planning. There will no longer be formal printed versions available. This approach will allow for rapid updating, for example, of the roles and responsibilities of NHS organisations resulting from the introduction of arrangements proposed in Commissioning a Patient-led NHS[4]. It will also allow for the timely publication and integration of guidance currently being developed on the following topics:

- children
- critical care
- burns
- radiation
- estates, facilities and service resilience
- NHS Direct
- mental health

Plans are already in hand to commence the review of further topics including chemical and biological preparedness and response. In reviewing issues relating to health protection, particularly CBRN (chemical, biological, radiological and nuclear) issues, the involvement of the HPA will be critical to ensure that guidance developed takes account of the latest developments and knowledge in these areas and is linked into the HPA services at local, regional and national levels.

Some of the main changes

Particular changes in the revised guidance include:

- The arrangements for the organisation and management of immediate medical care at the scene.
- The arrangements for oversight of the organisation and management of Mobile Medical Teams or their equivalent.
- NHS organisations are required to ensure they have in place robust command and control mechanisms to enable them to plan for, and respond to, major incidents linked with the command and control arrangements of the Strategic Health Authority (SHA), Strategic Coordinating Group (SCG) and the Regional Civil Contingencies Committee (RCCC).
- The Joint Health Advisory Cell (JHAC) arrangements have been revised and replaced with a more comprehensive means for providing health advice in the course of a major incident regardless of its cause, source or scale.
- Explicit arrangements are made for coordination and delivery of NHS resources in the course of an incident.
- The Department of Health will take control of the deployment of NHS resources in the event of a complex and significant major incident, including those on a UK wide and international scale, through its Emergency Preparedness Division Coordination Centre. All NHS organisations will be expected to respond to instructions delivered under these circumstances.

Introduction of Health Advice Teams and Public Health Advisers

One of the biggest changes made in the new guidance concerns the provision of public health and health protection advice in the course of an incident. The importance of providing clear and consistent public health messages and advice is now both widely accepted and readily sought, in particular in those incidents involving CBRN substances, irrespective of the cause: deliberate or accidental.

Health Advice Team

The HAT will include a Director of Public Health or equivalent.

The HAT may also include representatives of microbiology, epidemiology, toxicology, Health Protection Units including consultants in communicable disease control, environmental health officers, the Environment Agency, the Food Standards Agency, Water Company or Companies, the Defence Science Technology Laboratories (Dstl) often described as the Senior Scientific Officer (SSO – also represented on COBR), the Military, the Atomic Weapons Establishment, the HPA/NHS radiological protection adviser, and others.

The new guidance therefore reflects the changes in the NHS and other agencies including the HPA, as well as the need to offer the SCGs a more responsive and unified health advice response. Previously, an advisory committee, either the Joint Health Advisory Cell (JHAC) or the Health Advisory Group (HAG) was called to provide the police incident commander with public health advice in the event of deliberate release of a biological substance or chemical agent. Incidents involving radiological incidents included the provision of health advice through the HAG, again in relation to the public health impact of the incident. The JHAC/HAG consisted of representatives from a range of organisations and specialists appropriate to the incident.

Health advice will now be provided through a Health Advice Team (HAT) led by a designated Public Health Adviser (see box above). The HAT will be able to access and provide consistent advice from the NHS and the HPA and ensure its use and dissemination throughout the necessary organisations including its own. The HAT will need to be linked into the SCG, the NHS Strategic Command arrangements and the Department of Health Emergency Coordination Centre. A senior public health practitioner will chair the HAT. The Public Health Adviser will not usually fulfil the role of chair of HAT, but represent the team at the SCG meetings.

The range of relevant specialists needed to ensure comprehensive and authoritative advice will vary depending on the nature of the incident. SHAs with primary care organisations (PCOs) and their respective Regional Director of Public Health (RDPH) and Regional Director of the HPA must agree on the arrangements needed in their area to ensure that an appropriate Public Health Adviser can be nominated and is available at all times with appropriate support.

Glossary of terms

BASICS	British Association for Immediate Care
CCA	Civil Contingencies Act
COBR	Cabinet Office Briefing Rooms
DA	Devolved Administration
Dstl	Defence Science Technology Laboratories
HAG	Health Advisory Group
HAT	Health Advise Team, replaces HAG and JHAC
HPA	Health Protection Agency
JHAC	Joint Health Advisory Cell
NHS	National Health Service
PCOs	Primary care organisations
RCCC	Regional Civil Contingencies Committee
RDPH	Regional Director of Public Health
SCG	Strategic Coordinating Group
SHA	Strategic Health Authorities
SSO	Senior Scientific Officer

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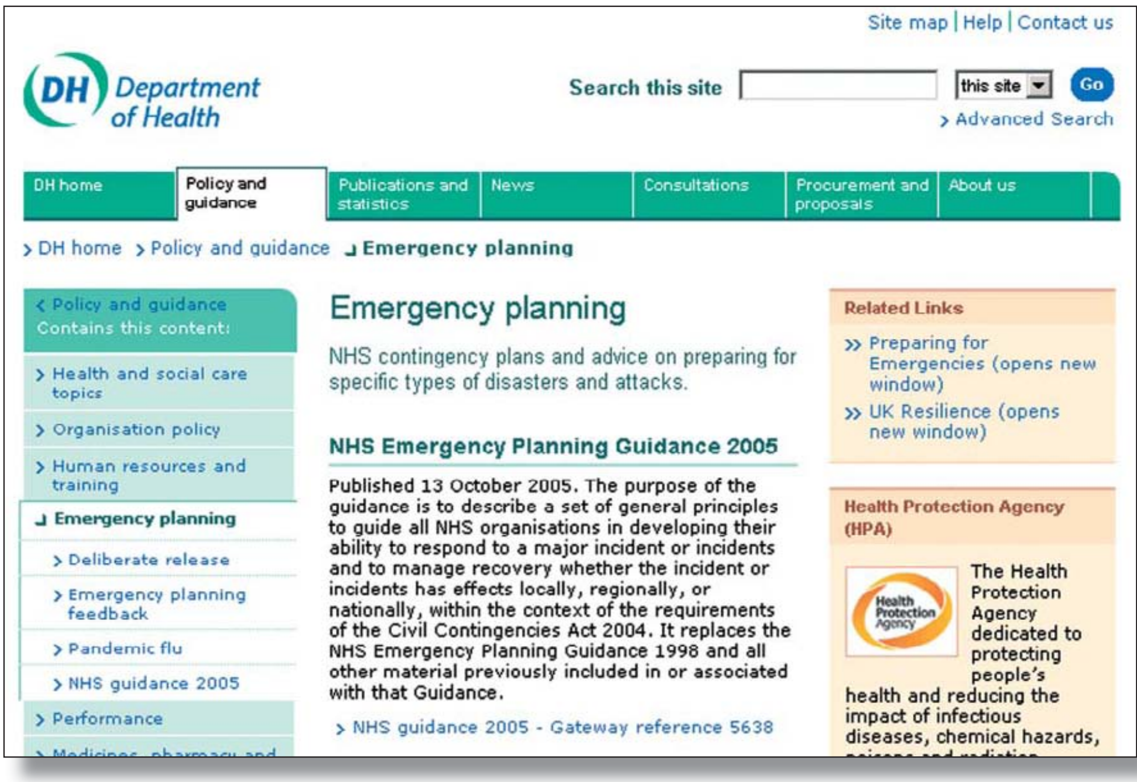

Blast and Toxic Lung Damage: a Challenge for Critical Care

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Introduction

The terrorist attacks on 7th July in London led to the admission of a number of casualties to intensive care units (ICU) in central London. Overall, of 142 casualties admitted to six inner London hospitals, 16 required treatment in ICU. Ventilatory and other support was required as a result of polytrauma and subsequent major surgery and lung damage from primary blast and toxic injury. Although there was no primary toxic attack, the fact that some blasts took place in tunnels led to the secondary production of a toxic environment from the presence of smoke and dust[1–3].

During the emergency medical response, chemical contamination of the blast sites was considered as part of the environmental hazard. At King's Cross it was possible to rule out a chemical incident as a result of on-site monitoring, but at the other incident sites this was not possible[4]. Subsequent reports by responding medical teams have highlighted the need to regard all explosive terrorist attacks as being potentially either totally or partially chemical in nature.

Although on-site analytical evidence can provide valuable evidence, the clinical state of the casualties and need for continued surveillance for unexplained chemical signs and symptoms and developing lung injury is important, For this reason, consultant medical toxicology staff from the Chemical Hazards and Poisons Division, London, took part in joint patient and ICU ward rounds at Great Ormond Street, University College Hospital and the Royal London Hospital where the potential dangers had been realised by the attending surgical and intensive care teams.

Blast and toxic injury to the lung

Blast injury has been described as being in four stages[5,6]. The primary phase consists of a high pressure wave as a direct result of the explosive detonation. The force of this wave is dependent on the type of explosive used and whether the explosion is in the open or a confined space. The effects on the tissues of the body are thought to be due to shear waves resulting from the overall magnitude of the body wall displacement. The structures at risk from the primary blast wave are those containing gas, including the gut and the middle ear but the most vulnerable target is the lung tissue. Secondary damage from blast is defined as that due to penetrating injury from bomb-encasing materials and other foreign bodies. Tertiary injury is blunt injury due to the body being thrown against rigid structures by the blast wind, while the quaternary phase is damage due to burns and associated chemical releases including smoke.

The alveoli of the lung where gas transmission takes place are the most vulnerable to damage from the primary and quaternary phases and there are clinical similarities with damage seen after exposure to lung damaging toxic chemical agents such as phosgene and isocyanates[7]. Toxic pulmonary oedema causes a massive filling of the lung alveolar sacs due to a direct result of exposure to a wide range of inhaled toxic substances including smoke. It is the endstage of exposure to a large number of hazardous compounds from both accidental and deliberate release.

A high percentage of survivors from enclosed blast injury show signs of severe hypoxaemia and require intubation and intermittent positive pressure ventilation (IPPV) within two hours of admission[8]. Experimental studies carried in the United Kingdom have shown that blast injury tends to be worse in the lung facing the explosion where the explosion is in the open but bilateral following a detonation in a confined space[9].

The most extensive clinical experience in the management of blast lung has come from Israel where suicide terrorist bombings have been frequent in recent years and caused over 900 casualties between 2000 and 2003 alone[5]. Suicide bombings caused 46% of these. The observed pathological changes have included pneumothorax, alveolar rupture, and subpeural, intraalveolar and perivascular haemorrhages. These changes present clinically as pulmonary contusions.

During a period of 24–48 hours following admission, a number of patients with blast lung may develop adult respiratory distress syndrome (ARDS) with increasing opacity of the lungs on X-ray and progressive hypoxaemia despite ventilation with high concentrations of oxygen and positive end expiratory pressure. The development of ARDS in such cases has been thought to be the consequence of fat embolism or of further alveolar damage caused by the IPPV itself due to continuous opening and closing of damaged alveoli.

Clinical management

There are close similarities in the management of primary blast lung injury and toxic pulmonary oedema from chemical exposure. In both situations management is founded upon careful ventilation using controlled pressure IPPV, together with specific treatment with corticosteroids.

Hospital critical care services play a major role in the management of casualties from both explosive and toxic releases and there are important consequences when mass casualties present. In hospital management, the ICU is the endstage of management of the severely injured from both explosive and chemical attacks. Intensive care facilities are founded around the provision of artificial ventilation using IPPV, usually with a continued applied pressure during the expiratory phase known as positive end expiratory pressure.

The number of ICU ventilators available in hospitals is usually limited but recently high dependency units (HDU) have been set up to supplement the ICU by providing IPPV for post-operative patients overnight using simpler gas powered ventilators. Such units could have an important role to play in providing IPPV for mass casualties.

Recently new strategies of lung ventilation for use in the ICU have been adopted where the lung is opened up initially and then kept open by the application of positive end expiratory pressure with ventilation using less than normal tidal volumes. This 'open lung' technique of management leads to relatively high concentrations of carbon dioxide in the blood (so-called permissive hypercapnia) but which can be tolerated with a sufficiently high inspired oxygen concentration. This approach to ventilation may be very important for the management of blast and toxic lung damage to prevent the onset of ARDS. New ventilatory strategies for blast lung may be supplemented by further study on the place of systemic corticosteroids whose position in the management of smoke and chemical injury is not yet clear[7].

Conclusions

All terrorist incidents can potentially cause both traumatic and toxic damage to lungs. An integrated approach to clinical management is necessary to manage lung damage both prophylactically and therapeutically. Hospital emergency and intensive care specialists are now increasingly aware of the role their departments must play in the management of terrorist victims.

Although significant blast injury was identified in the casualties in hospitals, fortunately no unexplained chemical signs and symptoms were identified following the explosions on 7th July.

Although we hope that experience with blast injury will remain rare in civil practice, there is an increasing risk of such cases presenting as they did last July. In conventional practice, smoke inhalation provides the most common clinical example of lung damage. while many industrial chemicals exist which provoke toxic pulmonary oedema. Everyday ICU experience from polytrauma, inhalational injury and the various causes of ARDS provides a valuable clinical background which can be translated into care for the victims of terrorist attacks when they occur.

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Chemical Incident Management in Paris

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Photograph 1 Emergency ventilation of a casualty inside a Paris mobile intensive care unit

Introduction

The attacks in London in July of this year provided a reminder of the need for emergency services to respond to the mass casualties and disruption caused by terrorist attack. The attacks were not primarily chemical in nature, although the sites had many of the characteristics of a chemical incident due to products of combustion, fumes and dust. The medical response in London was based upon plans developed around the use of the London Ambulance Service. However, there was a significant issue about deployment of on-site medical personnel in a UK mass incident, a situation which for some time has been normal practice in France.

Although the Greater London area and the Paris region are comparable in size, for historical and political reasons they are governed and organised very differently in terms of response to emergencies. This is reflected in their arrangements for the management of both accidental and deliberate mass chemical releases. In both cities fire, ambulance and police services are all involved in chemical incidents. This article considers the role of the emergency services in the management of chemical incidents in Paris.

Emergency services in Paris

In Paris the emergency services are essentially part of an integrated national response, although the Paris police service, under the control of the Prefect of Police, operates independently from the Gendarmerie Nationale. The Paris Fire Service (Brigade des Sapeurs Pompiers de Paris, BSPP) is a fire and rescue service which has its own intrinsic emergency medical capability. Its personnel are part of the French Army and the officers are cross-posted to other military formations. The medical response provided by firefighters is essentially that of an emergency medical technician and they are capable of providing extended basic life support (defibrillators are carried on fire appliances). The BSPP operates its own medical response vehicles and has a small number of mobile intensive care units which are medically manned by Army medical officers. The service takes the lead in the management of toxic agent releases and is equipped with detection and personal protective equipment to allow personnel to work in contaminated zones to provide rescue and early medical support

The main medical emergency service in Paris is the civilian Service d'Aide Medicale Urgente (SAMU), which is operated by the Assistance Publique – Hopitaux de Paris (AP–HP). Unlike London there are no individual trust management organizations; hospitals and emergency care are all under the control of the AP–HP for the whole Parisian region, with nearly 100,000 employees. SAMU is essentially a medically controlled and operated service. Each of the departments which form the Paris region has its own SAMU control room, accessed by the public number 15, which is under medical control. Calls are taken by specially-trained operators who take initial patient history and details before passing the call on to a SAMU emergency doctor who carries out a telephone interview and decides the best response for the call. Responses are flexible and include giving advice only, sending a BSPP medical team, arranging a visit by the patient's GP or a supply doctor, or sending a dedicated SAMU mobile intensive care ambulance with a crew led by another on-call SAMU emergency physician (photograph 1). In the case of extreme emergencies such as cardiac arrest both BSPP teams and a fast SAMU response vehicle are dispatched within seconds of the receipt of the call. BSPP fire stations are closely positioned in central Paris and responders can be on site to provide initial life support and automated defibrillation within minutes before handing over to the SAMU team providing medical cardiac support.

Disaster command and control in London and Paris

There are significant differences between the command and control systems in London and Paris. The gold, sliver and bronze command levels designated in the UK do not have an exact equivalent in Paris. The on-site incident commander reports to the Prefect of Police (there is no departmental Prefect in Paris, unlike the rest of France) who in turn reports directly to the Prime Minister (Figure 1).

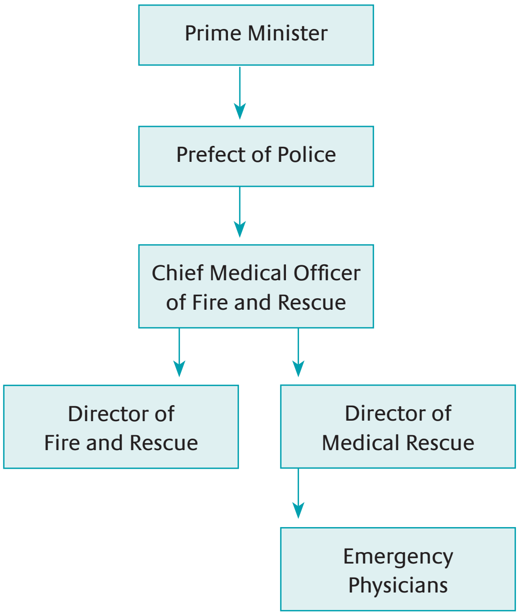

Figure 1 Command and control structure

Chemical incident response in Paris

Planning

In France there is an integrated national response system to all catastrophic incidents, including chemical, biological, radiological and nuclear incidents, whether they are major or minor. The system encompasses two key plans, designated Red and White. The red plan is activated early on at the time of the response and operated by the fire service. Part of its response is to evacuate casualties to a safe area away from the disaster site into the care of pre-hospital emergency medical responders who are controlled by the white plan (Figure 2).

The white plan is a pre-hospital and hospital emergency medical plan. Its activation is dependent on the number of casualties needing intervention. Under the French emergency system, the SAMU ambulance services are more closely linked with the hospital service than in the UK. Thus the white plan extends effectively beyond the hospital to link up with the red plan near the scene of the incident.

A modification of the white plan for the management of victims of a toxic release (Plan Biotox) was developed in 2002 from a major response plan issued by the Government some years earlier for conventional mass casualty incidents and is set out in a ministerial document called Circulaire 700. The plan identifies defence zones which are under the direct control of the Prefect of each department (with the exception of Paris which is under the control of the Prefect of Police). At the heart of each defence zone are referral hospitals containing special expertise and equipment as well as smaller hospitals, which are also capable of providing expertise on a regular basis. The reference hospitals are linked with the SAMU of the area they cover which is responsible for coordination of action.

Under the provision of the 2002 Act, each hospital must have a major response plan for the reception of mass casualties. This plan is most important for the large hospitals. In each of these hospitals a crisis centre is set up under the hospital director which has the following functions:

1 management of the white plan and relations with the media
2 coordination of medical resources – doctors and equipment
3 organisation of beds and personnel
4 economic and logistical functions
5 internal communications and traffic
6 reception of the patients and their records

In the case of chemical, biological and radiological incidents the white plan was modified in 2002 to provide extra responses, namely

1 identification of trained and equipped personnel who can respond to a chemical, biological and radiological incident
2 organisation of services and laboratories
3 stocktaking of material and drugs necessary for treatment
4 provision of personal protective equipment
5 organisation of specific reception areas which are away from the non-contaminated casualties
6 organisation of decontamination zones

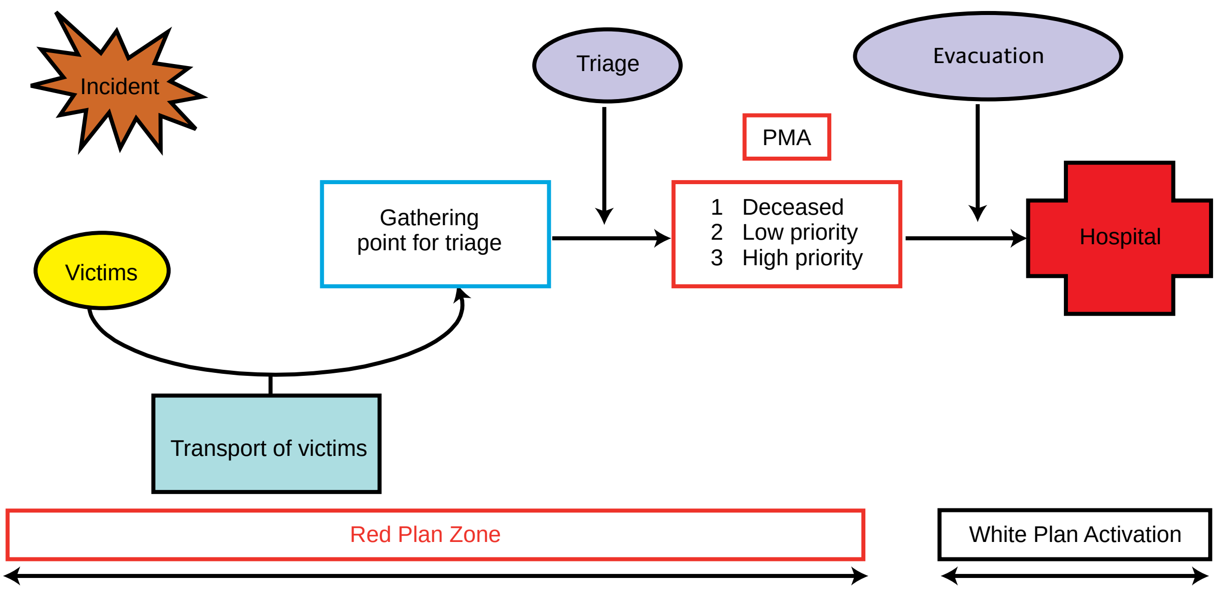

Figure 2 Interaction of red and white disaster plans for the evacuation of casualties

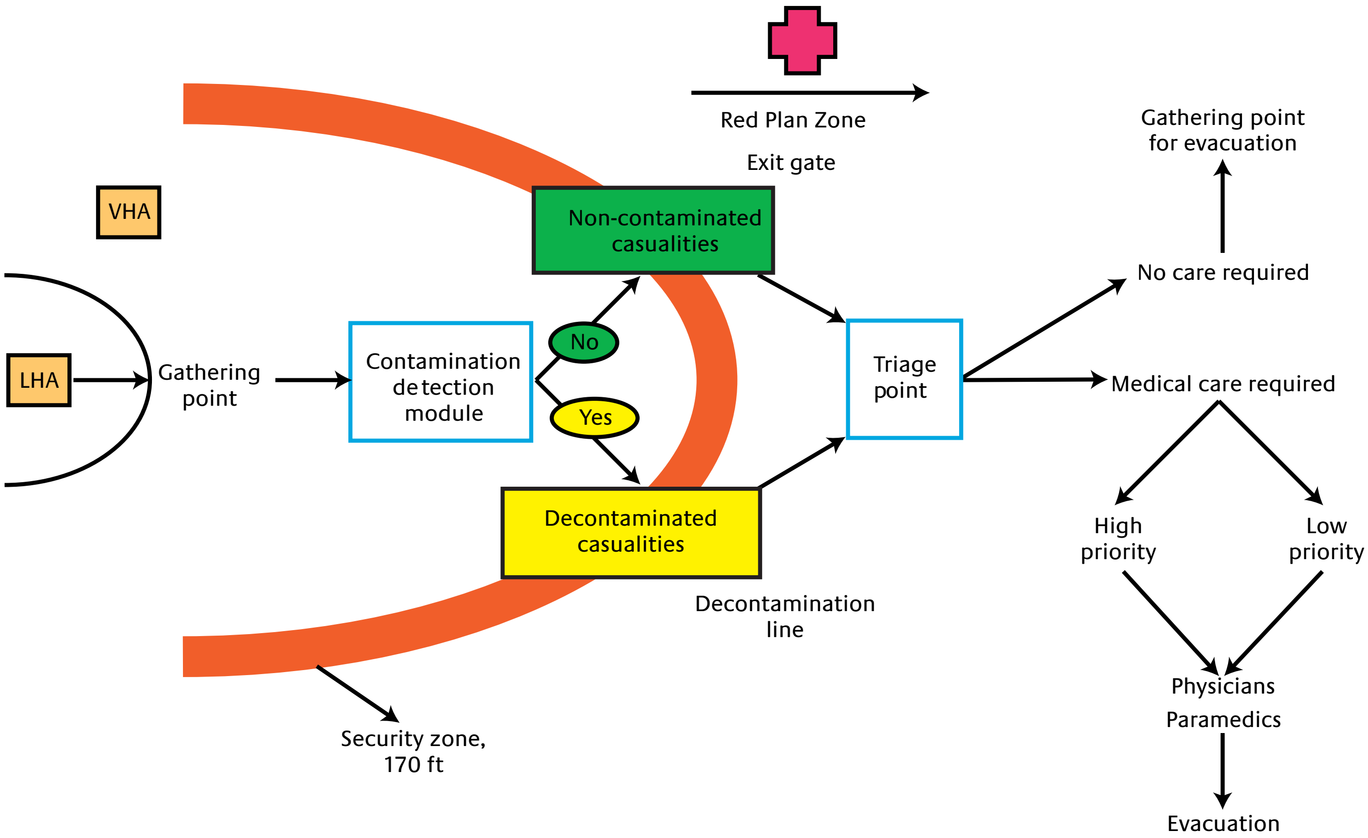

Figure 3 Red and white plan management of contaminated casualties

The annexes of the planning document Circulaire 700 detail specific responses required in the case of chemical release. These are

1. Identification of the chemical agent, using portable mass spectrometry and other techniques together with an analysis of the presenting signs and symptoms of the casualties – identification of the agent has high importance in relation to specific therapeutic measures used.
2. Protection of emergency personnel – the annex specifies that for emergency medical personnel when the identity of the agent is not known, level C protection with a filtration mask is essential. Protection equipment is to be held by SAMU and at the reference hospitals.
3. Decontamination – decontamination is to be carried out when the agent is not known or is persistent. The procedure may be carried out by decontamination units from Securite Civile (Civil Defence) which is still an important and well equipped and organised body in France.

Practical aspects

Red plan response

Figure 3 shows schematically the red and white plan arrangements and interaction for a chemical incident. An advanced medical post (AMP) is set up upwind and uphill of the incident site. Both the commander of rescue operations (COS) and senior medical officer present are concerned with recovery and triage of the victims. A medical officer from the BSPP performs primary triage in the contaminated zone and provides life support and the administration of antidotes. This is done in the outer area of the contaminated zone, prior to decontamination and transport to the AMP. Victims are triaged according to whether or not they are contaminated as well as for injury status. All victims at the incident site will be registered at the AMP prior to their release, providing good records of the patient's name symptoms and whether they were released or transported to hospital.

White plan response

In the case of a toxic agent release specially trained and protected SAMU medical response teams are sent to the incident. They work from the AMP which is set up just outside the decontamination zone and are responsible for re-triage and immediate treatment (photograph 2). Details of patients and their injuries are sent to the medical controller in the control room who decides the best equipped hospital to receive the case. In mass disasters nearly two-thirds of the available beds in Paris can be made ready for the receipt of casualties. SAMU teams perform more on-site treatment and stabilisation than paramedical teams in London, which means that the casualty can bypass the the A&E department and be sent straight to a medical or surgical service. Under the provisions of the Biotox modification of the white plan, SAMU teams can enter the contaminated zone and carry out life support for casualties who are classed as an absolute emergency. (The French emergency system has only two triage categories, absolute and relative; this is possible since triaging is done by medical officers and is based upon considerable medical experience.)

Hospital responses

Designated reference hospitals are equipped with their own decontamination and emergency response teams to deal with casualties who self-present without having been decontaminated at the incident site. This response was put in place following the experience in Tokyo in 1995 where many hundreds of contaminated patients arrived at one hospital causing secondary contamination of the A&E staff and department.

Photograph 2 Reception and decontamination facilities at a Paris chemical release reference hospital; the emergency physicians are wearing level C protection stored at the hospital with filtration respirators

Conclusions

There are considerable differences between London and Paris in the approach to the management of chemical releases. These reflect the different organisation of the emergency services in the UK and France. In Paris there is planned integration between the fire and emergency medical responses with deployment of protected on-site medical teams who are able to provide essential life support in a contaminated zone and to provide triage. The hospital and emergency medical services are closely integrated and there is provision for hospital reception and management of contaminated casualties.

Jersey Exercise: 7th October 2005

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Photograph 1 Simulated explosion (© CHaPD, London)

On 7th October 2005 a multi-agency live exercise was held in St Helier, the capital of Jersey, Channel Islands. The exercise followed on from a multi-agency table top scenario earlier in the year and involved the States of Jersey Fire and Rescue Service, ambulance service, police (States and Honorary), St Helier General Hospital, the Public Services Department, and local media. Invited observers included representatives from the fire, police and ambulance services of the UK mainland, emergency planners and the HPA.

Scenario

The exercise commenced at 16.00 on a Friday afternoon and involved an attack on a strategic government building in the centre of St Helier. In the scenario, an attacker was reported to have entered the building housing a number of government facilities including the tax office, and the Magistrates Court, spreading an unknown powder around the reception area, before detonating a device causing an explosion (photographs 1 and 2).

The first emergency vehicle, an ambulance, arrived on scene at 16.15, and parked around the corner, followed shortly thereafter by a fire engine. The Fire Service Incident Commander reconnoitred the scene, and liaised with colleagues from the police service to establish appropriate cordons. By 16.24 the Fire Service Incident Commander gave the order to contain the scene and set up decontamination facilities. The emergency services assessed the scene cautiously using the STEP 1-2-3 technique.

At 16.34 the Urban Fire and Rescue van arrived, and by 16.38 fire service personnel equipped with breathing apparatus further reconnoitred the incident scene (photograph 3). By 16.39 other fire service personnel had got the first ladder hose going for emergency decontamination.

The exercise involved multiple sites covering not just the response at the 'incident' scene but also the local hospital. The hospital initiated its secure procedure designed to prevent potentially contaminated self-presenting patients compromising the site (photograph 4). Porters were strategically stationed at the entrance doors and, due to the fortuitous geography of the building, were able to send potentially contaminated self-presenters via a side entrance, where the decontamination tent was set up and staff with personal protective equipment (PPE) were available.

Photograph 2 A significant effort had gone into planning the exercise, including the use of live casualties simulating 'toxic' and blast injuries (© CHaPD, London)

Photograph 3 Reconnoitring the scene of the incident (© CHaPD, London)

A major incident was called by all the emergency services. The fire service had its mass decontamination tent set up by 16.50, while the ambulance service had its clinical decontamination tent up by 16.55. The incident progressed and by 17.18 fire service personnel in gas-tight suits entered the incident building, while outside by 17.35 the 'walking wounded' were being supervised by the police while disrobing and putting on orange pre-decontamination suits. Two self-presenters attended the A&E department and were successfully decontaminated.

The public health aspects of the incident centred on a rapid assessment and identification of the unknown agent in liaison with the fire service. Representatives from Health Protection Jersey and Jersey Public Services attended the fire service silver meeting to assess and advise on the means of disposal of decontamination runoff water as well as incident scene security, minimising dispersal of the agent and appropriate infrastructure decontamination.

The exercise was terminated after four hours with all casualties at the scene decontaminated and triaged.

Photograph 4 Hospital warning notice (© CHaPD, London)

Discussion

Training exercises are a vital part of emergency preparedness, testing the ability of organisations to respond and work together effectively. Multi-agency live exercises require significant preparation, planning and resources but can achieve significant benefits in testing local response plans and identifying lessons.

Live exercises should attempt to be as realistic as possible and this exercise was an excellent example. Local residents and office workers had not been notified in advance of the exercise, ensuring that the emergency services responding to the incident had to communicate effectively whilst assessing the situation. However, the majority appeared unperturbed by the activity, and accepted the inconvenience.

The exercise enhanced the health services' understanding of the resources and skills available to them from the emergency services and other when responding to a major or catastrophic incident as well as exercising the health services' response. The Chemical Hazards and Poisons Division, London, was fortunate to have been asked to contribute to the exercise and to share in identifying lessons.

Viability of Cremation as a Method of Disposal for HazMat or CBRN Contaminated Fatalities

Leonor Wyborn, Chemical Hazards and Poisons Division, London

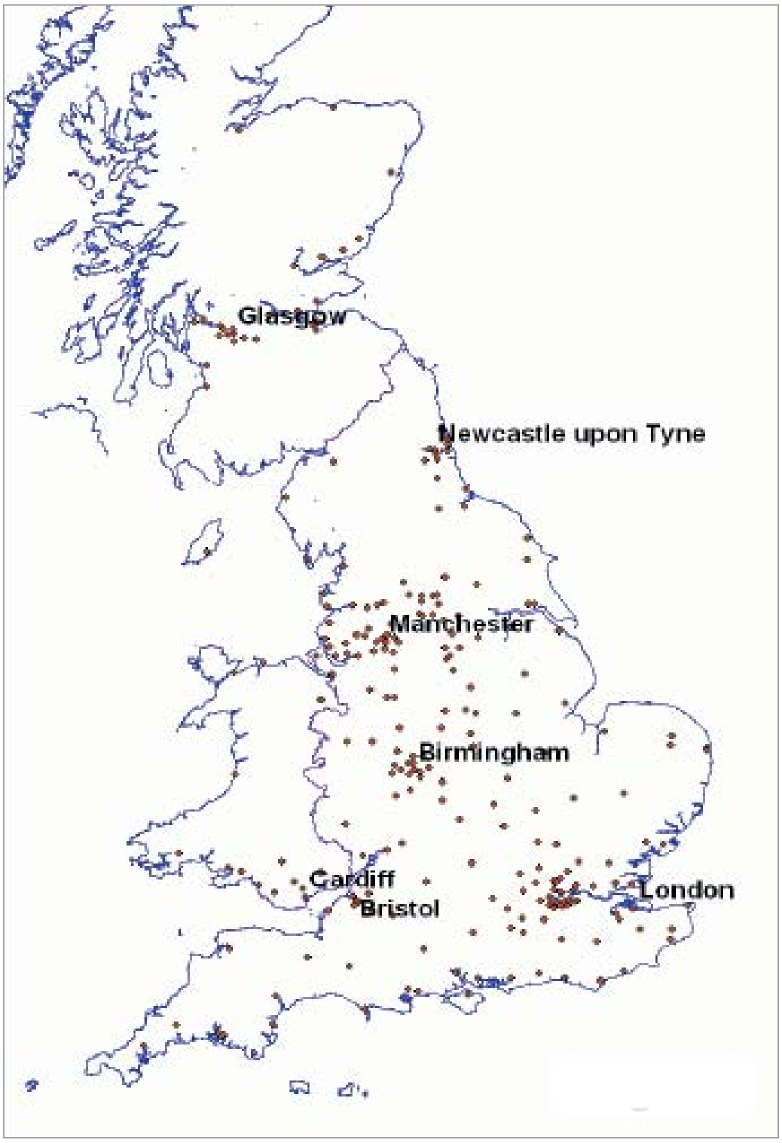
Introduction

No significant major incident resulting in chemically contaminated bodies has been recently recorded in the UK, but many such incidents have occurred around the world over the last 50 years. It is currently believed that a hazardous material (HazMat) or chemical, biological, radiological or nuclear (CBRN) event would result in mass fatalities. Taking into account public health and environmental issues, it has been suggested that cremation may be a safer method of disposal, although the potential does exist for secondary contamination to affect crematoria workers.

Cremation process

Approximately 70% of deaths in Great Britain result in cremation at over 245 crematoria[1,2]. The figure shows the locations of these crematoria with predictable clusters occurring in urban areas. Processes and emissions are controlled by the Secretary of State's Process Guidance Note 5/2 (04)[2].

The coffin of the deceased is received sealed[3] and is then placed on to the chapel catafalque (coffin stand). When the memorial service ends, curtains are drawn across and the coffin removed to a charging trolley. The coffin is only charged into the cremator primary chamber (600˚C+) once the secondary chamber has reached the required 850˚C[2]. The resulting ashes fall into the secondary chamber either naturally, through perforations in the hearth or manually by raking. After a sufficient period



Crematoria distribution in England, Scotland and Wales of time the ashes are transferred to an ash collector where they are left to cool before removing magnetic objects present using a magnet in a laminar airflow cabinet. To return the remains to the relatives in a more acceptable state the small pieces of ash are milled into a finer powder and transferred into an urn. The cremation process can take 20 minutes (infant) to 3 hours (large adult).

Secondary contamination issues

The process of cremation involves many more stages than burial and, consequently, the potential for secondary contamination of those working at crematoria is greater. The following issues have been identified during this work as areas of concern when dealing with chemically, biologically or radiologically contaminated fatalities.

- **Location of crematoria** Toxic components of a plume released from a crematorium stack may travel over populated areas and cause public health concerns. During research no plume modelling for crematoria stack release could be found, although legislation is in place to reduce this risk. The Cremation Act 1902 and the County Council General Powers Act 1935 state that crematoria should be situated no less than 100 yards from dwellings in London and 200 yards elsewhere in the UK[4]. Should the cremation of the chemical agent result in the production of dangerous decomposition products, these will be contained in the plume released from the crematorium stack.
- **Protection against leakage and off-gassing** Although coffins arrive at crematoria sealed, they are not hermetically sealed and, as a result, do not offer protection against leakage of hazardous agents or off-gassing[3]. Although it would be expected that a contaminated body would be placed in a body bag before being placed in a coffin, these are not especially leak proof/gas-tight and as such would only retard any release from the coffin. Also the cremator chambers are kept at a slightly negative pressure to contain any dangerous aerosols produced during cremation.
- **Equipment concerns** The table shows a list of equipment which may become contaminated and require decontamination or destruction.

Cremation of agents

Literature searches show that very little research has been published in the public domain on the consequences of cremation or incineration of chemical or biological agents. However, data does exist to show that radionuclides are not destroyed by heat, therefore making burial a more appropriate disposal method[5]. The US army believes that all chemical warfare agents are nullified when exposed to 538˚C for 15 minutes[6]. Provided stack scrubbing is in place to remove toxic products such as phosphorus pentoxide (produced by incineration of nerve agents) and the correct temperatures are used, the International Union of Pure and Applied Chemistry (IUPAC) states that "incineration is an environmentally safe method of toxic waste disposal"[7]. This, however, applies to incinerators not crematoria. Many biological agents are destroyed by temperatures below 170˚C, indicating that both chemical and biologically contaminated fatalities could potentially be safely cremated. However, further research needs to be done to confirm this. To cope with the increase in demand that would result from a mass fatality incident, throughput can be up to tripled by measures such as working extra hours and reducing the memorial service times.

Conclusion

From this investigation it can be concluded that cremation has the potential to be the safer method for disposal of chemically or biologically contaminated fatalities (but not those radioactively contaminated) when compared to burials. Additional research and scientific study are required to be able to properly assess the feasibility of cremation. This should be targeted at minimising harm to health and promoting public health protection if fatalities occur following exposure to potentially harmful chemical agents.

Acknowledgement

This work was carried out as part of a project placement in partial fulfilment of an MSc in Forensic Science, Department of Forensic Science and Drug Monitoring, King's College London.

References

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2 Secretary of State's Guidance for Crematoria Process Guidance Note 5/2 (04). London, HMSO, 2004
3 Federation of British Cremation Association. Code of Cremation Practice, May 2005
4 Federation of British Cremation Association. http://www.fbca.org.uk/docs.asp (accessed May 2005)
5 McDonnell CE. Disposal of Radioactive Wastes by Small Users. Radiation Protection Training Scheme Lecture Notes 2005. Chilton, HPA Radiation Protection Division
6 Domestic Preparedness Chemical Team. Guidelines for Responding to a involving Chemical Weapons Incident, August 2003. http://www.au.af.mil/au/awc/awcgate/army/sbccom_chem_response.pdf (accessed May 2005)
7 Pearson GS, MaGee RS. Critical Evaluation of Proven Chemical Weapon Destruction Technologies (IUPAC Technical Report). Pure and Applied Chemistry 2002; **74**(2): 187–316.

Equipment which may become contaminated		
Catafalque	Cremator chambers	Ferrous removal cabinet
Transfer trolley	Rakes	Ash pulverisor
Charging trolley	Ash collector*	Urn

* It has been claimed that ashes pose no contamination threat. Although this view is widely held, it is based on anecdotal not scientific evidence, and further work would certainly be required in substantiating this judgement with regard to CBRN contaminated remains.

CHaPD Developments

Strengthening Toxicological Expertise at CHaPD HQ

Rob Chilcott, Senior Toxicologist, Chemical Hazards and Poisons Division HQ, Chilton

The primary role of the Chemical Hazards and Poisons Division Headquarters (CHaPD HQ) is to provide the HPA with a central source of advice on chemical toxicity, particularly regarding the potential long-term effects of exposure. In support of these objectives, three toxicologists (John Pritchard, Sarah Bull and Rob Chilcott) have recently been recruited to form the Chemical Toxicity Team within the Toxicology Unit at CHaPD HQ – the general structure of the unit is shown in the figure. The team will initially be responsible for the production of three categories of documentation for providing toxicological information on priority chemicals, namely toxicity briefing notes, chemical incident briefing notes and systematic reviews.

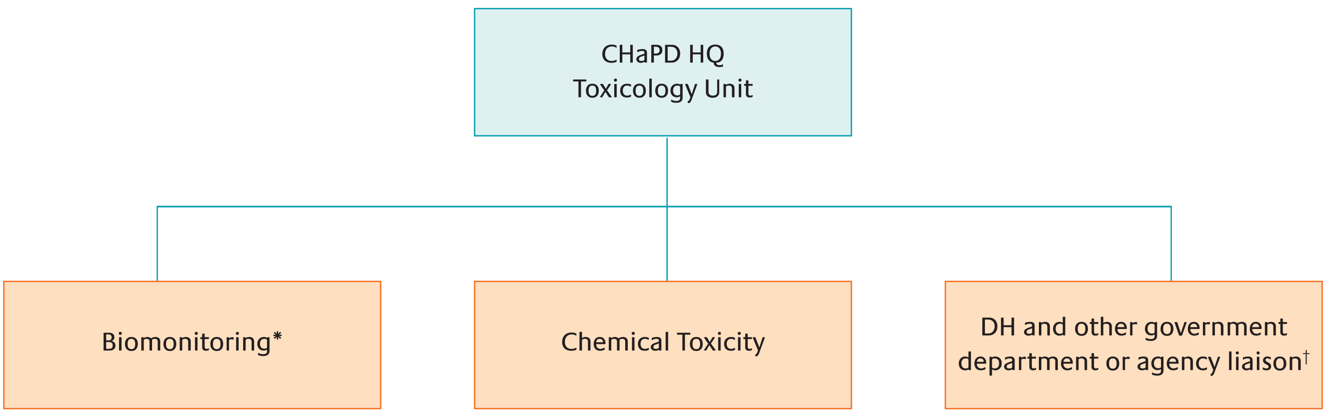
Technical briefing notes will concentrate on the chronic effects of chemicals (such as solvents, fuels, industrial gases and certain metals) that represent a range of hazardous materials that are in common use. The first set of documents is currently under review by CHaPD Unit Heads and may shortly be made available on the HPA website.

The team will also be responsible for the production of harmonised chemical incident briefing notes relating to acute exposures to chemicals. These will provide an authoritative source of information to the emergency services that deal with chemical incidents in the UK. The notes will largely be based on existing documents produced by CHaPD units at London and Cardiff. An example of one such note (on cadmium) is provided opposite. Clearly, it is vital that these notes fully meet all the practical requirements of first responders for a range of scenarios. Therefore, the team will liaise closely with CHaPD units that have extensive experience in such matters.

In addition, a longer-term strategy of the team includes the systematic review of key areas of interest to CHaPD and the HPA relating to environmental chemicals and public health. Two reviews are currently in progress to address this issue. One will seek to clarify the current state of knowledge on chemicals that specifically affect the nervous system, with emphasis on chronic degenerative diseases and developmental toxicity. The other will consider the reproductive toxicity of environmental chemicals and will highlight emerging techniques for assessing fertility or developmental problems that may be associated with chemical exposures.

Other duties of the team include:

- providing assessors or members for various government committees and working groups
- being a source of timely advice to HPA response teams and government during major incidents.
- drafting statements for the Communications Office
- providing chemical toxicity advice for the HPA National Poisons Information Service (NPIS)
- providing assistance in responding to requests for toxicological advice on chemicals received through the (recently established) HQ 'duty desk' system.



* Also responsible for CHaPD programme management.
† Includes advisory functions transferred from the Department of Health, including chemicals in soil, water and waste.

General structure of the Toxicology Unit at CHaPD HQ

Cadmium – Incident Management

Key Points

Fire

- Non-combustible solid; flammable dust/powder.
- Insoluble in water.
- Reacts with oxidising agents and acids.
- Use fine water spray and standard protective clothing.

Health

- Very toxic.
- Inhalation may cause irritation of the upper respiratory tract, shortness of breath or headache.
- Ingestion may cause gastrointestinal disturbances, oedema of face, neck and throat or sensory and motor disturbances.

Environment

- Avoid release into the environment.
- Inform Environment Agency of substantial incidents.

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes[a]

UN[b]		2570	Cadmium compound
EAC[c]		2X	Use fine water spray with liquid-tight chemical protective clothing in combination with breathing apparatus. Spillages and decontamination run-off should be prevented from entering drains and watercourses[d]
APP		–	
Hazards	**Class**	6.1	Toxic substances
	Sub risks	–	
HIN[e]		66/60	Slightly toxic/toxic/highly toxic substances

Chemical Hazard Information and Packaging for Supply Classification[f]

Classification	Xn	Harmful
	N	Dangerous for the environment
Label	Xn, N	Harmful, dangerous for the environment
Risk Phrases	R20/21/22	Harmful by inhalation, in contact with skin and if swallowed
	R50	Very toxic to aquatic organisms
	R53	May cause long-term adverse effects in the aquatic environment
Safety Phrases	S(2)	Keep out of the reach of children
	S60	This material and its container must be disposed of as hazardous waste
	S61	Avoid release to the environment. Refer to special instructions/safety data sheet

a Dangerous goods emergency action code list, HM Fire Service Inspectorate, Publications Section. London, The Stationary Office, 2004.
b United Nation Number.
c Emergency Action Code.
d Liquid-tight chemical protective clothing (BS 8428) in combination with fire kit (BS EN 469), gloves (BS EN 659) and boots (HO specification A29 or A30).
e Hazard Identification Number.
f Approved supply list (7th edition): information approved for the classification and labelling of substances and preparations dangerous for supply. Chemical (Hazard Information and Packaging for Supply) Regulations 2002.

Physicochemical Properties

Chemical/physical Properties	
Volatility[a]	Solid at standard temperature and pressure
Density[b]	8.64 g cm^{-3}
Flammability[a]	Non-combustible within solid bulk form. Powder may be flammable. Spontaneous ignition temperature of 250°C
Lower Explosive Limit	Not available
Upper Explosive Limit	Not available
Water Solubility[b]	Insoluble
Reactivity[b]	Most cadmium compounds react with oxidising agents, strong acids, magnesium and potassium. Explodes on contact with hydrozoic acid. Vigorous reaction with nitryl fluoride
Reaction or Degradation Products[b]	Slowly oxidised by air to form cadmium oxide
Odour[a]	Odourless

a Hazardtext® entry for cadmium. Thompson Micromedex Integrated Search Index (2005).
b The Merck Index (13th Edition). Entry 1613: Cadmium (2001).

Threshold Toxicity Values

Threshold Levels[a]

Exposure: ppm	Exposure: mg m^{-3}	Symptoms
0.05–0.69	0.01–0.15	Cough, irritation of throat. Gastrointestinal signs and symptoms (vomiting, abdominal cramps, diarrhoea)
2.30	0.50	Threshold for respiratory effects after 8 hours exposure
4.6–23.0	1.0–5.0	Immediately dangerous to health
23	5	Lethal after 8 hours
179	39	Lethal after 20 minutes
1149	250	Lethal after 10 minutes
11493	2500	Lethal after 1 minute

a Meditext® entry for cadmium. Thompson Micromedex Integrated Search Index (2005).

Emergency Response Planning Guideline (ERPG) Values

	ppm	mg m^{-3}
ERPG-1[a]	No values available	
ERPG-2[b]	No values available	
ERPG-3[c]	No values available	

a Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.
b Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
c Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

Exposure Standards, Guidelines or Regulations

Occupational Standards	WEL[a]	LTEL (8 hour reference period): 0.120 ppm (0.025 mg m^{-3}) STEL (15 min reference period): 0.230 ppm (0.050 mg m^{-3})	
Public Health Guidelines	Drinking Water Quality Guideline[b]	5 µg (Cd) L^{-1} (England and Wales)	
	Air Quality Guideline[c]	5 ng m^{-3} averaged over one year	
	Soil Guideline Values[d]	**Residential with plant uptake**	pH 6 – 1 mg kg^{-1} dry weight soil pH 7 – 2 mg kg^{-1} dry weight soil pH 8 – 8 mg kg^{-1} dry weight soil
		Residential without plant uptake	30 mg kg^{-1} dry weight soil
		Allotments	pH 6 – 1 mg kg^{-1} dry weight soil pH 7 – 2 mg kg^{-1} dry weight soil pH 8 – 8 mg kg^{-1} dry weight soil
		Commercial/industrial	1400 mg kg^{-1} dry weight soil

a Health and Safety Executive. EH40/2002 Occupational Exposure Limits 2002. The Stationery Office, London, 2002
b The Water Supply (Water Quality) Regulations, The Stationary Office (2000).
c WHO air quality guidelines – second edition.
d Department for Environment Food and Rural Affairs (DEFRA) (2002). Contaminants in soil: Collation of toxicological data and intake values for humans. Cadmium.

Decontamination

Important Notes

- Wear PPE appropriate to the type of incident.

Immediate Signs or Symptoms of Acute Exposure[a]

- Signs and symptoms of pulmonary exposure may be delayed 12–36 hours and include hypersalivation, metallic taste, cough, dyspnoea, chest pain and metal fume fever type features.
- Pneumonitis and pulmonary oedema may develop within 1–4 days.
- In severe cases death due to respiratory failure.
- Ingestion of small amounts causes irritation of the GI tract with nausea and diarrhoea usually within 15–30 minutes.
- Ingestion of larger amounts has effects on the metabolism of calcium and zinc and causes facial and pulmonary oedema.
- Skin contact causes irritation.

Skin Decontamination[b]

- Remove all soiled clothing.
- Wash all contaminated area thoroughly with soap and water.
- Treat symptomatically.

Eye Decontamination[c]

- This product is expected to be pH neutral but may be mildly irritating to the eyes.
- If symptomatic, immediately irrigate the affected eye with water or 0.9% saline for at least 10 minutes.

a TOXBASE entry for cadmium compounds (2002).
b TOXBASE entry for skin contamination – irritants (1996).
c TOXBASE entry for eye irritants (2002).

First Aid

Inhalation[a]

- Remove from exposure and give oxygen.
- Maintain a clear airway and adequate ventilation.
- Apply other measures as indicated by the patient's clinical condition.

Ingestion[a]

- Give oral fluids.
- Consider gastric aspiration or lavage.
- Apply other measures as indicated by the patient's clinical condition.

a TOXBASE entry for cadmium compounds (2002).

Position Statement on Municipal Solid Waste Incineration

Andrew Kibble
Head of Unit, Centre for Radiation, Chemical and Environmental Hazards, Birmingham

Foreword

The Health Protection Agency has prepared a short statement on municipal solid waste incineration (MSWI), issued in November 2005 and reproduced below. This provides public health professionals with the Agency's position on the health impacts of MSWI and will aid any decision making relating to applications under planning or integrated pollution prevention and control.

In preparing this statement, the Agency has reviewed the existing literature on incineration together with relevant statements from the independent expert advisory Committees on the Toxicity of Chemicals in Food, Consumer Products and the Environment (COT), Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC), and Mutagenicity in Food, Consumer Products and the Environment (COM). A draft position statement was then produced and subjected to peer review within the Centre and also the Department of Health. The statement went through multiple drafts before being approved by the Centre and the office of the Chief Executive. As a result of this process it is hoped that the position statement is scientifically robust, readable, logical, and free of ambiguity.

The statement is divided into three parts dealing with pollution potential, public health impact and evidence from existing health studies. It includes an introduction and conclusion for ease of use and cites key documentation upon which the statement is based. The importance of the Waste Incineration Directive is also discussed.

Any questions on the position statement should be directed to Andrew Kibble (andrew.kibble@hpa.org.uk).

Municipal Solid Waste Incineration

Introduction

The Health Protection Agency supports primary care trusts and local health boards in their role as 'statutory consultees' for the pollution prevention control (PPC) regime. Statutory consultees are considered to have special knowledge or expertise. Guidance is available at http://www.hpa.org.uk/hpa/chemicals/IPPC.htm.

Municipal solid waste incineration is subject to regulation under pollution prevention and control (PPC sector 5.1) and is likely to be a source of considerable public concern. Consequently the Chemicals Hazards and Poisons Division have produced this position statement on the public health consequences of these processes in order to help inform the debate.

Waste management

The introduction of the European Union Landfill Directive (1999/31/EEC) will fundamentally change the way waste is managed in the UK, with the most significant requirement being the progressive reduction in the amount of waste permitted in landfill. For example, by 2020 no more than 35% of the amount of biodegradable municipal solid waste produced in 1995 can be disposed of in landfill sites. This may place a greater emphasis on incineration as a means of waste disposal.

Pollution potential

The by-products of the incineration process may contain hazardous or toxic pollutants and emissions will contribute to background pollution levels. Since 1996 there have been significant cuts in emissions from incinerators in order to meet strict European Union legislation. This has led to the phasing out of the older, more polluting plants as new emission and operation standards were introduced. As a result contemporary facilities are substantially less polluting and modern abatement technology will help reduce the hazard from emissions provided that the facilities are properly operated at all times.

The European Union Waste Incineration Directive (often termed 'WID') 2000/76/EC will further reduce the potential to pollute. This was transposed into UK law on 28 December 2002 and all new incinerators already have to comply with the tighter provisions of this Directive. Previous existing incinerators have until 28 December 2005 to meet these standards. This new Directive aims to reduce and/or prevent possible negative effects on the environment caused by emissions into air, soil, surface water and groundwater, and thus lessen the risks which these pose to human health. Compliance will mean further significant reductions in the emissions of key air pollutants (such as nitrogen oxides, sulphur dioxide and hydrogen chloride, as well as dioxins and furans). As well as stricter emissions limits, this Directive also requires better management systems and increased monitoring of emissions.

The Waste Incineration Directive will therefore impose stricter operating conditions and emissions standards and so further reduce the potential human health impact. This should ensure that public health effects are unlikely. Pollution prevention and control permits will require immediate reporting of breaches of emission standards and the stopping of the waste feed should the abatement technology fail. These requirements will further reduce the potential for incinerators to cause significant pollution.

The incineration process can result in three main sources of emissions, (1) gaseous to the atmosphere, (2) via solid ash residues, and (3) via cooling water. Provided that solid ash residues and cooling water are handled and disposed of appropriately, atmospheric emissions remain the only significant route of exposure to humans.

Public health impact

The general public can be exposed to atmospheric emissions associated with incinerators through a number of routes; by direct inhalation and/or by indirect entry via the food chain being of particular importance. (For many pollutants including some of the trace metals, and carcinogenic organic compounds (such as dioxins and furans), the major route of exposure is through the food chain.)

There is no doubt that air pollution (from all sources) can have an adverse effect on the health of susceptible people (i.e. young children, the elderly and particularly those with preexisting respiratory disease). The adverse effects of airborne particles on health have been established through epidemiological studies and include increases in hospital admissions for both respiratory and cardiovascular disease, increased mortality and, when exposure is over long periods, reductions in life expectancy. There are also less severe but nonetheless important effects, such as increased symptoms in asthma sufferers. Other pollutants may have similar effects.

However, there is little evidence to suggest that incinerators are associated with increased prevalence of respiratory symptoms in the surrounding population. Modern, well-managed waste incinerators will only make a very small contribution to background levels of air pollution. Air-monitoring data demonstrate that emissions from the incinerators are not a major contributor to ambient air pollution. However, the contribution to local pollutant levels should be assessed on a site specific basis.

The Health Protection Agency recognises that there are particular concerns over emissions of dioxins and furans from incinerators. The following opinion on the health effects of these compounds, and of tolerable daily intakes, i.e. the amount that can be ingested daily over a lifetime without appreciable health risk, is informed by the advice of the independent expert advisory Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment[1]. This Committee has recommended a tolerable daily intake of 2 picogrammes TEQ/kg body weight/day[2] based on a detailed consideration of the extensive toxicological data available on dioxins and identification of the most sensitive effect, namely, adverse effects on the developing fetus resulting from exposure *in utero*. As this was the most sensitive effect it will protect against the risks of other adverse effects including carcinogenicity. The advice of two other independent expert advisory committees, the Committee on the Carcinogenicity of Chemicals in Food, Consumer Products and the Environment[3] and the Committee on Mutagenicity in Food, Consumer Products and the Environment[4], informed the conclusion, namely that dioxins do not directly damage genetic material and that evidence on biological mechanisms suggested that a threshold based risk assessment was appropriate.

The majority (more than 90%) of non-occupational human exposure to dioxins occurs via the diet, with animal-based foodstuffs like meat, fish, eggs, and dairy products being particularly important. Limited exposure may also occur via inhalation of air or ingestion of soil depending on circumstances. Provided that strict emissions limits are adhered to, inhalation is not a significant source of exposure for the general public.

Atmospheric emissions are also important through deposition to growing crops and pasture grass from which they can be incorporated into foodstuffs, either directly into edible crops or indirectly into animals that graze on the pastures. It is therefore possible that people who consume produce from local food chains within the area affected by emissions from the incinerator could receive a relatively higher exposure. However, current levels of dioxins emissions from incinerators are unlikely to increase the human body burden appreciably as incineration of municipal solid waste accounts for less that 1% of UK emissions of dioxins[5].

However, dioxins and furans are highly persistent pollutants and we strongly support the Government policy to reduce dioxin exposures further by all practicable means and welcome the stricter emission limits applied under the Waste Incineration Directive.

Health studies

Studies in the UK have principally focused on the possible effects of living near to the older generation of incinerators, which were significantly more polluting than modern plant. The Agency has considered studies examining adverse health effects around incinerators and is not aware of any consistent or convincing evidence of a link with adverse health outcomes. However, it is accepted that the lack of evidence of adverse effects might be due to the limitations regarding the available data.

A number of comprehensive reviews on incineration have been published. The Department for Environment, Food and Rural Affairs[6] have recently commissioned a review of the effects of waste management, which was peer reviewed by the Royal Society. Cancer, respiratory disease and birth defects were all considered, and no evidence was found for a link between the incidence of the disease and the current generation of incinerators. It concluded that although the information is incomplete and not ideal, the weight of evidence from studies so far indicates that present day practice for managing solid municipal waste has, at most, a minor effect on human health and the environment, particularly when compared to other everyday activities.

An earlier report by the Medical Research Council's Institute for Environment and Health on the 'Health Effects of Waste Combustion Products'[7] also concluded that 'epidemiological studies on people who work at or live near incinerators have shown no consistent excess of any specific disease'.

The Committee on the Carcinogenicity of Chemicals in Food, Consumer Products and the Environment[8] has reviewed a large study by the Small Area Health Statistics Unit that examined 14 million people living within 7.5 km of 72 municipal solid waste incinerators, which operated up to 1987. The Committee concluded that, 'any potential risk of cancer due to residency (for periods in excess of ten years) near to municipal solid waste incinerators was exceedingly low and probably not measurable by the most modern techniques'. We agree with this view.

Conclusion

Incinerators emit pollutants into the environment but provided they comply with modern regulatory requirements, such as the Waste Incineration Directive, they should contribute little to the concentrations of monitored pollutants in ambient air. Epidemiological studies, and risk estimates based on estimated exposures, indicate that the emissions from such incinerators have little effect on health. The Agency, not least through its role in advising primary care trusts and local health boards as statutory consultees for pollution prevention and control (PPC), will continue to work with regulators to ensure that incinerators do not contribute significantly to ill-health.

Notes

1. Available at http://www.food.gov.uk/science/ouradvisors/toxicity/
2. TEQ refers to Toxic Equivalents and is an internationally recognised method for considering the toxicity of mixtures of dioxins and furans based on considering their relative potencies compared to the most potent dioxin (tetrachlorodibenzodioxin, or TCDD).
3. Available at http://www.advisorybodies.doh.gov.uk/coc/index.htm.
4. Available at http://www.advisorybodies.doh.gov.uk/com/index.htm.
5. Available at http://www.defra.gov.uk/corporate/consult/dioxins-two/report2.pdf.
6. Review of Environmental and Health Effects of Waste Management; Municipal Solid Waste and Similar Wastes, published May 2004. Available at http://www.defra.gov.uk/environment/waste/research/health/.
7. Available at http://www.le.ac.uk/ieh/pdf/R7.pdf.
8. The full statement can be found at http://www.advisorybodies.doh.gov.uk/coc/munipwst.htm.

Health Protection in the 21st Century

Understanding the Burden of Disease; preparing for the future

Dr Pat Saunders, Chemical Hazards and Poisons Division, Birmingham

This report, published in October 2005, represents a first step in identifying and quantifying the burden of disease across the broad health protection spectrum from infections to environmental hazards. The Chemical Hazards and Poisons Division provided or contributed to chapters on environmental pollution, inequalities, chemical incidents and poisons.

Key messages include:

- Up to 57 children per 1,000 in England and Wales may have long-term lung function affected by air pollution. In England and Wales 20% of children have asthma and an estimated 30% of acute exacerbations of childhood asthma are related to outdoor air pollution. An estimated 36 children and 30 adults per 1,000 population may have asthma potentially attributable to chemical environmental factors.
- There is some evidence of an association between daily concentrations of particles and hospital admissions for treatment of cardiovascular disease. A 1 $\mu g\ m^{-3}$ drop in annual mean $PM_{2.5}$ particles throughout the lifetime of individuals in England and Wales may reduce mortality rate from cardiovascular disease by 0.1%.
- There is increasing evidence that environmental injustice is a real and substantive problem within the UK, although the causes, effects and distribution are varied and complex.
- Environmental quality varies between different regions and communities and there is an inequitable distribution of environmental hazards among children of different social groups and different regions of England and Wales.
- Catastrophic chemical releases are rare but there is a burden of low level incidents, with approximately 1,200 reported per annum, which potentially have a significant impact on morbidity.
- Large-scale regulated industrial processes are involved in only 1% of reported chemical incidents, suggesting that the specific controls placed upon these sites are effective risk management measures.
- For the period 1999–2004, it is estimated that 50,000 people have been exposed to chemicals as a result of chemical incidents, of which approximately 20% experienced symptoms post-exposure.
- In 2002, around 6,600 deaths were attributable to poisonings or exposures to noxious chemicals (11 per 100,000 population) in the UK.
- The cost of poisoning to the NHS in hospital bed days alone is approximately £110 million, excluding the cost of emergency department attendances.
- Enquiries to the National Poisons Information Service (NPIS) relating to childhood poisonings mainly concern household products, chemicals and pesticides.

The report is available at http://www.hpa.org.uk/hpa/publications/burden_disease/default.htm.

Environmental Issues

DWI 15th Annual Report on Drinking Water Quality in England

A summary of those parts relating to the South East Health Region

Dr Howard Eastcott, HPA South East

This paper tries to review information from the DWI annual report[1] and its health implications for the South East Health Region. The most useful means for understanding the complex nature of the water industry and its relationship to health at the regional health level is the map indicating how the areas covered in the report relate to the local government areas comprising the South East (Figure 1). This, together with a selection of critical discussion points, may be useful to other HPA regions.

Whilst most of the important aspects of the report are contained within the summaries for the drinking water regions, critical information – e.g. that relating to incidents – is not comprehensively carried in the summaries and requires a great deal of to-ing and fro-ing between regions and individual water companies to extract the relevant health-related detail. It is noted in the introduction that the DWI intends to bring out a national document devoted to incidents, their management and lessons learned – this will be helpful.

The drinking water for residents in the South East is derived from sources in at least four of the six English drinking water regions and from 12 of the 23 English water companies. From the map it will be clear that the South East Health Region comprises all of the Southern Drinking Water Region, a substantial part of the Thames Drinking Water Region and smaller parts of the Eastern and Western Drinking Water Regions. Within

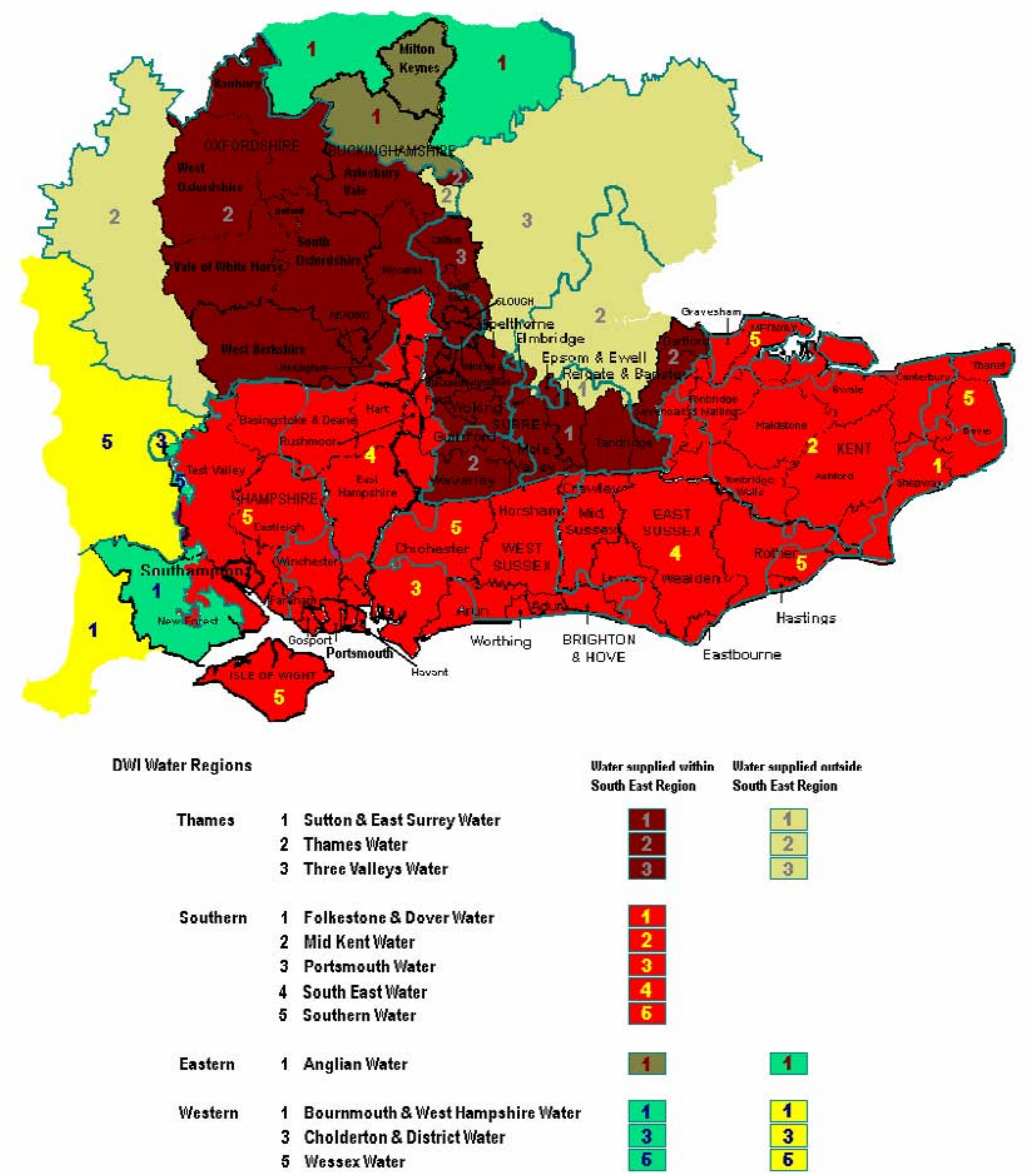


Figure 1 Map relating DWI water regions to water companies and local government boundaries in the South East Health Region

this overall framework there is a complex relationship between water companies and local government areas ;and within water company areas there are variations in the way that the different types of local water sources, the local populations of those areas and the drinking water they receive are related, making the whole system one of great complexity.

The overarching picture is of a water industry across the South East delivering drinking water of very high quality, better than 99.94% mean zonal compliance, in the face of increasingly stringent water quality standards and demographic, climatological and environmental factors that place added technical burdens on the water companies.

In the majority of instances where water samples failed to meet the quality standards, the cause was more often than not down to corrosion of ancient cast iron water mains. The DWI is supervising a managed programme of refurbishment and replacement of these sources of failure to meet the quality standards for iron, manganese and turbidity. Addressing these problems will go a long way to meeting the bulk of customer complaints. This is depicted by the crude map (Figure 2), compiled by stitching the maps from DWI regional pages to achieve as close a congruent fit as possible.

Failures to meet standards arise from environmental pollution, either chemical or microbial. The report details the activities designed to detect and deal with these where they arise. The table lists the exceedances for the Thames and Southern Drinking Water Regions combined. It was not possible to extract the contribution to London health region customers but these contributed the majority of lead level failures (mainly due to faults in domestic plumbing).

Whilst water quality is high, there is an appreciable variation in the chemical composition of drinking water within England. The treatment methods used in any particular works will reflect the sources of water that are treated. The report outlines the increasing use of granular activated charcoal filtration beds, membrane filtration, phosphate dosing and ozonation as means of achieving the relevant standards. A pattern also seems to be emerging of mixing waters from different sources in order to dilute chemical impurities that may breach water quality standards. In this regard there is a debate to be had over whether one simply aims to meet the relevant standard or to go for an ALARP (as low as reasonably possible) outcome.

The question of what standards are appropriate given the incomplete and imperfect understanding of all the potential risks is also a complex one. With the appointment of the DWI and the involvement of the public in a dialogue, at least this process is transparent.

Oil and chemical spills to vulnerable groundwater sources are also mentioned – for example, the Three Valleys Water Companies chalk aquifer polluted by a former chemical industrial plant at Sandridge in Hertfordshire. This incident was first detected in 2000 and is highlighted in this year's report under matters of local interest within the Thames Region report.

This incident may be only of local interest but the consequences have been major and the supporting re-engineering of water supplies in the area to minimise the impact of this source of bromate pollution will not be complete until 2008. This could have implications for the water industry as a whole from the potential impact of contaminated land where the contaminating plume has yet to reach an aquifer.

As a corollary of this, but not included in the report, the Environment Agency in the Southern Region has identified shallow chalk aquifers along the South Downs as being particularly vulnerable and has launched a proactive campaign to protect these from pollution by domestic heating oil spills, which are one of the most common types of chemical pollution incident reported to the Agency[3].

One final point raised in the DWI scientific report section that seems likely to have an impact on our ability to determine where water relating to a particular incident or locality was originally from are the new

Figure 2 Water zones in the South East Region with iron failures in 2004

Table Chemical parameters and turbidity for the Thames and Southern Drinking Water Regions combined in 2004

Substance	Standard	No. of tests	No. of failures	Notes[a,b]
1,2-dichloroethane	3.0 µg/l	4,089	0	This was a new parameter in the 2000 Regulations
Aluminium	200 µg/l	8,531	2	TVW (1), SRN (1)
Antimony	5.0 µg/l	4,009	3	The standard prior to 25/12/03 was 10 µg/l. SES (1), TMS (2)
Arsenic	10.0 µg/l	4,013	0	The standard prior to 25/12/03 was 50 µg/l
Benzene	1.0 µg/l	4,090	0	This was a new parameter in the 2000 Regulations.
Benzo(a)pyrene	0.01 µg/l	4,282	1	SEW (1)
Boron	1.0 mg/l	3,903	0	The standard prior to 25/12/03 was 2.0 mg/l
Bromate	10.0 µg/l	3,808	3	This was a new parameter in the 2000 Regulations. SEW (1), SRN (2)
Cadmium[d]	5.0 µg/l	2,579	1	SES (1)
Chromium[d]	50.0 µg/l	1,424	4	SRN (4)
Copper	2.0 mg/l	3,973	0	The standard prior to 25/12/03 was 3.0 mg/l
Fluoride	1.5 mg/l	4,080	0	
Iron	200 µg/l	10,395	33	SES (5), TMS (13) and TVW (4), MKT (1), SEW (8), SRN (2)
Lead	25.0 µg/l	13,255	76	The standard prior to 25/12/03 was 50 µg/l. SES (2), TMS (64) and TVW (3), PRT (1), SEW (2), SRN (4)
Manganese	50.0 µg/l	7,768	4	TVW (1), SEW (3)
Nickel	20.0 µg/l	3,964	4	The standard prior to 25/12/03 was 50 µg/l. SEW (4)
Nitrate	50.0 mg/l	9,289	2	TMS (1), TVW (1)
Nitrite	0.5 mg/l	9,310	1	The standard prior to 25/12/03 was 0.1 mg/l. PRT (1)
Individual pesticides[c]	0.1 µg/l	97,669	15	2,4-D PRT (1), SRN (1), Carbetamide TVW (1), SEW (1), Chlortoluron SEW (1), Glyphosate TVW (3), SEW (1), Isoproturon TVW (1), MCPA SEW (1), Mecoprop SEW (1), Metaldehyde PRT (1), Simazine PRT (1), SEW (1)
Polycyclic aromatic hydrocarbons (PAH)	0.1 µg/l	4,285	0	The standard prior to 25/12/03 was 0.2 µg/l
Tetrachloroethene and trichloroethene	10.0 µg/l	4,377	2	The standard prior to 25/12/03 for tetrachloroethene was 10 µg/l, and for trichloroethene was 30 µg/l. The new standard applies to the sum of the two substances. TMS (1), TVW (1)
Total pesticides	0.5 µg/l	3,563	4	TVW (2), PRT (1), SEW (1)
Total trihalomethanes	100 µg/l	4,212	9	SEW (6), SRN (3)
Turbidity	4 NTU	10,567	3	SES (1), TMS (2)

Notes

a For summary details of all tests undertaken by each water company refer to Part 3 in the full DWI report.

b For comparison, 1 mg/l is one part in a million, 1 µg/l is one part in a thousand million.

c A further 8,046 tests were carried out for aldrin, dieldrin, heptachlor, heptachlor epoxide, all of which met the relevant standard.

d The Southern tables include chromium but not cadmium; the Thames tables include cadmium but not chromium.

water supply licensing regulations designed to increase competition between water companies on prices. From autumn 2005 non-domestic customers who use at least 50 million litres of water per year in a set of premises will be able to purchase their water from either their existing water company or from a licensed water supplier. Whilst this process will no doubt be carefully regulated, we may see, particularly for chemical and environmental pollution, incidents threatening the purity of raw water sources and an increasing need to use isotope 'fingerprinting' and similar techniques to determine sources of contamination[4].

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2 CDR 2005; **15**(41): 13

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Bioavailability/bioaccessibility Testing in Risk Assessment of Land Contamination

A Short Review

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Introduction

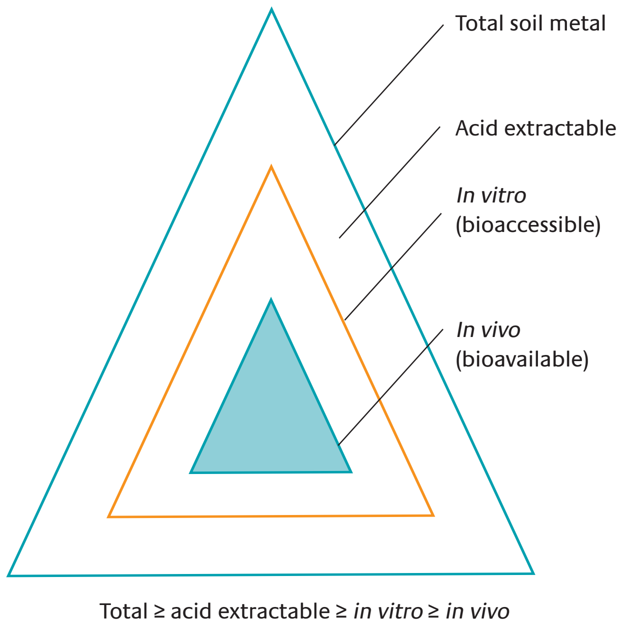
Bioavailability has long been established as a common concept in toxicology, nutrition and agricultural science. Broadly, it describes a chemical's ability to interact with the biological world (NRC 2003). The definition of bioavailability, however, varies between disciplines. In human health risk assessment, two operational definitions of bioavailability have been used – absolute and relative. Absolute bioavailability is defined as the fraction or percentage of an external chemical dose which reaches the systemic circulation, i.e. the ratio of internal dose to an applied dose (Hrudy et al 1996). Relative bioavailability is the comparison of absolute bioavailabilities of different forms of a chemical or for different exposure media containing the chemical (US EPA 2005).

As direct measurement of bioavailability of soil-borne chemicals in humans is often impractical, various animal models (*in vivo**) have been employed to study the bioavailability of toxic chemicals as a surrogate for children (Freeman et al 1992; Casteel et al 1997; NEPI 2000; NRC 2003; US EPA 2005) (Table 1). The limitations of such an approach are that bioassays are specific to the test organism, chemical and matrix, therefore interpretation of data, and extrapolation to humans, needs careful consideration (NRC 2003; Schoof 2004). Moreover, these animal models have not been validated against estimates of bioavailability in humans (for example, only one soil sample was studied for human bioavailability of lead, Maddaloni et al 1998). Despite these limitations, the use of animal bioavailability assays has increased in the last two and half decades, particularly in the USA, in order to set clean-up goals for contaminated sites (Casteel et al 1997; NRC 2003).

As routine use of animals in refining risk assessment is challenging in terms of cost, time, facility and expertise and ethical reservations, *in vitro*† bioaccessibility methods attempting to mimic human gut conditions have been developed (Ruby et al 1993, 1996; Drexler 1998; Sips 1998). Bioaccessibility is a measure of dissolution of a contaminant from soil in an *in vitro* study, while bioavailability is the fraction that is absorbed *in vivo*. The *in vitro* bioaccessible fraction should therefore be greater than, or equal to, the *in vivo* bioavailable fraction (see the figure).

Interest in bioaccessibility is mainly focused on the oral ingestion of soil because of the childhood behaviour of deliberate mouthing of soil or inadvertent mouthing of dirty hands. Oral bioaccessibility can be defined as the fraction of an ingested contaminant which is released into synthetic solution from the soil during digestion (Defra and Environment Agency 2002a). In *in vitro* methods, soils containing metals are incubated in a low pH solution for a period intended to mimic residence time in the stomach. The pH is then increased to near neutral, and incubation continues for a period intended to mimic residence time in the small intestine. In addition to the stomach and intestine phases, some *in vitro* methods also have a saliva phase (Table 2). In most *in vitro* methods, enzymes and organic acids are added to simulate gastric and small-intestinal fluids (NFESC 2000) with the exception of that of Drexler (1998). *In vitro* methods have been reviewed by Oomen et al 2002, Environment Agency and BGS 2002a, Grön and Andersen 2003, and Grön 2005.

* Latin for (with) in the living. *In vivo* is used to indicate the experiment with a live animal.
† Latin 'within glass' means within a test tube.



Hypothetical relationship of metals in soil with *in vitro* and *in vivo* fractions

Why does bioavailability/bioaccessibility testing matter in risk assessment?

Health criteria value (HCV) used in risk assessments of land contamination are generally derived from toxicological or epidemiological studies. For example, HCV for arsenic is based on epidemiological studies of people exposed via drinking water, while the oral HCV for nickel is based on observations on rats fed nickel in their diet (Defra and Environment Agency 2002b,c). In addition, HCVs are often based on the default assumption that a chemical is equally bioavailable in all media. This assumption might not be true for soil contaminants due to the effect of sequestration‡ in soil, which may cause bioavailability to differ from site to site depending on soil constituents and the prevailing physico-chemical conditions (NRC 2003; US EPA 2005).

The limitation of default estimates has been demonstrated in the USA, when site-specific bioavailability data were incorporated into the US EPA Integrated Exposure Uptake Biokinetic (IEUBK) model for lead and compared against the default (0.6 relative bioavailability). It showed that the bioavailability of lead could vary as much as two orders

‡ Sequestration refers to some combination of adsorption, partitioning, and/or chemical bonding (Ruby 2004).

Table 1 *In vivo* models used in bioavailability study of toxic chemicals

Subject	Target organs/tissues	Chemical	Reference
Human	Urine and blood	Pb	Maddaloni et al 1998
Juvenile swine	Blood, liver, kidney, bone	Pb, As	US EPA 2005
Monkey	Urine, faeces, blood	As	Roberts et al 2002
Rat	Blood, organs	Pb, As	Ruby et al 1996
Rabbit	Blood, organs	Pb	Ruby et al 1993

Table 2 Popular *in vitro* bioaccessibility models and their salient characteristics

Method	Segments	Chemical	References
PBET	Stomach, intestine	Pb, As	Ruby et al 1996
SBRC (or Drexler method)	Stomach	Pb, As	Drexler 1998
IVG	Stomach and/or intestine	Pb, As, Cd	Rodriguez et al 1999
MB	Saliva, stomach, intestine	Pb	Ellickson et al 2001
RIVM	Saliva, stomach, intestine	Pb	Oomen et al 2003
DIN	Stomach, intestine	Pb, Cd, Ni, PAH	DIN 2000

of magnitude with soil type. Of 19 soils, 47% showed higher relative bioavailability, 37% lower and only 16% were comparable to the default value. Therefore risk assessments, based on a default value, may not only overestimate risk but may actually underestimate risks, and may not therefore be appropriate for all circumstances (Ruby et al 1999; Ehlers and Luthy 2003; US EPA 2005).

Risk assessment using default estimates of average daily exposure based on a chemical's total concentration in soil may identify many areas of land where contamination may exceed a minimal or tolerable risk level. In large areas of the UK, natural arsenic levels in soil exceed the soil guideline values. The sources of such elevated levels are not necessarily anthropogenic in origin, but mainly relate to the soil's parent materials. Although no information is available about arsenic-induced health problems across the UK, caution is necessary as scientific uncertainty still exists over the effect of chronic low level arsenic exposure and the absence of a detailed medical/epidemiological study on health problems in the population[§]. Even so, the remediation of large areas of land may not be economically feasible and carries the risk that remediation activities, whilst reducing the levels of contamination within the ground, may result in wider pollution of the environment (Environment Agency 2001). Obtaining information on site-specific bioaccessibility, as a surrogate of the relative bioavailability of the chemical from the medium of interest relative to that of the critical study, would be likely to reduce uncertainty, strengthen risk assessment, and reduce the need for remediation.

Limitations and challenges of *in vitro* bioaccessibility testing

A science-based discussion of oral bioaccessibility testing, its applicability and limitations for use in risk assessment is given below. As arsenic contamination is a primary concern for the UK, a special emphasis is given to this chemical in relation to the progress achieved for lead.

§ The reports on urinary arsenic concentrations in humans in elevated areas are inconclusive (Johnson and Farmer 1989; Kavanagh et al 1998; Hinwood et al 2004).

In vivo and *in vitro* correlation

Despite uncertainty over the validity of the *in vivo* model itself, considerable efforts have been made to correlate *in vitro* methods against *in vivo* data either in parallel with the *in vivo* study or later in isolation (see, for example, Ruby et al 1993, 1996; US EPA 2005; Grön 2005).

In the case of lead, the *in vivo* database is robust, against which *in vitro* studies have been found to correlate well (Ruby 2004). In addition, US EPA (2005) also indicates a good *in vivo* and *in vitro* correlation using the Drexler method (stomach phase), and the relation could be predictive of lead's relative bioavailability. It is worth noting that the Drexler method, unlike most of the published *in vitro* methods, is not purely physiologically based as it does not use synthetic gastric fluid. The sample size (n=19) used in the US EPA study (2005) was limited. Therefore caution must be used when applying the Drexler *in vitro* method to soils containing lead phases different to those used in the US EPA study (2005). The recently completed Danish EPA study on lead validation also showed a good *in vivo* and *in vitro* correlation for lead using a modified version of the RIVM method (Grön 2005).

For arsenic, the *in vivo* database, unlike lead, is insufficient, and its reliability also questionable (Ruby 2004). The correlation between *in vitro* and *in vivo* data with currently available *in vitro* methods is still less robust and clear (Ruby 2004; Beringer and Maddaloni 2005). In addition, when the Danish EPA study reviewed available data on arsenic, it was found that *in vitro* results in some instances were equal to or less than *in vivo* data (Grön 2005). This leads to the questions of reliability of both *in vitro* and *in vivo* data.

More work is ongoing in the USA using a primate model to develop a validated *in vitro* method for arsenic using primate *in vivo* data (Yvette Lowney Exponent; Mark Maddaloni, US EPA, personal communication, 2005). In Europe, the Bioaccessibility Research Group Europe (BARGE) is to undertake a study for lead and arsenic with several *in vivo* tested US soils using a unified method (to be adapted from the Dutch RIVM method).

Reproducibility of *in vitro* data

Except for the Drexler method, all *in vitro* methods are physiologically based and attempt to mimic the gut conditions of children (Table 2). In principle, these methods should all produce a comparable bioaccessibility result for the same sample but, in reality, results were found to be method specific (Oomen et al 2002). For example, an interlaboratory study undertaken between BARGE members showed a considerable variability for three soils run through five *in vitro* methods. Variability was reported as: arsenic 6–95%, 1–19% and 10–59%; cadmium 7–92%, 5–92% and 6–99%; and lead 4–91%, 1–56% and 3–90% (Oomen et al 2002; Sips 2005). In addition, within-laboratory variability was also reported for all three metals. The reason for such a wide variability between the methods is believed to be due to a difference in their experimental set up and pH value (Oomen et al 2002; Grön and Andersen 2003).

In contrast, in the US EPA study on lead, the Drexler method showed a good within-laboratory reproducibility (average ≤2%) and between four laboratories (average difference of 2–3%, range of difference 1–9%) (US EPA 2005). With regards to reproducibility, it is expected that the current Environment Agency project involving UK laboratories and two from overseas will provide more information on lead and arsenic in UK soils.

Robustness of methods

A number of studies indicated that bioaccessibility/bioavailability vary not only from chemical to chemical, but from site to site and even between different forms of a chemical (Ng et al 1998; Danish EPA 2003; Stewart et al 2003; Ruby 2004). In the UK, the *in vitro* estimates for arsenic in three different parts of the country reported considerable variations: Cardiff area 6–15%; Wellingborough 2–9% and Devon 0.5–42% (Environment Agency and BGS 2002b). In the US EPA study, *in vitro* data ranged from 4.5 to 87.2% (n=19). This variability raises the question of how robust the in-vitro methods are for different UK soil types in relation to the soils *in vivo* bioavailability data. An *in vitro* method validated with certain soil types may not necessarily be applicable to other soil types, not only because of site heterogeneity but also because of likely differences in the disposition and metabolism of chemicals within the human body (Scoof 2004; US EPA 2005).

Standard method

It is debatable whether one method could be suitable for all contaminants. The behaviour of a contaminant within the environment and living organisms is often quite unique to each chemical For example, arsenic is present in soil as an anion, whereas lead is a cation (Ruby et al 1999). The dissolution of chemicals in the stomach and intestinal phases of the human gut is also likely to be chemical specific. Therefore different study designs are necessary to reflect these variable characteristics and a one-size-fits-all test may not be possible.

Certified reference materials

In order to be used on a routine basis like other analytical methods, the quality of *in vitro* methods needs to be checked against standard certified reference materials (CRM) for which the relative bioavailability is known (Environment Agency 2005a). However, until now, no such reference materials has been available and none of the *in vitro* methods used in the UK or in Europe has been subject to proficiency testing or formal accreditation, as these are currently not available.

Other than for lead, the sensitivity of *in vitro* methods for parameters such as solid to liquid ratio, pH, temperature, solution composition, digestion time and post-extraction stability are still not being addressed in detail, on a chemical by chemical basis.

Regulatory positions

The US EPA recently published a technical support document for lead, which sets out how *in vitro* data can be used to adjust a site-specific risk assessment (US EPA 2005). However, there is no formal policy or guidance on bioaccessibility. The national regulators in EU countries such as Denmark, Belgium and the Netherlands do not accept *in vitro* bioaccessibility testing in risk assessment (Irene Edelgaard Danish EPA; Marlies Ten Hove Dutch Soil Protection Committee; Sandra Boekhold Dutch VROM, personal communications 2005).

The Environment Agency for England and Wales recognises the potential usefulness of bioaccessibility testing in refining site-specific risk assessment. However, given the uncertainties associated with current *in vitro* test methods, the Environment Agency considers its application to be limited at this time (Environment Agency 2005b).

In order to further the development of our understanding of the efficacy of *in vitro* methods for the UK, the Environment Agency has undertaken several projects. These include a bioaccessibility ring test project, an English translation of a Danish EPA report, a literature review, and an international workshop (Environment Agency 2005b). The Environment Agency will continue to review advances in this field and promote discussion of the issues.

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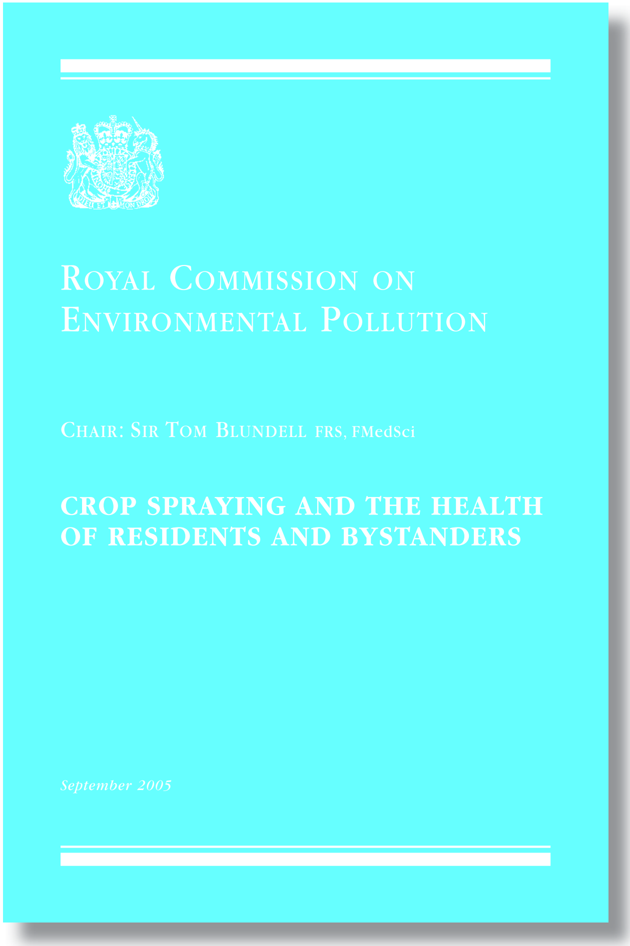
The Royal Commission on Environmental Pollution launched its special report on pesticides in September 2005, with the main aim of addressing a both complex and controversial issue, namely the human health risks that may be associated with the use of agricultural pesticides through direct exposure (not through drinking water, food or occupational exposure). This has been a topic of public concern for several decades, which is reflected by earlier reports, the 1987 House of Commons Agriculture Select Committee report *Effects of Pesticides on Human Health*[1], and the 1990 British Medical Association report *Pesticides, Chemicals and Health*[2]. The Commission's report was driven by the public's concern that pesticides may be causing a wide variety of acute and chronic ill-health effects in people living near or passing by fields that are sprayed with agricultural pesticides throughout the growing season.

Among the issues that the Royal Commission considered was the investigation of the science used to assess the risk to people from crop spraying. The report was structured into three key areas:

- assessing pesticide regulation
- exposure assessment model used by risk assessors
- current scientific understanding of the health effects potentially caused by pesticides

For the last area, the report examined the epidemiology and understanding of the health effects attributed to pesticides and looked at the toxicology data that underpin the approval of pesticides. Finally, there was a discussion of the systems that are currently in place for the public to report any ill-health effects that they attribute to pesticide spraying, both to medical professionals and to the regulators.



The report can be accessed at http://www.rcep.org.uk/cropspraying.htm

Framing the problem

'Pesticide' is used as a general term that encompasses a wide range of diverse chemicals, but that have the aim of disrupting the target organism in such a way so that an essential biological process is disrupted. Pesticides are made up of an active ingredient mixed with co-formulants that improve its function.

Pesticides, unlike most other chemicals, are carefully regulated in the UK. A stringent risk assessment process is undertaken before a pesticide can be used for any purpose, which involves extensive toxicological testing. The responsibility for the approval and safe use of agricultural pesticides in England and Wales lies jointly with the Department for Environment, Food and Rural Affairs (Defra), the Department for Work and Pensions (for the Health and Safety Executive, HSE), the Food Standards Agency, the Department of Health (DH) and the National Assembly for Wales Agriculture Department. According to the Commission's report, the official position is that a robust approach to the assessment of human health risks associated with pesticide exposure already exists, and that there is no scientific case for taking additional measures to protect members of the public who may be in the vicinity of a sprayed area.

However, members of the public have been complaining of a series of well-defined acute symptoms and a wide range of chronic health effects that they have attributed to pesticides. Some of the more chronic effects include multisystem and multisymptomatic disorders, often grouped under terms such as chronic fatigue syndrome (CFS) or myalgic encephalomyelitis (ME) and multiple chemical sensitivity syndrome (MCS). Many of these chronic health effects are difficult to assess using toxicological testing in animals.

GPs and hospital doctors are the first point of contact for the public when they feel that pesticides have affected their health, and they are responsible for referring a patient on to specialists in the secondary care sector. A consistent criticism of medical professionals has been the need for GPs to have enough toxicology training to, at the least, be able to recognise the symptoms that may be attributable to pesticides, and indeed other environmental chemicals, so that they can refer patients on to more specialised care. This was previously identified as a public health issue, and the DH issued a handbook *Pesticide Poisoning Notes*

Summary of the Commission's key recommendations that are particularly relevant to the HPA

1. Based on the conclusions from our visits and our understanding of the biological mechanisms with which pesticides interact, it is plausible that there could be a link between resident and bystander pesticide exposure and chronic ill health. We find that we are not able to rule out this possibility. We recommend that a more precautionary approach is taken with passive exposure to pesticides. The existing uncertainties indicate an urgent need for research to investigate the size and nature of the problem and any underlying mechanisms that link pesticide spraying to ill health.

2. We recommend that an imaginative systematic approach is taken to apply both well-validated as well as novel clinical investigative methods to those with chronic symptoms linked to pesticide spraying such as magnetic resonance spectroscopy (MRS) and gene and protein profiling.

3. We recommend that the Health Protection Agency (HPA) and related organisations within the devolved administrations in Scotland and Wales collect population data on pesticides, their metabolites and biomarkers of effects that would provide a sound basis for exposure assessment and also could be used to establish a national database for monitoring.

4. We endorse the Department of Health's move to strengthen higher professional development in the field of toxicology within general practice. They should also ensure that professionals working in public health and specialised poisons centres have a clear awareness and understanding of how to investigate the chronic health problems related to pesticides by residents and bystanders.

5. We recommend that a new national reporting and monitoring mechanism for ill health associated with pesticide spraying should replace the Pesticide Incident Appraisal Panel (PIAP), and that this should fall within the remit of the Health Protection Agency and related organisations in the devolved administrations.

6. We recommend that newly acquired and standardised clinical, physiological and laboratory information from those who attribute their adverse health effect to passive pesticide exposure should form the basis for future biological monitoring. In addition to those exposed to agricultural spraying, we recommend the establishment of a system that places greater emphasis on surveillance for adverse health effects of pesticides.

for the Guidance of Medical Practitioners in both 1983 and 1996[3,4], to all general practices, hospital accident and emergency departments, consultants in communicable disease control (CCDCs), medical schools and professional bodies.

Currently, all health care professionals have access to the National Poisons Information Service (NPIS) as a resource for toxicological information and expertise. However, this system is reliant on primary care professionals identifying the need to contact the NPIS system and thus tend to be of an acute nature, and requires details of the actual pesticide that has caused the ill-health effect. This information is often not available, as currently farmers are not obliged to provide this information direct to members of the public.

If a member of the public has concerns about possible exposure to agricultural pesticides, the HSE has the responsibility for investigating this concern. The HSE advises that the member of the public should first seek medical advice, and then report this to the HSE, which will investigate the claim. On completion of the investigation, the HSE Inspector will send details of reported cases to the Pesticide Incidents Appraisal Panel (PIAP). The PIAP system is set up to look for trends that might be indicative of associations between individual active ingredients and primarily acute ill-health effects, using a product-focused analysis, rather than to assess causality in individual cases or to provide feedback to individuals, which had been a cause of complaint from the public. The deliberations are published annually[5]. Currently, there is no remit for pesticides within the HPA, as Defra, HSE and DH maintained this responsibility when the HPA was formed.

It is difficult to estimate the numbers of people who feel that they suffer ill health as a result of pesticide exposure, and a need for a comprehensive surveillance system was identified to ascertain whether pesticides are indeed the cause of the reported adverse health effects. It is important therefore not only that the numbers should be properly recorded through well-designed proactive surveillance methods, but also that a proactive investigative service should examine reported cases. The panel lists the Commission's main recommendations dealing with health issues and reporting of ill-health effects.

Many of the issues that arise in the Commission's report on pesticides can be applied to exposure to other environmental chemicals, which are within the current HPA remit.

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Adverse Health Effects from Chemicals in Food and Drink reported to the National Poisons Information Service (London) 1998–2003

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Many people perceive chemical contamination of food as a threat[1]. However, data to identify and measure these issues are sparse, with the literature dominated by discussions of large-scale incidents or the risks of chronic exposure to particular chemicals. There is little mention of acute chemical contamination events with few references in the world literature; however, cases of extraneous chemicals in food are frequently the subject of enquiries to the National Poisons Information Service (London) [NPIS(L)]. The NPIS(L) advises on cases of suspected poisoning and therefore often deals with acute incidents of breakdowns in food safety.

The Food Safety Breakdowns Project, funded by the Food Standards Agency, was designed to gather and analyse information on incidents, which have resulted, or have been perceived to result, from a breakdown in food safety systems. Such incidents broadly fall into those of microbiological, chemical or physical contamination. The scope of the project was wide-ranging, included all forms of safety hazard, across the entire food chain, and encompassing all food and drink types. The project involved the Chemical Hazards and Poisons Division (London) [CHaPD(L)] and NPIS(L) in conjunction with the Centre for Disease Surveillance and Control (Colindale) and the Campden and Chorleywood Food Research Association Group.

The NPIS(L) collects data on every suspected poisoning that is reported to the unit. This reporting is not statutory or mandatory. These data are collected in the context of assisting medical professionals to manage poisonings. The data collection does not attempt to capture information on the exact circumstances of the exposure, but only those details that will assist in the primary function; agent identity, dose, patient age and clinical effects. Although clinical details are requested for cases of special interest, with the specific intention of using this data to monitor epidemiology of poisoning and efficacy of treatment recommended.

A search of the NPIS(L) database was performed for all cases relating to the contamination of food or drink reported between January 1998 and December 2003. These cases were then entered into a custom project database established to accommodate microbiological, chemical and physical hazards. Search facilities were added to allow identification of the incidents by location, scale, chronology, category, food/drink, food process, stage in foodchain and reported contributory factors. Although the data collected by the NPIS(L) were not designed to record information about detail of the event, valuable additional information was abstracted from free-text searching within the records, by expert review by a specialist in poisons information. These data were then subjected to statistical analysis.

The total number of enquiries related to the contamination of food or drink reported to the NPIS(L) between January 1998 and December 2003 was 3740, representing 0.5% of all NPIS(L) cases for the study period. Accident and emergency departments were responsible for just over half of the reports (50.5%), with NHS Direct and GP surgeries making up 19.5% and 16.7% of the calls respectively. The ambulance service accounted for 7.2%, community nurses 7.3%, pharmacists 3.2% and members of the public 3.1%.

Table 1 Top ten contaminating agents

	Agent name	Number of incidents	% of total
1	Descalers	1498	40.0%
2	Household cleaners (including kitchen, bathroom, toilet)	252	6.7%
3	Bleach	120	3.2%
4	Pesticides/Insecticides	90	2.4%
5	Oven/grill/barbeque cleaners	81	2.2%
6	Sterilising products	76	2.1%
7	Mercury	74	2.0%
8	Washing-up liquid/detergent	54	1.4%
9	Dishwasher products	54	1.4%
10	Plastic and glass	53	1.4%
	TOTAL FOR TOP TEN	**2352**	**62.8%**

Table 2 Top ten foodstuffs involved in food safety breakdowns

	Food/drink	Number of incidents	% of total
1	Tea and coffee	1190	31.8%
2	Drink not specified	318	8.5%
3	Baby feed/baby food	305	8.2%
4	Food nor specified	222	5.9%
5	Soft drinks and formulated soft drinks	147	3.9%
6	Alcoholic drinks	133	3.6%
7	Pasta, noodles and rice	116	3.1%
8	Vegetables and vegetable products	112	3.0%
9	Fruit juices and fruit concentrates	105	2.8%
10	Fruit and fruit products	83	2.2%
	TOTAL FOR TOP TEN	**2731**	**73%**

The range of contaminating agents reported was diverse; with descaler chemicals[2] involved in 40% of all food safety incidents. Household cleaners were responsible for 6.7% of enquiries, the second most common contaminating agent. All other household products were involved in 11.1% of cases. Gardening products accounted for 4.3%, while physical and biological contaminants 3.4%. Table 1 lists the top ten contaminating agents.

Table 2 lists the top ten foodstuffs involved in breakdowns of food safety. Beverages were affected in 50.6% of all incidents, with tea and coffee being the most common (31.8%). An alarming 8.2% of calls reported contamination of baby milk/food.

The project determined a number of means by which enquiries arose and also at what stage the breakdown occurred. The majority of enquiries were deemed to be accidental (86.4%), with consumer handling being the most common stage for adverse events to occur (Tables 3 and 4).

Table 3 Stage at which breakdown occurred

Stage name	Number of incidents	% of total
Component handling: preparation	2	0.053%
Component handling: treatment	7	0.2%
Consumer handling	3360	89.8%
Manufacture handling: preparation	1	0.03%
Not known	265	7.1%%
Other	1	0.02%
Preparation/sale	57	1.5%
Primary production	48	1.3%
TOTAL	**3741**	**100%**

Table 4 Means by which hazard introduced, by year

Date of incident	Means by which hazard introduced		
	Accidental	Intentional	Unknown
1998	632	29	48
1999	722	72	14
2000	597	97	38
2001	552	65	32
2002	452	55	17
2003	276	18	23
TOTAL	**3231 (86.4%)**	**336 (9.0%)**	**172 (4.6%)**

Morbidity associated with contamination was apparent, as 31% of cases involved a patient experiencing clinical features. No deaths were recorded in the study period.

The results revealed a surprisingly large number of enquiries involving children. A total of 303 cases were reported just involving children where contamination of baby foods was implicated, mainly by descaler chemicals, occurring almost exclusively in the home. Just under half of these cases were reported from an accident and emergency department, with NHS Direct and community medical centres making up the majority of the remainder. There were no reports of serious ill health with most children remaining asymptomatic. Of those who did experience clinical effects, vomiting, abdominal pain and buccal irritation were the most common effects (Table 5). The majority of incidents resulted from consumer handling errors.

Table 5 Clinical features experienced by children

Clinical feature	Number of patients with symptom
Asymptomatic	262
Vomiting	20
Abdominal pain	5
Crying/distressed	4
Buccal irritation	4
Nausea	1
Malaise	1
Drowsy	1
Coughing	1
Burning sensation	1
Burning mouth	1
Blisters	1
Anorexia (lack of appetite)	1

Incidents were mainly accidental in nature, with most patients only experiencing mild clinical features, if any. These were mainly the result of consumer handling errors, e.g. not following manufacturer's instructions or inappropriate attention paid whilst preparing or cooking foods. However, these seemingly minor accidents generated a large number of presentations to accident and emergency departments and enquiries to both NHS Direct and GP surgeries.

There were no reports of serious ill health during the study period, so it could be surmised that no significant health or food safety problem exists. Nevertheless there is an unchanging pattern of food safety breakdowns that lead to distress, morbidity and a burden in time and resources to the health service. The predominance of consumer handling errors involving descaler chemicals resulting in adverse incidents means that action on this would give the best 'value' from a public health perspective. Action to reduce the frequency of these events, by packaging and labelling requirements or education, is urged.

Acknowledgements

The Breakdowns in Food Safety Group comprised: Roy Betts, Nick Edwards, Martin Hall, Clare Hughes, Iain Gillespie, Virginia Murray, Sarah O'Brien, Morven Reid and Mike Stringer (Chairman) and was funded by the Food Standards Agency.

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International Experience and Perspectives in Strategic Environmental Assessment

SEA Conference, September 2005, Prague, Czech Republic

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Following on from the introduction to strategic environmental assessment (SEA) in the September issue of the Chemical Hazards and Poisons Report*, this article provides an update on the latest developments in SEA. This information was gained through participation in the SEA conference in Prague, which was organised by the International Association for Impact Assessment (IAIA). The meeting involved several hundred participants from tens of countries and nine parallel sessions running over five days.

General issues

Over 100 examples of effective SEA worldwide were examined, with 36 new case studies from 2005 alone. The conference focused on good practice and it was agreed that the main five steps to ensure quality are:

- capacity strengthening
- enforcement
- guidelines
- monitoring
- integration with authorities

The need for both a capacity needs assessment and a pilot study before an effective SEA regime can be established was also highlighted.

The benefits of implementing SEA were found to go beyond simply addressing the triple-bottom-line of economic, social and environmental issues in planning. The case studies identified a clear link to the promotion of good governance, publicly accountable decision making, and the promotion of inter-sectoral work.

Communication was identified as key in SEA and documents should be tailor-made products in the language of the stakeholder. This is important as the SEA process, unlike the one-stop permitting (integrated pollution prevention and control, IPPC) or planning (environmental impact assessment, EIA) processes, involves multiple decisions at multiple points in time by multiple stakeholders.

Health

The consideration of health at strategic levels is far from widespread and the way in which health is addressed differs considerably. For example, in Australia health impact assessment (HIA) is a component of EIA/SEA procedures, while in some German Bundesländer HIA is a separate process at strategic levels. The legislative approach to HIA also differs: in Québec HIA is undertaken because of a statutory requirement, while it is a voluntary procedure in England and is carried out mainly at the project level. In England and Wales there is currently no statutory consultee for health within the SEA process, although it is clear that health input it is critical component of many SEAs.

Therefore the main questions were how the health community will be able to inform the SEA process and whether this involvement should be fully integrated or separate to decision-making. Health professionals might be involved through the courts as the European Convention on Human Rights places obligations on public authorities to prevent the infringement of their citizens' rights to life. This might mean a court could expect some form of assessment to have taken place beforehand and, where the infringement was health related, the courts may well expect some form of HIA to have been undertaken.

Another way is through health 'champions'. Examples were given of the Mayor of London, who has decided that London plans will have a HIA input, and certain directors of public health who have insisted that consultants carrying out Local Transport Plans and Regional Spatial Strategies in their areas would need to guarantee that health would be adequately covered before a contract was awarded.

Finally, the SEA Protocol, which implements the political commitments made at the Third European Conference on Environment and Health, indicates that health should be consulted at the different stages of the process and so goes further than the SEA Directive. Therefore, once the protocol is ratified by the required number of countries (likely to happen in two to three years' time), the wording of the SEA Protocol is likely to require a routine health consultee response.

It was concluded that there exists a policy window for implementing HIA in decision-making for non-health sector SEAs. This presents an opportunity for the integration of health into the SEA regime. This process could be facilitated by developing quality criteria covering, amongst others areas, the quality of evidence, methods used, level of participation, transparency, and equity.

Overall, this was an extremely stimulating conference. It will definitely assist the formulation of HPA policies on SEA guidance, pilot projects and SEA reviews, as well as strategy on the level and type of future involvement with this regime.

* Fisher P and Kibble A. Strategic environmental assessment and its implications for the Health Protection Agency. Chemical Hazards and Poisons Report 2005: No. 5; 29–31

Contaminated Land Risk Assessment

CLEA UK Software Seminar, November 2005, Reading

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The Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency have published a series of reports that provide a scientifically based framework for the assessment of risks to human health from land contamination. By providing a consistent approach to risk assessment, the framework facilitates the rapid identification of sites that pose a significant risk to human health and help avoid blight on other sites. The framework does not consider risks to other receptors such as plants and animals, buildings, and controlled waters. This framework includes the contaminated land risk assessment (CLEA) model, health criteria values (TOX reports) and soil guideline values (SGVs). A range of documentation can be found at the Environment Agency's CLEA homepage: http://www.environment-agency.gov.uk/subjects/landquality/113813/672771/?lang=_e.

This seminar launched the beta version of CLEA UK, replacing the old CLEA 2002 software. Although the software has undergone extensive testing by both the Environment Agency and Atkins Environmental, this beta version will be further tested by practitioners over the next six months, at which point a final version will be released. The Environment Agency did stress that although the beta version should be used 'with caution', the results should be correct for the existing parameter range.

CLEA UK is based on Microsoft Excel and is layered to allow for both generic quantitative risk assessments (GQRAs) and detailed quantitative risk assessments (DQRAs), allowing the input of site-specific data.

The flexibility of CLEA has been increased with the ability to add chemicals, soils (but only unsaturated soil types) and buildings to the model. Moreover, the parameters for all these factors can be tweaked either temporarily or permanently (by accessing the database library). Additionally, multiple contaminants can be assessed, with no limit to the number of chemicals that can be assessed. Moreover, there is no significant increase in processing time when fewer than 15 chemicals are assessed.

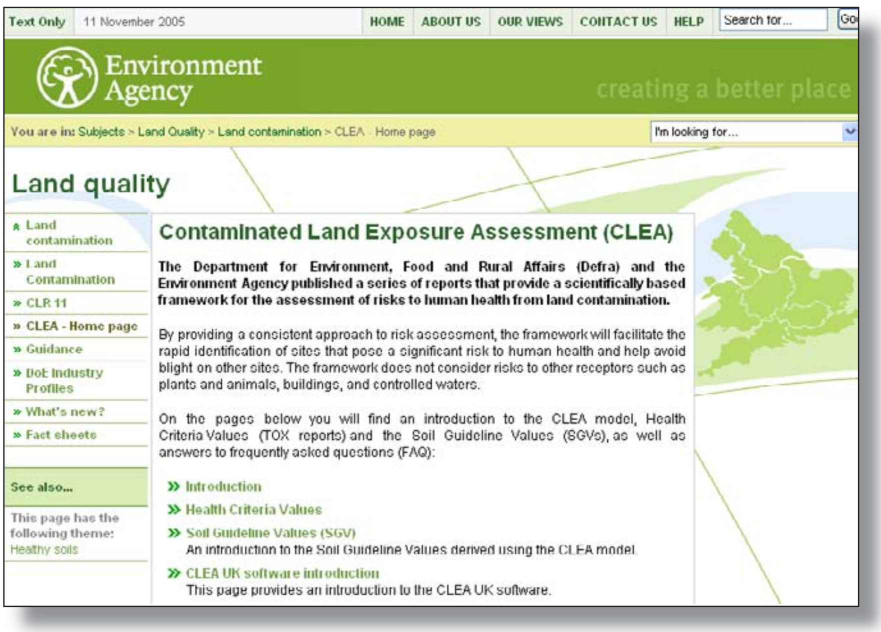
Work is saved as an Excel spreadsheet with a randomised password to prevent data being tampered with after results have been generated. Furthermore, the time and date will automatically be saved as part of the file name. Unfortunately, justification for tweaking parameters will not be displayed in this report and the responsibility is on the practitioner to identify these in the main contaminated land report.

On the negative side, the model is not able to manage bioaccessibility, a reducing source term (e.g. due to biodegradation or pathway mitigation) or a difference in soil temperature (data must be corrected to 10°C). Further information on the Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency's approach to bioaccessibility can found at http://www.environment-agency.gov.uk/commondata/acrobat/bioacc_update_v2_970501.pdf.

The Environment Agency has published Briefing Note 4 (BN4), which details the approach incorporated into the CLEA model to derive soil guideline values when health criteria values (HCVs) are available for more than one exposure route (e.g. oral, inhalation and dermal). BN4 expands on the process originally detailed in Table 3.4 in CLR10. However, if a number of pathways are combined this method can only be carried out for a single chemical. BN4 is available at www.environment-agency.gov.uk/commondata/acrobat/clea_bn4_1208099.pdf

A copy of the CLEA UK CD can be ordered for £5 at http://publications.environment-agency.gov.uk

Note: the above version of CLEA UK may have some compatibility issues with Excel 2000. The Environment Agency is hoping to release an Excel-2000-friendly version of the software in the near future.



Training

Disaster Health Education and Training: Results of a Pilot Questionnaire to Understand Current Activities

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Introduction

At the 2003 World Congress in Disaster and Emergency Medicine in Melbourne, Australia, the World Health Organisation requested that the World Association of Disaster and Emergency Medicine (WADEM) consider international standards and guidelines on education and training for multidisciplinary health responses to major events that threaten the health status of a community.

A Working Group of the Education Committee of the WADEM was established, and an initial paper was published on the issues relating to this activity[1]. A series of four meetings of the Working Group was convened that led to an international group meeting in Brussels, Belgium, in October 2004. Following this meeting a conference report was published in January 2005[2]. This paper is a follow up to that report.

At the meeting, 50 representatives from 18 countries participated and a wide range of multidisciplinary groups including public health, paramedics, emergency medicine practitioners, nurses, intensive care personnel, toxicologists, family medicine practitioners, clinical psychologists, social scientists and geographers were represented. These individuals, committed to disaster health management, represented governmental, intergovernmental and non-governmental organisations. Only 45 of the participants were trainers.

When considering the need for a multidisciplinary health response to major events, the term 'disaster health' was created to replace 'disaster and emergency medicine'. The new term incorporates all relevant disciplines. Disaster health was seen to be at the heart of a set of interconnecting disciplines based on the Bradt model[3]. A framework for disaster health was constructed (Figure 1). It includes three main disciplines – clinical and psychosocial care, public health, and emergency and risk management – as interconnecting circles surrounded by the support disciplines and disciplines that define the context in which they are set.

As a result of the meeting on education and training in disaster health, a survey of the 45 trainers from 15 countries was undertaken. The participants agreed to pilot a questionnaire, which was a retrospective descriptive survey, to:

- assess current activities of trainers
- facilitate information sharing and curriculum development
- understand the perceived barriers to creating an international system of standards, guidelines and accreditation.

Results

Of the 45 trainers, 31 responded (68.9%). They came from Europe (23), the USA (3), New Zealand (1), the Middle East (2) and the Indian subcontinent (2). Responses were coded and tabulated using a Microsoft Excel version 2000 spreadsheet. By analysis, all responses are expressed as frequencies.

The breadth of disciplines represented by the respondents is summarised in Figure 2. Details of the disciplines were taken from Figure 1 where, for example, context is identified as political, social, economic, level of health care and community. It is interesting to note that all disciplines were represented.

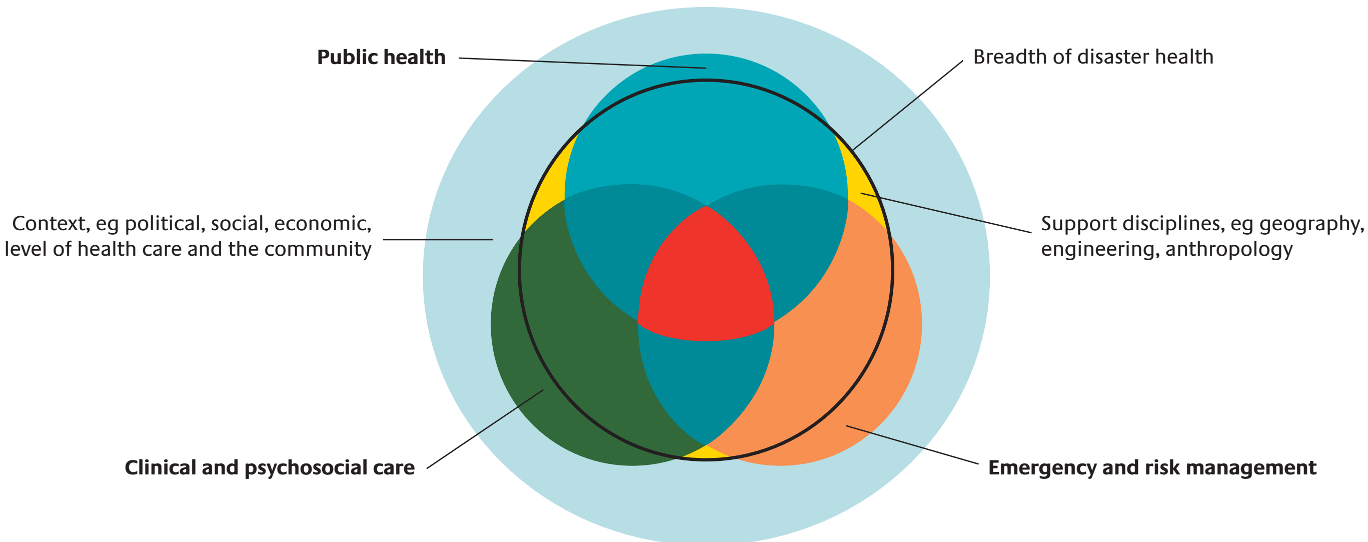

Figure 1 Framework for disaster health (after Bradt et al, 2003)

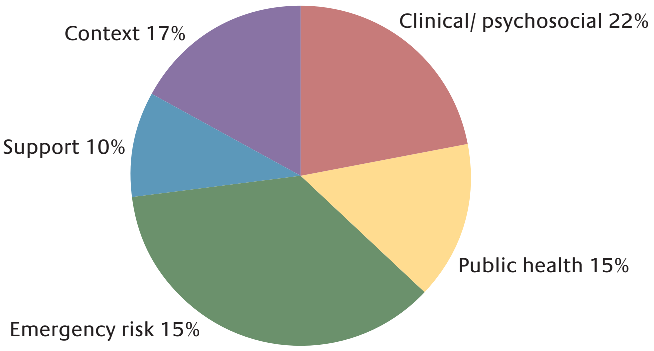

Figure 2 Disciplines represented (most respondents reported that they were involved in more than one discipline)

The levels of training provided in disaster health training were identified. They are Level 1, community; Level 2, responder basic; Level 3, 1st responder, divided into provider, tactical and strategic; Level 4, 1st responder graduate; Level 5, professional/masters; Level 6, specialist/consultants; and Level 7: doctoral/management. The frequency of levels of training identified as being provided by the respondents is summarised in the table. Most respondents support all levels but particularly levels 2, 3 and 5. This information is summarised in Figure 3.

Levels of training provided

Level		Frequency (%)
1	Community	36
2	1st responder basic	58
3	1st responder provider	61
3	1st responder tactical	45
3	1st responder strategic	48
4	1st responder graduate	26
5	Professional/masters	48
6	Specialist/consultant	39
7	Doctoral/management	42

Course accreditation was reported to be an issue. Only 65% of respondents reported that their courses were accredited. Of these 23% were accredited locally, 58% nationally and only 13% internationally.

Conclusion

This pilot provided a tool to share knowledge within the World Association of Disaster and Emergency Medicine. Such a survey could be used more widely with other international organisations to identify current skills, knowledge and resources and to help identify gaps in provision. Information gathered suggests that responders would welcome a more coordinated and more international system of training in disaster health. In addition, there was a clearly identified need to facilitate development and audit of existing accredited courses.

It was considered important to increase our knowledge of education and training in disaster health by undertaking a further project to widen the information available. Further funding for this work is being sought.

A full report of this work will be published in Prehospital and Disaster Medicine, January 2006.

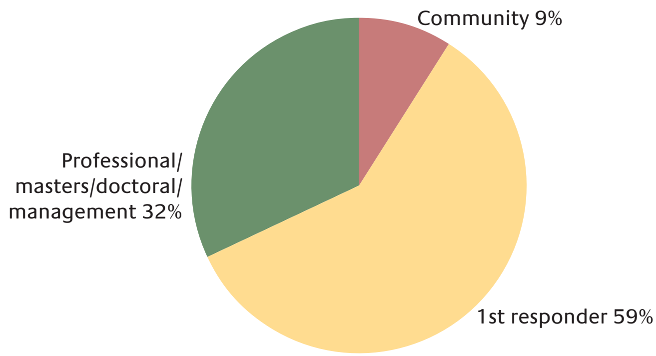

Figure 3 Levels of training provided

The authors acknowledge with thanks the financial support of the Health Protection Agency in taking forward this work and the support from all the delegates who responded to our pilot questionnaire.

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Chemical Incident Training: Assessment via a Health Professional Questionnaire

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Introduction

The role of local and regional teams is likely to increase substantially with the wider health protection responsibilities given to the Health Protection Agency (HPA) and the integration of the former Regional Service Provider Units into the national Chemical Hazards and Poisons Division. Health professionals in local teams will have had formal training and considerable experience of communicable disease, but chemical and environmental issues have been increasingly added to the brief in recent years, without the same level of expertise being assured.

Chemical Hazards and Poisons Division (London), CHaPD(L), was tasked to carry out an assessment of London health professionals. The aim of this exercise was to ascertain the level of preparedness for dealing with chemical incidents and being a representative on the Joint Health Advisory Cell (JHAC) in the event of a major chemical incident.

Method

In November 2004, a confidential questionnaire was sent to the Regional Director of the HPA for London. It was then distributed to all consultants in communicable disease control (CCDCs), specialist registrars in public health (SpRs), specialist trainees in public health (SpTs) and health protection nurses via the Health Protection Unit (HPU) directors. The questionnaire was also sent to all SpRs and public health professionals being trained in London via a public health trainees mailing list. The questionnaires were subsequently analysed at CHaPD(L).

Results

A total of 37 questionnaires were returned out of 40 sent to HPU staff in London and approximately 100 sent to SpRs and public health professionals being trained in London.

Analysis of these questionnaires was performed under the headings of experience, training and dealing with chemical incidents.

Experience

Figure 1 illustrates that 86.5% (32/37) of the health professionals have held their position between 0 and 6 years.

Training

Figure 2 shows that in the last five years 89.2% (33/37) respondents have only dealt with between 0 and 10 chemical incidents. A total of 28 (75.7%) of respondents had attended a 'how to respond' training day organised by CHaPD(L).

Dealing with chemical incidents

Respondents were least confident about their toxicological knowledge of hazardous chemicals and were most confident about knowledge of how to contact other organisations. A greater number of respondents were not confident, as opposed to confident, about public health consequences, decontamination, PODS and shelter or evacuation.

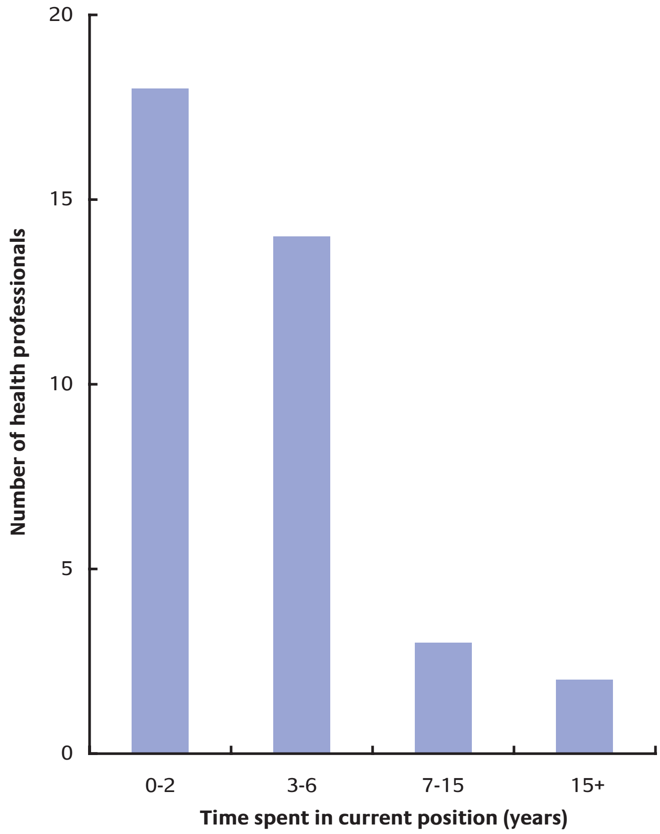

Figure 1 Length of time health professionals have spent in their current roles

With regards to exercises, 67.6% (25/37) had participated in table-top exercises and 27.0% (10/37) had taken part in a live exercise.

Only 5.4% (2/37) of health professionals had ever taken part in a real JHAC and 32.4% (12/37) had taken part in exercise JHACs. The roles played on the JHAC included chair, observer, HEPA, support to chair, health lead for PCT and expert adviser.

Conclusions

The results of the questionnaire highlight the areas in which London health professionals feel least confident. Most of the respondents had only dealt with a minimal number of chemical incidents, this may contribute to the fact that the majority of respondents did not feel confident about their ability to deal with chemical incidents. This provides the opportunity to organise specialised training to improve confidence in these areas.

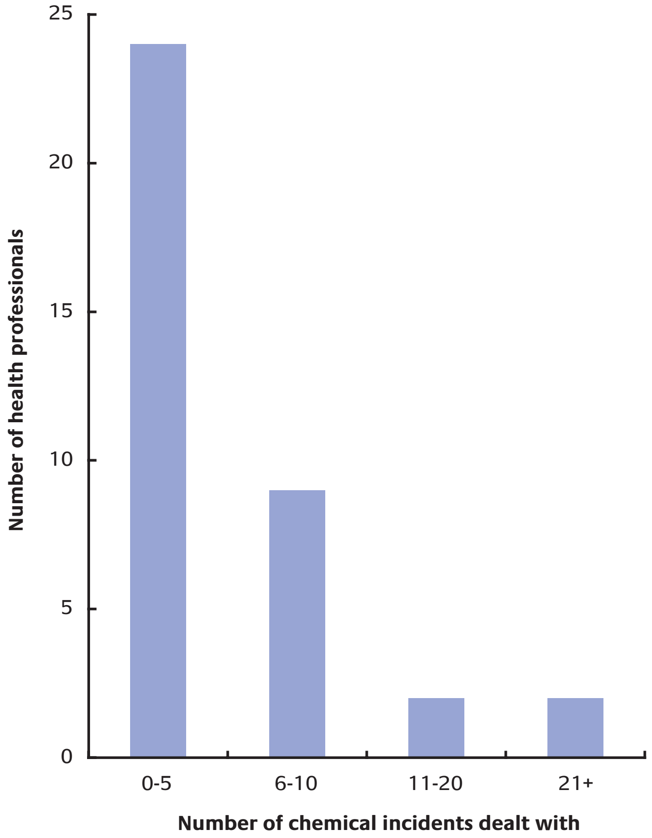

Figure 2 Number of chemical incidents dealt with by health professionals in the last five years

The majority of respondents did not feel confident about their toxicological knowledge of hazardous chemicals. This suggests that it is important that support from experts is available in the event of chemical incidents.

The survey showed evidence that very few health professionals have taken part in a live exercise. It was also stated that whilst table-top exercises are good for discussing action points, they do not test communication channels or lines of responsibility. The opportunity to attend more live exercises may also help to define the roles and responsibilities of HPUs, for example.

Very few health professionals have participated in a real or exercise JHAC. This could be considered as an area in which training courses and opportunities should be developed. However, a positive finding was that many of the respondents had attended the 'how to deal with chemical incidents' training days organised by CHaPD(L).

Although many respondents have attended the training courses, it is important to remember that this does not compensate for experience in actually dealing with chemical incidents. Suggestions were made that a secondment to CHaPD(L) should be made compulsory.

Acknowledgements
The author is grateful to Dr Paul Crook, CCDC South West London Health Protection Unit, Roger Gross, Regional Director HPA London, and all the London HPU Directors and their staff.

Developing Competencies in Environmental Public Health

Dr Jackie Spiby, Consultant in Public Health, South East Public Health Group and North East London Strategic Health Authority

Introduction

With the increasing awareness of the impact of climate change and the ever-increasing use of natural resources the importance of pursing sustainable public health practice is be recognised. The public are also increasingly concerned about environmental hazards and are looking for advice on health protection outside the communicable disease box.

The following aims to identify the competencies required for those involved in environmental public health. It was formulated by those already working in the area and reflects the need for a coming together of the knowledge and skills base of environmental science, public health, clinical toxicology and environmental epidemiology.

Core competencies

The two main competency domains are:

1. Specialist environmental public health knowledge and skills.
2. Generic organisational skills.

Domain 1: specialist environmental public health knowledge and skills

This domain contains five competency areas:

A Toxicology: the science that studies the effects of drugs, environmental contaminants, and naturally occurring substances found in food, water, air and soil and the use of that information to predict safe exposure levels (http://www.toxicology.org, 2003).

- Understanding basic chemical terminology and concepts.
- Understanding basic principles of toxicology, including hazard (known or unknown), route of exposure, dose duration and response, susceptibility, metabolism, target organs, excretion and differential diagnosis.
- Understanding biological sampling methods, biomarkers and their uses and limitations.
- Understanding toxicokinetics and toxicodynamics.
- Understanding mutagenicity, carcinogenicity and reproductive toxicity.
- Understanding toxicology of the major systems: renal, respiratory, skin, liver, CNS.
- Understanding removal from exposure, decontamination and the principles of evacuation and shelter.
- Understanding antidotes: availability, their limitations and the role of symptomatic and supportive care.
- Knowledge of the sources of toxicological information, how to access and use them and their limitations.

- Understanding national and international organisations and their role in service provision.
- Understanding the use of toxicology data in health and environmental standard setting.
- Awareness of the limitations of data on many chemicals, chemical cocktails and interactions.

B Environmental science: the study of physical chemical and biological conditions of the environment and their effects on organisms.

- Basics of environmental pathways: source, pathway, receptor – land, water, food.
- Key issues in relation to health impacts of air, water and land pollution.
- Principles of environmental pollutants and impacts on health.
- Awareness of the common applications of ionising radiation and exposures to non-ionising radiation.
- Environmental sampling: its uses and limitations for air, land and water.
- Environmental impact assessment and links to health impact assessment.
- Understanding the process of determining environmental standards, what standards are available, how to access them and how to utilise them.
- Awareness of the main environmental legislation.
- Understanding of ionising radiation physics and biology.
- Awareness of ionising exposure pathways and health effects.

C Environmental epidemiology: the epidemiology and investigation of common environmental exposures, such as water contaminants, air particulates, environmental tobacco smoke, radon in homes, toxic waste sites, electromagnetic fields, and lead.

- Methods of investigating environmental hazards.
- Estimation of exposure and problems of measurement.
- Analysis of health and exposure data including using GIS.
- Basics of occupational epidemiology.
- Disease cluster investigation, analysis and management.
- Fundamentals of surveillance.
- Critical appraisal of evidence methods.

D Risk assessment and management: the identification and quantification of the risk resulting from a specific use or occurrence of a chemical, taking into account the possible harmful effects on individual people or society of using the chemical in the amount and manner proposed and all the possible routes of exposure and the control of that risk.

- Understanding of acute and chronic response to the main types of environmental incidents and being able to recognise when to ask for help.
- Understanding risk management and standard setting.
- Understanding the dimensions of hazards identification and risk characterisation, risk management, risk communication.
- Understanding the principles of qualitative and quantitative risk assessment and ongoing monitoring.
- The main modes of prevention and control of exposure to environmental hazards.
- Cost effectiveness and cost benefit analysis and decision making prior to implementation of interventions.
- Risks and regulations covering public and occupational ionising exposure.
- Risks associated with exposure to non-ionising radiation.

E Environmental public health: the science and art of preventing disease, prolonging life and promoting health where environmental hazards are the key factor, through organised efforts of society.

- Understanding the relevance of other agencies and organisations and their roles.
- Understanding incident planning and incident team management.
- Understanding major incident command and control structures.
- Understanding environmental health policy at a international, national, regional and local levels
- Understanding of national radiation emergency response arrangements.
- Being aware of the main elements of relevant legislation and regulation, e.g. air pollution, IPPC, land contamination and planning.
- Understanding the principles of sustainability and relevance to public health.
- Understanding the principles and use of health impact assessment.
- Understanding the resource implications of environmental incidents, what needs to be paid for and by whom and the ability to prioritise resource use to ensure cost effectiveness.
- Managing the process, including media skills, risk assessment, communication and analysis.
- Developing and implementing preventive programmes and working towards reducing health inequalities and promoting social inclusion.
- Communicating and involving the public and other stakeholders through the appropriate channels.
- Communication and media management.
- Ensuring evidence-based activities.

Domain 2: generic organisational skills

A Teaching

- Using appropriate strategies and opportunities to share knowledge on environmental public health.

B Research

- Critical analysis of literature.
- Developing research programmes.
- Participating individually or collaboratively in research.

C Management and leadership

- Ensuring effective management of the service at whatever level.

Training Days for 2006

The Chemical Hazards and Poisons Division considers training in chemical incident response and environmental contamination for public health protection a priority. The 2006 programme is being developed to offer basic and more detailed training, along with the flexibility to support Local and Regional Services initiatives as requested.

How to Respond to Chemical Incidents
30th May, Sherman Education Centre, Guy's Hospital, London
15th June, William Leech Building, The Medical School, Newcastle University
28th November, Sherman Education Centre, Guy's Hospital, London
(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; and 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(L) to help the health response; the resources available for understanding the principles of public health response; and the training needs of all staff required to respond to chemical incidents. A maximum of 40 places are available for each course.

Environmental and Occupational Epidemiology Spring Meeting
17th February, London School of Hygiene and Tropical Medicine, London
(For the HPA environmental network, consultants in health protection with a special interest in environmental contamination and academics working in environmental epidemiology)
This is a joint meeting organised by the Chemical Hazards and Poisons Division, Health Protection Agency, the International Society for Environmental Epidemiology and Epidemiology in Occupational Health and the International Commission of Occupational Health. The meeting will address the recent and rapid expansion of environmental and occupational epidemiology and health risk assessment and the scientific need to better understand and explain the effects of environmental pollutants on human health. It will focus on topical methodological and research issues largely, but not exclusively, reflecting current work in the UK. Plenary talks will consist mainly or exclusively of invited speakers with an invited poster session, which will be discussed by topic, led by a moderator. Registration fee will be £30. A maximum of 100 places are available.

Basic Understanding of Roles and Responsibilities of Organisations in Environmental Hazards Management
28th February, Sherman Education Centre, Guy's Hospital, London
(For the HPA environmental network, local consultants and HPU staff in health protection and local Environment Agency staff)
This is a joint meeting organised by the Chemical Hazards and Poisons Division, Health Protection Agency and the Environment Agency. The meeting will address issues relating to local collaboration and provide an opportunity to meet the recent and rapid expansion of environmental and occupational epidemiology and health risk assessment and the scientific need to better understand and explain the effects of environmental pollutants on human health. It will a focus on topical methodological and research issues largely, but not exclusively, reflecting current work in the UK.

Contaminated Water Training Day
30th March, Sherman Education Centre, Guy's Hospital, London
(For consultants in health protection, CsCDC, CsPHM and specialist registrars in public health medicine and local authority environmental health officers)
Water incidents are potentially of considerable concern and present important issues for public health protection. Most usually water contamination may arise from acute events (such as spills, leaks etc) but public concern is also focused on chronic long-term contamination issues such as persistent organic pollutants which have the potential to present a risk to human health. It is anticipated that this training should provide delegates with the tools and information required to provide an appropriate and timely response to chemical incidents that result from water contamination. A maximum of 40 places are available.

Fundamentals in Toxicology for Health Protection
5–9th 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 improve their skills)
The aims of this short course are to summarise the key concepts in toxicology, to explore the key concepts in toxicological risk assessment, exposure assessment and to examine the scope and uses 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 will provide an understanding of the limitations resulting from the lack of data on many chemicals, chemical cocktails and interactions. These examples will provide an appreciation 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 is £500. A maximum of 20 places are available.

Contaminated Air Training Day
29th June, Sherman Education Centre, Guy's Hospital, London
(For consultants in health protection, CsCDC, CsPHM and specialist registrars in public health medicine and local authority environmental health officers)
Air incidents are potentially of considerable concern and present important issues for public health protection. Air contamination may arise from acute events (such as fires, spills, leaks etc) but public concern is also focused on chronic long-term contamination issues such as air quality and its potential to present a risk to human health. It is anticipated that this training should provide delegates with the tools and information required to provide an appropriate and timely response to chemical incidents that result from acute and chronic air contamination. A maximum of 40 places are available.

Course calendar

Title	Date
How to Respond to Chemical Incidents	30th May, 15th June, 28th November
Environmental and Occupational Epidemiology Spring Meeting	17th February
Basic Understanding of Roles and Responsibilities of Organisations in Environmental Hazards Management	28th February
Contaminated Water Training Day	30th March
Fundamentals in Toxicology for Health Protection	5–9th June
Contaminated Air Training Day	29th June
Introduction to Environmental Epidemiology Short Course	September (1 week, date to be confirmed)
Contaminated Land Training Day	27th September
Environmental and Public Health Training Day – Advanced Update to Include Integrated Pollution Prevention and Control (IPPC)	26th October

Introduction to Environmental Epidemiology Short Course
1 week in September (date to be confirmed), London School of Hygiene and Tropical Medicine, 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 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 roughly £500. A maximum of 20 places are available, please see the leaflet for further information.

Contaminated Land Training Day
27th September, Gassiot House, St Thomas' Hospital, London
(For consultants in health protection, CsCDC, CsPHM and specialist registrars in public health medicine and local authority environmental health officers)
Land contamination incidents are of considerable concern and present extremely interesting and important issues for public health protection. Occasionally land contamination may arise from acute events (such as spills and leaks) but most public concern now concentrates on chronic long-term contamination issues (waste disposal including landfills, an abandoned factory site, or other brownfield sites). These have resulted in chemical contamination of the soil and present, or have the potential to present, a risk to human health. It is anticipated that this training should provide delegates with the tools and information required to provide an appropriate and timely response to chemical incidents that result in land contamination. A maximum of 40 places are available.

Environmental and Public Health Training Day – Advanced Update to Include Integrated Pollution Prevention and Control (IPPC)
26th October, Sherman Education Centre, Guy's Hospital, London
(For the HPA environmental network, consultants in health protection with a special interest in environmental contamination and local authority environmental health practitioners)
The general aim of this training day is to raise awareness of some recent developments in environmental science. The specific educational objectives include familiarising participants with current issues relating to environmental sciences including modelling, monitoring, risk assessment and relevant research topics. Using the IPPC regime as an example, the course will describe many if the key risk assessment tools and sampling methodologies used by industry and regulators. Case studies will include the Environmental Agency's H1 assessment tool and the use of air dispersion modelling in IPPC and Local Authority air quality review and assessment reports. A maximum of 40 places are available.

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.

All training events can be viewed on our website at www.hpa.org.uk/chemicals/training.htm.

For booking information on these courses and further details, please contact Karen Hogan, our training administrator on 0207 771 5384, or chemicals.training@hpa.org.uk.

CHaPD(L) staff are happy to 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 771 5383.

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0807 606 4444

Available to government departments, allied agencies and organisations, front line responders, the NHS and other HPA divisions.