Chemical Hazards and Poisons Report

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Editorial

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As usual, in this issue a number of significant incidents are presented. This time they focus on events at sea with the report of the Lucky Lady incident in the Humber estuary and the MSC Napoli incidents, focusing our attention on the health protection issues on our shorelines. Other incidents included in this issue are a report on rashes and their investigation in a school in Scotland, an incident involving nickel in drinking water in London, a fire at a commercial composting site in Surrey and recent health protection issues in hospitals in Merseyside.

A number of articles related to emergency preparedness are included. Of note is a pair of papers considering the collaboration between the Maritime and Coastguard Agency and the HPA. These demonstrate our links and offer ways for even closer collaboration. Also included is a paper on the WHO website on emergency response. The Scientific and Technical Advice Cell (STAC) may require an introduction to colleagues who may not be aware of this development. Thus, a paper on the development of STAC and its related group dynamics is included as an area for further assessment. Exercise Orpheus 1 was a major incident exercise of note testing the front line systems; this paper reports on the many areas for learning identified in this excellent exercise. **MAS**s-casualties and **H**ealth-care following the release of toxic chemicals or radioactive materials - **MASH** - is a European Programme that plans to introduce technical tools and suggest organisational measures to increase the competence and capability of healthcare systems in the European member states

Environmental science issues are, as always, of significance, and in this issue the focus is on public health issues relating to contaminated land bio-remediation and naphthalene. A summary of REACH (**R**egistration, **E**valuation, **A**uthorisation and Restriction of **Ch**emicals), the new EU regulations for chemical substances, is also provided. Reflecting the increasing use of economic tools in decision-making, there is an article on the true health costs of poor housing.

A series of conference reports are included in this issue. They cover the Health Protection Agency conference at Warwick University in September 2008; the 'Stinkfest' conference - a one day event celebrating the 150 year anniversary of the Great Stink of London, University College London; a report on the International Disaster and Risk Conference (IDRC) at Davos, Switzerland, August 25 – 29, 2008; and a Homes, health, and climate change workshop held at the HPA in London in November 2008.

As a result of our on-going efforts to improve the service we offer our readers, we have updated the *Chemical Hazards and Poisons Report* pages of the HPA website, which now include detailed 'Guidelines for authors' and a searchable index for articles in previous issues. Over the next few months, we will also launch an email version of the Report for those of you who would prefer to receive it electronically. We hope that this will cut down the financial and environmental costs of publishing the report. The next issue of the *Chemical Hazards and Poisons Report* is planned for September 2009; the deadline for submissions for this issue is 1st August 2009. Please do not hesitate to contact us about any papers you may wish to submit on chapreport@hpa.org.uk, or call us on 0207 759 2871.

We are very grateful to Mrs Mary Morrey for her support in preparing this issue.

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Front cover image: Debris from MSC Napoli

Incident Response

Review of maritime chemical incidents at sea: Description of reported maritime Incidents, 2004 – 2008

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"During the last twenty years, there has been a considerable development in the transport and handling of hazardous chemical products. Ships which transport chemical products carry a whole range of products which often pose a number of problems and risks in the case of accidents. Maritime transport of hazardous substances can be done either in bulk or in packaged form. Products in bulk are transported either by chemical carriers, as is the case of liquid substances at an ambient temperature, or by gas carriers if gaseous substances are involved. The capacity of tankers for chemical products varies from 400m^3 to 40.000m^3 and tanks vary from 70m^3 to 2.000m^3. The capacity of ships carrying liquefied gases also varies and can reach 100,000m^3/l"

Bonn Agreement[1]

Introduction

A great variety and quantity of hazardous chemicals are transported at sea. The Maritime and Coastguard Agency (MCA) is usually the first agency to respond to a maritime incident. The MCA will make an initial assessment of both the potential and actual pollution risk, and the potential for impacts on public health. Where a potential risk to human health is identified, the MCA will contact Chemical Hazards and Poisons Division (CHaPD)/Health Protection Agency (HPA) for advice and support. Based on the information provided and following consultation, CHaPD can provide advice on public health management of the incident to the local public health team. In England, this will be the local Health Protection Unit (HPU) or Primary Care Trust (PCT); in Wales, the National Public Health Service; in Scotland, Health Protection Scotland; and in Northern Ireland, the Department of Health, Social Services and Public Safety. While there is a long standing cross-agency collaborative relationship between the MCA and CHaPD, due to a number of recent incidents[2, 3], it was decided to conduct a review of the maritime incidents reported to CHaPD to identify any learning points.

In the context of this review, 'maritime' is taken to mean 'of, related to, or adjacent to the sea'[4]. As with all incidents reported to the CHaPD units, maritime incidents are recorded on the CHaPD national incident database. This database forms the basis for the current review of incidents.

Aims and objectives

The aim of this project was to review and describe the maritime chemical incidents in UK water reported to CHaPD over the past 5 years (2004-2008). The review considered the number and types of incidents reported to CHaPD, the type of information gathered during and after the incident, and the reporting mechanisms used. The objective was to identify the key data and information that are needed to best respond to chemical incidents at sea with respect to actual or potential impact on public health, so that this might inform and improve future CHaPD response efforts. This is the first of two reports describing the reported maritime chemical incidents. Part two of the report describes the current alerting system used by the MCA to report maritime incidents to CHaPD[5].

Methodology

The CHaPD database was searched for potentially relevant incidents. The CHaPD standard definition of a 'chemical incident' is "an acute event in which there is, or could be, exposure of the public to chemical substances which cause, or have the potential to cause, ill health." [6] This is the definition used for all incidents reported to CHaPD, not just those at sea. As this definition includes 'potential' incidents, the presence of an incident on the database does not necessarily preclude an associated public health risk, it indicates that CHaPD were notified and aware of an incident. The purpose of the review was not to evaluate the impact on public health of maritime incidents but to evaluate aspects of the incident response and this approach ensured that all potentially relevant incidents were captured.

Sources of data

The national CHaPD database was searched for records of maritime chemical incidents reported between March 2004 and April 2008.In addition, an email request was sent out to all CHaPD units and Local and Regional Services (LaRS) environmental leads requesting information about any incident(s) that they may have dealt with which may not have been reported in the CHaPD database.

For each incident identified, information was collated on the following:

- type of incident e.g. grounding, collision, oil spillage, fire, release of harmful noxious substances (HNS)
- packages (containers/drums) found on the shoreline
- transport
- location (e.g. open sea / ports and harbours)
- type of chemical involved
- date of incident
- agencies involved
- casualties/ fatalities
- source of alerting, including who initially notified CHaPD

MCA ACOPS survey report[7]

In order to obtain an overview of the type and numbers of incidents that generally occur at sea, secondary data were collected from the Advisory Committee on Protection of the Sea (ACOPS) survey. ACOPS publishes an annual survey of reported pollution incidents attributed to vessels and offshore oil and gas installations operating in the United Kingdom Pollution Control Zone. The survey is conducted on behalf of the MCA and aims to monitor trends in the number of incidents, the

Table 1: MCA ACOPS survey data[7]

MCA ACOPS survey data (2001-2006)						
Year	2006	2005	2004	2003	2002	2001
Total number of reported incidents	559	548	664	585	703	678
Mineral oils	417(75%)	441(80.5%)	592(89.2%)	514(87.9%)	664 (94.4%)	648(95.5%)
Chemicals (including oil based mud and related products)	138(24%)	101(18.4%)	34(5.1%)	48(8.2%)	10(1.4%)	9(1.3%)
Location						
Open sea	80%	79%	81%	75%	78%	72%
Ports and harbours	17%	19%	16%	19%	17%	20%
Larger discharges (Two tonnes or more)	28	37	27	21	19	17
Largest Discharge	30 tonnes of oil & 7,250 tonnes of chemical spilled after the chemical tanker 'Ece' sank following a collision in the English Channel on 31 January while carrying a cargo of phosphoric acid	An accrued total of 66 tonnes of hydraulic oil (HW 540) discharged to sea over a period of four months from the 'Captain Installation' due to a leak in the sub-sea template hydraulic control system.	40 tonnes of light diesel oil and 1 tonne of hydraulic oil released after the 'Mfv Elegance' sank off the Orkneys on 5 March	150 tonnes of brine (sodium chloride), released on 7 December after a supply vessel accidentally severed a bunkering hose at the Douglas installation	200 tonnes of ethyl acetate released after the acid carrier 'Bow Eagle' was damaged in a collision with a French trawler in the English Channel off Start Point on 26 August	157 tonnes of diesel oil released from the 'Tanker Averity' at Stanlow Dock on 26 September due to human error during a cargo loading operation.

geographical distribution of spills, the sources of pollution, and the nature of the pollution.

The MCA defines a 'marine pollution incident' as "pollution by oil or other hazardous substance." [8] In this instance, 'oil' refers to oil of any description as defined by Section 151 of the Merchant Shipping 1995 Act[9]. "Other hazardous substances" are those substances prescribed under Section 138A of the Act. They also include any substance that, although not prescribed, is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea. Similarly to the CHaPD definition of a 'chemical incident', the MCA definition of a 'marine pollution incident' is also very broad and covers a wide range of substances and circumstances. Due to this broad remit for the MCA, it is important to note that an incident as defined by the MCA will only occasionally be considered an incident for CHaPD and the HPA.

Table 1 illustrates the number and types of incidents reported in the ACOPS survey from 2001 – 2006. Each year, over 500 incidents occurred at sea. The majority of these incidents (75% to 95%) involved mineral oils, most of which have a low toxicity. These data indicate that the number of incidents involving chemicals (including oil based mud and related products) have increased from 1.3% in 2001 to 24% in 2006. Around 80% of the reported incidents occur in open waters, with approximately 20% occurring in ports and harbours.

Results

As illustrated in Table 2, a total of 10 incidents were recorded in the CHaPD database. Incidents were generally evenly spread across the regions and over the years included in the study. There was a mix of different incidents ranging from a beach contaminated with chemicals, to the grounding of a ship, an explosion, and structural failure of ship. The sources for reporting were varied, with three incidents reported by the MCA over the last 5 years. The daily media trawl conducted by a CHaPD Press Officer also identified a number of incidents. This media trawl is an important aspect of the CHaPD early alerting system[10]. For example, the media trawl is likely to identify significant maritime incidents that may not be dealt with directly by the MCA, such as those that involve packages (containers/drums) found on the shoreline as usually the Local Authority (LA) is the primary responder.

Agencies involved

In the majority of the reported incidents, a number of different agencies were involved in the response. The main agencies were the HPA (via the HPU or CHaPD teams), Primary Care Trusts (PCT), the Environment Agency (EA), LA, the MCA, the emergency services (police/fire), and the media. In two of the incidents, an Environment Group was formed, signifying the potential seriousness of the events. However, formation of an Environment Group does not necessarily imply that there was a public health issue. An Environment Group (EG)[11] may be set up at the very early stages of an incident, when a real threat to the human, marine and coastal environment is considered likely. The Environment Group is made up of representatives of the relevant statutory nature conservation body, the environmental regulator, relevant health bodies and the government fisheries department. The concept of an EG is to provide coordinated public health and environmental advice to all respondents with a role in a significant maritime pollution incident.

Casualties

Only one of the identified incidents reported casualties. This was also

Table 2: Maritime chemical incidents reported to CHaPD, March 2004 to April 2008

Date incident reported	Reporting agency	Vessel Name	Brief description	Location – HPU region	Person(s) / organisation(s) notified	Chemical(s) Involved
07/04/2008	MCA	Happy Lady	Venting of Ethylene from a tanker[1]	Humber Estuary - Yorkshire and Humber	HPU, Environment Agency (EA), MCA, Local Authority (LA), CHaPD	Ethylene
14/01/2008	Guy's & St. Thomas' Poison Unit	City of Sunderland	Ship carrying cars grounded off coast	Coast of Happisburgh, Norfolk - Eastern	Environment Group including the MCA, EA, CHaPD was formed	Release of fuel oil & diesel from vehicles on board
19/01/2007	MCA	Napoli	Structure failure of ship[2]	Devon - South West	Environment Group formed: MCA, CHaPD, HPU, EA, FSA, CEFAS, LA, Police, Media	Hydrocarbons and mixture of chemicals*
17/03/2006	Local Authority	NA	Contamination of beach with lead, mercury, PAHs and naphthalene	Beach in the New Forest Area - South East	CHaPD, HPU	Mix - lead, mercury, PAHs & naphthalene.
01/05/2006	BBC news article	NA	Oil contamination of beach	North West	HPU	Hydrocarbons
11/05/2005	PCT	NA	Smoke from smouldering fire from 750 shredded tyres in cargo hold	Eastern	CHAPD, HPU, PCT/EA/Fire Service/Other	Products of combustion
13/09/2005	HPU	NA	Discovery of asbestos in the shingle on the beach	Minster beaches, Swale - South East	CHaPD/HPU/LA	Asbestos
28/10/2005	BBC news article	NA	Bleach containers washed up on Dorset Beach	Dorset beach, South West	CHAPD/HPU/Police/LA/ Fire Service	Threat of Bleach - Fume -(not released - LA removed containers)
10/08/2004	MCA	The Coral Alcropora	Release of 200 litres of vinyl chloride, resulting in dense white cloud, visibility less than 1 m	Manchester shipping canal - North West	Major incident declared by Cheshire Fire, HPA, CHaPD, PCT, A&E, Fire, Port Health, Regional Emergency Planning Officer	Vinyl chloride
03/06/2004	Government Office (DEFRA)	NA	Tanker containing styrene and toluene ran aground	Hampshire -South East	CHAPD/HPU/PCT/MCA/ Central Govt	Styrene & Toluene

*Chemical included - glyphosate, methyl bromide, ethanol, rubber solution, white phosphorous, potassium hydroxide, phosphoric acid, tetrachloroethylene, dimethylsulphide, toluene diisocyanate, hydrogen peroxide and epoxy resins

the only incident for which a major incident was declared and involved the cargo ship "The Coral Alcropora". The incident occurred in 2004 in the Manchester shipping canal and involved an explosion, which was caused by the opening of a valve of a vinyl chloride storage tank. There were ten reported casualties and the crew were evacuated from the ship.

Discussion

The results of the review indicate that of the 500+ maritime incidents documented in the MCA ACOPS survey each year, only a small minority of incidents were reported to HPA/CHaPD. However, the majority of the incidents involved mineral oils and most occurred in the open sea so are unlikely to have required public health input. Due to the constraints of the current review, it was not possible to review all maritime incidents included in the ACOPS survey for their likely or potential impact on public health. Nonetheless, it is important to ensure that the mechanisms in place are sufficiently sensitive to identify incidents with an actual or potential public health risk.

The review has raised some questions for consideration.

- Does the MCA recognise and report all incidents with a potential impact on public health? This is not considered a likely explanation for the relatively small number of incidents reported to the HPA. MCA operational staff are fully aware of the formal procedures for alerting public health responders[5] and are trained to adopt a precautionary approach in all instances. Therefore, can we conclude that there relatively few maritime incidents with a potential impact on public health? The only definitive way to establish this would be through a joint audit of all incidents logged by the MCA. Such a review could also assist in the development of a complementary risk assessment process for use in both agencies.

- Is there sufficient awareness in each agency regarding the skills and expertise available to them through their partner agency? Do individuals responding to incidents have sufficient access and awareness of the contacts within the partner agency? It was not possible to include an evaluation of these issues. However, the relative rarity of maritime incidents requiring public health input highlights the need to ensure that there is an institutional awareness. It is hoped that the two reports resulting from this review will facilitate at least part of this.

- Does this suggest a training need for CHaPD and the MCA?

Conclusions and Recommendations

The results from this study indicate that few of the incidents recorded by the MCA require public health input. In the absence of a joint audit of all incidents logged by the MCA and HPA/CHaPD, it has not been possible to establish if all incidents with potential or actual public health implications were notified to the HPA. Such a joint audit may be beneficial to both agencies as it might be possible to use the outcomes to inform the development of a consistent risk assessment procedure, to be used in both agencies. This has the potential to improve the collaborative response procedures in both agencies.

Acknowledgements

The authors would like to thank the following individuals for their assistance: Robie Kamanyire, David Russell, and Jeff Russell from CHaPD.

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11 Maritime Pollution Response in the UK -The Environment Group, MCA (http://www.mcga.gov.uk/c4mca/mcga-stop1_01.pdf)

Review of Maritime chemical incidents at sea: Current assessment and reporting procedures

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Introduction

This is the second of two articles describing the results of a review of maritime chemical incidents reported to the Chemical Hazards and Poisons Division (CHaPD) and/or the Health Protection Agency (HPA) over a period of 5 years. This article details the current assessment and reporting procedures and makes some suggestions for possible amendments to the current alerting system in order to improve the identification of incidents with a potential impact on public health.

Methodology

Information on the current risk assessment, alerting and reporting mechanisms in each agency was identified from the CHaPD Operating Procedure (OP) for Maritime Chemical Incidents and from the Maritime and Coastguard Agency (MCA) guidelines for maritime pollution prevention, respectively. The MCA guidelines were evaluated from a public health perspective to identify any potential gaps in the risk assessment process.

Results

Current alerting system

The MCA is usually the first agency to respond to a maritime incident. Figure 1 illustrates the current alerting system used by the MCA to notify CHaPD. The lead MCA operations room will notify the duty Counter Pollution and Salvage Officer (CPSO) of the Counter Pollution and Response Branch (CPR). The CPSO will make an initial assessment of the potential risk of pollution occurring, the potential risk associated with any pollution that has occurred, and will also consider the potential impact on public health. The duty CPSO can obtain support from the MCA Counter Pollution and Response Branch (CPRB) duty scientist and environmental chemist based at MCA Headquarters. MCA also have the resources for the modelling of oil and Hazardous and Noxious Substances (HNS) in the seawater column, sea surface and atmosphere.

Any threat will be assessed according to the three options described in Table 1 and the current alerting system will be initiated depending on this options appraisal:

For Option 1, the MCA will identify that there is no need to proceed further unless the situation changes, i.e. the revised assessment indicates that there is or is likely to be a threat to public health, or the situation is unclear. All incidents will continue to be monitored whenever there is perceived to be a possible threat.

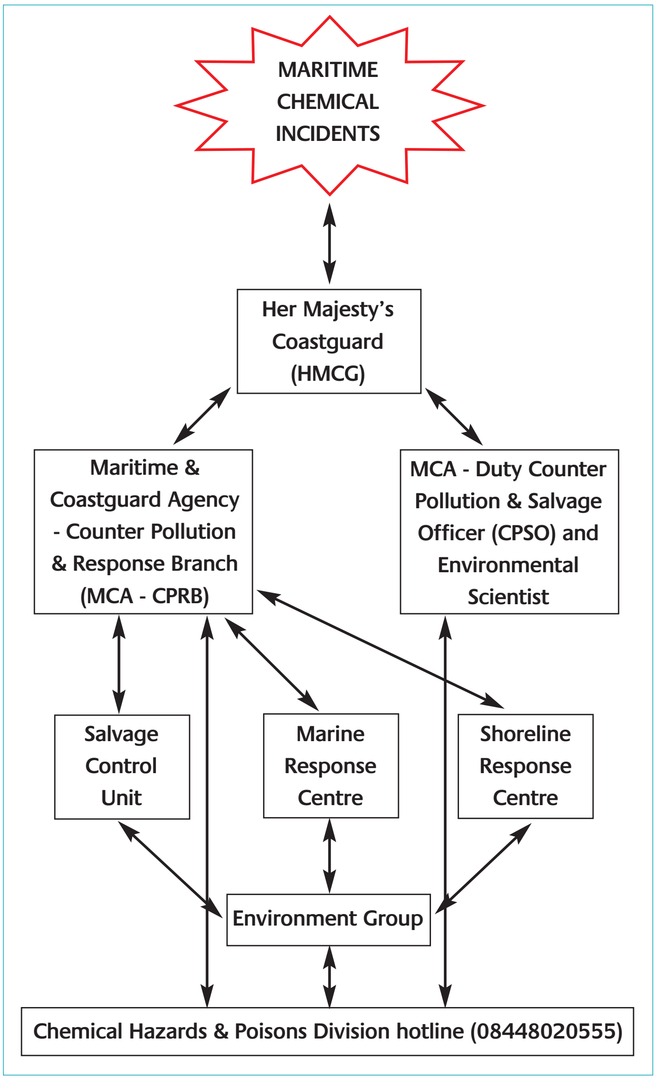

Figure 1: Current Alerting System used by the Maritime and Coastguard Agency

For Options 2 and 3, where there is deemed to be a risk, the Duty CPSO or CPR scientist will contact CHaPD using the CHaPD hotline number; 0844 892 0555. This is a 24-hour incident response number. In a significant chemical incident, an Environment Group will be set up by the MCA and public health advice will be fed into that group, which will support all operational cells set up. The MCA scientific, technical and operational advice note "Maritime Pollution Response in the UK: The Environment Group", fully describes the role of the Environment Group in providing advice on potential impacts on the environment and public health1. In the case of a Civil Contingencies Act-led incident, a Scientific and Technical Advisory Cell (STAC) may be set up to respond to any public health and/or environmental issues.

Upon notification of an incident, based on the information provided, and following consultation, the on-call CHaPD scientists/consultant

Table 1: Summary of different options

	Level of Public Health Threat
Option 1	There is not currently or likely to be a threat to public Health
Option 2	There is or is likely to be a threat to public health
Option 3	The situation is unclear, i.e. it is uncertain whether there is a risk to public health

may provide advice regarding public health management of the incident. In England, advice will be proffered to the local public health team local Health Protection Unit (HPU)/Primary Care Trust (PCT), whilst in Wales the National Public Health Service will be contacted. In Scotland and Northern Ireland, CHaPD will liaise with Health Protection Scotland and the Department of Health, Social Services and Public Safety, respectively. According to the nature of the incident, first line responders, other HPA divisions, and other public health and allied professional will be contacted as appropriate.

MCA risk assessment procedures

MCA staff will make an initial risk assessment of both the potential or actual pollution risks and the potential for impacting upon public health. For Option 1 and 2, as described above, the MCA will contact CHaPD/HPA. The actual information recorded will be dependent upon the incident. This information is organised under the headings in Box 1[1].

Box 1: MCA Checklist for maritime or coastal incident

What is the nature of the incident?
What is the pollutant?

- Specific Name
- Composition

What is the scale of pollution?
What is the exact location of the pollution?
What is the current extent of the pollution?

- Aerial
- At sea
- On shore

Is there a known risk to human health?
What is the risk of further pollution?
Is the risk of the casualty / source of pollution moving elsewhere?
What response action has been taken?
What response action is planned?
Who has been notified?

This checklist covers most of the information needed for any maritime risk assessment issues. However, it is possible that it does not provide enough information to estimate the threat to public health. For example, it does not include information regarding the population density, potential population at risk, and adverse health effects reported from an incident that may have only been detected through public health surveillance, for example, calls to NHS Direct. It has not been possible to provide a definitive list of criteria for the notification of incidents to the HPA/CHaPD. In general, HPA should be informed of any incidents where the public could be potentially or actually exposed. There will often be an element of subjectivity in the notification process. Therefore, it is important for CHaPD/HPA to liaise closely with the MCA to ensure a risk assessment is undertaken in an appropriate manner.

Integration of public health concepts to MCA checklist

When investigating the health consequences of any potential chemical incident it is necessary to develop a conceptual model including the source(s) of pollution, relevant exposure pathways, and receptors. For incidents at sea, humans may be the main receptor of concern but other receptors with an indirect effect on human health may also be important, for example, fish and shellfish. To make the MCA risk assessment checklist more sensitive to public health implications, it is proposed that some additions to the current checklist are included (Box 2). This proposed checklist is based on the "source – pathway – receptor" conceptual model of risk assessment[2].

Box 2: Proposed "Source – Pathway – Receptor" Checklist

Source

Deliberate or accidental?
Nature -fire, collision, explosion, spill, leakage, explosion etc?
Where (location)? (Port, harbour, open sea)
Time and Date
Mode of transport (ship/boat/cruise/cargo*)
Chemical (s) (CAS Number, IUPAC/UN etc)
Bulk, containers, drums
Toxicity/severity (known effect)
Type of Hazard
Form (gas/liquid/solid)
Concentration
Amount / size

Pathway(s) (ingestion, inhalation, dermal)

Media (Air/water/land)
Sea (Tides) & weather condition
Wind direction and other meteorological conditions

Receptor (human/animal)

Casualties (number/symptoms)
Population density
Population at risk – public/staff/crew*
Sensitive sub-populations – schools/residential homes etc.

* issues relating to occupational health should be referred to HSE (e.g. cargo ship)

Based on the information provided by the "source – pathway-receptor" checklist, the MCA may decide whether there is a threat to public health using the flowchart below (Figure 2), which has been derived from the reporting system used by the Environment Agency (EA).The MCA may then contact the HPA to notify them of incidents they believe may be of public health concern (Table 1). The MCA may also request advice and information from the HPA about the population likely to be affected and any potential vulnerabilities. As described in the flowchart, there is no need to inform CHaPD if there is no threat to public health (Option 1). However, MCA should contact CHaPD if there is an actual or potential risk to public health. If there is

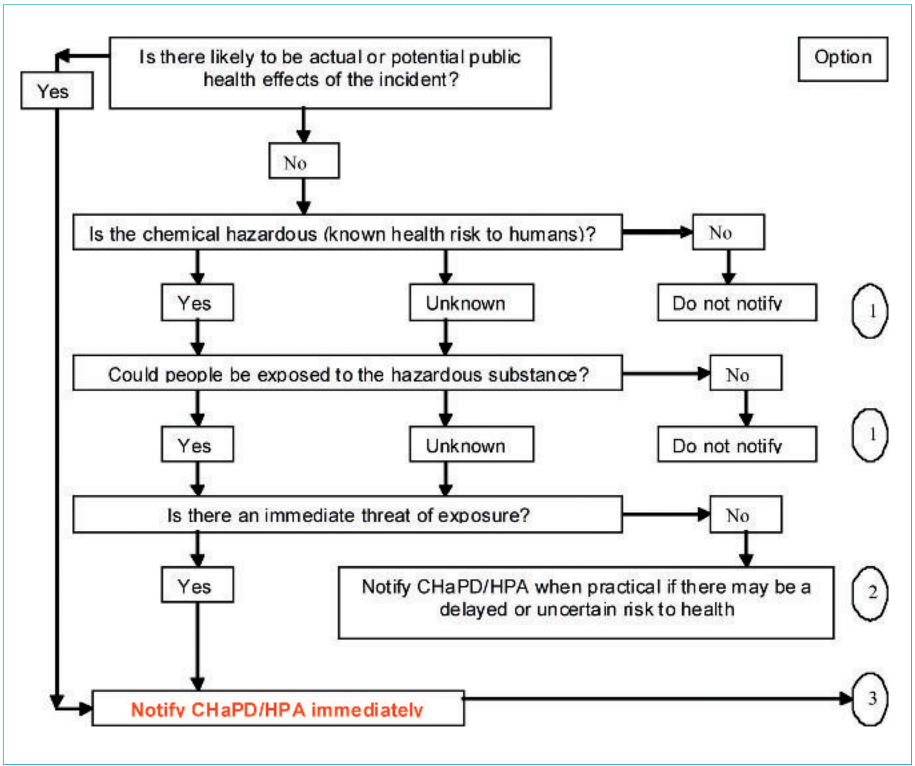

Figure 2: Public Health risk assessment (Adapted from Environment Agency reporting system[3])

an immediate threat of exposure to a chemical (Option 3), the MCA should contact CHaPD immediately.

The MCA should continue to inform CHaPD/HPA of all relevant incidents with the potential for an impact on public health. Multi-agency training between the MCA, CHaPD/HPA and the UK Standing Environment Groups may improve staff understanding of the roles and responsibilities in responding to maritime incidents, and also may ensure that that operational staff are aware of the skills and expertise available through the other agencies when responding to an incident. Consideration should be given to a shared audit of events between the MCA and the HPA. Implicit in this is the recognition that communication should be a two-way process; the HPA/CHaPD should also contact/notify MCA if they receive information regarding a maritime incident with the potential to affect public health from other sources (e.g. BBC news, Local Authority etc).

Discussion

Currently, as part of their standard response protocol, the MCA carry out a risk assessment for the potential public health impacts of the incidents to which they respond. However, the majority of incidents that the MCA respond to do not require public health input[4]. The addition of the source-pathway-receptor conceptual model to the MCA checklist may make it more sensitive to identifying aspects critical to public health. Additionally, it may facilitate more effective communication between the MCA and the HPA/CHaPD when dealing with an incident identified as having the potential to impact on public health.

In the absence of a detailed review of the MCA and CHaPD response to individual maritime incidents in the past, it has not been possible to provide a definitive list of the criteria that each agency uses to notify the other. Further training in the mutually agreed recognition of trigger points may be achieved through the existing emergency response workshops programme as run by the MCA, with input from CHaPD/HPA. These workshops also provide a useful opportunity for improving understanding of the roles and responsibilities of each agency and the cross-agency expertise available through this collaborative working relationship. The data available to the MCA through their own resources may not be adequate for evaluating the *level of risk* associated with a potential threat to public health. This kind of information may be readily available to the corresponding public health team, for example, size of the population at risk, population density or health effects that might be identified through syndromic surveillance. Additionally, the workshops provide an opportunity for the staff of both agencies to meet and develop stronger collaborative relationships. Such collaboration has the potential to improve both agencies' capacity to respond to those incidents that do require a public health response.

Conclusions and recommendations

Currently, as part of their standard response protocol, the MCA carry out a risk assessment for the potential public health impacts of the incidents to which they respond. The majority of incidents that they respond to do not require public health input. However, the addition of the source-pathway-receptor model to the MCA checklist may facilitate more effective communication between the MCA and the HPA/CHaPD when dealing with an incident identified as having the potential to impact on public health. Additionally, the proposed changes may make it easier to identify and describe potential public health threats resulting from an incident.

Acknowledgements

The authors would like to thank the following individuals for their assistance: Dr David Russell, Robie Kamanyire, and Jeff Russell from CHaPD

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The Happy Lady: All at Sea
The public health aspects of ethylene venting from a gas carrier in the Humber estuary

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Incident summary

Early on the afternoon of Monday 7th April 2008, the Maritime and Coastguard Agency (MCA) contacted the Chemical Hazards and Poisons Division (CHaPD) of the Health Protection Agency (HPA) regarding the "Happy Lady," a gas carrier anchored off Spurn Head in the Humber estuary. The local coastguard office had contacted the Counter Pollution and Response Branch of the MCA (at the Agency's Southampton headquarters) as the ship owner had requested permission to vent 40 tonnes of ethylene; thus the MCA sought advice from the HPA over the potential public health risk. The HPA liaised closely with the MCA and other external agencies throughout the duration of the 'incident.'

The nearest populations were on the banks of the Humber estuary. The local coastguard reported that, on the north bank, Kilnsey was some 6 miles away, with the main population centre of Hull some 20 miles distant. On the south bank were Humberstone, Cleethorpes, and Grimsby, some 2, 4, and 6 miles away, respectively. The prevailing wind as of 06:00 on the 7th was forecast from the northwest, changing to blow from the south to southwest from 06:00 on the 8th.

CHaPD and the Humber Health Protection Unit (HPU) discussed the information available. Ethylene is lighter than air; it was thought probable that the distance from residential areas and moderate wind would ensure safe dispersal, although the flammability and low explosive limits of ethylene were a consideration. Impacts on passing shipping (commercial and ferry traffic) and other vessels using the Bull anchorage were also possible.

The ship could not move further offshore due to a 2 metre fracture of the hull and fears that the hull could split in rougher water. The possibility of a specialist Fire Service team attending with a mobile flare was discussed, but proved not to be viable with this type of ship. The unique design of this ship also precluded any attempt at ship-to-ship transfer. The damage sustained meant that the ship was unable to vent to a shore flare and, in any case, no suitable facilities existed in the Humber area which could accept ethylene. Venting would be undertaken by using compressors to introduce hot air into the tanks to boil off remaining vapour, followed by backfilling with inert gas. This would take place over a 3 day period.

A risk assessment was needed to address the fact that venting would take place over an extended period, in which conditions would be variable. Due to the circumstances and extended time period of the release, media interest was thought probable. As a precautionary measure, at 14:11 modelling was requested to predict ground-level ethylene concentrations in the locality and to quantitatively confirm that there were unlikely to be adverse impacts on public health, both in terms of public exposure and explosive risk. The HPU liaised with the Environment Agency and Local Authority.

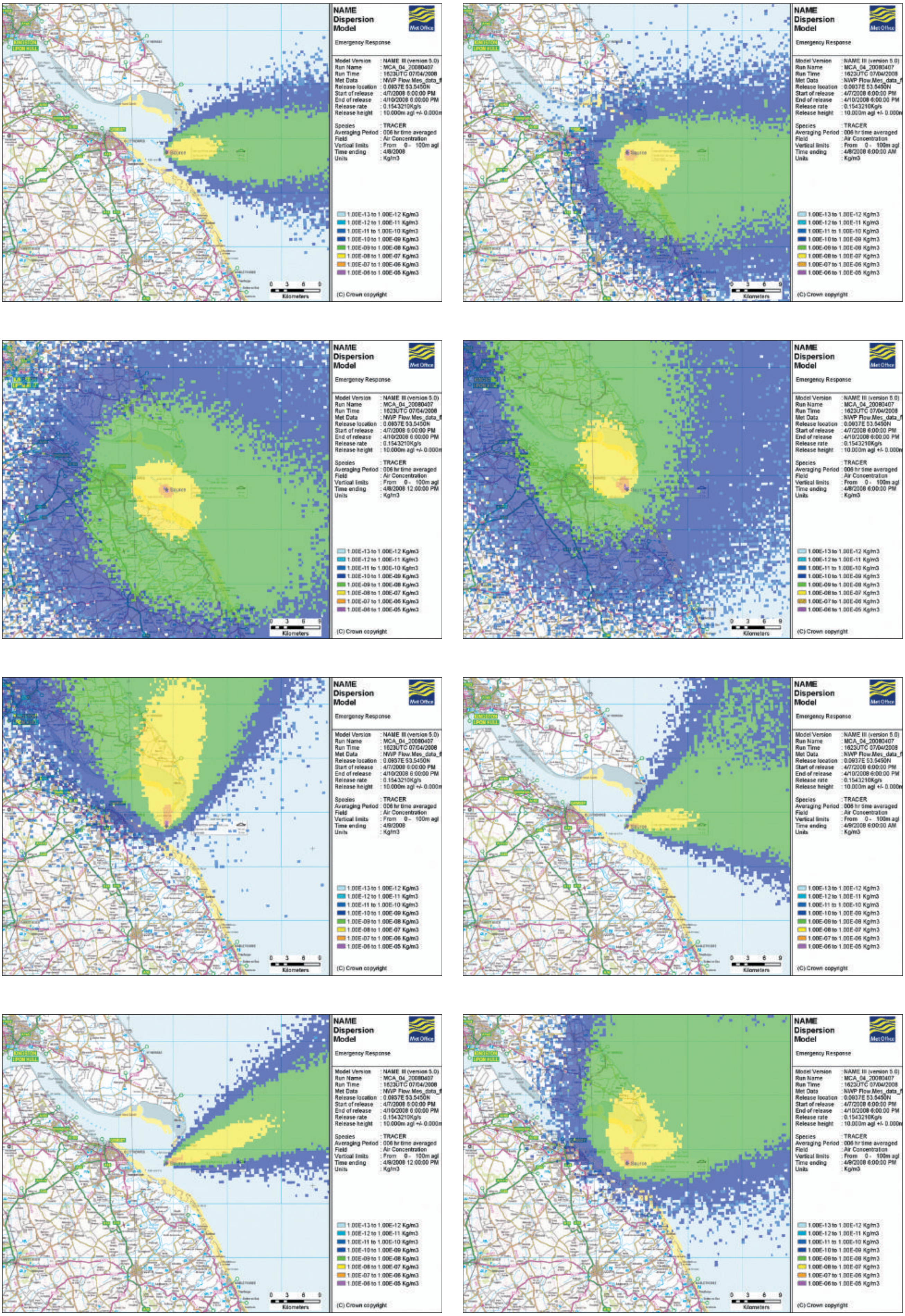
Ethylene: overview
Ethylene is a common raw material in the synthetic organic chemical industry. It is shipped as compressed gas; under pressure and below 10°C it exists as liquefied gas.

The gas has a characteristic sweet odour. It is colourless, lighter than air, extremely flammable and can form explosive gas/air mixtures. Explosive limits are relatively low: 2.7% - 36.0% by volume in air. It is of a low order of toxicity and vapours are not irritating to the eyes or upper respiratory tract. High concentrations may lead to anaesthetic effects. On loss of containment, ethylene can act as a simple asphyxiant, causing suffocation by lowering the oxygen content of the air in confined areas, leading to drowsiness, unconsciousness or death. It is not classified as a human carcinogen.

No UK Workplace Exposure Limit exists. As a guide to occupational risks, US standards are a value of 200 ppm (over 8 hours).

Modelling was also a means of informing the radius of the exclusion zone to be imposed by the MCA around the vessel. The responsibility for imposing such a zone falls to the Secretary of State's Representative (SOSREP) who is free to act in this regard without recourse to higher authority. On behalf of the Secretary of State, the MCA SOSREP is able to oversee, control and, if necessary, to intervene and exercise "ultimate command and control" acting in the overriding interest of the UK in salvage operations within the UK waters involving vessels or fixed platforms where there is significant risk of pollution. This introduced a political element to the advice required; modelling outputs were expected to become available early on the evening of the 7th and a timely assessment and response was thus required by public health on-call. Handover from in-hours to out-of-hours required that staff be fully briefed and that the information required to interpret modelling outputs be to hand.

Initial appraisal of modelling outputs, received at 18:06, showed the conversion factor given by the Met Office to be incorrect; thus CHaPD on-call liaised with the Met Office in order to clarify the validity of the outputs. Predicted concentrations were many orders of magnitude below those concentrations able to cause asphyxiation, or explosive limits – predicted maximum ground-level concentrations were approximately 8.5 ppm. The results of the modelling confirmed that there was unlikely to be any risk to the public at the levels predicted but that there was a potential risk to the crew if they were still aboard the vessel, as levels on deck may have been sufficiently high to exceed occupational standards. As this


NAME Dispersion Model
Met Office
Emergency Response
Model Version : NAME III (version 5.0)
Run Name : MCA_04_20080407
Run Time : 1623UTC 07/04/2008
Met Data : NWP Flow.Mes_data_f
Release location : 0.0937E 53.5450N
Start of release : 4/7/2008 6:00:00 PM
End of release : 4/10/2008 6:00:00 PM
Release rate : 0.1543210Kg/s
Release height : 10.000m agl +/- 0.000m
Species : TRACER
Averaging Period : 006 hr time averaged
Field : Air Concentration
Vertical limits : From 0 - 100m agl
Time ending : 4/8/2008
Units : Kg/m3
1.00E-13 to 1.00E-12 Kg/m3
1.00E-12 to 1.00E-11 Kg/m3
1.00E-11 to 1.00E-10 Kg/m3
1.00E-10 to 1.00E-09 Kg/m3
1.00E-09 to 1.00E-08 Kg/m3
1.00E-08 to 1.00E-07 Kg/m3
1.00E-07 to 1.00E-06 Kg/m3
1.00E-06 to 1.00E-05 Kg/m3
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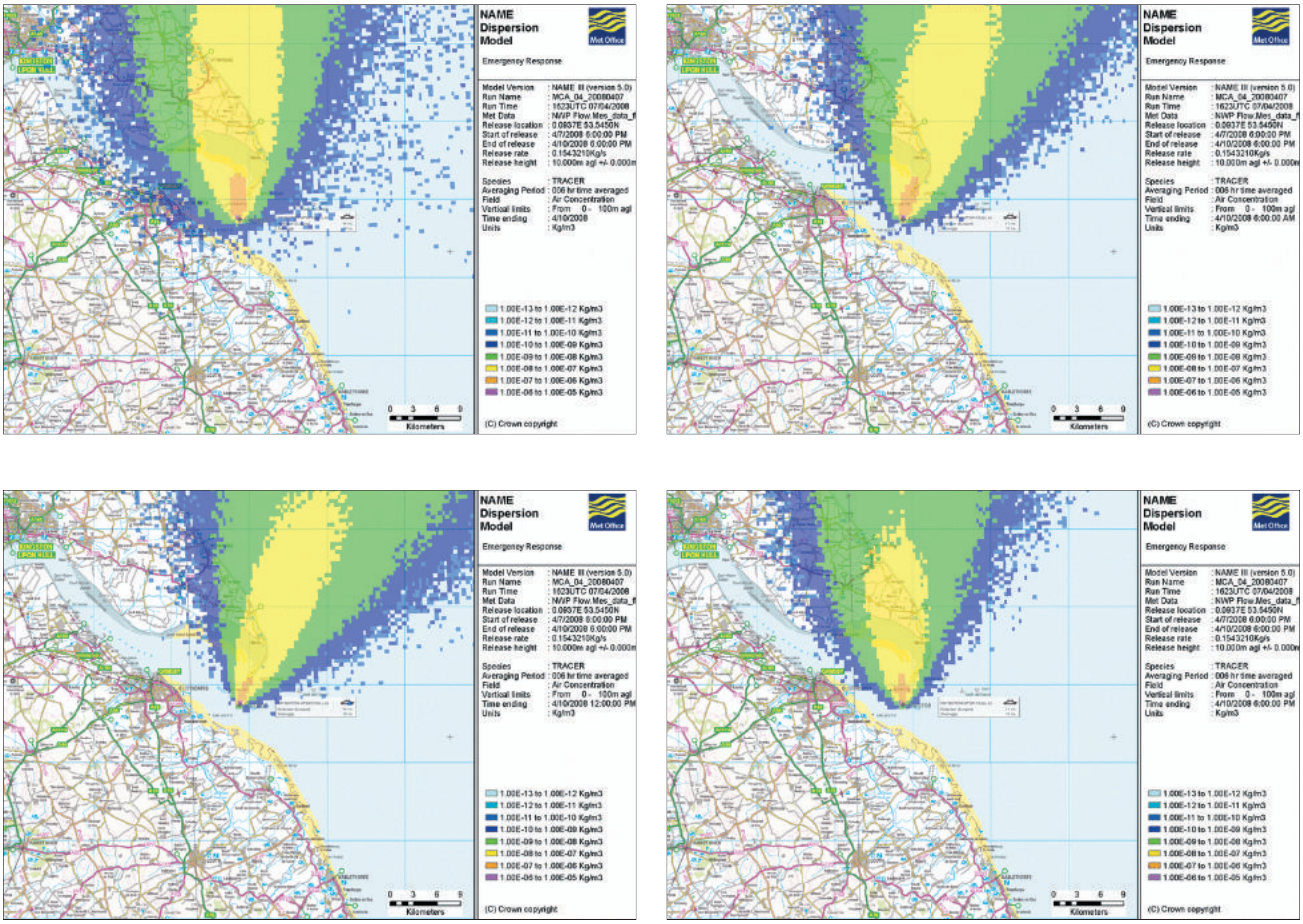

Modelling outputs

The source was assumed to be 10 metres above ground/sea, with 40000 kg (40 metric tons) released in total continuously over a 72 hour release period. The outputs are expressed as 6 hour air concentration averages.

Figure 1: Modelling outputs

was an occupational safety matter, under the remit of the Health and Safety Executive (HSE), CHaPD on-call queried whether the MCA had notified the HSE; whose out-of-hours contact subsequently proved problematic for the MCA. The MCA were advised that the crew should stay up wind and off-deck where possible, and well away from the release point.

The MCA determined that a 0.5 mile exclusion zone would be set up around the ship. The MCA reported that the owners had been made aware of concerns and had responded, stating that the venting procedure was covered by a standard operating procedure, therefore the crew were trained to undertake the venting and were aware of the risks.

The process of warming the ship's tanks prior to venting began on the 8th. As the venting was anticipated to begin late on the 8th/early on the 9th of April, the predictive modelling outputs were premature and did not cover the full time period of the release. A further modelling run was undertaken on the morning of the 9th, yet the vessel was still warming up its boilers and venting did not commence until the 10th. The MCA requested the Met Office carry out further modelling once it was confirmed that venting of the gas was finally going ahead, running another 3 day model once venting commenced at 10:00 on April 10th. The results of both modelling runs were very similar to the initial run undertaken and did not alter the HPA's assessment that there was unlikely to be any risk to the public from the release. When venting was complete, the vessel made for port at Hull in order to carry out repairs.

Learning points

- Early briefing and effective handover between in-hours and out-of-hours staff aided the HPA's response to the incident.
- Modelling outputs became available in a timely manner and were key to carrying out a fully-informed assessment of potential risk to public health. However, it is important to ensure the validity of information is double-checked: in this case the incorrect conversion factor provided would not have materially altered interpretation had it been used, but this could well have been a critical factor if predicted concentrations were higher.
- The MCA may set up an Environment Group at the very early stages of an incident, when a real threat to the marine and coastal environment is considered likely. The Environment Group is made up of public health representatives and representatives of the relevant statutory nature conservation body, environmental

Figure 2: The Happy Lady at dock (Source: Phil Young, Environment Agency

regulator and Government fisheries department. In this case those agencies were notified; but as the main question posed by the MCA was in regard to public health an Environment Group was not formed. This caused some confusion on the day and should be clarified at an early stage in future incidents of this type. In this case the HPU liaised directly with the Environment Agency and Local Authority to notify them and obtain their input.

- It proved useful to contact the vessel's owners to obtain a material safety data sheet for ethylene; in any incident it is worth contacting the company or operator involved to obtain any further chemical information that may be available.

Further reading

Maritime and Coastguard Agency – Pollution Response

http://www.mcga.gov.uk/c4mca/mcga07-home/emergencyresponse/mcga-pollutionresponse.htm

Information on ethylene

http://www.cdc.gov/niosh/ipcsneng/neng0475.html

The role of the Maritime and Coastguard Agency

The Maritime and Coastguard Agency (MCA) is the competent UK authority that responds to pollution from shipping and offshore installations. The MCA is regularly called upon to react to a wide range of maritime incidents and has developed a response procedure to deal with any emergency at sea that causes pollution, or threatens to cause pollution. The "National Contingency Plan for Marine Pollution from Shipping and Offshore Installations" (NCP) sets out command and control procedures for incident response. These procedures have built-in thresholds to allow for flexibility of response to different degrees of incident.

MCA's Counter Pollution and Response (CPR) Branch is based on a regional response with central operational, technical and scientific support. A Counter Pollution & Salvage Officer (CPSO) is based in each region, supported by scientists, a mariner, a cost recovery specialist and logistics support specialists at the MCA's headquarters in Southampton.

Response to an Incident

Initial information about an incident is usually reported to one of the 19 HM Coastguard (HMCG) stations around the UK by many sources e.g. the vessel in difficulty, passing vessels, observers and the public. HMCG will then instigate search and rescue operations where necessary and this action will hold primacy over any other forms of response. They will also inform the duty CPSO if there is any pollution or threat of pollution i.e. a drifting ship, a grounded ship etc. The CPSO then decides the relevant course of action, instigates the appropriate level of response, and alerts relevant people. There are a number of response cells that can be set up to deal with an incident:

A Salvage Control Unit (SCU)
A Marine Response Centre (MRC)
A Shoreline Response Centre (SRC)

The response will be dictated by the scale and type of incident. An Environment Group may also be set up at the very early stages of an incident, when a real threat to the marine and coastal environment is considered likely. This group provides environmental advice to all three specialist response centres.

Operation MSC Napoli

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With thanks to Nicola Thompson and colleagues at Weymouth and Portland Borough Council

Introduction

MSC Napoli (Figure 1) suffered flooding to the engine room during force 8 gales in the Channel on Thursday, 18 January 2007. The 26 crew abandoned ship and were safely rescued from their lifeboat by helicopter.

The ship began to break up through the onslaught from the heavy seas. This created a massive risk of pollution and could have affected some of the UK's most beautiful coastline. There were over 3,500 tonnes of heavy fuel oil on board and 1,500 tonnes of diesel together with a very mixed cargo, some of which was highly toxic.

Figure 1: The MSC Napoli in better days. (Image printed with permission from the Law Offices of Countryman & McDaniel, www.CargoLaw.com)

MSC Napoli incident command and control structure

The command and control structures for maritime incidents are different from those on dry land. A multiagency Strategic Co-ordinating Group (SCG) was established on Friday, 19 January, with direct links to Government through the representative of Secretary of State for the Environment.

This strategic group was advised by a tactical Salvage Control Unit led by the Maritime Coastguard Agency (MCA) based in Weymouth.

The SCG requested that the Dorset Resilience Forum's Environment Group should be convened to advise on the impact of this incident on human health and the wider environment e.g. bird life, marine plant life, fish and crustaceans. This Environment Group provided scientific and technical advice to the Salvage Control Unit but there were difficulties in communicating these messages to those in control of the response on land. The salvage and the land based command structures were established in parallel and it took several days to establish good communications. The control structure is illustrated in Figure 2.

CONTROL OF SALVAGE	CONTROL OF SHORELINE RESPONSE
• Strategic Coordinating Group – Gold equivalent ↕ • Salvage Control Unit – Tactical ↕ • Environment Group – Scientific and Technical Advice	• Gold Command, Devon ↕ • Silver Command, Dorset

Figure 2: Command and control structure of MSC Napoli incident

The Environment Group met for the first time on the morning of Saturday, 20 January at the MCA Offices, Weymouth. The group was chaired by the Environment Agency and had representatives from Health Protection Unit (HPU), MCA, Dorset County Council, Weymouth and Portland Borough Council, Natural England, and Marine Fisheries Agency. The MCA representation included a "Hazardous Cargoes Adviser".

Risk assessment of hazardous cargo

The "sitreps" on the position of the Napoli varied from moment to moment but the vessel eventually came to ground 1.4 nautical miles off the coast and east of Sidmouth in Devon (Figure 3).

Figure 3: Location of MSC Napoli

Early assessment of risks identified the possibility of the following.

- Serious oil pollution with impact on wildlife, e.g. iconic seafans, the beaches and rivers along a World Heritage coastline and special areas of conservation e.g. Chesil Beach, the Fleet and Sidmouth to West Bay.

Table 1: Examples of chemicals on board the MSC Napoli

Chemical	Danger to Human Health	Other Impacts	Risk of Harm
Methyl bromide (34.4 tonnes on board in cylinders)	Highly toxic if the gas is inhaled. Initially nausea, vomiting, progresses to confusion, convulsions – sometimes intractable, pulmonary oedema.	Moderately toxic to fish; not expected to accumulate in the food chain.	Low – cylinders are very robust but air monitoring on Napoli instigated in case of release.
Herbicides – glyphosate, fluazifob-butyl and propaquizafop	Low mammalian toxicity.	Very dangerous to the environment.	Fairly high if drums wash overboard and reach the beach.
Tetrachloroethylene (60 drums)	Irritating to skin, respiratory and gastrointestinal tract. Can cause respiratory depression and loss of consciousness.	Does not accumulate in food chain.	Fairly high if drums wash overboard and reach the beach.
Diesel	Irritating to eyes, respiratory systems and skin. Vomiting after ingestion leads to chemical pneumonitis. Breathing in large quantities of diesel vapour leads to dizziness, headache and vomiting.	Very damaging to environment e.g. birds.	Risk of dermal contact high. Risk to environment very high.
Phosphorus pentasulphide	Highly reactive and corrosive. Contact with eyes or skin causes severe burns. Also corrosive if inhaled or ingested.	Very toxic to aquatic organisms.	Low due to packaging. Contact with water leads to hydrogen sulphide gas and danger of explosion.
Toluene diisocyanate	Severe irritant to eyes, skin and respiratory tract (sensitiser). High concentrations can cause pulmonary oedema. May cause long term asthma.	Hydrolyses quickly so effects limited.	Low due to packaging.

- Effects of oil pollution on the wider environment.
- Loss of a varied cargo thought to include:
  - vodka and perfume;
  - pesticides, paints, epoxy resins, flammable solvents, e.g. tetrochloroethylene;
  - car air bag activators in pressurised containers;
  - methyl bromide and a range of other chemicals.
- Damage to the environment from chemicals e.g. glyphosate (a herbicide).
- Risk to the food chain, e.g. shellfish beds.
- Risk of explosion if some of the chemicals mix.
- Risk to the health of salvers.
- Risk to the health of public encountering chemicals on beaches.

Very early on in the incident, an attempt was made to obtain the full ship's manifest from Rotterdam. Information started to become available on the afternoon of Saturday, 20 January and the local HPU was in regular contact with the Chemical Hazards and Poisons Division (CHaPD) of the Health Protection Agency (HPA) over the course of that weekend and for several weeks to come. Some of those chemicals on board are shown in Table 1.

Early actions taken to protect human health and the environment (18 January to 21 January 2007)

Early actions advised by the Environment Group and the Salvage Control Unit were particularly aimed at protecting the environment and the foodchain:

- HMS Argonaut and two tugs tried to put a boom around the Napoli to contain oil and diesel. This was difficult, due to the heavy seas;
- booms were placed across local rivers at risk e.g. the Axe and the Sid;
- an exclusion zone was established to keep fishermen out of the area.

In addition, access to the beaches near the Napoli was to be blocked by Devon Police to protect the public. Salvers took measures to strengthen the lashings holding the cargo to the ship so that they could cope with a 30º roll and 80 mile an hour winds.

The MCA started modelling dispersion of escaped pollutants, based on tidal flows and predicted weather patterns. The modelling covered sudden and slow release of pollutants, and the release of containers – both floating and sinking/rolling on the seabed. The highest priority was to remove as much oil as possible from the Napoli and this was a very hazardous operation for the salvers, working in appalling weather conditions.

By Sunday, 20 January, the heavy seas overnight resulted in 150 containers being lost from the Napoli. These were not thought to contain hazardous materials. The ship's manifest confirmed that hazardous materials were stored in the centre of the hold with non hazardous cargo on the outside. Six teams of coastguards walked the beaches to identify oil and containers. By 10.15am, a Gold Command had been established in Devon. The Royal Society for the Prevention of Cruelty to Animals and the Food Standards Agency had been notified and the salvers had been advised of the nature of hazardous chemicals on board.

At this time, key messages to Gold Command included:

- close the beaches;
- reconnaissance staff to avoid contact with broken containers;
- Salvage Control Unit to be notified if hazardous material identified.

By Sunday afternoon, drums of nitric acid and potassium hydroxide had been lost overboard. Isopropanol drums were also lost. Isopropanol is a highly flammable chemical and the advice to the shoreline responders was to avoid contact with sparks, try to prevent entry into waterways and cover spillages with sand/soil; the isopropanol would naturally decompose to water and carbon dioxide.

However, early on in the incident the valuable nature of some of the cargo attracted the public and the press then appeared in droves. Sky News reported that there were beer kegs, motorbikes and Toyota cars on the beach, and looting had already begun (Figure 4). Despite the public being attracted by "loot" to an area where a number of hazardous materials were washed up, there was only one casualty overcome by fumes from a burning container.

Figure 4: Branscombe beach with the MSC Napoli in the background.

Longer term actions taken to protect human health and the environment (21 January to 2 February 2007)

The Environment Group continued to meet almost daily until 2 February 2007. This created resource issues for the HPU. The Regional Health Emergency Planners provided much valued assistance in maintaining the HPA's response to the incident. Close contact continued to be made with CHaPD.

Health protection queries continued to focus on the likely health effects if members of the public and those involved in the environmental clean up operation were exposed to open containers of chemicals washed up onto the beaches. A decision was made not to use volunteers in the early stages of the clean up due to the hazardous nature of some of the cargo.

Advice continued to be required from the Environment Group on dealing with the wreck of the container ship. There was a debate as to whether it would be better to use the ship as a diving wreck or to recycle her.

Risks involving recycling the Napoli by cutting up *in situ* included:

- risks to salvers from what would be a dangerous operation;
- noise pollution;
- damage to life on seabed from "steel swarf" – small fragments from the cutting operation;
- large metal chunks and other items being lost and washed up on beaches;
- impact of debris on scallop beds to the east of the wreck.

Eventually, it was decided to break the wreck into sections using controlled explosions. Part of the Napoli was then towed to Belfast for recycling and the remaining sections of the ship were cut up *in situ*, just off the east Devon coast. Before the recycling could proceed, the two thousand or so containers remaining on the Napoli were taken to Portland Port using an enormous crane barge.

Weymouth Port Health Authority were responsible for:

- inspection of all containers;
- examination of cargo and refrigerated unit records;
- determination of fitness to enter the food chain;
- issuing paperwork;
- disposal of unfit / contaminated foodstuffs.

Figure 5: Inspection of containers at Portland Port. (Image courtesy of Weymouth and Portland Borough Council)

The examination of the cargo (illustrated in Figure 5) involved the following procedure:

- the container number was checked off against the manifest if available;
- interested parties were asked to make themselves known;
- the seal was opened with bolt croppers;
- examination of the contents was undertaken and photographs taken;

- the container was re-sealed, along with a Port Health seal if the cargo was relevant;
- paper work was completed indicating the status and determination of fitness of the contents.

Surprisingly, some food transported in refrigerated containers remained fit for human consumption even after several days with no power. Other foods had exceeded temperature regulations, had become contaminated with sea water and chemicals, or were physically damaged; these had to be destroyed as they were unfit for human consumption.

Managing the disposal of the containers from the Napoli created a major challenge for the Weymouth and Portland Port Health Authority, which was exacerbated by a number of factors which are outlined here.
- A number of owners failed to claim their undamaged consignments resulting in food perishing whilst on the dock side. This subsequently had to be destroyed by incineration or sent to landfill. Liquid cargoes created unique disposal issues as they had to be deliquified before reaching landfill.
- The identification of unlabeled chemicals not on the ship's manifest made their disposal complicated. Mixed use containers caused difficulties and highlighted a huge trade in undeclared goods worldwide.
- The destruction of large quantities of spirits occurred due to importation complications which prevented possible reuse by conversion to industrial alcohol.
- Producers and manufacturers would not allow the re sale of their branded goods for fear of damaging their commercial reputation.

The Napoli salvage operation was the largest ever worldwide. However, modern containers ships can now load x 22 wide x 7 high containers - five times the number on board the Napoli

Key messages for responding to future incidents

Maritime disasters of this kind are bound to happen again in the future, and even bigger container ships are being built which can carry five times the number of containers that could be carried by the Napoli. The following learning points can be identified.
- Be aware that command and control arrangements for maritime incidents operate in parallel to the land based Gold and Silver commands.
- Establish links between sea and land based command structures at an early stage.
- Hazardous cargo will be stored centrally and containers lost at an early stage in an incident will usually be from the outer layers and so less hazardous.
- Try to obtain the ship's manifest at the outset of the incident – the MCA's Hazardous Cargoes Adviser will facilitate this.
- Consider mutual aid arrangements – big salvage operations will take many months to complete and HPA advice may be needed over a long period of time.
- Try to influence responsible media reporting and be very assertive. By Day 3 of the incident the health messages from the Environment Group began to modify the style of reporting but these messages should have been more strongly promoted at an earlier stage.

Further reading

Marine Accident Investigation Branch. Report on the investigation of the structural failure of MSC Napoli English Channel on 18 January 2007. Report No 9/2008,

April 2008. Available at:

http://www.maib.gov.uk/publications/investigation_reports/2008/msc_napoli.cfm

An outbreak of unusual skin rash at a new school

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Background

In November 2007, nearly 50 students and staff attending a newly opened senior school in Scotland complained of a rash which resembled sunburn. This rash mainly affected exposed areas, especially the face, neck, hands and lower arms, but it also affected unexposed areas. Some cases also reported skin irritation and headaches; one reported breathing difficulties. The rash usually lasted 24-48 hours and recurred in some children; parental concern was growing and some children were being kept out of school. Based on the appearance on photographs, a dermatologist thought that the rash was consistent with some form of allergic reaction.

The school campus, which was opened in August 2007, has a senior school for 450 students and a smaller primary school. The school was built on vacant ground adjacent to a former primary school which was then demolished to provide car parking for the new campus. The new senior school was bordered by an electronics factory, which used volatile chemicals in the manufacture of circuit boards. The main source of air ventilation within the school was by 'trickle' vents built into windows or by physical opening of windows. There had been a history of problems with the school heating system due to difficulties in implementing the building management system, designed to operate the heating systems remotely by telemetry. In early November the school had been too cold; following adjustments the school then became overheated. The first reports of skin rash occurred after the episode of overheating.

Initial monitoring was undertaken by the Environmental Health Service of Argyll and Bute Council. Histories were taken from initial cases to try to identify possible environmental factors in the school and community which might have been associated with the rash. Enquiries were also made of practices and systems at the adjacent electronics factory. A strong smell of hydrocarbons near the school was also noted and was subsequently identified as being due to visible contamination of a small stream (burn) nearby, later confirmed as 'red diesel' oil.

A multi-agency Incident Management Team (IMT) was convened, chaired by a local Consultant in Public Health from NHS Highland and supported by Health Protection Scotland (HPS). Members visited the school and reviewed the initial information, including data from the case histories collected by the local Environmental Health Officers (EHOs). The IMT agreed that a systematic epidemiological and environmental investigation was required to try and identify the cause. Co-incidentally, within hours of the initial visit, one investigation team member developed the characteristic rash.

Investigation methods

A case was defined as a student or staff member who developed an unexplained skin rash, localised to individual sites or generalised affecting numerous sites, with or without additional symptoms, between 19th November and 21st December 2007, while attending the school premises.

Epidemiological investigation

A case-control study was undertaken in December 2007 to investigate factors potentially associated with the rash.

All cases and controls completed questionnaires requesting details of their symptoms, allergies, eating/drinking habits, activities, foreign travel and use of cosmetic/chemical products, timetable information and use of rooms and information on their families and siblings. Their travel routes and use of school premises were identified using maps and plans of the school. Cases were asked to give details of the timing and distribution of the rash using a diagram (Figure 1).

Year cohorts differed in their room use patterns. Years one ('S1', age 11 to 12) and two ('S2', age 12 to 13) tended to move round the school rooms in their class groups. Older years were together only for daily registration then separated. Controls were selected who were similar to cases apart from not having had the rash, matched for: age, sex and by school year (e.g. a 12 year-old S1 girl was matched with another 12 year-old S1 girl). For staff cases, another staff member of the same gender was used as a control. Statistical analyses were carried out using SPSS.

Environmental investigation

Temperature and relative humidity levels were monitored by EHOs within the school to characterise trends in some of the rooms used by cases. In addition, given the new furnishings and fittings and the presence of 'new building' odours within the school, monitoring was undertaken, supported by Glasgow Scientific Services, of aldehydes and volatile organic compounds (VOCs) in selected locations.

Results

Forty-four cases met the case definition: 42 school students and 2 members of staff. Thirty-nine controls were obtained. A pair matched case-control design was used, giving 39 case-control pairs for the study.

Case characteristics

The rash affected multiple skin sites, both exposed and unexposed (Figure 1). Onset occurred most often during later morning class periods P3 and P4. The incidence was 9/100 for students with a 3:1 female to male ratio. Year S2 had the highest attack rate (27%), followed by S6 (15%), S3 (8%), S5 (4%), with S1 and S4 joint lowest (1%). A second year class (2K) had the highest attack rate (40%). The majority of the cases reported the onset of the rash while in one of four rooms. Ventilation in these rooms was by the same means; trickle

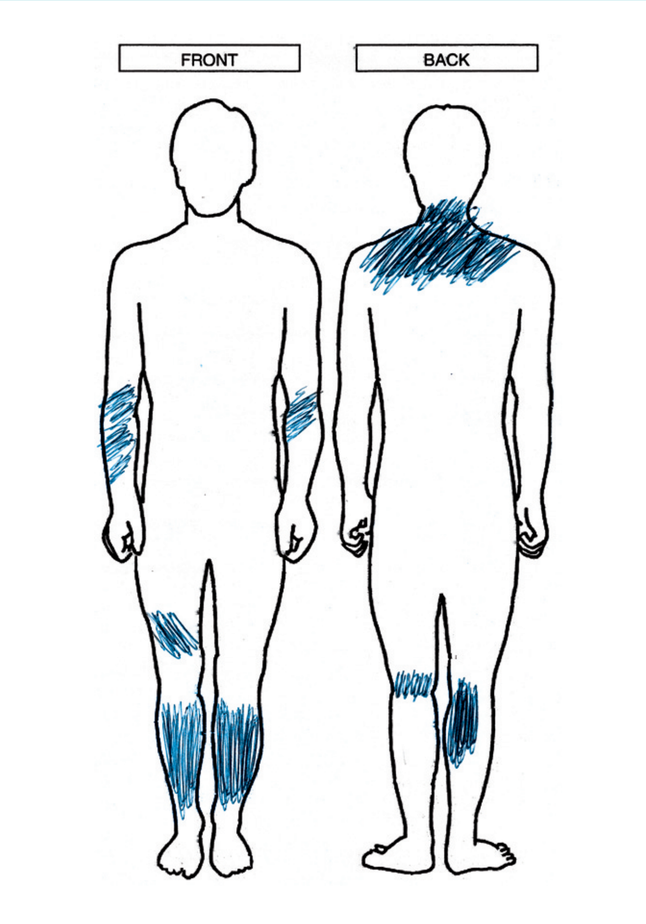

Figure 1: Rash distribution on a case.

vents or opened windows except for G56. This was a music room with no external windows; it had mechanical forced air ventilation, taking air directly from outside, which was then directly heated. To allow for different usage of the rooms, a 'room attack rate' was calculated by taking the number of cases who developed the rash per room, divided by the total number of students using that room on that same day. The 'daily attack rate' over the period ranged from 0 to 7.7/100 students/room.

Ten of the 42 student cases reported a sibling at the school as also having had the rash; 5/36 cases reported another family member not attending the school as having had a similar rash around the same time.

Case-control analysis

There were no significant differences detected between cases and controls associated with the following factors: home address postcode; history of asthma, hay fever, allergies or prior skin conditions; contact with pets or other animals; field sports, walking, horse riding, swimming, use of the gym or use of school showers; use of a new washing powder, exposure to new domestic household chemicals or use of new cosmetics; foreign travel; drinking tap water; mode of travel to school or use of a footbridge across the polluted stream; use of staircases, corridors or rooms for breaks or lunch or registration rooms.

Significant associations were found for being a case as follows:

- use of room G56 (the music room): odds ratio 3.4 (95% CI 1.08 – 10.88) for being in G56 at the time of rash onset or one or two periods before.
- having additional symptoms of: itching skin, headache, itchy/sore eyes, feeling hot, dizziness (Table 1)
- having an affected sibling ($p = 0.002$)

Controls were significantly more likely than cases to report using a new personal hygiene product such as perfume or deodorant.

Environmental investigation results

In the small selection of rooms tested, the average temperatures fluctuated between 20-22°C with peaks of 24°C or more in certain rooms. One room had relatively low humidity levels and carbon dioxide levels in some rooms were relatively high. Limited sampling for VOCs did not identify abnormal levels.

Discussion

Possible explanations for the outbreak were initially hypothesised as:

- UV radiation induced rash
- parvovirus infection
- mass psychogenic illness
- allergic reaction to an unidentified substance
- response to poor indoor air quality (low humidity).

UV radiation induced rash

Both exposed and unexposed areas of skin were affected, suggesting that natural or artificial UV exposure could not explain the pattern alone. Mercury lamps were used in communal areas but there was no evidence to suggest these were faulty or leaking mercury vapour.

Table 1: Odds ratios for additional symptoms reported by cases versus controls.

Reporting symptom	% cases reporting symptom	% controls reporting symptom	Odds ratio	p-value
Itching skin	96%	26%	58.8	<0.000 *
Headache	77%	34%	6.5	<0.000 *
Feeling hot	61%	18%	7.0	<0.000 *
Itchy/sore eyes	46%	13%	5.5	0.002 *
Dizziness/faintness	36%	3%	21.1	<0.000 *
Sneezing	25%	11%	2.8	0.151
Nausea	25%	8%	3.9	0.075
Sore muscles	18%	13%	1.5	0.563
Respiratory problems (wheezing and/or difficulty breathing)	18%	5%	4.0	0.097

* Statistically significant results at the 5% significance level

Parvovirus infection

The skin rash had some features suggestive of parvovirus infection but was not typical; no serological evidence of recent parvovirus infection was found. This explanation therefore seemed unlikely.

Mass psychogenic illness

Simultaneous symptoms, including rashes[1], affecting clusters of children and students have been reported previously and classed as 'mass psychogenic illness'; defined as subjective symptoms affecting a group who attribute their symptoms to an external cause in the absence of objective evidence of an environmental source. Common reported features include: subjective symptoms such as nausea, headache, dizziness, itching; a predominance of symptomatic females; occurring in social groups under particular stress or with pre-existing concerns; clustering within classes and social groups; spread of outbreak by 'line of sight'; and spread of symptoms from older/more authoritative persons to younger persons[1,2,3]. Such events may have an 'environmental' trigger (e.g. in this case, potentially the odour from the diesel contaminated stream nearby), but the symptoms go beyond what can be toxicologically explained[4,5]. Although there was a 3:1 female to male ratio and clustering of cases in certain classes, this outbreak did not appear to be a classical 'mass psychogenic' episode. Cases were distributed across year groups, cases did not collectively attribute their symptoms to any environmental source or odour, and the rash appeared in both exposed and unexposed areas, which was confirmed by objective observers (teachers, school nurse and school doctors), suggesting that a psychogenic explanation alone is not adequate.

Allergic reaction

Although there was a borderline significant association with self-reported food allergy ($p=0.057$), the full analysis did not find an association between the rash and a past history of allergy generally. There was no evidence of association with exposure to specific furnishings, fabrics, plants or water via showers. Interestingly, use of new personal hygiene products was found to be more common in controls than cases; however there was no immediately obvious explanation for this finding, although some selective recall bias could not be eliminated as a possibility.

Poor indoor air quality

The rash onset in multiple locations within the school over the period might have been consistent with exposure to an airborne agent. The late morning peak in onset times suggested the possibility of a time/dose/exposure relationship. The rash had some resemblance to heat-related urticaria (heat rash) but did not have a typical 'heat rash' appearance and there was an absence of skin swelling; the rash was generally more erythematous with large confluent areas affected (Figure 2).

Limited indoor air sampling indicated potential air quality problems in some rooms with high peak temperatures, low humidity and relatively high carbon dioxide levels; however there were insufficient data to incorporate into the case-control study or to allow a meaningful comparison with room attack rates.

Ideally, comprehensive sampling in all implicated rooms would have enabled correlation of attack rates with indoor air quality variables.

Further investigations of the diesel oil contaminated stream and the nearby electronics factory failed to identify plausible *source-pathway-receptor* linkages with the cases and so they were not considered to be significant aetiological or contributory factors.

Figure 2: Rash on leg of schoolchild.

Although some children reported other members of their family who did not use the school as having similar symptoms, this could not be objectively validated and local General Practitioners (GPs) did not report an increase in consultations for rashes more generally.

Limitations

The outbreak proved challenging to investigate due to the school being located on an island, creating practical difficulties for the investigation team. The physical resources available to the local authority and the NHS were limited. Efforts were made at the time by the local authority EHOs to monitor for likely candidate environmental agents consistent with the situation, especially volatile organic compounds, but no evidence of excess levels was found. The lack of capability to carry out a more comprehensive indoor air quality investigation, rapidly and ideally contemporaneously with the experience of the rash presentation among cases, reduced the potential for identifying the presence of any specific aetiological chemical or other agent. However, a comprehensive air quality analysis in such a large multi-roomed school building would have involved considerable planning and resources. There are helpful guidelines on the investigation of indoor air quality, though not specifically designed for use in school premises[6]. Further guidance on the investigation of such problems in school premises would be useful.

A relatively complex and detailed questionnaire was required to obtain the necessary level of information on individuals' use of the school facilities and other potentially relevant environmental exposures. The school layout diagram helped track student movement within the school and use of rooms. Patterns of room use were validated using the school's computerised timetable and registration data systems. The body diagram (Figure 1) was helpful in characterising the rash distribution. The matched case-control study design was relatively complex and the differences in room use behaviour between the first two year cohorts and the rest presented analytical challenges.

Although the main analytical investigation used a case-control methodology, the senior school student population was also considered as a cohort. Hence attack rates were calculated for each room. However, the robustness of using attack rates as a means of identifying rooms where exposure to a causal factor might have occurred was uncertain. The rash onset may have been delayed such that it appeared some hours after 'exposure' to a 'high risk' room used earlier that day or even before. Hence, the room in which the rash onset was reported might not be the room where 'exposure' to a causal agent actually occurred. This appeared to be supported by the case-control analysis which identified room G56 (the music room) as the only room significantly associated with being a case but only if the case had been in the room either at the time of rash onset or in one of the proceeding two periods.

Conclusion

The cause of the rash remains unclear. There may have been a psychogenic element to some of the reported symptoms but this could not alone account for the physical appearance of a rash. Although testing did not confirm elevated volatile hydrocarbons, the new school was full of new furniture, fittings and carpets, all of which may have contributed to its distinctly 'new' odour. The case-control study helped to eliminate a number of potentially relevant exposure factors and identified an association with one room in particular; the only room with a forced air ventilation system. High attack rates in other rooms suggested the possibility of more widely distributed factors within the school. There was some evidence to support there being sub-optimal indoor air quality. Some of the other symptoms reported by cases would be consistent with low humidity in particular and inadequate fresh air flow rates. On balance, the most likely explanation for the phenomenon was thought to be sub-optimal indoor air quality (low humidity, high carbon dioxide) possibly combined with other airborne agents.

Investigation of such problems is complex and time consuming and may not provide a definitive explanation. Throughout the process however, it was useful to be able to reassure anxious parents, teachers and school authorities that their concerns were being addressed through the investigation and that any potential environmental hazards, especially the possible relationships to external factors including the nearby electronics factory, were being considered. The lack of association between the rash and exposure to such external factors provided useful reassurance. Given that the incident occurred in an island community, it was also helpful for local EHO and NHS Board members of the IMT to be able to liaise with local General Practitioners and community health nurses and doctors in order to "manage" the community concerns, which arose from time to time.

The outbreak effectively ended when the school broke up for the end of year holiday. Work was carried out on the heating and ventilation system before the new term to try to optimise the system and ensure better air exchange rates. A few new cases were reported in the new term but the phenomenon did not persist. A more detailed air quality survey was carried out at a later date. It is hoped that this will provide objective evidence as to the adequacy of the ventilation systems, air quality and air exchange present in the school more recently.

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Acknowledgements

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Problems at a commercial composting site

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Introduction

Composting appears fairly high up on the waste hierarchy triangle and is an important method to help reduce the amount of waste which ends up in landfills and incinerators; however it is not without its own unique problems.

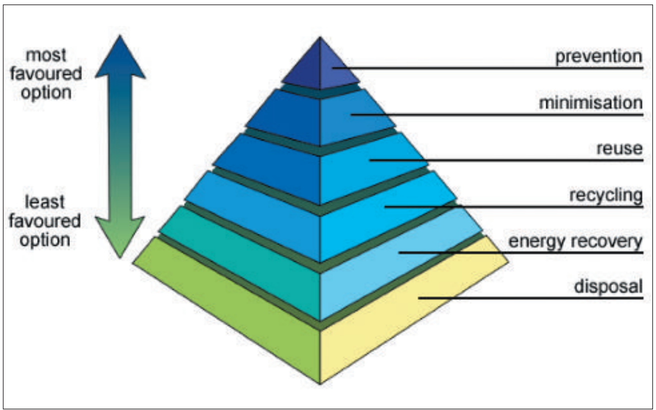

Figure 1: The waste hierarchy triangle (Copyright-free image, wikipedia[1])

What is composting?

Composting is the process of controlled biological decomposition of biodegradable materials under managed conditions that are predominantly aerobic, and that allow the development of thermophilic temperatures as a result of biologically produced heat. Compost, the result of composting, provides a sanitised and stabilised solid particulate material that confers beneficial effects when added to soil.

Background to the local Situation

The incident pertains to a site in Surrey of approximately 2 hectares (ha), within a wooded clearing of around 5 ha of Green Belt (see Figure 2). The site is approximately 125 metres from the nearest residential property.

This local composting site first came to the attention of the Health Protection Unit (HPU) in August 2006 due to a large on-site fire. The site was well known to the local Borough and County Councils before this event, and had been the subject of many previous complaints from residents.

Recent History

In 2004, as a non-statutory consultee, the Borough Council (BC) received a Waste Management Licence Application and Working Plan from the Environment Agency (EA) for an open windrow green waste composting facility at Brick Kiln Farm, of 15,000 tonnes throughput per annum. There had been previous composting activity at this site on a smaller scale (< 5,000 tonnes p.a.) which was previously exempt from requiring a licence. The site had already attracted concern from local residents, who had made complaints of odour to the BC.

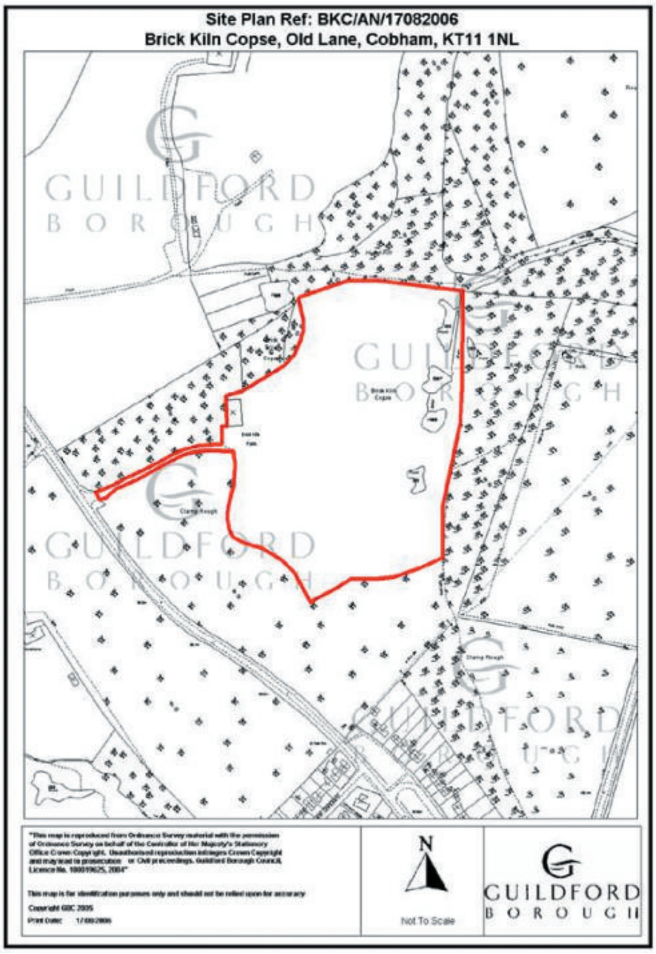

Figure 2: Map of Brick Kiln Farm (© Guildford Borough Council)

In July 2005, the local Fire and Rescue Service (FRS) contacted the BC Emergency Out-of-Hours Call Centre to inform them that they were treating a fire at Brick Kiln Farm compost site. A large section of the waste compost pile was on fire and was expected to burn for several days as the FRS had deemed that a controlled burn approach was the best management option. A site visit was made the following day by staff from the Environmental Health (EH) department of the BC to assess the fire and smoke impact. Previous poor management of the site had resulted in the eruption of spontaneous large fires which had lasted several months.

Over 100 complaints about smoke were received from the community between 4 July and 23 September 2005. Claims ranged from general nuisance due to smoke, to associated ill-health effects. At the time, the HPU were not aware of the problem. A site visit from EH described the site thus; *"a large section of a waste pile was on fire towards the centre to eastern end of the site. I saw a large broad plume of thick greyish-white smoke coming off the burning windrow, which had an objectionable, intense acrid smell. A south to south-west breeze was blowing the smoke northwards away from the more densely populated housing."* At that time the site had no valid Waste Management Licence and Planning consent had lapsed.

In early 2006, the site changed hands when the original company went into liquidation. The new company was allowed ownership of the site on the condition that they cleared all the remaining illegal waste (most of which was unsuitable for composting) before they began any processing of compost. However, in July 2006 the fires recurred – there had been no change in the volume of waste material on the site because someone, believed to have been arsonists, had set fire to new equipment which had been purchased for the purpose of processing the waste. Once again, an oversized pile of organic waste ignited and continued to burn in hot dry summer conditions. There was a lot of smoke and more complaints from local residents. The FRS were involved again and decided that the controlled burn option was the best way to deal with the fires. Towards the end of August 2006, the HPU were finally informed of this problem. By this time the fires were almost extinguished and the smoke was much less of a problem. Residents were still very angry and a public meeting was organised by the local councillor. There had been some local and national press coverage and the EA had successfully prosecuted and fined the first company involved.

A public meeting

The public meeting was predictably fraught and attended by over 120 residents. Representatives from FRS, the composting company, Surrey County Council planning, Local EH and the local HPU were on the 'panel' to answer questions. This was the first significant involvement of the HPU.

At the meeting, EH agreed to start air quality monitoring at the site (although the smoke had now abated as the fires had been extinguished), and a survey of local residents to investigate their symptoms and perceived health effects was proposed. The composting company declared their long term interest to clear the site and develop a well managed commercial composting facility on the site. This was met with a very angry response from residents.

HPU work

After the public meeting, the local HPU, with assistance from the Chemical Hazards and Poisons Division (CHaPD), London, undertook a literature review on smoke from compost fires and associated health effects. The literature review found no published material relating to the health effects of smoke from compost fires. Assumptions were therefore made about similarities between fires involving vegetation, forest fires and general products of combustion in assessing any potential health effects.

The likely pollutants in the smoke plume at Brick Kiln Farm were identified as hydrogen chloride, hydrogen fluoride, nitrogen dioxide, sulphur dioxide and dioxins.

The known acute health effects of exposure to smoke involve respiratory, eye and skin irritation. Further effects include nausea, headache and anxiety. Exposure to a combination of sulphur dioxide and nitrogen dioxide has been shown to enhance the airway response to inhaled allergens in asthmatics.

Dioxins and particulate matter are likely to have been produced during the combustion process. There is a known association between exposure to particulate air pollution and short term respiratory effects, especially in those with existing respiratory illness, in the very old and the very young. It is widely accepted that while particulates can exacerbate existing asthma, there is little evidence to suggest that particulate pollution is a primary cause of asthma. An association also exists between long-term exposure to fine particulate matter (PM_{10} and $PM_{2.5}$) and cardiovascular mortality.

Figure 3: Smouldering compost heap (© Guildford Borough Council)

The HPU and Primary Care Trust (PCT) worked together on a health questionnaire which was sent to local residents to assess the degree of self reported symptoms and effects in the local community. There was a poor response rate to the questionnaire of just 31%. This was thought to be partly because the large fires had been extinguished by the time the questionnaire was received. The most commonly reported symptoms were sore eyes, headache, sore throat and wheeze, which fit with the expected effects of exposure to smoke and pollutants from a vegetation fire.

No air quality monitoring was conducted whilst the fires were burning. The only measure of exposure was self reported or a proxy measure using distance from the fire. The level of self reported exposure was greater in those living closest to the fire.

A report from the HPU was sent to the PCT and Chief of EH, and subsequently an action plan was compiled by EH to manage future fires.

Currently, the compost material remains on site and smoulders from time to time. It is regularly reviewed by one of the local pollution offices from EH. In the event of another long hot summer there may well be another large fire.

Discussion

This case raises several issues both on a local and national level:

This site is situated within green belt land and is only 125m from the nearest residential dwellings. There has been pressure from local residents for some years for the whole site to be returned to green belt and trees replanted.

Figure 4: Photograph of the Brick Kiln Farm site taken in late August 2006 (© Dr. Margot Nicholls)

Locally, there was insufficient inter-agency communication – the HPU were not aware of the fires until the incident was almost over. Communication with residents occurred very late in the chronology of events and earlier discussions between Public Health and key members of the public may have helped to alleviate some of their anxieties relating to health effects.

Air quality monitoring should have been undertaken early on in the incident to make a proper assessment of exposure for local residents, it was a waste of effort and resources to monitor air quality after the fires had been extinguished.

The health questionnaire was very time consuming to undertake and ultimately added very little to the management of this incident. The response rate was poor and there was little added benefit to the incident management. Earlier HPU involvement might have improved communication with local residents and specific health concerns could have been addressed in a more appropriate manner.

There has been a move away from landfill as a method of waste management and composting is seen as an effective alternative[2]. There is currently no published literature on the health effects of fires at commercial composting sites. These sites rely on the development of thermophilic temperatures and uncontrolled fires may occur in poorly managed facilities. It is important to establish any effects from these fires on those living in close proximity.

Suggested recommendations

- There should be better interagency communication between local EH and the HPU, including joint emergency plans of action to deal with any recurrence of this particular problem.
- As the main regulatory and licensing agency for waste sites, the Environment Agency (EA) is a key player and should always be included in any events or discussion around waste disposal incidents.
- An agreement should be put in place to arrange rapid air quality monitoring/grab samples when indicated.
- A large amount of waste remains on the Surrey site and remains an unresolved issue. There would be a considerable cost involved in clearing the site and at a time when composting should take precedence over landfill there are some difficulties with this plan of action.
- Research is needed to determine the best method to prevent, control and extinguish large compost fires, and to produce more information on the potential effects on health of compost fires.
- There may be a need for tighter controls and regular inspection of commercial composting sites to ensure that they are properly managed.

References

1 **Waste hierarchy image, Copyright-free image.** **http://commons.wikimedia.org/wiki/File:Waste_hierarchy.svg**

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Unexpectedly high nickel levels in newly refurbished care home

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Introduction

The North East North Central London Health Protection Unit (HPU) were contacted by a local water company regarding high levels of nickel (Ni) in water samples from a newly refurbished care home for elderly residents in June 2008. During a routine inspection of the premises the water company had noted that solder on new pipes and fittings may have been lead. Water sampling and testing were therefore undertaken, and although lead levels were found to be normal, Ni levels were found to be elevated.

Investigation

Initial water sampling results from 23 June for Ni ranged from 22 to 400 µg/l. The recommended prescribed concentration and value (PCV) for Ni is 20 µg/l, which is the legal recommended drinking water level for the UK[1]. The water company confirmed that the incoming water supply did not contain high levels of Ni. It was therefore concluded that the source of Ni was a problem local to the premises, and was likely to be from the newly installed plumbing.

As the home was due to reopen the following week the immediate concern was of exposure of residents and staff to Ni through ingestion of, and contact with, mains supply water. Chemical Hazards and Poisons Division (CHAPD) London were consulted and advised the HPU that exposure to water through washing and bathing, at the levels identified, did not constitute a health risk. However, bottled water should be provided for drinking, washing salads etc, and the staff at the home would need to ensure that tap water was not consumed by residents.

Repeat samples were collected following thorough flushing of the hot and cold water systems. A second set of samples was collected on the same date after running the outlet for two minutes, and these demonstrated a significant reduction of the Ni levels (table 1) . This confirmed that, following immediate flushing at the tap, Ni levels could be reduced to an acceptable value. However, it was felt that repeated flushing prior to use of water was not a practical or safe solution to the problem.

Repeat sampling results on 8 July following flushing on the previous night were still unsatisfactory. A multi-agency meeting was held with representatives from the borough council, the water company and the HPA. A representative from the tap manufacturers also attended, as the new taps were considered to be the likely source of Ni. They were not aware of any health effects in people exposed to elevated Ni levels, either through ingestion or skin contact.

The suggested solution was repeated flushing of the pipes, however the effectiveness of this needed to be demonstrated in a scientifically robust manner. On 11 July flushing and sampling was again undertaken to include a protocol where consecutive 250 ml water samples were collected from the running tap. This would give an idea

Table 1: Water sampling results on 2 July 2008 - pre and post flush (2 minutes)

Location	Pre flush µg/l Ni	Post flush (2 mins) µg/l Ni
BOLIER ROOM	110	3.9
ROOM 21	45	4.7
DINING ROOM MAINS TAP	57	4.8
ROOM 23	95	4.5
ROOM 24 COLD	86	8.3
ROOM 24 HOT	110	8.7
ROOM 25 COLD	52	4.6
ROOM 27 COLD	180	5.5
ROOM 28 COLD	250	4.9
ROOM 28 HOT	110	9.2
MEDICAL ROOM	22	4.1
DINING ROOM ADJ 30	210	4.9
ROOM 1 COLD	57	4.6
ROOM 3 COLD	93	4.4
ROOM 4 COLD	57	4.4
STAFF ROOM OPP 6 COLD	61	5.1
ROOM 7 COLD	200	4.4
DINING ROOM ADJ 8 COLD	110	5.7
ROOM 8 COLD	61	4.5
ROOM 8 HOT	95	12
ROOM 9 COLD	66	5.3
ROOM 11 COLD	49	4.7
ROOM 12 COLD	44	5
ROOM 13 COLD	33	5.6
STAFF BEDROOM COLD	1200	10
ROOM 15 COLD	170	6.9
ROOM 16 COLD	120	4.8
ROOM 17 COLD	120	4.8
ROOM 19 COLD	76	4.6
ROOM 20 COLD	93	4.8
ROOM 31 COLD	29	10
ROOM 32 COLD	49	5
ROOM 33 COLD	80	5.1
ROOM 35 COLD	37	5.1
ROOM 36 COLD	24	6.7
COAT & LINEN STORE	85	Not done
CLEANING CUPBOARD	2700	Not done

Key: Green: < 20 µg/l Ni
Yellow: 20 – 100 µg/l Ni
Red: > 100 µg/l Ni

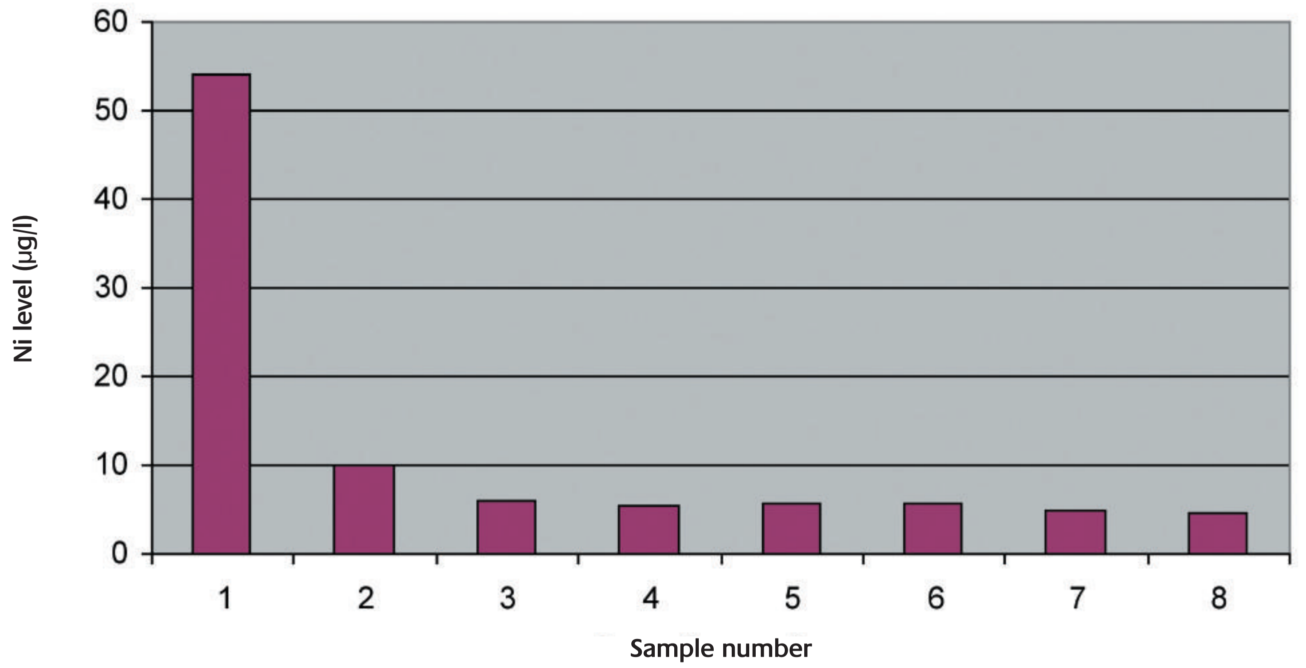

Figure 1: Decay curve for Ni in mains tap water. Each sample represents a 250 ml aliquot taken from the tap. PCV = 20 µg/l

of how quickly the levels of Ni reduced with flushing.

Figure 1 shows an initial Ni level of 54 µg/l falling to 10 µg/l after the first 250 ml have been drawn from the tap. At a flow rate of 5 litres per minute this would require a three second flush to achieve the PCV threshold (20 µg/l). It was agreed that a flushing regime of between 3 -15 seconds would be adequate and practical for daily use.

The home was scheduled to reopen on 21 July and as the water was still not considered safe for immediate consumption from the tap, the following advice was given by the HPU.

1. A regular daily flushing regime of 15 seconds was to be implemented throughout the home, in all rooms everyday. Since all the rooms were not being opened together, it was particularly important that the unused areas continued to be flushed.

2. Bottled water would be provided in a jug for the night, so that residents wouldn't have to open taps (as they might not remember to let the water run).

3. The flushing regime should be part of the regular housekeeping in the rooms, so that staff flush taps for 15 seconds and record this daily.

4. Repeat tests after a month, without first flushing to check whether the flushing has worked and is actually being implemented properly.

Further sampling in August identified high levels of Ni (330 µg/l) from one outlet in a staff room. This was confirmed by a different laboratory (926 µg/l), which progressively reduced to 10 µg/l after 1 minute 45 seconds flushing. The taps fitted to the sink in the room were not new but had been salvaged from the previous installation and re-used. The decision was taken to remove and replace these taps with new taps.

Discussion

Nickel in drinking water may arise due to the leaching of the metal from new Ni or chromium-plated taps and is affected by the hardness and temperature of the water. The concentration of Ni can be increased when the pipes are assembled with tinned copper and gunmetal fittings[2]. In this incident, high levels of Ni were reported from water samples following refurbishment of a care home. New water fittings were a potential source as the incoming water supply did not contain high levels of Ni. There was also the possibility that the pipes or taps were chromium-plated which releases much higher concentrations of nickel initially; these concentrations decrease significantly with time[3].

Exposure to high levels of Ni can result in acute toxicity (see box), although, with the magnitude of levels in this case (up to 400 µg/l from initial results), the expected health effects would be minimal. These include a slight possibility of exacerbation of existing nickel-sensitive skin conditions and a very low chance of gastrointestinal symptoms. However, the water is in breach of the Water Quality Regulations until such times as the Ni levels are below 20 µg/l. CHaPD and the HPU advised that water could not be consumed if Ni levels exceed 20µg/l. They also advised that remediation must be in place before residents could be admitted, unless the staff could clearly enforce bottled (alternative source) water for drinking.

The WHO recommends that where Ni leaches from alloys in contact with drinking water or from Ni or chromium-plated taps, management should be by appropriate control of materials in contact with the drinking water and flushing of taps prior to use[3]. Although nickel levels were reduced after repeated flushing of water pipes and taps, it was still not considered safe for immediate consumption. As the home was scheduled to reopen in the following week precautionary advice was provided by the HPU.

Health Effects of Nickel[3]:

- The main routes of nickel intake for humans are inhalation, ingestion and absorption through the skin.
- The most common harmful health effect of Ni in humans is allergic dermatitis and sensitisation. Approximately 10–20% of the population is sensitive to Ni. Once acquired, Ni sensitivity usually persists and may aggravate atopic dermatitis. Occupational asthma from Ni sensitivity is also reported[4].
- There are reports of nausea, vomiting, diarrhoea, giddiness, lassitude, headache, and shortness of breath from acute accidental exposure to water highly contaminated with Ni (1.63 g/l i.e. 1,630,000 µ/l)[5].
- Ingestion of 15g of nickel sulphate was fatal in a child[6].
- The most serious harmful health effects from exposure to Ni, such as chronic bronchitis, reduced lung function, and cancer of the lung and nasal sinus, have occurred in people who have breathed dust containing certain Ni compounds while working in refineries or processing plants. The levels of Ni in these workplaces were much higher than usual (background) levels in the environment.
- Eating or drinking levels of Ni much greater than the levels normally found in food and water have been reported to produce lung disease in dogs and rats and to affect the stomach, blood, liver, kidneys, and immune system in rats and mice, as well as their reproduction and development. No human study is available.

Leaching of Ni diminished after a few weeks as chromium was rarely found at any time in the water; this indicates that the leakage of Ni was not of corrosive origin, but rather attributable to passive leaching of Ni ions from the surface of the pipes[3]. The latest sample results confirm this, as Ni levels were below the PCV recommended level on repeat testing. If the increase is as a result of corrosion, then an increase of pH to control corrosion of other materials should also reduce leaching of nickel[2] but this was not necessary in this incident.

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Recent health protection issues in Merseyside hospitals

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Introduction

Since its inception in 2003, the Health Protection Agency (HPA) has worked in partnership with many agencies, particularly the National Health Service (NHS). The HPA has striven to ensure that its many roles are understood by its partners and the general public. However, its role in providing expertise and support in the management of chemical incidents is still not widely understood. Two recent incidents on Merseyside have highlighted three areas that still need answering locally, and possibly nationally.

Incident 1: Tertiary Referral Hospital
One Friday in October 2008, workmen were repairing the roof of the operating theatre suite in one of the tertiary centres on Merseyside using decothane. This is a solvent often used in the surface coating of buildings. Fumes from this volatile substance were sucked into the air conditioning system of the theatres, causing staff to suffer from nausea, vomiting and difficulty in breathing.

Some 20-30 staff attended occupational health and theatres undertaking elective procedures were closed. Two theatres with ongoing operations were kept open, with staff rotating to keep exposure to any vapours to a minimum.

The hospital held two incident control meetings on the Friday but did not involve the local Health Protection Unit (HPU). Cheshire and Merseyside HPU was ultimately notified of the incident through the National Poisons Information Service (NPIS), which had been asked by the hospital for advice concerning decothane.

Decothane is a mixture of 2-methoxy-1-methylethyl acetate (CAS number 108-65-6), diphenylcresyl phosphate (CAS number 26444-49-5), isophorone di-isocyante (CAS number 4098-71-9), propyl acetate (CAS number 109-60-4) and triphenyl phosphate (CAS number 115-86-6). It is harmful by inhalation and can cause sensitisation by inhalation and skin contact.

Over the weekend the air inside the theatres was monitored by a reputable environmental firm without finding any raised levels of decothane and the theatres reopened on Monday morning.

Incident 2: District General Hospital
A minor spill of mercury at the back of a trailer full of cardboard boxes and tyres at a parcel distribution centre was noticed before normal office hours by two women who had been working in the trailer for about 10 minutes. One woman, wearing gloves, touched the substance while the other, without gloves, did not. The supervisor came and poked the substance with his key. A fourth employee was employed outside the trailer, transferring boxes laid on a conveyor belt by the women inside the trailer. The fire brigade were informed of the spill, the container sealed and the drains underneath the trailer were sealed.

The mercury came from an unmarked box and was believed to have contaminated the shoes of the staff, who all subsequently attended the local accident and emergency department (A&E), driving there in the car of one of the employees. There was nothing visible on the sole of the shoes of any of the four employees. The shoes were removed and bagged in A&E following consultation with the fire brigade HAZMAT officer. In the A&E, the clothes worn by the women were changed for protective clothing and bagged. None of the employees showered in the A&E.

The amount of mercury spilled varied in different reports, from one pint initially, through to a more moderate spill, and then to the HAZMAT officer's later observation of a "smartie-sized" puddle of the element. A specialist company was employed to clean up the mercury and search for the source.

The local HPU was informed through North West Ambulance. NPIS was called separately by the A&E who required advice on the symptoms and treatment of mercury poisoning. NPIS informed the Chemical Hazards and Poisons Division (CHaPD) but there was no discussion between the HPU and CHaPD until after the incident was closed.

The A&E also required advice on whether to close the A&E department and approached a HAZMAT officer. The HAZMAT officer advised that this was unnecessary but did not discuss the issue with the HPU.

Discussion

The two incidents highlight three areas that need addressing:

1. While hospitals understand the role of the HPA in communicable disease control (e.g. meningitis contact tracing; outbreaks of norovirus), there is a gap in their understanding of the expertise in public health, incident management and supporting sciences, such as toxicology, that the HPA can offer in environmental and chemical incidents.

    - The HPA needs to work on helping hospital staff and management to understand its role in responding to non-communicable disease situations.

2. Issues concerning the closure of all or part of a hospital can have major consequences for the community and the health service. The closure of an A&E means that emergencies must be re-routed elsewhere, with possible strain on nearby hospitals. The re-routing of ambulances and the general public will cause inconvenience and increased risk to health[1]. The closure of the theatres of a tertiary referral hospital can have greater consequences since such

a hospital specialises in supporting other hospitals across a large area. Decisions to close even a part of a hospital are not taken lightly and local HPUs are in a position to support and advise hospital trusts in minimising disruption to the health economy as a result of a chemical incident.

- Any decision to close part or all of a hospital needs to take into account the upheaval any closure can cause within a health economy when making public health decisions.

3. The proper management of a health protection incident (including those involving chemicals) with the possibility of harm to human health requires all three of the following:

   i knowledge of the supporting science (in these cases, toxicology)
   ii expertise in public health practice
   iii sound judgement informed by both of the above and the local context in which the incident is occurring.

   In communicable disease incidents, all three of these are usually provided by the HPU, and reference to specialist advice from the HPA Centre for Infections is the exception rather than the norm. In incidents involving chemicals (or radiation, or physical threats), the HPU is unlikely to be able to provide detailed knowledge of the supporting science. Equally, the supporting specialist division is unlikely to have knowledge of the local context or access to public health expertise. This highlights the importance of early alerting and communication between HPUs and other divisions, as well as other responding services other than the HPA in order to respond effectively. In certain circumstances, HPUs may have to adopt different procedures for responding to and managing communicable disease and environmental incidents.

Conclusions

During an incident, CHaPD (specifically, the on call team member) and the Local and Regional Services (specifically, the affected HPU) should routinely alert each other concerning the incident. If appropriate, discussions on details and response should be held, but lack of perceived need for any discussion should not stop the reporting by either division.

Discussions between the HPUs and the central divisions of the HPA need to continue outside incident response, in such a manner as to enhance understanding of the roles and responsibilities, expertise and abilities of each other.

Incident response often requires contributions from a number of different agencies outside the HPA, as well as from various divisions within the HPA. Discussions between the HPA and other parts of the NHS are important to enable mutual understanding and appropriate support in incident management.

Visits to other units and agencies / trusts, as well as joint exercises, enhance such discussions and understanding and should be part of the continuing professional development of everyone involved in incident management of any type. This is as important in communicable disease control as in environmental incident management.

The possible closure of any NHS trust should be discussed at Local Resilience Forum level, with consequences of and clear indications for closure identified in plans before such situations arise.

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Emergency Planning and Preparedness

World Health Organization: Environmental health in emergencies website

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During and after an emergency situation, such as war or a natural disaster, there are considerable risks to health from environmental risk factors. These could be from damage to sanitation infrastructure, release of chemicals or the effects of the disaster on psychosocial health.

In January 2008, the World Health Organization (WHO) launched a new website dedicated to environmental health in emergencies, available at: **www.who.int/environmental_health_emergencies**. The website provides information and resources on the likely health problems that may arise from emergencies such as conflicts, natural hazards, chemical or radiological incidents and deliberate releases. An overview of the resources available is provided here.

Key resources

Generic resources

One of the major WHO resources for health in emergencies is *Environmental health in emergencies and disasters: a practical guide*, available to download on the site. This book deals with pre-disaster activities, emergency response, shelter, food, sanitation, vector and pest control, control of communicable diseases, chemical and radiation incident response, handling of the dead, health promotion, community participation and human resources.

Technical notes and fact sheets on sanitation, water treatment and emergency health management are provided on the website. The site also links to generic WHO information, such as drinking water quality guidelines and air quality guidelines. Directories of emergency response centres and poisons centres across the world are listed.

Specific disaster resources

In addition to the generic information described above, specific information is provided on different types of emergency. The natural disasters section provides information on waste management, including healthcare waste, hazardous waste and the disposal of unwanted pharmaceuticals; education and health promotion advice; and information specific to tsunami emergencies.

Advice on technological incidents, which are recognised as occurring more frequently and with increasing severity, includes fact sheets on arrangements for preparedness and medical response to nuclear, radiological and chemical emergencies, along with approaches to environmental epidemiology.

Information on poisoning and the public health response to the use of biological and chemical weapons are provided, including mental health advice associated with terrorism.

The WHO defines civil conflict, war and large-scale movements of people as complex emergencies. The additional resources under this heading deal with meeting the needs of children during such catastrophes, refugee health, human rights and addressing psychosocial wellbeing.

Each section also provides links to relevant expert organisations, such as INCHEM from the International Programme on Chemical Safety, which provides safety information on individual chemicals, United Nations organisations like the International Society for Disaster Reduction, UNICEF and the UN Refugee Agency. Links to non-governmental organisations such as the International Federation of Red Cross and Red Crescent Societies and Save the Children are also provided.

Disaster management cycle

The WHO website supplies advice for the different phases of the disaster management cycle. A copious number of links to WHO resources and non-WHO resources are given for each of the six phases: prevention, preparedness, event, detection, response and recovery, as in Figure 1.

Figure 1: The WHO Disaster Management Cycle (Source: WHO, 2008)

Past incidents and emergencies

An archive of details relating to recent and past environmental health emergencies is kept on the website, such as the recent melamine contamination of Chinese food and the outbreak of lead contamination in Senegal.

Conclusion

This WHO website provides authoritative, practical advice for environmental health emergencies and also brings together a wealth of information from expert organisations from across the globe. The Health Protection Agency has not been involved in this project although the WHO environmental health and emergency team welcome suggestions and are constantly updating and adding new information. This site is a useful resource for Health Protection Agency employees dealing with emergencies, especially where little or no national guidance exists in the UK.

Challenges of the Science and Technical Advice Cell (STAC): Group Dynamics at the Strategic Level

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Introduction

During emergencies such as disease outbreaks, pandemics and chemical or radiological releases, Health Protection Agency (HPA) staff are regularly invited to join inter-agency teams. The formation of and participation in inter-agency teams is an everyday part of work in both health protection and emergency planning. This inter-agency working is seen at all levels in all kinds of emergencies. It is seen as so important it has been made a statutory requirement, for all those who are involved in civil protection, to engage with and be involved in inter-agency work and information sharing[1].

The focus for this paper is the implementation of the Scientific and Technical Advisory Cell (STAC) by the HPA on behalf of all partners in London. The STAC aims to provide a forum, away from the multi agency Strategic Co-ordination Group (SCG), for scientific and technical issues to be discussed by experts from various organisations in order that a consensus can be reached and this agreed decision, rather than the discussion, can be taken to the SCG. Though this strategic level scientific and technical advice reflects every day working, it is increasingly being recognised that this high level stressful decision making places special demands on decision makers[2].

Aims

This paper aims to investigate the potential pressures on a scientific group working at the Strategic level, however the observations made are pertinent to all inter-agency groups operating in an emergency. Though the observations are specifically made about the London STAC Arrangements, as I have led on the development of these, the general concepts of STAC are common across the country whether STAC Arrangements are maintained by the HPA, NHS or Local Resilience Forum.

The key principle of STAC is to bring together experts from various fields and organisations in an emergency situation and for these experts to reach a consensus on scientific or technical issues arising from the emergency, taking into account the likely high time pressures and possible limited information[3]. As the inter-agency STAC Arrangements have developed, it has become increasingly clear how challenging inter-agency work can be. Differing goals, responsibilities, influence and authority have all impacted on the process.

These challenges led me to consider the pressures upon the members of the STAC; operating in a time pressured, and potentially information poor, role in an inter-agency team with differing understanding, goals and influence. In acknowledging the potential threats to effective team work in such a pressured environment, it is hopefully possible to mitigate against these threats.

Training

As mentioned, there are several obstacles to the team work of the STAC. Some of these can be avoided through planning and training of key staff. The wide cadre of specialists who could potentially be involved mean that training for all those who may be involved in a STAC is unfeasible in terms of time and finance*. However, effective team-working can be improved by training a pool of chairs, deputy chairs, managers and support staff. Other approaches are however needed for those who are likely to form the main membership of the group.

Group Formation

The formation of any group can be a challenging time, bringing issues of conflicting social behaviour and differing understanding of goals and procedures to light[4]. Tuckman and Jensen[5] suggest that at this 'forming' stage, groups are at their most immature and are therefore also at their most ineffective and inefficient. The very nature of many 'big bang' emergency situations is that these first few hours may be the most important for STAC with the highest time pressures and the most limited information. It is therefore crucial that everything possible is done to ease group formation. Suggestions for STAC which are equally applicable to other areas include early alerting and early information sharing. Increasing use of alerting systems and teleconferencing is making this easier. Teleconferencing can bring its own threats to effective team working and strict chairmanship of teleconferences is needed if they are to be used as an effective tool. The roles of all members of the team and all of the organisations involved should be clearly understood by participants and a brief outline of these as an annex to any emergency plans can be helpful.

Primary Task

All the members of the STAC team will share the same primary task. This is primarily to take incoming information and provide a source of coordinated scientific and technical advice to the SCG[3]. This input and output system of identifying the primary task can be crucial to really understanding the role of a team[6]. Under this primary task however, different organisations will have different priorities[7]. For example health protection, environmental protection and animal health may be different aspects of STAC. Although all of these aspects have overlapping factors, different agencies will see different priorities for these aspects. Some guidance is provided on priorities within STAC through the varying chairmanship of the cell. This should be decided by consensus between all agencies involved.

Group Size

There is the potential for STAC to require the specialist input of various scientific and technical experts across a broad range of subject areas. This means there is the potential for a very large group to form.

Generally groups of between 2 and 12 are considered as most effective. Any larger than this and the pressure on the chair increases significantly, tolerance of the chair's decisions decreases and probably most importantly for STAC, the time required to reach decisions increases[8]. Group membership of STAC is encouraged to vary throughout its life, for example by having a pool of key agencies and then having visiting experts to deal with specific issues. Advice can also be sought via email, internet, phone and fax with each member acting as gateway to information from their whole organisation.

Group Boundaries

STAC has a designated chair and deputy chair, however those members involved in the group will be from a multitude of organisations. Each member of the STAC group will have loyalties to both the STAC and their home organisation[9]. The chair, or their nominated deputy, leads the group and coordinates meetings; however, each constituent group member retains direct responsibility for the management of their own organisation's resources. This raises issues of role clarification and accountability for STAC members. Role based responsibilities and draft ground rules can attempt to set out, in advance, clarification of this accountability and the tasks which members are required to undertake. This dual management structure can work very effectively with appropriate boundaries in place which are understood by both the chair and the contributing organisations. Widespread discussion and also circulation of the Arrangements, which still continues to increase, has ensured that those inside and outside of a STAC understand those boundaries.

Stress

For individuals involved in STAC, stress is likely to be a factor which impacts on their performance as an individual and as part of a team. Various factors including time pressures, long working hours, role conflict and ambiguity, and workload all play a significant part in work stress[10]. Performance is clearly related to stress, with increasing stress increasing performance to a point, beyond which performance begins to be adversely affected[11]. The numbers of stressors likely to be in play during a large incident are considerable. It is important for all organisations to decrease stress wherever possible. Clearly defined roles should decrease role conflict issues. Time pressures and workload can both be limited by the use of action plan based work. Minutes taken during meetings should include those individuals or sub-groups responsible for actioning various points rather than tackling seemingly insurmountable tasks as a whole group.

Implications for Practice

Whilst the introduction of mitigation against these potential problems is mostly aimed at preventing issues occurring in the first place, inclusion of these mitigations in plans will hopefully also serve as a reminder and allow problems which do occur to be tackled appropriately.

The key negative implication for practice in the case of the London STAC Arrangements has been that the document has increased in size to explain the roles of individuals and organisations. All of the supplementary information has however been issued as appendices so as to prevent the plan itself from becoming unusable.

By consideration of these issues when writing the arrangements there is a hope that better team working will occur, with all members of the team being clear of their role and the role of others. This should hopefully occur with both people's STAC roles and also their role as a member of their home organisation. The use of role based responsibilities for each STAC member and a brief description of the role of agencies likely to be involved in STAC should both help.

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*** STAC training for Chairs and Deputy Chairs takes two full days and is currently funded at a cost of £220 per person by the Department of Health**

MASs-casualties and Health-care following the release of toxic chemicals or radioactive materials - MASH

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Mass emergencies following exposure to toxic chemicals and/or to radioactive materials may develop at a rapid rate and reach a magnitude sufficient to overload the health care system. The temporarily overloaded or inadequate health care system may rapidly become a crisis, involving all sectors of the society and its political management. The **MAS**s-casualties and **H**ealthcare following the release of toxic chemicals or radioactive materials (MASH) project is financed by DG Health of the European Commission. It adheres to the idea expressed by the Commission that generic preparedness, planning and interoperability are key elements in mitigating the impact of mass emergencies[1]. MASH started in April 2008 and is scheduled to last 30 months.

The MASH project will specifically study the preparedness planning of the European member states; the EU 27. The first objective is to map and clarify current capabilities to deal with exposed patients following a given set of scenarios involving the release of toxic chemicals or radioactive compounds. The second objective is to suggest improvements to the current procedures through a series of activities described below.

The following article is a short description of the project. At this stage, there are no results to report but these will be published when they are available. Despite the absence of specific results, we thought that it would be of value to share our plans with interested partners at the beginning of the project. Therefore, for each of the activities described below, I have also included details for the relevant point(s) of contact (POCs), along with their e-mail address, to encourage interested readers to make contact.

The study is scenario driven. Accordingly, we are presently developing a set of scenarios covering accidental and intentional release of chemicals, and radioactive compounds. Where possible, our scenarios will be developed from already existing incidents. Subsequently, these seminars will be used as the common reference for a number of activities. (POC: Dr Gudrun Cassel, gudrun.cassel@foi.se)

Two activities being conducted in parallel with the scenario development are the evaluation and mapping of the present level of preparedness within EU 27. A questionnaire, complemented by some follow-up interviews, will be used to gather the information. The material will be compiled and discussed at seminars in the early spring of 2009, before it is reported back to the Commission (DG Health). (POC: Dr Armin Riecke, arminriecke@bundeswehr.org; Prof Viktor Meineke, viktormeineke@bundeswehr.org; Prof David Baker, 113445.3600@wanadoo.fr).

Further parallel activities involve reviewing the development and usefulness of modern biotechnology, and of modern information and communication technology (ICT). Each technology will be assessed for its particular benefits. A primary issue is the usefulness of biotechnology in diagnostics and the usefulness of ICT in mapping the situation, in sorting patients, and in information gathering and communication. These reviews will focus on technologies already available or available in the near future (POC: Dr Leif Stenke, leif.stenke@ki.se; Jon Legarda, jlegarda@ceit.es).

The final activity of MASH will be a foresight study of how to improve the efficiency of healthcare services within EU 27 to respond to the release of toxic chemicals or radioactive materials. It is hoped that this will also increase the European perspective on these issues. The foresight should, based on today's principles, incorporate critical developments within healthcare management, biotechnology and ICT and should suggest tomorrow's improvements to the primary medical care process (POC: Prof Virginia Murray, virginia.murray@hpa.org.uk).

Dissemination of these results is, as many of you know, a very important element of any EU project. In our case, dissemination of the results and conclusions will be directed towards the target groups, i.e. health planners of the Commission, health planners of the member states and, within each member state, the local planners and operative medical personnel.

It is our hope, and the expectation of DG Health, that MASH will introduce technical tools and suggest organizational measures that increase the competence and capability of healthcare systems in the European member states. This should eventually result in better protection of European citizens. Such measures reflect the Commission's ambitions to make our society more resilient and secure, and therefore, they should be of strategic value.

The partners in this project are:

- The European Centre for Chemical, Biological, Radiological, Nuclear and Explosive events (CBRNE), Umeå University, Sweden;
- Bundeswehr Institute of Radiobiology affiliated to the University of Ulm InstRadBio Bw, Munich, Germany;
- Centro de Estudios e Investigaciones Técnicas de Guipúzcoa, CEIT, San Sebastián, Spain;
- Health Protection Agency, HPA, London, United Kingdom;
- Karolinska Institutet, KI, Stockholm, Sweden;
- SAMU de Paris, Assistance Publique Hopitaux de Paris, SAMU, Paris, France;
- Swedish Defence Research Agency, FOI, Umeå, Sweden.

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New tools for alerts and capturing immediate effects of rapid-onset events across Europe

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Summary

In the UK and across the world, seismological networks broadcast rapid earthquake information to the public on the Internet, and, after felt earthquakes, individuals rush to their computers to find out the cause of the shaking they have just experienced. As a result, the traffic on a web site exhibits massive increases. These surges provide a means to gather *in-situ* information on the earthquake within 10–20 minutes of occurrence, at a time when information is critical to evaluate their impact. In recent years, the European Mediterranean Seismological Centre (EMSC) has developed software to take advantage of this public concern and interest, supplementing the "natural" surge with on-line gathering of observations by the public in a formatted way, thereby increasing the value of the information. It has also encouraged the transfer of mobile phone photographs of immediate effects to the Centre. And, of course, these tools can be readily extended to serve those who deal with any rapid onset, potentially disastrous event. When a web-site becomes well known, the surge of visitors can take place within 1-3 minutes of the event, thereby providing an opportunity for authorities and emergency services to receive very rapid alerts of an impending issue or crisis, often before technical data can be collected and confirmed.

Examples from Europe and the UK

The EMSC comprises 83 member institutions in 55 countries, and coordinates the collection and distribution of earthquake information throughout Europe and the Mediterranean region, and, for larger events, across the World. By monitoring its web traffic through the number of page loads against time (in minutes), EMSC has observed peaks of interest following earthquakes which were felt or damaging. Figure 1 illustrates this dramatically; each spike in the period 2004 to early 2008 can be correlated with such an earthquake. Five are named on the Figure, which also shows the general trend of increasing numbers of visitors as the web site became better known and valued.

Among these surges, we have zoomed in on one following an earthquake off the coast of Portugal on 12 February, 2007, with a magnitude of 6.1 (Fig 2). Within 3 minutes of the occurrence of the earthquake, EMSC web traffic rose to a level where the increase was easily detectable above the background traffic. This is quicker than EMSC can confirm the earthquake's occurrence using the seismological data which is transmitted from its members across the Euro-Med region; typically, that takes 6-12 minutes for a large earthquake and longer for smaller ones.

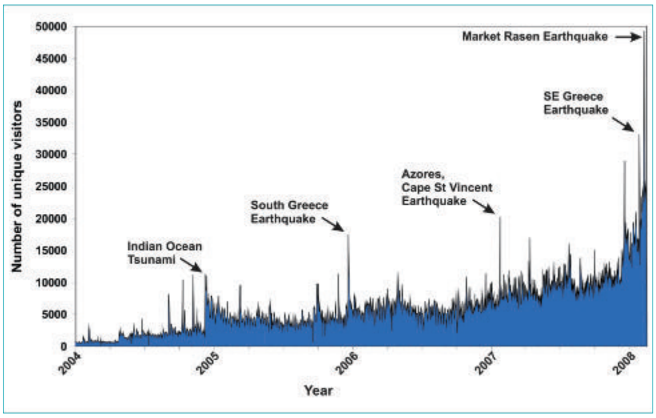

Figure 1. Daily traffic observed on the EMSC web site, 2004 - 2008. Each spike can be related to an earthquake in the Euro-Med region or a global earthquake.

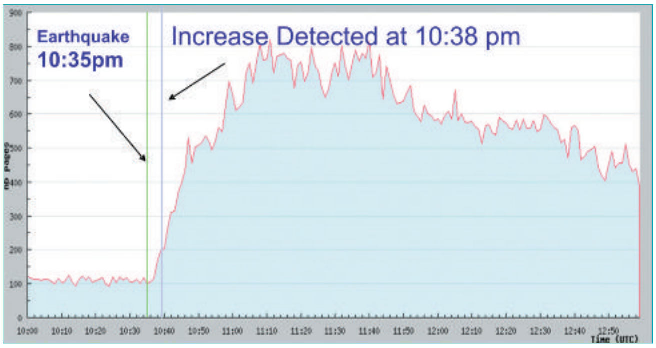

Figure 2. Number of loaded web pages per minute. The surge of traffic was detected 3 minutes after the occurrence of the Azores Cape Saint Vincent Ridge earthquake on February 12, 2007.

The observed surge of web traffic (Fig 2) is initiated by visitors who have just felt the earthquake, so their geographical origin falls within the area where it has been felt. By locating the Internet Protocol (IP addresses) of these visitors, one can map the area where the event has actually been felt. Figures 3a-3d show (in the increasing sizes of the red dots) how the initial surge (Fig 3a) comes mainly from those who felt the earthquake in the Algarve, Lisbon and Madrid. In the following minutes there are further, new increases in traffic from southern Portugal, a wide area of Spain and in Rabat, Morocco (Figs 3b-3d). This picture of where the earthquake was felt has been confirmed subsequently through the completion of on-line questionnaires which visitors are invited to submit. These, of course, give more details of the degree of shaking and more precise information on each reporter's locality. This information can be available as a contoured map within a few hours.

In addition to gaining the assistance of web site visitors in providing a rapid alert and follow-up with further details, they are also invited to supply photographs of the immediate impacts of the event which can include explosions as well as earthquake damage, triggered landslides

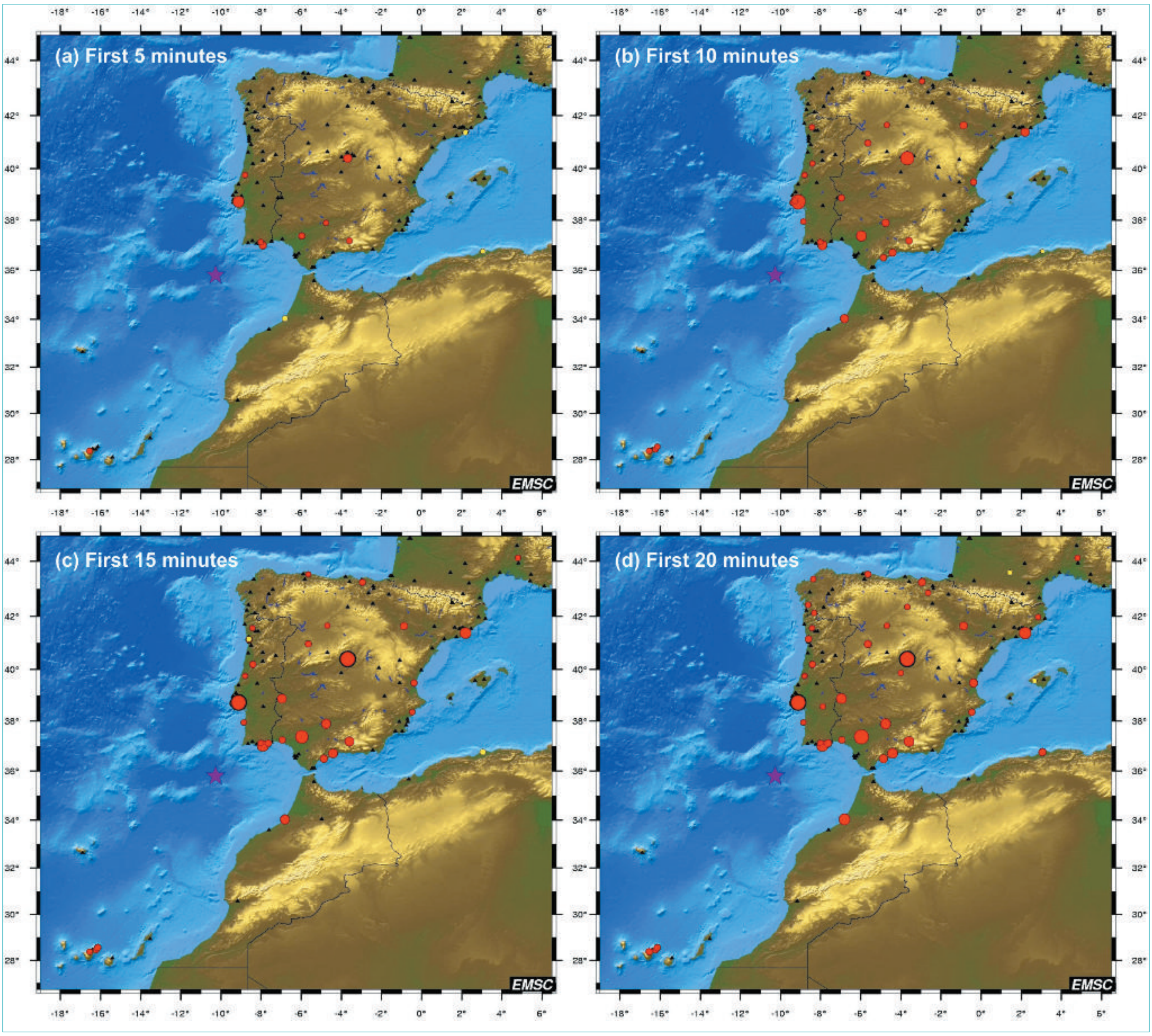

Figure 3. Felt observations mapped for the Azores Cape Saint Vincent Ridge earthquake (magnitude 6.1) on 12 February 2007: in the following 5 minutes (3a), 10 minutes (3b), 15 minutes (3c) and 20 minutes (3d). The star represents the epicentral location. Red dots show the geographical origins of statistically significant increased web traffic observed during the time windows.

and tsunamis. Figure 4 shows such an image supplied by a witness of an ammunition storehouse explosion in Slovakia on 2 March 2007. There were 2 explosions, 1 minute and 10 seconds apart, the first visible as the plume of smoke and the second as the fireball.

The largest earthquake to occur in the UK for 24 years also caused a surge in web traffic at the EMSC (Figure 5). It was centred on Market Rasen, in Lincolnshire, with a magnitude of 5.2 and a depth of 18km. With this depth, damage at the epicentre was limited but it was strongly felt up to 100km away with isolated damage occurring within that region. It was felt, to a lesser degree, as far as Aberdeen, throughout Wales and to the south coast of England. The web-traffic enabled the area in which it was strongly felt to be mapped out within a few minutes. Questionnaires, completed at this time, contributed to the picture and to the more comprehensive on-line questionnaire survey conducted by the British Geological Survey within a few hours (over 30,000 respondents, in total).

Figure 4. Photograph provided by a witness of the explosion of an ammunition storehouse in Novaky (Slovakia) on 2 March 2007. There were 2 explosions, 1 minute and 10 seconds apart, the first visible as the plume of smoke and the second as the fireball.

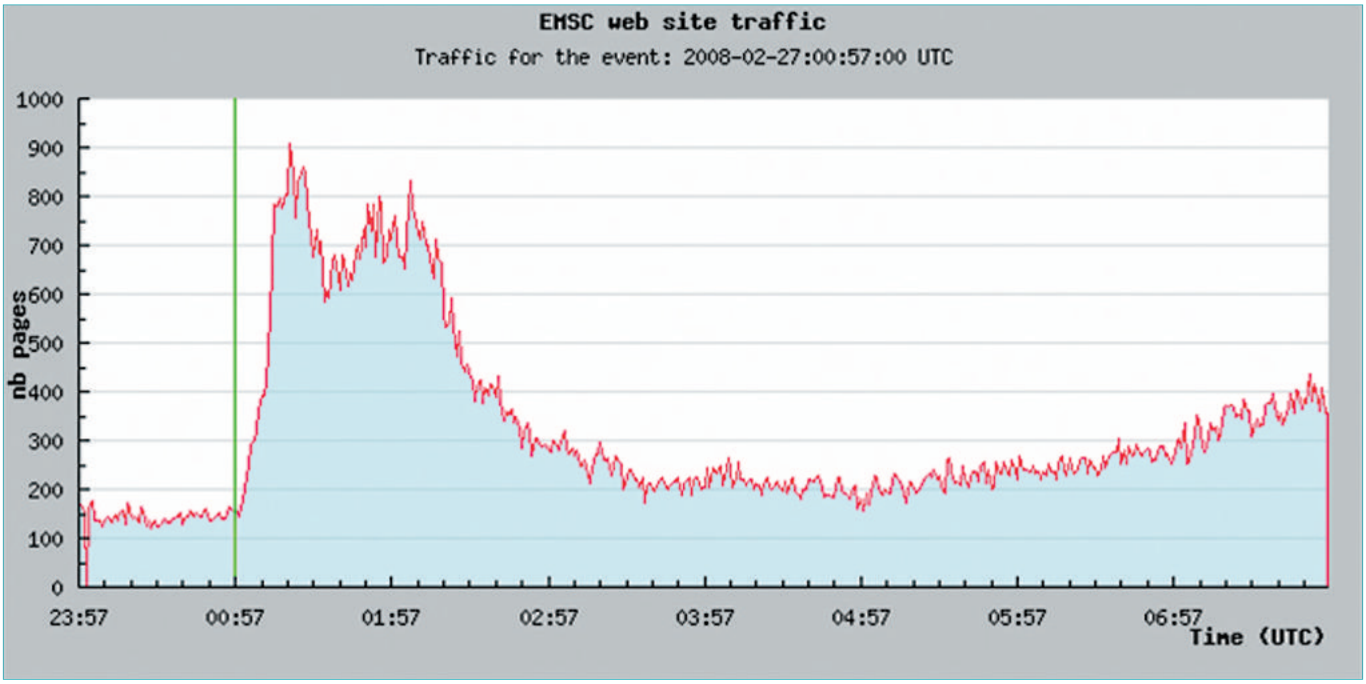

Figure 5. Number of loaded web pages per minute showing the traffic surge after the occurrence of the Market Rasen earthquake on 27 February 2008.

Limitations

The main limitations in using this technique for achieving alerts and information on any rapid onset event are its restriction to regions with widespread public access to the internet and that the web site needs to be well known as a source that can provide information to a concerned public. These criteria are not as well met in Morocco as in Portugal and Spain, which explains the relative difference in response shown in Figures 3a-3d (we know that the earthquake was strongly felt along the Atlantic coast of Morocco). Of course, access to the internet and knowledge of information centres is growing rapidly; the baseline activity in Figure 1 illustrates this for the EMSC.

Figure 3 also highlights another problem, with Barcelona apparently responding strongly to the earthquake although we now know it was not felt there. This is probably the result of using Internet Provider (IP) addresses to locate those visiting the web site. In some large regions, traffic passes through a single router which can provide a single location that is not geographically representative of the widespread public visiting the web site. It does not detract from the alerting function of the technique but can limit confidence in the precise area affected, although the opportunity to collect additional information from visitors corrects this a little later.

In order to counter other potential anomalies, the background traffic, against which surges are seen, is filtered to take out professional institutions (e.g. those who might be alerted by their seismometers to visit the web site, rather than because they felt the earthquake), as well as automated search engine visits. The procedure also allows for seasonal and daily variations in visitor traffic from different localities.

Conclusions

- In recent years, the European Mediterranean Seismological Centre has recognised that very rapid surges in web traffic can provide alerts to critical, rapid-onset events within 1 to 3 minutes.
- For general use of this tool, a limitation is that the web site must become one that is well known to the public (or can easily be found through a search engine) so that it is seen to be a ready source of useful information. Otherwise, it will not be visited and the two-way flow of data will not happen.
- Examples given here (and many more in existence) show that web traffic surges can beat conventional alert systems in raising the alarm for events which affect the public at large. In principle, for the largest events they can also identify where internet access has been denied through power outages or equipment damage.
- The attraction of so many web site visitors (who produce these surges) provides the opportunity to garner further information on the immediate effects, when they are fresh, and to provide photographic information of the impacts before the emergency services begin to make safe any damage.
- Limitations of reduced public internet access are likely to recede within a few years as connectivity becomes ubiquitous, and hopefully, competition reduces dependence on a single, remote hub as the IP address serving a large region (which diminishes the geographic localisation of some individual visitors).
- Finally, with the technique and the tools now well proven for earthquake surveillance, the door is wide open for Civil Protection and health protection agencies to adopt them for the broad spectrum of issues which they face.

Acknowledgements

The authors thank other members of the EMSC team; Gilles Mazet-Roux, Sébastien Gilles and Sergio Rives, together with Sylvie Marin and Michael Aupetit, of EMSC's host organisation LDG, for their pioneering work in developing these observations and practical techniques.

Report on Exercise Orpheus I, 05 March 2008: Ambulance Service Hazardous Area Response Teams

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Introduction

Field Exercise Orpheus I was developed and delivered by the Health Protection Agency (HPA) as part of a programme of exercises commissioned by the Department of Health (DH). This programme, which includes an annual field training exercise, is designed to exercise and evaluate the role of the Health Service in the multiagency response to major incidents or health threats. These include Chemical, Biological, Radiological, Nuclear or Explosive (CBRN(E)) terrorist incidents, civil incidents such as flooding and heat wave or those involving hazardous materials (HAZMAT), emerging or re-emerging infectious agents such as SARS and pandemic influenza.

Figure 1: Exercise Orpheus - Urban Search and Rescue teams work in an unstable collapsed multi-story building (Image © HPA, 2008)

Scenario

Exercise Orpheus I took place on 5 March, 2008, at The Fire Service College, Moreton-in-Marsh, Gloucestershire and was specifically designed to evaluate the capability of the recently formed Ambulance Service (AS) Hazardous Area Response Teams (HART) whose principle role is to work alongside Fire & Rescue Services (FRS) and/or the Police to triage and provide immediate clinical support for casualties entrapped in hazardous environments. The exercise presented two parallel scenarios designed to evaluate specific operational aspects of the HART capability, namely the role of:

- specialist Urban Search and Rescue (USAR) trained paramedics in the triage and provision of immediate clinical support, *in situ* and during rescue, of casualties trapped in an unstable collapsed multi-story building
- specialist paramedics from the London Ambulance Service HART Incident Response Unit in the triage, immediate treatment and rescue of casualties in the Hot Zone of a terrorist incident at a motorway service station involving a bus crash and the deliberate release of a nerve agent (Sarin).

Figure 2: Exercise Orpheus - Urban Search and Rescue teams work in an unstable collapsed multi-story building (Image © HPA, 2008)

The exercise involved the deployment of a significant proportion of the current AS HART capability, AS support from Trusts from across the United Kingdom, a major national deployment of specialist FRS USAR Technicians and resources and FRS CBRN crews, plus a limited deployment of CBRN Units from Gloucester Police. Exercise Orpheus was accompanied by a number of auxiliary exercises to test specific response capabilities and was followed by Exercise Orpheus II held on 16 June at the John Radcliffe Hospital Oxford to evaluate the response of the Emergency Department of an Acute Trust in the earliest stages of receiving self presenting casualties and worried well from the CBRN incident exercised in Orpheus I.

Figure 3: Exercise Orpheus – Casualty is rescued from an unstable collapsed multi-story building (Image © HPA, 2008)

Figure 4: Exercise Orpheus – Urban Search and Rescue teams work through the rubble from an unstable collapsed multi-story building (Image © HPA, 2008)

80 experienced volunteer casualties from Casualties Union and Amputees in Action Ltd played and maintained the roles of realistic casualties trapped for considerable lengths of time in challenging circumstances on a cold March day. Injuries that required attention from the AS HART paramedics ranged from breathing difficulty to head injuries and severed limbs.

Exercise Orpheus I was ambitious in concept and execution, being the largest national AS exercise of its kind to date. Whilst, unsurprisingly, a number of in-exercise operational difficulties were encountered some of which usefully reflected issues likely to be encountered in a real incident, a considerable number of valuable learning points emerged from the two arms of the exercise or as joint issues that will inform the development and roll out of the AS HART Programme.

The exercise also demonstrated the high degree of interdependency between the HART and FRS Teams essential to bringing early clinical support to trapped casualties, and supported the need to promulgate the capability of the AS HART paramedics across the Emergency Services and beyond, along with the need for joint training and exercising and the development of common working procedures. The effective deployment of AS HART Paramedics alongside FRS at major incidents will undoubtedly lead to the saving of lives.

Conclusions

In summary, Exercise Orpheus I demonstrated the capability of specialist teams of paramedics to provide immediate clinical support to casualties trapped in realistic and challenging circumstances, support that was not readily available before the development and deployment of the A.S HART teams. The exercise further demonstrated the critical interdependency of the HART teams and the FRS in providing clinical support *in situ* in these circumstances.

Figure 5: Exercise Orpheus – Casualty is triaged by member of the Ambulance Service (Image © DH, 2007)

Figure 6: Exercise Orpheus – The Hazardous Area Response Team attends the scene (Image © DH, 2007)

Figure 7: Exercise Orpheus – Casualties knocked over by bus (please note, casualty by bus wheel is an Amputee) (Image © HPA, 2008)

Environmental science and Toxicology

Contaminated land bioremediation and public health issues

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Introduction

Due to the industrial legacy of Britain, many areas of land within the country are affected by contamination. When these sites are re-developed there is a need to ensure that the land is suitable for its intended end use and in many cases remediation or “clean up” of the site is required.

There are many methods of remediation, including “bioremediation” where microbial activity is used to break down contaminants. However, due to the release of volatile gases and odours that are produced, this method may lead to complaints from the public and present a public health problem.

At a site in Greater Manchester, a bioremediation strategy was implemented to clean up a site affected by past industrial use. When remediation began, the Council received public complaints of a ‘mothball’-like odour. To ensure that the process did not present a public health problem, a multi-agency group was set up and through joint working a monitoring strategy was devised and implemented. Atmospheric levels of a marker substance (naphthalene) were monitored and the results were compared to a Health Criteria Value (HCV) recommended by the Health Protection Agency (HPA). Monitoring was undertaken throughout the remediation process with results and information being fed back to residents close to the site. The strategy ensured that concentrations of naphthalene experienced off-site were within set guidelines and that public concerns were addressed.

Sites contaminated with polycyclic aromatic hydrocarbon residues (PAHs) can be remediated using a number of techniques. One of these is known as “on-site, *ex-situ* bioremediation” in which contaminated soil is excavated and placed in windrows (large piles) on site. Bio-remediation is affected by a process of soil turning and hence, aeration. This encourages microbial degradation of PAHs. The process can also result in the release of volatile substances, such as naphthalene, into the nearby environment.

Description of the incident

A bioremediation programme was undertaken at a former tar works in Salford, Greater Manchester (see Figure 1). The site was previously used for producing chemicals and solvents for the paint industry, additives for motor fuel, naphthalene for the dye industry, creosols and phenol for resin, and pitch for electrodes. Post 1965, the site was used for the storage and distribution of heavy fuels. The site was mainly contaminated with tar and tar residues (see Figure 2).

Following demolition, and as soon as the contractor commenced major excavation and treatment, the Local Authority (LA) received a number of complaints from local residents and businesses about nuisance odours arising from the site and their loss of amenity. In total, 102 complaints were received between May and October 2006. These complaints were not only received during operator working hours, but also throughout the night, with a large number of residents complaining of a stronger odour from 5 pm until 5 am the next morning.

Figure 1: The site prior to development (Source: Steve Edgar, Vertase FLI Ltd)

Some residents complained of ill health, such as headaches and nausea, which they attributed to a ‘mothball’ odour. This was later attributed to naphthalene emissions. Most complaints were received during warm weather when the contractor was excavating the most contaminated and odorous areas of the site.

Figure 2: Contamination present on site (Source: Steve Edgar, Vertase FLI Ltd)

As well as the potential for local odour nuisance, there was also a possibility of nearby public exposure to Volatile Organic Compounds (VOCs). A Multi Agency Group (MAG), which included the LA, HPA, Environment Agency (EA), and Health and Safety Executive (HSE), was set up to consider the potential risk to public health from any emissions from site and how emissions of concern might be controlled for the protection of public health. The teams from EA and the HPA collaborated to develop a sampling strategy for possible airborne contaminants. Due to the nature of contamination, it was possible that a variety of different VOCs were emitted from the site. However, as it would not be cost effective to monitor for all VOCs, naphthalene was used as an indicator substance. Naphthalene is an effective indicator due to its low odour threshold and relatively low HCV. Additionally, an analytical profile of vapour emitted from the site indicated that if the HCV for naphthalene was not exceeded then other VOC emissions would not be present at levels known to be a risk to human health.

Toxicology of naphthalene

As a vapour, naphthalene can irritate the skin and eyes. Inhalation of low levels of naphthalene vapours over extended periods of time (e.g. from extensive use of mothballs) has been associated with a risk of haemolytic anaemia, particularly in individuals with a deficiency of glucose-6-phosphate dehydrogenase (G-6PD)[1,2].

Exposure threshold

The Environmental Assessment Level (EAL) of 100ppb published in the Environment Agency's IPPC H1 Guidance[3] was not considered to be an appropriate threshold for the protection of the population under consideration. This is because the EAL is derived from an Occupational Exposure Limit for naphthalene, subsequently withdrawn by the HSE to reflect further information about the irritant effects of naphthalene.

Therefore, in providing advice for an acceptable level of ambient naphthalene to ensure protection of a non-occupational population, the HPA looked to authoritative data sources from published literature. Subsequently, a HCV endorsed by the Department of Environment, Food and Rural Affairs (Defra), the EA and the Department of Health in the Contaminated Land Report Series, TOX 20 (DEFRA)/EA 2003) was selected as an appropriate environmental level for naphthalene[4].

The TOX 20 HCV for naphthalene is set at 3mg/m^3 (equivalent to 0.6ppb) and is taken from a United States Environmental Protection Agency (USEPA) derived reference concentration (RfC)[5]. The inhalation RfC is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Monitoring Strategy

Remediation at the site was scheduled to be conducted over a number of months; therefore, a monitoring strategy was implemented to ensure that human exposures were kept within the appropriate HCV for naphthalene over the duration of the works.

Real-time VOC monitors (Photo-ionisation detectors, or PIDs) are not sensitive enough to detect very low levels (<1ppb) of naphthalene; therefore, a monitoring strategy using both real time PID readings and passive samplers was devised to detect any exceedance of the naphthalene HCV. The monitoring strategy consisted of the following:

Real-Time PID Readings: On site monitoring points (MPs) were positioned using site specific dispersion modelling which took account of a number of variables, including weather conditions. Regular PID readings were taken to produce real-time indications of likely off-site concentrations of naphthalene. These readings were analysed daily and if readings were found to exceed 0.6ppb, corrective action was taken (see Table 1 for the detailed action plan for responding to exceedances).

Diffusion Tube Monitoring: Passive samplers (diffusion tubes) were sited at fixed locations at the site boundary (compliance point, or CP) and at the nearest residential premises. The main objective of this long-term monitoring was to provide reassurance to residents and workers that the intervention measures taken when exceedances of naphthalene were reported from the PIDs was effective at ensuring the off-site naphthalene levels were below the threshold of concern. The position of the monitoring and compliance points is illustrated in Figure 3.

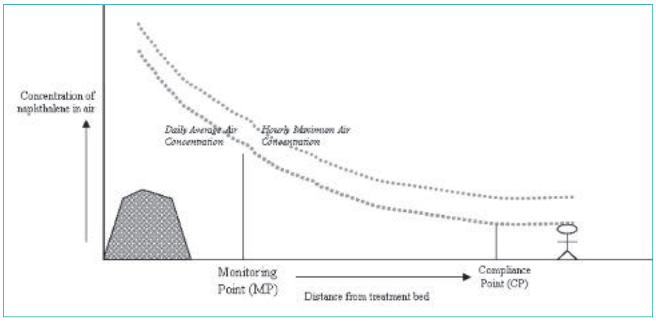

Figure 3: Position of monitoring points (MP and CP) (Source: Environment Agency)

An action plan was devised for contractors to follow in case of a likely exceedance of HCV. This is illustrated in Table 1.

Table1: Action Plan for possible exceedance of naphthalene Health Criteria Value

Photo-ionisation detector Reading at Compliance Point	Action	Interpretation
Limit of Detection (LOD) (Trigger Level) e.g. 0.1ppb	Continue activities as normal.	Naphthalene levels at Compliance Point (CP) within Health Criteria Value (HCV)
Between LOD and 10x LOD (Between Trigger and Action Levels)	Ascertain why high readings encountered – reassess and monitor hourly. Take further PID readings closer to site boundary to estimate potential off-site levels.	Naphthalene levels at CP could exceed HCV for short periods. May not be of any significant health consequence.
>10x Trigger Level (Action Level)	**STOP WORKS** Re-assess operating procedures. Take further PID readings closer to site boundary to estimate potential off-site levels.	HCV for naphthalene could be exceeded at CP by a substantial amount

Figure 4: Windrow covering and aeration (Source: Steve Edgar, Vertase FLI Ltd)

A number of other activities were conducted by the members of the MAG to manage the remediation of the site. These included the following.

- Local Authority officers visited or spoke with all complainants to explain the remediation process.
- The contractor sent out a number of informative letters to local residents informing them of what was being undertaken on site.
- HPA officers visited a number of residents to reassure them that the results of the ambient monitoring programme undertaken by both the contractor and LA indicated that there was likely to be no health impacts associated with the work.
- Meteorogical data was used by the LA and contractor to manage activities on site.
- All treatment beds were classified depending on their "odour potential".
- All remediation beds were sealed or covered at weekends to minimise emissions from site (See Figure 4).
- Regular inspections by both the EA and LA were undertaken throughout the works to constantly improve management and regulation.

Conclusions

The LA noted that the more residents were informed, the fewer the number of complaints received. This highlights the effectiveness of pro-active communication in reassuring concerned residents.

Throughout the remediation works undertaken at the site, it was demonstrated that multi-agency working and effective strategies for dealing with public complaints and concerns can be very successful.

It was also shown that an effective monitoring strategy can be implemented for bioremediation activities and when employed with an action plan, these can reduce the risk of potentially harmful exposures occurring as a result of the remediation of contaminated land.

The principles and methods used throughout this monitoring regime have also been used at a number of similar remediation sites throughout the North-West. Although dispersion modelling is not a precise science, it is an invaluable method to predict concentrations of pollutants at variable distances from a number of on-site sources as demonstrated in Figure 5. Using these figures, it is then possible to undertake on-site continuous monitoring and to use the results to predict ambient levels of vapour at locations where vulnerable populations may be present. Additional diffusion tube monitoring should also be carried out at receptor locations to confirm that no HCVs are exceeded.

This method enables contractors or regulators to implement preventative action plans if HCVs are likely to be exceeded.

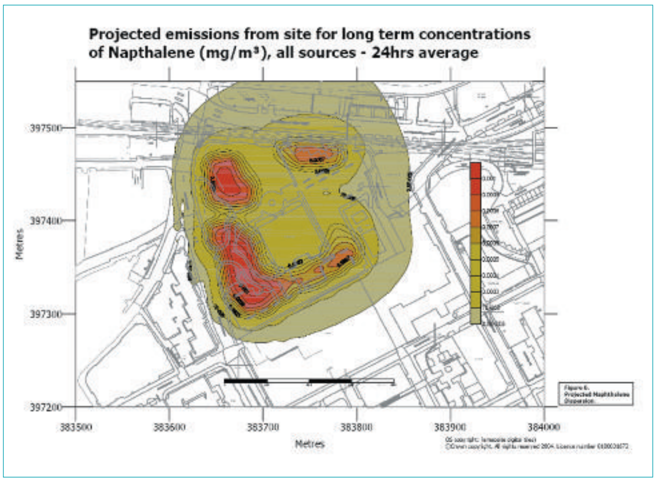

Figure 5: Air dispersion modeling for long-term concentrations of naphthalene, 24-hr average (Source: Celtic Technologies Limited).

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The cost of poor housing

David Ormandy, Professor and Principal Research Fellow, Warwick Law School.

Background

Methodologies are being developed to balance the cost of works to remove potential threats to health in houses with the savings from the reduced demands on the health services. This has been made possible through the adoption of the Housing Health and Safety Rating System (HHSRS) as the prescribed system for the assessment of housing conditions.

Prior to 2006, housing conditions were assessed against the statutory Standard of Fitness. This, originally introduced in the 1950s, listed nine requirements and if a house was judged to fail one or more of these, it was deemed unfit for human habitation. Although there were health principles behind the requirements, the phrasing of them focused attention on the building and on the presence or otherwise of building related defects and deficiencies. One consequence of this was that the severity of defects and deficiencies tended to be judged by the extent and cost of the remedial work needed – the greater the cost, the more severe the problem.

A study into the effectiveness of the statutory controls on standards in existing housing[1] highlighted gaps and contradictions, and suggested that a new approach be developed, one which shifted the focus to the potential threats to health and/or safety from housing conditions – the effect of defects. The government accepted the suggestion and commissioned the development work.

The Housing Health and Safety Rating System

The first step was to identify the evidence on potential housing hazards. To do this, an extensive literature review was carried out of medical, health, architectural, engineering, ergonomic, and surveying databases, along with other libraries and resources. The result was that 29 potential hazards were identified (see Box 1), all, to a greater or lesser extent, attributable to the state and condition of the dwelling (none were included that were attributable solely to occupier behaviour).

The next step was to develop a logical method of assessing the risk from any hazard. It was decided that a two-stage approach was the most appropriate; first assessing the likelihood of an occurrence (an event or exposure) over the next twelve months, then the severity of the possible outcomes from that occurrence. The outcomes considered were those serious enough to warrant medical attention (so providing evidence to support the System) and these were categorised into four Classes of Harm (see Box 2)[2]. This approach allowed comparison of hazards where there was a high likelihood but minor outcome with those that were very unlikely but where the outcome would be extremely severe.

Box 1: HHSRS Potential Housing Hazards

Physiological Requirements
- Damp and mould growth etc
- Excessive cold
- Excessive heat
- Asbestos etc
- Biocides
- Carbon monoxide and fuel combustion productions
- Lead
- Radiation
- Uncombusted fuel gas
- Volatile organic compounds

Psychological Requirements
- Crowding and Space
- Entry by intruders
- Lighting
- Noise

Protection Against Infection
- Domestic hygiene, pests and refuse
- Food safety
- Personal hygiene, sanitation and drainage
- Water supply

Protection Against Accidents
- Falls associated with baths etc
- Falling on level surfaces
- Falling on stairs etc
- Falling between levels
- Electrical hazards
- Fire
- Flames, hot surfaces etc
- Collision and entrapment
- Explosions
- Position and operability of amenities etc
- Structural collapse and falling elements

Both to validate this approach and to provide national benchmarks (average likelihoods and outcomes), data on housing conditions were matched with data on hospital episode, GP records, and home injuries[3].

The HHSRS[4] is now a part of the government's Decent Homes Standard[5] and is incorporated into the English Housing Survey (EHS)[6].

Decent Homes = Better Health

Through the forerunner of the EHS, the English House Condition Survey, it had always been possible to estimate the cost of the remedial works needed to make houses fit for human habitation. However, as the Fitness Standard focused on the building, it was only possible to show that this benefited the housing stock. As the HHSRS focuses on the potential health outcome from a hazard, its introduction and use in the EHS has opened up the possibility of estimating the reduction in the health burden that would result from removing or minimising potential hazards – i.e., to show the health benefits.

Box 2: Examples of HHSRS Classes of Harm

Class I

This covers the most extreme harm outcomes. It includes – Death from any cause; Lung cancer; Mesothelioma and other malignant lung tumours; Permanent paralysis below the neck; Regular severe pneumonia; Permanent loss of consciousness; 80% burn injuries.

Class II

This Class includes severe conditions, including – Cardio-respiratory disease; Asthma; Non-malignant respiratory diseases; Lead poisoning; Anaphylactic shock; Crytosporidiosis; Legionnaires disease; Myocardial infarction; Mild stroke; Chronic confusion; Regular severe fever; Loss of a hand or foot; Serious fractures; Serious burns; Loss of consciousness for days.

Class III

This Class includes serious conditions such as – Eye disorders; Rhinitis; Hypertension; Sleep disturbance; Neuro-psychological impairment; Sick building syndrome; Regular and persistent dermatitis, including contact dermatitis; Allergy; Gastro-enteritis; Diarrhoea; Vomiting; Chronic severe stress; Mild heart attack; Malignant but treatable skin cancer; Loss of a finger; Fractured skull and severe concussion; Serious puncture wounds to head or body; Severe burns to hands; Serious strain or sprain injuries; Regular and severe migraine.

Class IV

This Class includes moderate harm outcomes that are still significant enough to warrant medical attention. Examples are – Pleural plaques; Occasional severe discomfort; Benign tumours; Occasional mild pneumonia; Broken finger; Slight concussion; Moderate cuts to face or body; Severe bruising to body; Regular serious coughs or colds.

The first attempt at this was made by Sheffield Hallam University who used the Decent Homes programme of Sheffield Homes (the local social housing provider) and HHSRS to estimate the health benefits of that programme. They carried out a similar exercise in Ealing[7], and in both cases showed that the programme of works not only maintained and improved the housing stock but should also produce a reduction in negative health effects and therefore, an estimated reduction in the demands on the health services.

Health and Care Costs

The Building Research Establishment (BRE), who is responsible for designing the EHS and analysing the data gathered, has been developing a methodology to estimate health and care costs for each of the four HHSRS Classes of Harm. While there may be other costs to society (police and judicial services, fire services, poor educational achievement, loss on income tax), these are more difficult to quantify, and so the BRE concentrated on health and care costs which they estimate to account for a maximum of 40% of the total cost to society attributable to unsatisfactory housing conditions.

By matching the data on the HHSRS hazards, the likelihoods and outcomes, with the estimated health and care costs, the BRE has developed a Tool Kit in collaboration with the Chartered Institute for Environmental Health (CIEH)[8]. This Tool Kit includes a calculator that can be used to help demonstrate the value of a housing intervention (remedial action) by producing a likely baseline estimate of incidents arising from risk factors in the home within local authority areas, together with the health costs and costs of mitigating the hazard. This figure can be used as evidence of the costs related to the health burden and subsequently compared to the costs of improvement works and the likely 'pay-back' time.

Now What?

This approach of balancing the costs of housing intervention against the potential savings to the health services has only been made possible through the development and introduction of the health focussed HHSRS. It is early days, and more work is necessary (and is being done) on estimating the cost of poor housing to society. Even so, the results so far are staggering.

Using this Tool Kit and Calculator, one local authority has been able to argue that for an investment of around £2.3 million in remedial works to housing over two-and-a-half years would give an estimated saving to the health services of around £8.5 million.

Even without putting any monetary value on quality of life and other direct and indirect costs to society, based on these figures, investing in improving our housing, both privately or publicly owned, makes good economic sense.

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REACH – the new EU regulations for chemical substances

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Introduction

During December 2006, the European Council of Ministers voted to adopt a new framework for the manufacture and import of chemical substances in amounts of one tonne or more per year into the European Union (EU). The development of this legislation had taken 5 years and entered into effect on 1st of June 2007. It replaces several existing laws on chemicals (e.g. Notification of New Substances Regulation (NONS) and Existing Substances Regulation (ESR)) and is underpinned by the 'precautionary principle'[1]. The regulations, known under the acronym 'REACH' (**R**egistration, **E**valuation, **A**uthorisation and Restriction of **Ch**emicals), have two main aims: to improve the protection of human health and the environment, and to maintain the competitiveness and enhance the innovative capability of the EU chemicals industry[2].

The necessity of new policy

The issues leading to the generation of the new regulations are numerous. The pre-REACH European framework was a historically developed patchwork of various directives and regulations that was shown to provide insufficient information on the hazards and risks of a large number of common chemicals. One characteristic of this fragmented development of the old framework was the differential assessment requirements on chemicals by their time of registration, with newly developed chemicals (i.e. dealt under NONS) having more safety data than those developed decades ago (i.e. under ESR).

Under the terms of the old framework, chemicals that were available on the European market from 1971 to September 1981 were named "existing" chemicals, and these numbered more than 100,000 different substances. Chemicals developed and marketed following this date were referred to as "new" chemicals. A requirement was generated for these "new" chemicals to be tested for their effects on human health and the environment before they were marketed in the EU, while "existing" chemicals had no similar assessment requirement except those chemicals that are prioritised under ESR. This allowed a relative lack of information on the hazard and risk of many of the 100,000+ "existing" substances to continue. This discrepancy has led to increasing public concern over potential risks of chemicals to public health and the environment.

The EU also believed that the delegation of responsibility for gathering and assessing data on hazards and risks of chemicals was not appropriate. REACH shifts this responsibility from public regulatory bodies to traders or industry under a policy of 'no data, no market'.

A third motivation to produce the new framework was to decrease the reaction time of the EU for introducing European-wide control measures to prevent supply and use of chemicals that presented a serious hazard to the public health and/or the environment.

The REACH process[3]

The practical implementation of REACH began in June 2008. Each stage of the process is described briefly below. In order to process chemicals in a consistent manner, a new central agency - European Chemicals Agency (ECHA) - has been established. The ECHA is based in Finland. ECHA is tasked with the management of the Registration, Evaluation, Authorisation and Restriction of Chemicals using the best available information, taking into account the potential socio-economic consequences of the restriction of use of a chemical product. The responsibility for overall decision making lies with ECHA, as well as ensuring consistency across member states. ECHA will seek to avoid any unnecessary animal testing in gathering of the information required under REACH by the promotion of sharing of data or read-across wherever appropriate. In the event of multiple registrations of the same chemical, a "Substance Information Exchange Forum" (SIEF) will be formed. This will allow data sharing for the purposes of Registration, reducing the duplication of studies, and will act as a forum for agreement on the classification and labelling of the substances concerned[4]. It is notable that REACH does not apply to radioactive substances, non-isolated intermediates, certain substances used in national defence and substances subject to customs supervision. Further derogations from the requirements of REACH are permitted for medicines, chemicals classified as foodstuffs and plant protection products as these are judged to be comprehensively regulated for under other legislation.

Registration[5]

The first stage of the REACH process to be implemented is the requirement for manufacturers and importers of a chemical substance in excess of 1 tonne per year to collect information on the physicochemical, health, and environmental properties of the substance and to use these data to establish how the material may be used safely. A *technical dossier* must then be produced detailing the data and risk assessments and supplied to the ECHA, containing the information in Box 1. For substances produced in quantities of 10 tonnes or more, a detailed *chemical safety report* (CSR) must also be produced and supplied to ECHA for review. The requirements of the CSR are illustrated in Box 2. If data cannot be supplied then the product will be prevented from use in the EU. About 150,000 substances have been registered by 65,000 companies between 1 June and 1 December 2008[6].

Evaluation[7]

Evaluation under REACH is spilt into appraisal of the registration dossiers submitted to ECHA, and the assessment of certain substances that are thought by ECHA or a Member State Competent Authority to present a risk to human health or the environment.

ECHA will perform *dossier evaluations* to assess testing proposals made by an industrial registrant or to check that the *technical dossiers* and CSRs comply with their requirements. *Substance evaluations* will then be conducted on the substance of concern by the competent authority of the individual European member states; in the UK this is the Health and Safety Executive, supported by the Environment Agency[8]. To ensure a consistent approach, member countries will report their findings to ECHA for review. These substance evaluations may lead ECHA to conclude that control measures are required under the restriction or authorisation procedures of the framework.

Authorisation

Where a member state reports that a substance evaluation indicates the chemical is a **s**ubstance of **v**ery **h**igh **c**oncern (SVHC), an *authorisation* will be required for their use and their placing on the European market. ECHA will publish a list of substances that will require authorisation.

The criteria for being a SVHC are substances that are classified as:

- Carcinogenic, Mutagenic, toxic to Reproduction (CMR);
- Persistent, Bioaccumulative and Toxic (PBT) or very Persistent and very Bioaccumulative (vPvB), or
- Identified from scientific evidence as causing probable serious effects to humans or the environment, equivalent to those above, on a case-by-case basis, such as endocrine disrupters[3].

These SVHC materials have been shown to have hazardous properties that present a risk to public health and the regulation seeks to ensure that the risks generated by the specific uses of these chemicals is fully assessed and mitigated against. A number of chemicals have already been identified as candidates for authorisation, including anthracine[9]. Anthracine is a polycyclic aromatic hydrocarbon used in the production of dyes and synthetic fibres[10], and has been shown to be very persistent in the environment[11]. The list of SVHCs as of December 2008 is shown in Table 1.

Companies seeking to continue to use these chemicals will have to apply for authorisation. They will be required to demonstrate that risks associated with the specific uses of these substances are adequately controlled or that the benefits from their use outweigh the risks. These companies will also have to show that they have investigated the option of substituting the chemicals with alternative materials that present less of a public or environmental hazard. Should an authorisation be granted to a company, the company will be allowed to use the chemical for a set period of time. At the end of this period the authorisation will be reviewed. If suitable alternative substances have been developed by this date the authorisation may be withdrawn.

Restriction

The restriction of chemical materials from the European market based on public health information is not novel. The “Limitations Directive” for Dangerous Substances and Preparations has historically restricted the marketing of materials such as asbestos[12].

The Restriction aspect of REACH will enter into force on 1 June 2009. It is anticipated that the number of *restriction dossiers* will be limited in 2009 and will rise to an average of 10 per year afterwards[13].

Table 1. ECHA list of Substances of Very High Concern (SVHC) as of December 2008 (Source: European Chemicals Agency[9])

Substance identification		Reason for inclusion*
Substance name	EC (CAS No.)	
Triethyl arsenate	427-700-2	Carcinogenic
Anthracine	204-371-1	PBT
4,4’- Diaminodiphenyl-methane (MDA)	202-974-4	Carcinogenic
Dibutyl phthalate (DBP)	201-557-4	Toxic for reproduction
Cobalt dichloride	231-589-4	Carcinogenic
Diarsenic pentaoxide	215-116-9	Carcinogenic
Diarsenic trioxide	215-481-4	Carcinogenic
Sodium dichromate	234-190-3 (7789-12-0 and 10588-01-9)	Carcinogenic, mutagenic and toxic to reproduction
5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene)	201-329-4	vPvB
Bis (2-ethylhexyl) phthalate (DEHP)	204-211-0	Toxic to reproduction
Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified: - Alpha-hexabromocyclododecane - Beta-hexabromocyclododecane - Gamma-hexabromocyclododecane	247-148-4 & 221-695-9 (134237-50-6) (134237-51-7) (134237-52-8)	PBT
Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins)	287-476-5	PBT and vPvB
Bis(tributyltin)oxide (TBTO)	200-268-0	PBT
Lead hydrogen arsenate	232-064-2	Carcinogenic and Toxic to reproduction
Benzyl butyl phthalate (BBP)	201-622-7	Toxic to reproduction

*PBT - Persistent, bioaccumulative and toxic; vPvB - very persistent and very bioaccumulative

Public health implications of REACH

One of the primary motivations for the implementation of the REACH framework was to create a positive public health impact by expanding the knowledge base of the chemicals we use and to ensure proper controls for those chemicals that are linked with disease.

At each stage of implementation REACH has clear potential public health benefits. Registration and evaluation of the technical dossiers and CSRs should aid public health in a number of ways. It will increase the knowledge base on hazards presented by chemicals by ensuring that industry has collected complete data on their properties. It will ensure that evidence-based guidance on how to use chemicals in a safe manner is provided to downstream users and benefits should be seen by the requirement for risk characterisation to be undertaken on substances classified as dangerous (e.g. PBT or vPvB). It should guarantee that sufficient data are available on all registered chemicals and also that chemicals identified as presenting a risk to human health are comprehensively evaluated.

The use of authorisations under REACH may promote the development of newer less harmful materials and will time-restrict the use of SVHC in sections of industry where their use is currently essential. PBTs, vPvBs and those CMR substances for which a safe level cannot be defined will not be authorised[3], hence public exposure to these materials should be reduced.

The properly implemented authorisation process of SVHC should generate the desired impact by limiting the release of persistent toxic materials to the environment. Exposure to chemicals is estimated to account for some 1% of the overall burden of all types of disease in the EU[14]. Thus if the implementation of REACH achieves a 10% reduction in these diseases, there would be a 0.1% reduction in the overall burden of disease in the EU. This is equivalent to around 4,500 deaths due to cancer being avoided every year. Assuming an approximate value for each life of €1 million, the potential health benefits of REACH are estimated to be roughly €50 billion over a 30 year period[3].

The restriction process already in place prior to REACH will continue, but under REACH this process will be accelerated to ensure that once substances presenting unacceptable risks to human health or the environment have been identified, EU wide restrictions are implemented to limit or prevent their use, which will have obvious associated public health benefits.

Box 1: Information required in a registration technical dossier

- Identity of the manufacturer/importer;
- Identity of the substance and information on the manufacture and use of the substance;
- Classification and labelling of the substance;
- Guidance on its safe use;
- Study summaries of the intrinsic properties of the substance;
- An indication as to whether the information on manufacture and use, the classification and labelling, the study summaries and/or, if relevant, the Chemical Safety Report has been reviewed by an assessor;
- Proposals for further testing, if relevant;
- For substances registered in quantities between 1 and 10 tonnes, the exposure related information for the substance (main use categories, type of uses, significant routes of exposure).

Source: European Chemicals Agency (2008) Reach Guidance on Registration[5]

Box 2: Information required in a registration Chemical Safety Report (CSR) (substances in excess of 10te)

Information/ data
Collection of all available data on the hazard of the substance, and human and environmental exposure occurring in relation to the conditions under which the substance is used as well as information on the manufacture and uses.

Hazard identification, Hazard assessment, Classification, PBT and vPvB assessment.
The hazard of the substance is identified and assessed including determination of its classification in accordance with Directive 67/548/EEC, establishment of Derived No Effect Levels (DNELs) for relevant routes of human exposure and Predicted No Effect Concentrations (PNECs) for environmental targets.

An assessment of the persistency, bio-accumulative and toxic properties of the substance is performed to conclude whether or not the substance fulfils the PBT, vPvB assessment criteria.

Exposure assessment
If the substance is classified as dangerous or fulfils the PBT or vPvB criteria, an exposure assessment and risk characterisation shall be performed and included in the report to demonstrate that the risks are adequately controlled.

This exposure assessment is done using exposure scenarios for each use of the substance. The exposure assessment consists of two steps: the generation of exposure scenario(s) (ESs) and estimation of exposure for each ES developed. Exposure scenarios are sets of conditions that describe how substances are manufactured or used during their life-cycle and recommendations on controls of exposures of humans and the environment.

The ES will include consideration of the conditions of use and Risk Management Measures which the registrant recommends the user(s) to implement. The first ES will normally reflect the current practice.

The exposure assessment needs to consider all life-cycle stages of the substance resulting from the manufacture and identified uses, and covers each human population and environmental compartment known to be, or supposed to be, exposed.

Risk characterisation
In risk characterisation the exposure of each human population and environmental compartment being exposed is compared with the appropriate DNEL or PNEC. Concern is raised if the estimated exposure is higher than the appropriate DNEL or PNEC. Remedial measures such as introducing more stringent risk management measures may be required until it can be demonstrated that risks are adequately controlled.

For substances with non threshold properties (e.g. genotoxic carcinogens) where it is not possible to derive a DNEL or PNEC, the same basic steps as set out above are likely to be followed in deriving appropriate ES, and the risk characterisation will be more qualitative and/or semi-quantitative.

Final exposure scenario and communication in Safety Data Sheet
The final output of this process is an ES that specifies the conditions of use where risks are adequately controlled for the manufacturing and use processes covered by this ES. This is summarised and communicated in an exposure scenario attached to the Safety Data Sheet that is provided to the user in the supply chain of the substance.

Source: European Chemicals Agency (2008) Reach Guidance on Registration[5]

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Haber's Law

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Introduction

Fritz Haber, one of Germany's greatest scientists of the late 19th and early 20th centuries, was born in Breslau in 1868. His family were prosperous chemical and dye merchants. An early interest in chemical experiments at home led to Haber attending courses at Berlin and Heidelberg universities. These courses were followed by a short time in the family business, but this seems to have been unhappy and Haber went back to university. He flourished; organic chemistry led to thermodynamics and electro-chemistry and by 1905, with his book *"The Thermodynamics of Technical Gas Reactions"* in print, he was an acknowledged leader of German chemistry. Arguments with Nernst (physiologists will recall the Nernst equation!) followed, but with the Haber Process for synthesising ammonia, for the production of fertilisers and explosives, Haber swept to a Nobel Prize in 1918 (awarded in 1919). An early discovery had related to the strength of C-C as compared with C-H linkages in aliphatic and aromatic compounds and this led to Haber's Rule:

> *"As regards thermal stability the C-C link is stronger than the C-H link in aromatic compounds and weaker in aliphatic compounds".*

Haber's Rule, Haber's Process; next came Haber's Law.

In 1914, Haber placed the resources of the Kaiser Wilhelm Institute, which he directed, at the service of the German War Ministry. Explosives were needed and the Haber Process provided the essential ammonia. Then, in late 1914, Haber turned to chemical warfare. Nernst was already active in the field and working on irritants, but Haber's drive and enthusiasm again swept him to the front: he introduced chlorine as a chemical warfare agent in a large-scale and very effective attack on April 22nd 1915 and in late 1916, he was appointed Chief of the Chemical Warfare Service with responsibility for all aspects of the subject from research to training. A range of agents were developed including sulphur mustard in 1917.

The post-War period was less happy for Haber: he failed to extract enough gold from seawater to pay off the German war debt, he fell foul of the Nazi regime (he was of Jewish origin) and despite continuing to produce first class work, was effectively exiled in 1933. He died in 1934.

Haber's Law

Haber's toxicological work on chemical warfare agents led him to suggest that for a given animal species and a given chemical, the likelihood of mortality could be expressed as:

$$Ct = w$$

where: C is the exposure concentration ($mg.m^{-3}$)
where: t is the duration of exposure (minutes)
and: w is the mortality product (Tödlichsckeitproduckt) or Lethal Index (LI)

Thus, if the exposure to x $mg.m^{-3}$ for 10 minutes caused death, so would exposure to $0.5x$ $mg.m^{-3}$ for 20 minutes.

This equation seemed to apply well to compounds said to produce irreversible effects by local reactions e.g., chlorine and phosgene. Compounds producing systemic poisoning, such as carbon monoxide and hydrogen cyanide, fitted the equation less well and an "elimination factor" e was included to allow for this:

$$(C - e)t = w$$

The equation $Ct = w$ describes a rectangular hyperbola. This relationship can be plotted as a straight line very simply by writing:

$$C = w\frac{1}{t}$$

If C is plotted against $\frac{1}{t}$ a straight line of gradient w will be produced. We may recall that the equation for a straight line is:

$$y=mx+b$$

In our equation $C = y$, $w = m$ and $\frac{1}{t} = x$.

b is the intercept on the y axis – in our case b is zero as the line passes through the origin.

American work led to dispute regarding Haber's figures for the Lethal Index of many chemical warfare agents. In dogs, for example the LI for phosgene was 10 times greater than that reported by Haber in cats (4500, as compared with 450 $mg.m^{-3}.min$). In 1921, Flury noted that compounds that were rapidly detoxified in the body did not follow Haber's Rule[1] and in 1934, Flury and Wirth reported that for some compounds C seemed more important than t [2]. In 1940, Bliss revived an equation[3]:

$$(C-C_o)^n t = k$$

proposed by Ostwald and Dernoschek in 1910[4] – before Haber's work was undertaken. In this equation, C_o is the threshold concentration and n and k are constants. Toxicologists have focused on C in the Haber Rule and the general form:

$$C^n t = k$$

has come to be widely used. n can vary from 1 to about 7, being high for irritant compounds. This equation lends itself to logarithmic transformation:

$$C^n t = k$$
$$n \log C + \log t = \log k$$
$$\log t = -n \log t + \log k$$

This too, represents a straight line, the gradient being ***-n*** and the intercept on the y-axis being log ***k***.

Much effort has been put into defining ***n*** for different compounds. In 2007, the Health and Safety Executive (HSE) published a document: *"Assessment of the Dangerous Toxic Load (DTL) for Specified Level of Toxicity (SLOT) and Significant Likelihood of Death (SLOD)"*[5]. This lists a large range of chemicals and an extract from the table is reproduced in Table 1 below.

Table 1: SLOT DTL and SLOD DTL Values for Various Substances

Substance name	'n' value	SLOT DTL (ppm^n.min)	SLOD DTL (ppm^n.min)
Acrolein	1	420	1680
Ammonia	2	3.78×10^8	1.03×10^9
Arsine	2	3706	5.9×10^4
Bromine	2	2.5×10^5	8.67×10^5
Carbon dioxide	8	1.5 x 1040	1.5×10^{41}
Hydrogen cyanide	2	1.92×10^5	4.32×10^5
Hydrogen sulphide	4	2×10^{12}	1.5×10^{13}
Methanol	1	8.02×10^5	2.67×10^7
Methyl isocyanate	1	750	1680
Ozone	1	1980	3600
Sulphur dioxide	2	4.655×10^6	7.448×10^7
Vinyl chloride	1	3.39×10^6	1.36×10^7

Assumptions regarding the value of ***n*** also underlie the US Acute Emergency Guideline Levels (AEGLs)[6]. AEGLs for two example chemicals, hydrogen cyanide and the nerve agent GA (or Tabun), are reproduced in Tables 2 and 3 below, respectively. AEGL 1, 2 and 3 imply minimal risk, risk of significant health effects or impaired capacity to escape from a scene of release of the chemical concerned, and a significant risk of death, respectively.

Table 2: AEGLs for Hydrogen cyanide (ppm)

	10 min	30 min	60 min	4 hr	8 hr
AEGL1	2.5	2.5	2.0	1.3	1.0
AEGL2	17	10	7.1	3.5	1.0
AEGL3	27	21	15	8.6	6.6

Table 3: AEGLs for GA (Tabun) (ppm) [mg/m3]

	10 min	30 min	60 min	4 hr	8 hr
AEGL1	0.0010 [0.0069]	0.0060 [0.0040]	0.00042 [0.0040]	0.00021 [0.0014]	0.00015 [0.0010]
AEGL2	0.0013 [0.087]	0.0075 [0.050]	0.0053 [0.0035]	0.0026 [0.0017]	0.0020 [0.0013]
AEGL3	0.11 [0.76]	0.057 [0.038]	0.039 [0.26]	0.021 [0.14]	0.015 [0.10]

n can be derived from data defining effects at two concentrations of ***c*** and ***t*** (assuming it is constant!) as follows:

$$C\, t = k$$
$$n \log C_1 + \log t_1 = \log k$$
$$n \log C_2 + \log t_2 = \log k$$
$$n \log C_1 + \log t_1 - n \log C_2 - \log t_2 = 0$$
$$n (\log C_1 - \log C_2) = \log t_2 - \log t_1$$
$$n = \frac{(\log t_2 - \log t_1)}{(\log C_1 - \log C_2)}$$

A critical assumption is that ***n*** is constant and, in particular, that it does not vary with ***t***.

Recent work by Bide and Risk has suggested that this may not be true for sarin[7]. Additionally, and less surprisingly, ***n*** seems to vary with the end point considered. Professor Tim Marrs has pointed out that further work by Bide *et al.*[8] suggests that for human lethality (based on extrapolation from animal data), ***n*** = 1.40 for exposures in the range of 0.17 to 30 minutes. For the mouse, ***n*** = 1.8 for the range 1 to 6 hours and that for human miosis, ***n*** approaches 4. Miller *et al.*[9] have taken the analysis further and have pointed out that a three dimensional surface is needed to illustrate the equation:

$$(C - C_o)^{\alpha} t^{\beta} = k$$

or, in a non-threshold case:

$$C^{\alpha} t^{\beta} = k$$

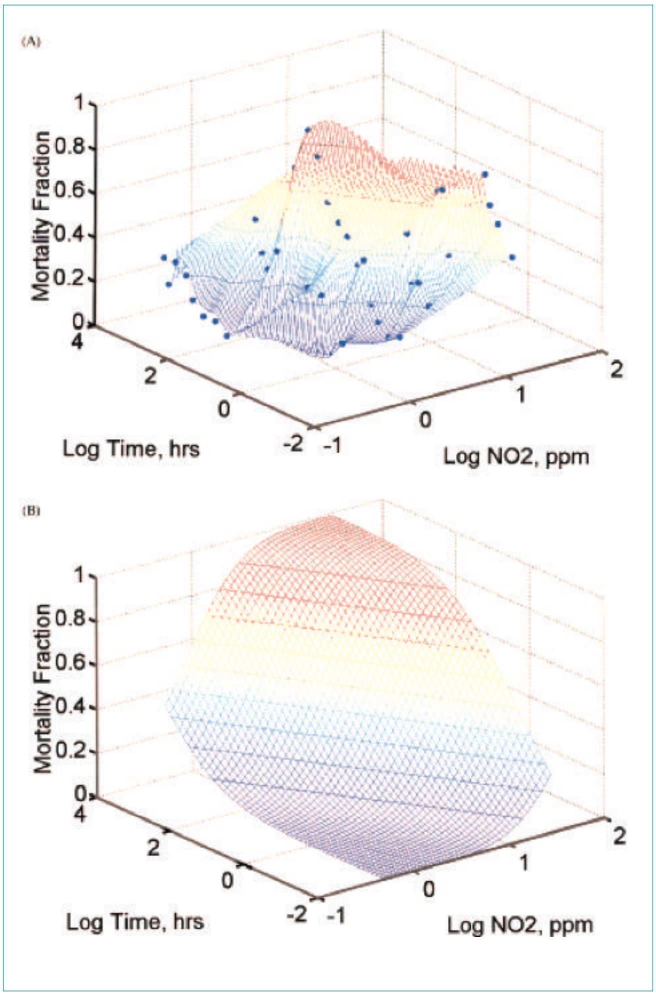

Figure 1: 3-Dimensional plots of the power function (Image © Miller)

This leads to a mathematical problem! In the words of the authors:

> "The introduction of an exponent on either C or t into Haber's rule generates what is termed a power function, which represents a family of curves parameterized by the values of γ, the exponent, and k. Given two variables X and Y, one must select either XγY = k or XYγ = k since the number of parameters to be estimated cannot exceed the number of variables. When dealing with concentration and time as the two variables of interest, the type of response outcome led Bliss (1940) to emphasize C while Drucker[10] emphasized t."

A way out of this difficulty is provided by a 3-dimensional plot (See Figure 1).

Using data from studies of the effects of NO^2 on bacterial infectivity in mice, and a probit model to fit the data (probit value = y) the authors fitted the following equation:

$$y = m + \alpha \ln C + ß \ln t$$

and derived the following table:

Table 4: Parameter estimates and their confidence limits for a probit model to fit the murine infectivity data[11] (Table is reproduced from Miller *et al*., 2000[9]).

Parameter	Estimate	95% Confidence limits	
		Lower	Upper
m	2.576	1.969	3.076
α	0.947	0.744	1.185
ß	0.294	0.216	0.387

The results of the model are compared with the real data used to derive the model in the pair of graphs shown above (A shows the real data, B shows the model results). The fit is not perfect! It will be seen that the model surface resembles the sigmoid curve familiar to toxicologists; it begins fairly flat, steepens and then flattens off again at high concentrations and long time periods. But the key lies in the slope of the surface: very different levels of effect (mortality fraction) can be produced by similar products of concentration and time. Haber's Law has long played an important role in toxicological thinking and, in its original (***Ct = k***) or modified ($C^n t = k$) forms, underlies much work in the standard setting field. Recent work has shown that even in its modified form it may not be completely reliable. Further work to explore its applicability to a range of compounds is still needed: a remarkable conclusion after about 93 years of use!

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UCL Environment Institute

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Introduction

The UCL Environment Institute (UCL-EI) is the focal point for environmental research and related activities in University College London (UCL). Our remit is to engage in, as well as facilitate and coordinate, environmental research within UCL and with external partners. Currently the UCL-EI has joint projects with: large property developers (Development Securities, Hermes), insurance companies (JLTRe), and water and waste companies (Thames Water, North London Waste Authority). The UCL-EI also hosts the Thames Estuary Partnership (TEP) and co-ordinates UCL's contribution to HYDRA (an 8 institution collaborative program on water management). As well as industrial partners, we have also worked with the media such as The Independent, The Guardian, Channel 4 and Sky News. We strongly support partnerships and collaboration to further innovative environmental research at UCL. We aim to improve communication between those who carry out the research and those who need its findings as this leads to a better understanding of how the environment functions, the human impact and how environmental policies can be effectively implemented.

The Institute also seeks to enhance connections between the arts community and environmental professionals through its artist and writer in residence programmes. Both programmes will help to explore and promote the relationship between the arts, science, business and technology, as a means of enhancing understanding and fostering collective action. Environmental research is fundamentally a collaborative, interdisciplinary enterprise that engages artists and scientists with government, environmental agencies, business, the voluntary movement and the general public.

Background

The UCL-EI has at its centre the overriding theme of climate change. Climate change is the greatest environmental challenge facing the world today, as rising sea levels and extreme weather events will have a significant impact on every aspect of our lives. The operating structure of the UCL-EI and the high expertise of its staff are particularly suited to deal with the complexity of key risks such as: Flooding; Adaptation to Climate Change; Chemicals and Radioactive Waste. These key themes require knowledge of the fundamental science of both the natural and built environments; the understanding of economic constraints and social response to risk; the capability of selecting and using new instruments for early warning, such as the use of satellite data; the expertise in modeling natural systems. When considering how climate change is going to affect the UK, it's useful to understand the risks that current climate already poses to individuals, landscapes, organisations and the economy. This formed the basis for our three main themes:

Cities and Climate Change: According to the United Nations, 50% of the world's population live in cities, using over 75% of the global energy consumption. We need to adopt policies that will help mitigate global warming and improve quality of life; cities have great potential to instigate and implement innovative solutions to climate change and in cities, small changes can have huge effects.

Water Initiative: Water has long been considered a right in the UK. Changes to the earth's climate in terms of increase in precipitation and sea level rises have a direct effect on increasing the extremes of flood and drought. Natural disasters are no longer things that happen elsewhere and at the same time consumption is increasing.

Climate Initiative: Our scientific understanding of climate change is sufficiently robust to make us highly confident that greenhouse gas emissions are causing global warming. The consequences of climate change will become disproportionately more damaging with increased warming. Higher temperatures will increase the chance of triggering abrupt and large-scale changes that lead to regional disruption, migration and conflict.

Each of these themes is led by a Co-Director and these areas ensure that the Institute provides an unparalleled combination of expertise in the science of climate, earth and water systems, and in the social science of the built environment.

Cities and Climate Change: Co-Director, Professor Yvonne Rydin

The focus of the Cities and Climate Change theme is twofold.

- It analyses the possibilities for reducing carbon emissions through changing the nature of our cities - how they are planned and built, how they are managed and serviced, and what activities take place within them.
- It researches the changes that need to be made at the city level to adapt the built environment and its functions to climate change, and to make cities more resilient.

We are interested in how current patterns of urban governance are implicated in climate change and how they can be altered to achieve better mitigation and adaptation. Within this, we are particularly interested in the role that knowledge and technological innovation play. We examine how policy, planning and practice, on the one hand, and knowledge, information and innovation, on the other, mutually influence each other and how interaction can lead to more sustainable outcomes. The work undertaken focuses spatially on cities, the urban and the built environment.

Water Initiative: Co-Director, Dr Sarah Bell

The Water Initiative builds on UCL's strengths in water research to devise interdisciplinary approaches to solving the enormous challenges in this field. Supplying water to human settlements, protecting homes and infrastructure from floods and maintaining the health of aquatic ecosystems are major challenges in the UK and around the world. More than 1 billion people worldwide do not have access to a safe water supply. Many of the world's major rivers no longer flow to the sea. Water environments and resources have been placed under pressure by growing populations, increased extraction for agricultural irrigation and industrial development, changing land use and increased domestic consumption. All of these problems will become more difficult to manage in a context of climate change. More erratic rainfall patterns combined with background trends of increased or decreased rainfall in different areas will make the challenge of managing water resources and environments ever more difficult.

Climate Initiative: Co-Director, Dr Stuart Robinson

The Climate initiative aims to understand how climate change works and how it affects Earth's environments and biota. We are interested in understanding the linkages between the causes, machinations and consequences of climate change on a wide range of timescales from the deep geological past to the instrumental records of the present. Through an understanding of the present, and a consideration of the past, we also aim to make predictions of future climatic, biotic and environmental change.

In order to achieve these aims, we:

- facilitate networking between research groups/individuals from different departments within UCL.
- inform the UCL climatic and environmental sciences community of the facilities (i.e. laboratory) and opportunities (i.e. seminars, graduate courses) available within UCL.
- provide a portal through which the public, media, schools, business, government, and Non-Governmental Organisations (NGOs) can access the science of climate change and its consequences

Examples of some of our current Projects

Global Zero Carbon Capacity Index, Supported by the Royal Institute of Chartered Surveyors

The residential sector contributes about 30% of total Green House Gas (GHG) emissions. Thus, there is great theoretical potential to reduce emissions by improving the performance of the built environment. This project will produce an index on the capacity of countries' built environments to move towards the zero-carbon ideal. Commissioned by the Royal Institution of Chartered Surveyors, the index aims to bring together internationally comparable data on key emission reduction factors that fall within the direct competence of the built environment sphere at a range of scales (urban area down to individual building) and across a range of activity sectors (domestic, business, industrial, transport).

It is envisaged that the index will be relevant to development, property and spatial planning bodies where there is interest in promoting, complying with or investing in carbon emission reduction measures. Initially, the index may focus on NW & S Europe, N America, Australia, New Zealand and Hong Kong, but with the potential to expand coverage to other parts of the world.

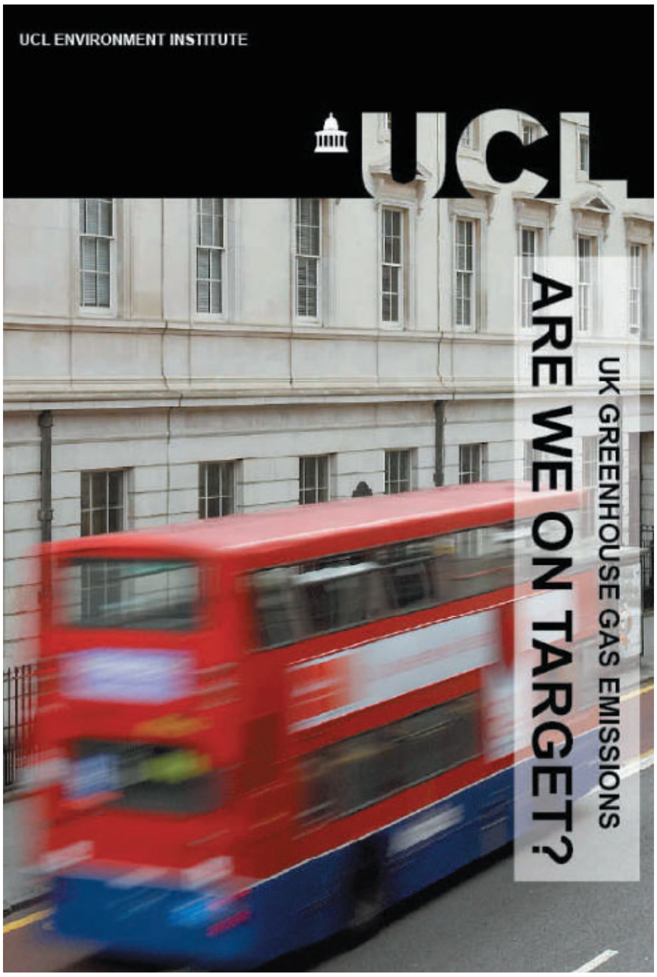
Bridging the Gaps, funded by the EPSRC

Bridging the Gaps is a three-year Engineering and Physical Sciences Research Council (EPSRC) funding programme, designed to encourage interdisciplinary research into sustainable urban spaces. The programme will make space, time, equipment and money available for researchers at UCL to interact and develop new ideas for interdisciplinary research into all aspects of sustainable cities, particularly in the context of climate change.

The tasks of planning, designing and managing sustainable cities in the context of global climate change present serious challenges for the 21st century. The Bridging the Gaps programme will provide UCL researchers with resources and opportunities to devise innovative research agendas, which address the challenges to engineering and the physical, mathematical and engineering sciences of creating and maintaining sustainable urban spaces in the context of global climate change. Bridging the Gaps aims to bring researchers working on different elements of these problems together in new ways, and to reach out to research communities currently not engaged with these issues.

Publications

Are We On Target? Audit of UK Greenhouse Gas Emissions to 2020: will current Government policies achieve significant reductions? (Commissioned by Channel 4 for Dispatches)



This report assesses the UK Government's current policies to reduce carbon emissions and the likelihood of achieving their stated targets and policy aims. We are faced with a future of catastrophic storms, floods, droughts and heat waves, unless we combat climate change. The UK Government has thrown down the gauntlet by enshrining in law the UK pledge to cut GHG emissions by at least 12.5% by 2012 and 60% by 2050 compared with the baseline emissions of 1990. Compared with other countries, these are very ambitious targets and provide international leadership in tackling global warming. It has also set policy aims to achieve significant cuts in GHG emissions by 2020. In the DEFRA Climate Change Review (2006), the policy projection was to achieve a cut in GHGs of ~20% by 2020. In the subsequent DTI Energy Challenge Report (2006), additional policies are estimated to add an extra 19.5 – 25.3 mega tonnes of carbon savings which would achieve a total cut in GHG emissions of ~30% by 2020.

Climate Change: The Risks for Property in the UK (Commissioned by Hermes)

Climate change is a growing risk to older properties and southern UK cities, including London, and should inform the decision-making of property investors. The report found that the entire Thames estuary is most at risk to flooding, storm damage and subsidence through drought. Climate change is changing the context for property investment. Already, governments are requiring property developers and owners to think about their carbon emissions; consumer demand is heading the same way. But even if the property sector moves towards a zero-carbon built environment, it will still have to cope with the impacts of the climate change that is already happening. Future UK climate patterns will affect obsolescence rates and running costs, even of recently developed properties, and change the spatial patterns of demand for property across the UK.

The overall objective of the report was to scope the physical impact of climate change on UK property over the next 50 years. It provides the first detailed analysis of the impacts of climate change specifically targeted on the UK property sector, looking across the full range of possible impacts and considering how these affect the different sectors of the property market.

Full reports can be downloaded from http://www.ucl.ac.uk/environment-institute/Publications/cities.htm

Conference and workshop reports

Health Protection Conference 2008

Catherine Keshishian and Angie Bone
Chemical Hazards and Poisons Division, London

The Health Protection Agency's (HPA) annual conference was held at the University of Warwick from 15-17th September 2008. Over 1300 delegates attended, half of whom were from organisations outside the HPA. On each day, four different tracks ran in parallel reflecting the expert disciplines of the HPA, including chemicals, radiation, infectious disease, emergency response, natural hazards and behavioural sciences.

Day 1 – Chemicals and radiation exposure

The chemical and radiation exposures symposia commenced with a presentation from Simon Clarke (A&E consultant at Frimley hospital and honorary HPA consultant) on current procedures for the decontamination of multiple chemical casualties and the expected challenges. This was followed by a series of presentations on weaponised tungsten from the Defence Science and Technology Laboratory. Weaponised tungsten is being developed to replace depleted uranium, but animal models suggest concerns regarding its toxicity.

The afternoon symposia covered new developments in the medical use of CT scanning, the public health implications of waste derived fuels, and risk communication of chemical and radiation hazards.

Day 2 – Surveillance and incident management

A series of presentations were given regarding international surveillance systems for health, including risks and outbreaks associated with infectious disease, medicine, food, bioterrorism, animal health, radiation, chemical and seismic events.

During the Bronze and Silver Command workshops, representatives from the ambulance, fire and police services, the Environment Agency, local authority and HPA described their respective roles in both the Bronze and Silver Commands during emergencies. (For more on the Bronze, Silver and Gold Command structures, please see *Chemical Hazards and Poisons Report* Issue 7.) The presentations generated much discussion between the audience and experts regarding the HPA's role and what more could be done to strengthen relationships between agencies.

Day 3 – Behavioural science, natural hazards and land contamination

There were a number of sessions of interest to CHaPD staff on the final day of the conference. The behavioural science session began with two presentations on mass psychogenic illness, including one from Professor Simon Wessely, one of the world experts on the subject. (For more on mass psychogenic illness, please see CHAP Report Issue 13.) Some preliminary results from the HPA-led study of the mental health effects of the summer 2007 floods were given, which significantly showed that two months post-flood, 68% of flood victims showed signs of psychiatric distress; the full results will be presented in a coming issue of the CHAP Report. The session ended with a thought-provoking talk from Professor Richard Williams on the medicalisation of normal human reactions post-disaster.

A new theme for the HPA conference addressed the health effects of natural disasters and climate change. The first session focussed on climate change and heatwaves. This included presentations on the joint HPA/Department of Health update report on the health effects of climate change[1], the HPA evaluation of the national heatwave plan[2], and the particular vulnerability of older people to heatwaves. The audience were reminded that most of those present would be in this population group as heatwaves become more frequent and more intense.

In the second session, delegates were fortunate to be addressed by Sálvano Briceño, the director of the United Nation's International Strategy for Disaster Reduction, who impressed on the audience that the disaster associated with a natural hazard is a result of human actions and not from the hazard itself, for example from overpopulation or poor building construction. A similar theme was expressed by Garry de la Pomerei on the risk to children in schools from poor infrastructure, including in the UK. Dr Chris Browitt demonstrated the ways that a new satellite technology that measures small ground movement can be used to predict where natural and anthropological disasters may occur, such as landslips and flooding. Of great importance to the HPA were the flood events from summer 2007, which were discussed in three presentations: lessons learned, the local response, and risk assessment for chemical contamination.

In the afternoon, a series of talks regarding land contamination were given. Norm Healey from Health Canada discussed the problems associated with remediation of contaminated land at remote lighthouses. Two delegates from Forest Research presented new research on how vegetation and charcoal can be used to remediate land. Finally, presentations were given regarding the conflicting drivers for managing contaminated land, such as sealing off potentially hazardous areas that are popular public leisure spots.

Conclusion

A full programme and copies of some of the presentations from the conference are available for a limited time at www.hpa-events.org.uk/hp2008. As always, the conference provided an excellent opportunity not only for learning but also for making new friends and strengthening relationships with colleagues from within the HPA and across the public health system.

Useful links

1. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_080702
2. http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1204100449763

"STINKFEST" – A one day event celebrating the 150 year anniversary of the Great Stink of London, University College London

Helen Smethurst
Chemical Hazards and Poisons Division, London

The University College London (UCL) Environment Institute organised a conference on 17th June 2008 to commemorate the 150 year anniversary of *The Great Stink* of London, which led to the construction of London's sewerage system. In the early 19th century the River Thames was practically an open sewer, with disastrous consequences for public health in London, including numerous cholera epidemics. Proposals to modernise the sewerage system had been put forward in 1856, but were abandoned due to lack of funds. However, after *The Great Stink* of 1858, Parliament realised the urgency of the problem and resolved to create a modern sewerage system. The conference marked this anniversary as well as raising awareness and initiating discussions regarding a number of environmental issues facing London in the 21st century. These issues included: storm water overflows into the Thames; climate change and renewable energy; and urban planning.

Speakers on the day included:

An Introduction was given by Professor Mark Maslin Director of the Environment Institute.

- Richard Dennis, UCL - The Great Stink: Odour Out of Place

This talk discussed the Great Stink of 1858 and, more broadly, the Victorian anxieties about 'miasma' (foul-smelling air that was thought to cause disease) spreading from the poor to the rich areas of London via sewer gases violating the home. The development of Joseph Bazalgette's sewerage system, whilst improving the situation, brought more fears to the city due to the new interconnecting pipe work carrying waste between people and places.

- Phil Stride, Thames Water - The Thames Tideway Tunnel

Presently, the Thames is subject to numerous storm events which result in the discharge of untreated sewage into the river. The Urban Waste Water Treatment Directive requires improved wastewater treatment; therefore, in March 2007 the Government announced its decision to support the development of the Tideway Tunnel solution which involves the capture of millions of tonnes of storm sewage and preventing it from entering the river Thames. The Thames Tideway Tunnel project comprises of two separate and independent projects; the Thames Tunnel and the Lee Tunnel, which will both divert storm waters from the river and to the sewage treatment works at Becton.

- Jill Goddard, Thames Estuary Partnership - Current pressures on the Thames

The Thames Estuary Partnership is a charity providing a framework for the management of the estuary, co-ordinating projects and seeking to further the interests of local communities, local economy and the environment. This talk focussed on the pressures that the estuary faces from the different users of the river and the diverse habitats and wildlife it supports.

The afternoon panel was chaired by visiting Professor to the Geography Department of UCL, Dr David Goode.

- Sarah Bell, UCL - The Vulnerability of the Thames to Climate Change

Dr Bell in her presentation discussed the outcomes of a UCL Environment Institute project working with the World Wide Fund for Nature assessing the vulnerability of the Thames Basin to climate change impacts on water resources, water quality, ecology and flooding.

- Yvonne Rydin, UCL - Urban Planning and the Environment in London

The Great Stink was evidence of a major failure of urban governance to protect the environment and public health. This talk considered how effective the current forms of governance in the capital are in delivering an environmentally sustainable London.

- Eric Fraga, UCL - Process Systems Engineering and the Environment

This talk illustrated the application of process systems engineering techniques for water distribution networks and biofuel production and its applicability for decision making in complex systems.

International Disaster and Risk Conference at Davos, Switzerland. 25th to 29th August, 2008

Prof. Virginia Murray
Chemical Hazards and Poisons Division, London

The International Disaster and Risk Conference (IDRC) in 2008 was one of a series of meetings designed to promote the integrated risk management approach for all types of disaster, but concentrating on natural hazards such as floods, hurricanes, earthquakes and other natural disasters; indeed, it addressed disaster and risk reduction and climate change adaptation in particular. Over 1,000 delegates from many local, national, regional, international and organisations attended. Besides the World Health Organization, the United Nations International Strategy on Disaster Reduction was well represented.

The conference aimed to cross subject areas, professions, and sectors in order to encompass scientific understanding with business, policy responses, the media and citizen participation - thus, encouraging stronger ties and devising approaches for moving towards a more truly integrated way of thinking about disaster and risks. The audience targeted to attend were the natural, engineering and social sciences, politics, governments, the private sector, civil society, international organizations, NGOs and other risk management professions. Notable and committed speakers presented excellent papers in the many sessions and workshops, frequently opening understanding of the complex and worrying issues related to mitigation and response.

The first day of the conference was devoted to discussions on climate change adaptation, highlighting crucial linkages with disaster and risk reduction, and the necessity for widespread professional and coordinated global policy actions. The discussion with representatives from various subject areas, professions and development sectors elaborated a series of direct, practical proposals to identify and bridge existing and potential gaps in the cooperation between the various actors. In particular, the session entitled 'Mainstreaming Climate Change Adaptation and Disaster Risk Reduction – The Need for Harmonization' addressed the issue that the professional and scientific communities (including both individual experts and organizations or institutions) that deal with climate change and disaster reduction are not identical. Both groups address the many risks in natural hazards, such as those posed by cyclones, floods and droughts. Both aim to reduce the vulnerability of people, as well as their animals and crops, and their livelihoods. Yet, there are differences that have often kept the two groups apart, such as different professional background and 'languages', and often working to different time scales.

The second day considered the issues of 'Critical Infrastructure Protection and Resilience'. Every year, tens of millions of people are affected by natural hazards such as droughts, floods, storms, cyclones, earthquakes, landslides, tsunamis, wildfires and by many other technical or biological risks, pandemics, diseases, by terrorist attacks and other risks. Greater population densities in ever more urban and semi-urban areas, peoples' increasing mobility, expanding globalization, lack in energy supplies, growing environmental degradation, climate change, and the cycle of poverty all worsen the impact of hazards. Nations and communities suffer not only from the losses faced by individual people and families, but also to a very large extent from the losses and damage to critical common structures: schools, hospitals, transport and communications systems, community and social services, food and water supply, etc.

On the third day there was an excellent session on 'Make Health Facilities Safe from Disasters'. Jonathan Abrahams, from the World Health Organization (WHO) Risk Reduction and Emergency Preparedness: WHO Six-year Strategy for the Health Sector and Community Capacity Development 2008, announced the joint UN-International Strategy on Disaster Reduction, World Health Organization and World Bank initiative 'Keeping Hospitals safe from disasters International Day for Disaster Reduction' to be held on the 8th of October 2008[1.] He also shared details of the UN 2008-2009 World Disaster Reduction Campaign[2].

The conference was used to also launch the Global Risk Forum (GRF Davos), which is a newly established international organization based in Davos, Switzerland. The GRF aims, through its various activities, at serving as a Center of Excellence in knowledge and know-how exchange, transfer and application. The Mission statement of the GRF includes 'aims at serving as a centre of knowledge and know-how exchange for the application of contemporary risk management strategies, tools and practical solutions. Thus, GRF Davos aims at reducing vulnerability for all types of risks and disasters to protect life, property, environment, critical infrastructure and all means of business for the worldwide community on a sustainable basis.' Details on the GRF can be found http://www.grforum.org/index.php.

References

1 **'Keeping Hospitals safe from disasters: Reduce Risk, Protect Health Facilities, Save Lives.' International Day for Disaster Reduction, 8 October 2008 http://www.searo.who.int/en/wdd/**

2 **Hospitals Safe from Disasters: Reduce Risk, Protect Health Facilities, Save Lives. UN International Strategy for Disaster Reduction, 2008-2009 World Disaster Reduction Campaign http://www.unisdr.org/eng/public_aware/world_camp/2008-2009/pdf/wdrc-2008-2009-information-kit.pdf**

Homes, health, and climate change workshop, HPA Holborn Gate. 11th of November, 2008

Dr Angie Bone
Chemical Hazards and Poisons Division London

Background

The Foundation for Science and Technology is a 'neutral platform for debate of policy issues that have a science, engineering or technology element'. It hosts regular dinner/discussions and posts a summary of the events and copies of presentations on its website. When requested, Professor Virginia Murray has attended relevant events on behalf of the Health Protection Agency.

In June 2008, the Foundation organised a discussion on 'Improving the Energy Efficiency of the Existing Housing Stock' [1]. The UK Government has committed to an 80% reduction in carbon emissions from 1990 levels by 2050 [2], and housing accounts for 27% of current UK emissions [3]. There is now a strong policy drive to reduce emissions from homes. The meeting debated the many challenges facing the UK in achieving this aim, but it was apparent that the potential health impacts, both positive and negative, risked being overlooked.

The homes, health and climate change project

As a result of the Foundation meeting, the Homes, Health and Climate Change project evolved. It aimed to scope existing knowledge on the impacts on occupant health of carbon emission reduction and heatwave adaptation in homes, through literature review and consultation with experts and organisations from a wide range of relevant disciplines.

An initial assessment found that whilst some of the health benefits of warmer homes in winter have been described, consideration of any potential negative impacts of some of the measures promoted has been less evident. A chief area of concern was the impact of increased air tightness on indoor air quality if ventilation is insufficient. Potential hazards include radon, carbon monoxide, environmental tobacco smoke, other chemicals in contained domestic environments, as well as mould and house dust mites.

As part of this project a workshop was hosted by CHaPD London on the 11th November 2008. The aims of the workshop were to:

- review the measures used in homes to reduce carbon emissions and adapt to heatwaves, and to consider their impacts on occupant health
- identify and prioritise gaps in knowledge and public health policy/action
- establish future priorities in terms of public health research, policy and service delivery

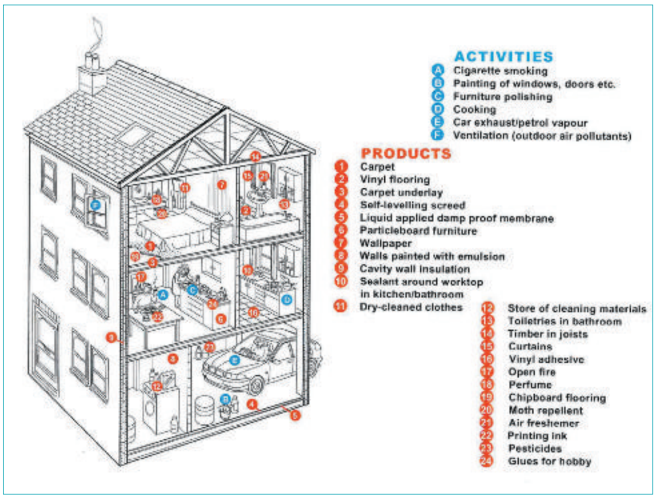


Figure 1: Factors influencing indoor air quality in the home (Source: Crump, 2004[4])

Those attending the workshop included representatives from the HPA, the Department of Health, the Department for Communities and Local Government, the Building Research Establishment, Warwick School of Law, British Gas New Energy, the London School of Hygiene and Tropical Medicine, the London Teaching Public Health network, and the Chartered Institute for Environmental Health. A series of presentations by some of the participants was followed by discussion groups in the afternoon.

The outcomes of this initial scoping project are a series of recommendations for future public health research, policy development and action. These are to be followed up by the HPA and its partners over the coming months, through the establishment of a homes, health and climate change stakeholder group. More information is available from Virginia Murray at CHaPD London.

References

1 The Foundation for Science and Technology website (http://www.foundation.org.uk, accessed 22.12.08)

2 UK Climate Change Act (http://www.opsi.gov.uk/acts/acts2008/pdf/ukpga_20080027_en.pdf, accessed 22.12.08)

3 Building a Greener Future: Policy Statement. 2007. Department for Communities and Local Government

4 Crump D (2004) Maintaining good air quality in your home. BRE IP 9/04

The 20th Annual conference of the International Society for Environmental Epidemiology (ISEE) 2008: Exposure and Health in a Global Environment. Pasadena, California. 12th to 16th October, 2008

Dr Emer O'Connell
Chemical Hazards and Poisons Division, London

The opening plenary, 'California perspectives on environmental policy', showcased some of California's innovative environment and health policies such as their early vehicle emissions reduction programmes, their Green Chemistry Initiative, and their early identification and championing of migrant and environmental justice issues. **Mark Horton**, Director of California's Department of Public Health, also provided an overview of the California Environmental Contaminants Biomonitoring Programme, which will be used to establish temporal trends in contaminant levels, and to assess the effectiveness of policies and programmes to reduce exposures to specific chemical contaminants.

The second plenary session tackled some of the difficulties associated with translating epidemiological and exposure discoveries into action, particularly how scientists must facilitate a policy-maker's need to weigh up the economic costs and benefits of intervention, while maintaining their role in communicating how the broader costs and benefits are distributed across a society, and ensuring environmental justice. **Frank Ackerman,** from Tufts University, delivered an especially inspiring presentation on the costs and benefits associated with chemicals policy. To summarise, he argued that true cost-benefit analysis is impossible as many crucial societal benefits, such as the reduction in neurodevelopmental damage in children following the removal of lead from petrol, have no meaningful prices. He also concluded that such analyses are also unnecessary as most policy proposals (other than climate change!) are very inexpensive.

Across the three day conference, the results of research projects from across the world were presented, methodological conundrums were thrashed out, and emerging issues were discussed and prioritised. As with previous conferences, the health impacts of indoor and outdoor air pollution featured heavily on the schedule and there was a lot of interest in the sessions on communicating uncertainty. While previous conferences have featured climate change issues, this year brought these issues to the top of the agenda and a real sense of integrated thinking emerged. There is a significant role for the environmental epidemiology community in identifying, evaluating and communicating the multiple health impacts of climate change and the enthusiasm to rise to this challenge was evident.

There were several sessions covering environmental justice (EJ), and attendees were encouraged to actively consider potential EJ issues within the other broader sessions that they attended; this highlights the priority this topic has among the environmental epidemiology community. A session on community-based participatory research was particularly popular and highlighted the need to involve affected populations and communities in population-based exposure assessments and risk reduction interventions.

Next year's ISEE annual conference will be hosted jointly by the Irish and UK chapters, and will be held in University College Dublin from the 25th to 29th of August. With the overarching theme of 'Environment, Food and Global Health', the programme promises to be an exciting one. As well as covering the traditional ISEE topics, sessions will link issues such as climate change, EJ and food, with a 'farm to fork' consideration of the health impacts of food production and consumption. To access the conference programme, and for details on abstract submission and conference registration, go to the ISEE Dublin 2009 website: http://www.isee2009.ie/home/. The deadline for the early bird registration fee is June 30th, 2009.

Training Days for 2009 to 2010

The Chemical Hazards and Poisons Division (CHaPD) considers training in chemical incident response and environmental contamination for public health protection a priority. The 2009-2010 programme is being developed to offer basic and more detailed training, along with the flexibility to support Local and Regional Services initiatives as requested.

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

Date	Title	Length of event	Level of event	Venue
14th May	**Incidents during transport of hazardous materials**	One day	2	Holborn Gate, London
1st-5th June	**Essentials of Toxicology for Health Protection**	Five days	3	King's College, London
23rd June	**How to Respond to Chemical Incidents**	One day	1	Holborn Gate, London
September	**How to Respond to Chemical Incidents**	One day	1	Holborn Gate, London
September	**Understanding Public Health Risks from Contaminated Land**	One Day	2/3	Holborn Gate, London
October	**Carbon Monoxide Workshop**	One day	2/3	Holborn Gate, London
October	**Operational Lead Workshop**	One day	2/3	Holborn Gate, London
November	**Essentials of Environmental Science**	Five days	3	King's College, London
November	**Odours Workshop**	One day	2/3	Holborn Gate, London
February 2010	**Introduction to Environmental Epidemiology**	Five days	3	London School of Hygiene & tropical Medicine

Planned one day training events for 2009 include:

Level 2 Phase 2 Chemical Incident Training

Various dates around the country

For CCDCs, Health Protection Specialists, practitioners and scientists, and other HPU/LaRS staff involved in the response to acute or chronic chemical incidents, HPA Regional Directors and Regional Epidemiology staff, CHaPD Supra-regional service staff, toxicologists, environmental scientists and other specialist staff with daytime duty-desk responsibilities, HPA Health Emergency Planning Advisors (HEPAs).

The level 2 programme is for all HPA staff in the region who are, or might be, involved in the HPU response to acute or chronic chemical incidents. Some places will be available to other regions for HPA staff who cannot attend on dates in their own region.

Aims:

- to train HPU and LaRS-regional HPA staff to achieve 'Level 2' competence in the public health management of acute and chronic chemical incidents
- to enable HPA professionals to maintain and develop existing competency and good practice.

Educational objectives:

- to demonstrate an understanding of the roles and responsibilities of Health Protection staff and specialist Divisions and of other agencies involved in chemical incident management, and how they interact with Health
- to enhance local multidisciplinary team working in the context of chemical incidents
- to understand the principles of human health risk analysis processes, including risk assessment steps, and demonstrate their practical application in the investigation and management of a chemical incident
- to understand the application of biomonitoring, environmental sampling and modelling in the investigation and management of a chemical incident
- to demonstrate practical application of media skills and communication skills in managing unresolved public concerns in environmental incidents
- to understand the types of tools, guidance and plans that are useful for chemical and environmental incidents.
- *(Further self-defined learning objectives as may be identified using pre-course questionnaire)*

These events are run free of charge.
If you have any questions about this event please contact:
Lyn Wengreen
Email: Lyn.Wengreen@liverpoolpct.nhs.uk Tel: 0151 290 8115

Training Days for 2009 to 2010

How to Respond to Chemical Incidents

23rd June, Holborn Gate, London
September, Holborn Gate, London

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

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

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

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

Incidents during transport of hazardous materials

14th May, Holborn Gate, London

This course is designed for those working in public health, paramedics, fire and police professionals and environmental health practitioners who may have to respond to incidents arising from the transport of chemicals.

Aims:

- to provide an understanding of the transport of hazardous materials in the UK
- to provide an awareness of the public health outcomes from incidents during the transport of hazardous materials
- to provide an understanding of the interactions with other agencies involved in transport incident management.

Educational objectives:
- to be aware of the processes for response to transport incidents
- to be aware of the information available from the 'Hazchem' labelling of transported chemicals.

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

Training Days for 2009 to 2010

Understanding Public Health Risks from Contaminated Land

September, Holborn Gate, London

For Consultants in Health Protection, CCDCs, CPHMs and Specialist Registrars in Public Health Medicine and Local Authority Environmental Health Officers

This day aims to provide delegates with an understanding of legislative and organisational framework underpinning contaminated land risk assessment and how to provide an appropriate timely response in relation to public health risks.

Aims:

- to understand the role of public health in the management of contaminated land investigations
- to raise awareness of the appropriate and timely response to contaminated land investigations
- to understand the interaction with other agencies involved in the investigation and management of contaminated land.
- to review the principle and current issues relating to the management of contaminated land incidents and investigations including:
  - the toxicology underpinning derivation of tolerable concentrations
  - Soil Guideline Values
  - the local authority perspective on implementing Part II A
  - the risk assessment process
  - the nature of public health risks from contaminated land and risk communication.

Educational objectives:

- to understand by using incident examples the process for public health response to contaminated land issues
- to understand by using examples and case studies the type of information and the limitations of the risk assessment models provided to public health from other agencies regarding contaminated land
- to understand by using incident examples the roles and responsibilities of the different agencies involved in investigating and managing contaminated land

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

Carbon Monoxide Workshop

October, Holborn Gate, London

For health and other professionals with responsibility or interest in carbon monoxide awareness and risk reduction, including: Local HPA – HPU & regional, CHaPD, Local authorities: Environmental Health, housing, and others involved with awareness-raising and prevention of carbon monoxide poisoning, Health and Safety Executive, Toxicology – clinical and poisons.

Aims:

- carbon monoxide surveillance, reporting and mortality in England
- methods used for biological and environmental monitoring of carbon monoxide (CO), their potential and limitations
- emergency and local response to CO incidents
- government, regulatory, health service and other programmes to prevent CO exposure and toxicity
- local-level Programmes to raise awareness of, minimise, or eliminate CO poisoning
- research initiatives to enhance information about clinical aspects of CO toxicity and/or effective interventions to prevent it
- how to identify local-level priorities for CO awareness-raising, prevention and research.

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

Training Days for 2009 to 2010

Operational Lead Workshop

October, Holborn Gate, London

For local authority, HPA/U, NHS staff, and others involved with management/prevention lead cases.

This day is aimed at local authority Environmental Health Practitioners, but will also be of interest to public health and health protection professionals.

The day will focus on the operational environmental public health response to cases of lead toxicity, including:

- roles and responsibilities of local authorities and environmental health, public health and health protection, and other partners
- lead 'action card' for Environmental Health Practitioners
- environmental investigation for lead
- biological sampling
- legislation for the investigation and management.

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

Odour Workshop

November, Holborn Gate, London

This course is designed for those working in public health, health protection or environmental health and who have an interest in odour related incidents (chronic and acute).

The day will focus on odour, its regulation, the management of odour related incidents and how odour can affect public health, including:

- roles and responsibilities of local authorities and environmental health, the Environment Agency, public health and health protection
- investigating and managing odour related incidents
- odour checklist
- environmental monitoring and modelling of odours
- public response to odours.

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

Training Programme for 2009 to 2010

Planned one week training courses include:

Essentials of Toxicology for Health Protection

1-5 June, King's College, London

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

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

The fee for this course will be around £600. A maximum of 30 places are available.

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

Please see below for booking details about this event.

Essentials of Environmental Science

5 day course, November, King's College London

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

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

The fee for this course will be around £600. A maximum of 30 places are available.

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

Please see below for booking details about this event.

Training Programme for 2009 to 2010

Introduction to Environmental Epidemiology

5 day course, February 2010, London School of Hygiene and Tropical Medicine

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

The aims of this short course are 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. The course will also show how to explore study design and the practical consequences of choices made when planning and undertaking an environmental epidemiological study. This will include an appreciation of the influence of finance, politics and time constraints on the choice of study, to review the advantages and difficulties of multi-disciplinary and multi-agency working in environmental epidemiology, and to use strategies for communicating risks concerning investigation of environmental hazards.

The fee for this course will be around £600. A maximum of 30 places are available.

Please see below for booking details about this event.

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

Booking Information

Those attending CHAPD (L) courses will receive a Certificate of Attendance.

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

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

Events organised by other HPA centres

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

Upcoming conferences and meetings of interest

International Society for Environmental Epidemiology, August 2009

The 21st annual conference of the International Society for Environmental Epidemiology (ISEE) will take place in Dublin from Tuesday August 25th to Saturday August 29th 2009. This is a joint British-Irish conference.

The conference theme is 'Environment, Food and Global Health' and aims to provide an opportunity for the food and agriculture research community to come together with the environmental epidemiology community to explore the many different ways in which food production, food processing, and food distribution impact on human health.

The programme will also address the full spectrum of topics in environmental epidemiology, including:

- outdoor and indoor air pollution
- electromagnetic fields & Ionising radiation
- water pollution
- dioxins & heavy metals
- environmental equity
- ethics and methods in environmental epidemiology
- risk perception and communication.

One day of the meeting will be shared with the 2009 meeting of the Society for Environmental Geochemistry and Health.

For more information, see http://www.isee2009.ie/home/

Conference on Persistent Organic Pollutants, April 2009

The 3rd Network Conference on Persistent Organic Pollutants, hosted by the University of Birmingham, will be held on Wednesday 22nd and Thursday 23rd April 2009.

The programme will include aspects of:

- human exposure (trends, pathways, biomarkers, etc.)
- human health impacts
- measurement and modelling of environmental levels, fate and behaviour
- advances in the sampling and measurement of POPs
- ecotoxicology
- formation, sources, emission inventories, and release pathways
- regulatory aspects.

For more, see:
http://www.gees.bham.ac.uk/research/projects/nercpops/conference3.shtml

HEALTH Protection *2009*

Health Protection Agency

14-16 September | University of Warwick

Health Protection 2009 will showcase the latest scientific research and new developments in protecting against infectious diseases, environmental hazards and preparation for health emergencies. Over 1200 delegates are expected to attend, from public health services and hospitals, environmental health, emergency planning, laboratories and research institutions.

Call for abstracts

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

Topics in the conference and poster exhibition will include:

- Antimicrobial resistance and HCAI
- Assessing and valuing health risks
- Chemicals, poisons and radiation
- Emergency preparedness and response
- Epidemiology at the frontline
- Health protection in sustainable homes and communities
- Hepatitis, TB, gastrointestinal diseases, respiratory infections, pandemic flu
- Immunisation
- Protecting health of healthcare workers
- Public health microbiology
- Sexual health
- Translating science into novel interventions

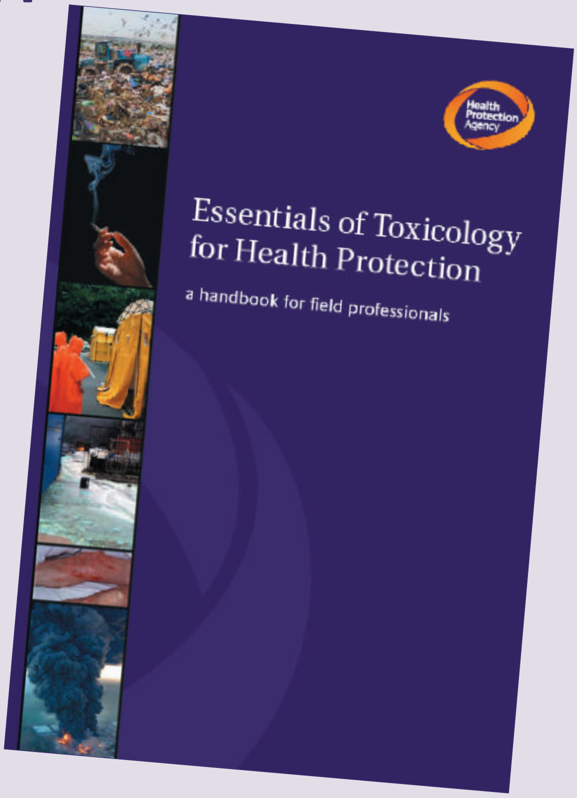
For further information on this leading multi-disciplinary health protection conference, abstract submission details and to book your place please visit:

www.healthprotectionconference.org.uk

Closing date for abstract submissions – 13 May 2009

Essentials of Toxicology for Health Protection

a handbook for field professionals



This is the first book aimed at a wide range of professionals in environmental public health, including:

- health protection consultants
- public health specialists and trainees
- public health practitioners
- environmental health practitioners
- environmental scientists
- staff of the emergency services
- the water and waste industries
- other industrial and regulatory bodies.

Section 1 - **Fundamentals of Toxicology**
provides a general introduction and explains how toxicological information is derived.

Section 2 - **Applications of Toxicology**
considers exposure assessment, susceptible populations, the medical management of chemical incidents, and sources of toxicological data.

Section 3 - **Environmental Toxicology**
considers pollutants in air, water, and land, food contaminants and additives, and exposures to toxic agents in the workplace.

Section 4 - **A Review of Some Toxic Agents**
discusses a selection of important toxic agents: carbon monoxide, pesticides, heavy metals and trace elements. It also considers traditional medicines and the deliberate release of toxic agents.

A chapter on basic medical concepts and a glossary are included as appendices for those readers who don't have a background in medicine, biology or the health sciences.

Now available from the Health Protection Agency

Price: £19.99

To order a copy, email kalpna.kotecha@hpa.org.uk

ISSN 1745 3763

Chemical Hazards and Poisons Division Hotline: 0844 892 0555

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