Health impact of the Buncefield oil depot fire, December 2005
Study of accident and emergency case records

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ABSTRACT

Background On Sunday 11th of December 2005, an explosion occurred at the Buncefield oil depot, Hertfordshire, resulting in a large fire that blazed for several days. Two Accident and Emergency (A&E) departments were placed on stand-by to receive casualties. A simple surveillance system was put in place during the acute phase of the incident, but this was not adequate to fully examine the health impact of the fire.

Methods Retrospective study of A&E records at Hemel Hempstead and Watford A&E departments for the period that the fire burnt.

Results Two hundred and forty-four people attended A&E as a result of the fire: 187 were members of the emergency services; 17 were oil depot workers; and 40 were members of the public. The most common presenting complaints were respiratory symptoms (n = 66) and injuries (n = 38). Twenty-five (21%) individuals were referred for medical follow-up. There were no fatalities.

Conclusion There was a significant impact on local health services, with many emergency service personnel attending A&E asymptomatically. Alternative health service provision for these individuals, possibly near to the scene of the incident, should be considered. This incident has also highlighted an urgent need to develop surveillance systems that enable real-time monitoring of the acute public health impact of major incidents.

Keywords emergency situations, public health, surveillance

Introduction

During the early hours of Sunday 11th of December 2005, an overflowing storage tank containing unleaded motor fuel exploded at the Buncefield oil depot near Hemel Hempstead, Hertfordshire, UK. The blast resulted in a large fire that engulfed over 20 storage tanks and blazed for several days.1 Exposure to combustion pollutants is known to have the potential to cause short- or long-term adverse health effects among those exposed.2–5 Two Accident and Emergency (A&E) departments nearest to the fire were placed on stand-by to receive casualties. A simple surveillance system was put in place during the acute phase of the fire to ascertain the aggregate numbers of individuals presenting for medical care due to the fire, but this was not fully adequate to examine the extent of the health impact. A survey of attendances to Watford and Hemel Hempstead A&E’s was therefore conducted in order to investigate the health impact resulting from the event on the locally exposed population, and to collect and analyse epidemiological data on attendees to the A&E department.

Methods

We carried out a retrospective descriptive study of attendances to Hemel Hempstead and Watford A&E departments. We reviewed all A&E case records (n = 714) for the period 06:00 Sunday 11th December to 18:00 Wednesday 14th December 2005, during which time the fire continued to burn. We identified all records that met the case definition: a clear statement indicating that the attendance was a result of the Buncefield oil depot fire. Information on exposure, date and time of A&E attendance, presenting complaint, past medical history, diagnosis and follow-up, was recorded on a standardized questionnaire. Data were entered onto an Access database and analysed using Excel.
Results

During the study period, 244 people sought medical care in the A&E departments of Hemel Hempstead and Watford as a result of exposure to the fire. Most people attended on the day of the explosion (185 out of 244; 76%) (Figure 1). Nearly 92% (170 out of 185) of attendances related to the fire on the day of the explosion were recorded in Hemel Hempstead, with the remainder of attendees related to the incident (8%) going to Watford A&E. Of all A&E attendances at Hemel Hempstead on Sunday 11th of December, 66% (179) were attributed to the fire.

The attendees fell into three groups: workers at the depot at the time of the explosion; members of the public; and emergency services deployed at the scene—mainly police officers and fire fighters attending the incident (Table 1). Emergency service workers were initially advised by their senior colleagues to attend A&E for a medical check-up, due to concerns about the potential adverse health effects related to exposure to the smoke. A total of 187 emergency workers attended A&E in Hemel Hempstead or Watford, of whom only 34% presented with symptoms attributed to the incident.

There were 120 people who presented with symptoms attributed to the fire. The main symptoms are presented in Table 2, some individuals reported more than one complaint. Of the 120 symptomatic attendees, 63 were members of the emergency services, 17 were workers at the oil depot and 40 were members of the public.

The most common symptom was respiratory irritation such as exacerbation of asthma ($n = 3$), shortness of breath ($n = 14$), sore throat ($n = 32$) and cough ($n = 15$). The second most common presentation was injuries, ($32\%$), mainly lacerations, sprains and one person with a fracture. Headache ($16\%$) and anxiety ($12\%$) were also common presentations. The proportion of attendees diagnosed with anxiety in this study ($12\%$) is similar to the percentage of nearby residents with psychological distress identified through a survey of 4920 residents surrounding the oil depot that identified a prevalence of psychological distress of 9%.

Figure 2 presents the proportion of symptoms within each group attending A&E. The proportions do not add up to 100% as some attendees presented with more than one complaint.

The highest percentage of injuries and anxiety were reported in workers at the oil depot. Members of the public also suffered from a relatively high proportion of injuries, anxiety and respiratory complaints, which may be a direct result of exposure to the impact of the explosion.

In comparison, headache and respiratory complaints were the most common symptoms seen in emergency workers,

<table>
<thead>
<tr>
<th>Table 1 Main presenting complaints of attendees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of attendees</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Respiratory</td>
</tr>
<tr>
<td>Headache</td>
</tr>
<tr>
<td>Injuries</td>
</tr>
<tr>
<td>Anxiety</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

Fig. 1 Distribution of A&E attendances by date and time ($n = 244$).
which may be a result of ongoing exposure to the thick smoke and wearing personal protective equipment (PPE).

Oil depot workers with a history of mental health problems were four times more likely to present with anxiety than those with no past medical history. However, interestingly, there was no association between previous mental health problems and attendance at A&E in members of the public.

Of the 11 members of the public who presented with respiratory symptoms, seven had a medical history of respiratory illness. One of two people who presented with angina had a previous history of cardiac complaints.

Of those who presented to A&E symptomatically, 25 (25 out of 120; 21%) were referred for further medical follow-up. Fifteen were referred to their GP, three were referred to an orthopaedic surgeon, one to a cardiologist and three more were required to make a follow-up appointment at A&E. People with a previous cardiac or respiratory medical history were six times more likely to require follow-up, (OR: 6.19, CI 95%: 2.6–14.5), although 84% of the referrals were unrelated to previous medical complaint, but a direct result of the incident and injury related. Three members of the public were admitted to hospital, two went to plastic surgery for severe lacerations and one person required oxygen therapy. There were no fatalities.

### Table 2

**Distribution of symptomatic and asymptomatic cases among attendances of the Hemel Hempstead and Watford A&E, between 11 December 2005 and 14 December 2005**

<table>
<thead>
<tr>
<th>Case Type</th>
<th>Symptomatic n, (%)</th>
<th>Asymptomatic n, (%)</th>
<th>Total n, (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Services</td>
<td>63 (34%)</td>
<td>124 (66%)</td>
<td>187 (77%)</td>
</tr>
<tr>
<td>Worker</td>
<td>16 (94%)</td>
<td>1 (6%)</td>
<td>17 (7%)</td>
</tr>
<tr>
<td>Public*</td>
<td>38 (95%)</td>
<td>0 (0%)</td>
<td>40 (16%)</td>
</tr>
<tr>
<td><strong>Total Number:</strong></td>
<td>117 (48%)</td>
<td>127 (52%)</td>
<td>244 (100%)</td>
</tr>
</tbody>
</table>

*Insufficient data were available for two members of the public.*

### Discussion and recommendations

#### Main finding of this study

**Service impact**

The incident had a significant impact on the workload of the Hemel Hempstead and Watford A&E departments. The majority of individuals seen at the departments were emergency service personnel, of whom most were asymptomatic. Future consideration by occupational health services should include the provision of an occupational triage post for emergency personnel near to the scene of the incident. This would deal with immediate concerns such as treatment of minor cuts and sprains, reassurance regarding respiratory symptoms, and general health and occupational health advice.

The Buncefield Fire Occupational Health Working Group undertook a survey to measure the health impact among individuals deployed to control the fire and its aftermath. A postal questionnaire was completed by 815 individuals deployed to the site. Only 26 individuals reported to have attended A&E, mostly on the basis of managerial advice ($n = 23$ out of 26). The difference in the number of A&E attendees found between the two studies is likely to be due to the relatively low response rate (44%) to the occupational health questionnaire.

#### Health impact

Despite the extensive fire and thick smoke, the acute public health impact as indicated by A&E attendances was relatively small. This may be due to the time of explosion; 06:00 on a Sunday morning, and the high combustion temperature of this fire which reduced most hazardous chemicals to carbon and water. The favourable local wind and weather conditions reduced the fire’s potential health impact further by allowing the smoke to rise to the higher levels of the atmosphere.

The main health impacts following the fire were respiratory symptoms and injuries, followed by headache and anxiety. Injuries were mainly seen in oil depot workers.
Further consideration should be given to the adequacy of training of on-site personnel with regard to the potential hazards to be found due to an incident such as Buncefield, and to the provision of an occupational triage post near to the scene of the incident, as discussed above.

The highest proportion of attendances due to anxiety was among oil depot workers, but the numbers are small. Presentation was more common in those oil workers with a past medical history of mental health problems, whereas this association was not found in members of the public. It is not clear from this study how to interpret these findings, and further studies of on-site workers after a major incident should be carried out to explore the reasons for the measured adverse psychological impact. This may identify training issues for personnel, or may indicate that a triage service, such as recommended above, could have alleviated immediate anxiety and prevented A&E attendance.

The main symptoms displayed by emergency service personnel were headache and respiratory complaints. Emergency services were working in very challenging conditions: wearing full PPE and subjected to very high temperatures and thick smoke. Further consideration needs to be given to the health and safety of emergency service personnel with comprehensive advice about how to wear PPE effectively, and by making sure adequate personnel are deployed to the scene to allow appropriate shift length and to ensure that individuals do not become tired and dehydrated.

Surveillance
Hemel Hempstead and Watford A&E departments did not feel it was necessary to invoke their major incident plans during the acute phase of this incident since, although capacity was stretched, it was not felt that the departments were being overwhelmed.

Many A&E departments will employ the use of special ‘incident’ A&E records during a major incident in order to readily identify individuals associated with the incident. As this did not happen, it was difficult to identify individuals presenting as a result of the incident, although a system was set up for the A&Es to report aggregate numbers seen due to the fire from the outset. This information was clearly important as part of the acute response, but did not give any detailed information on the individuals presenting to the A&E departments such as presenting complaint.

This incident highlights the need for the Department of Health, in collaboration with the Health Protection Agency, to develop user-friendly surveillance systems for A&E departments to provide public health teams and emergency planners with rapid information on the main presenting complaints, and most common diagnoses made in those who seek medical attention in the acute phase of an incident. A pattern in presentation of certain symptoms would enable emergency responders to rapidly assess whether harmful chemicals were released during a major incident, such as in a chemical fire or a bombing. This will allow public health teams to provide more timely and accurate health advice, and to better target at-risk groups. Timely information in the acute phase of an incident, especially an incident of high public profile, is essential to limit the numbers of people seeking medical advice inappropriately. In addition, timely information will reduce stress levels in the population due to uncertainty caused by the incident, which will aid recovery work.

What is already known on this topic
Exposure to combustion pollutants is known to have the potential to cause short- or long-term adverse health effects among those exposed. Major environmental incidents can have a considerable impact on the capacity of A&E departments.

What this study adds
Despite this being the largest fire in Europe since World War II, the health impacts were comparably small. The main burden on the A&E health services was due to emergency personnel, the majority of which were asymptomatic. There is a need to develop a separate triage point for the monitoring of the health of occupational emergency workers during major incidents. A triage point can provide health advice and deal with anxiety, minor cuts and bruises and only refer the more seriously ill for treatment to the local A&E departments. It is advisable that during future incidents, emergency services liaise with local A&E departments to discuss local capacity, prior to referring emergency service workers to local A&E departments. Such an approach would prevent the influx of large numbers of emergency workers to local A&E departments and exhaust their capacity, thus limiting the response capacity for members of the public.

A limited system was in place at the A&E departments in the acute phase of the incident to monitor the acute public health impact of the fire on the general public. Investment is needed to develop surveillance systems that enable real-time monitoring of the health impact during a major incident. Guidelines for a minimum data set should be established to determine the information to be collected by surveillance systems in major incidents, to advise emergency planners, enable A&E departments to help manage major incidents and to provide timely information on the public health impact of a major incident.
Limitations of this study

Two hospital A&E departments were put on ‘stand-by’ during the incident as these were closest to the scene of the fire. Our study only identified cases attending these two A&E departments. People may have sought medical help from primary care services or from A&E departments further afield, although there is no evidence for this. It is also possible that some people presented to A&E with symptoms resulting from exposure to the fire, and that no record of this was made in their case notes. Therefore it is possible that the number of attendees to the A&E resulting from the Buncefield oil depot fire, as found in this study, is an underestimation of the true number of consultations resulting from the fire.

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Conflict of interest

The authors have no direct conflicts of interest.

References