Health Protection in the 21st Century

Understanding the Burden of Disease; preparing for the future.
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This is an important report. It is the first step in a long-term project to assess and quantify the burden of disease from infections to environmental hazards. This report builds on information collected from a wide variety of sources, thus as we collect and verify more data, we will be able to strengthen the evidence base on the overall burden, and its component parts.

As the report points out, many had come to believe that at the beginning of the 21st Century the majority of public health protection problems had been overcome. While this may be true of some of the infectious diseases, such as diphtheria and polio, which were previously the cause of high mortality amongst children, new problems have emerged. There is also a picture of continuing inequality, which impacts on both the lifespan and quality of life of various sections of the population, including children. We must therefore not be complacent, but must identify the sources of those inequalities, and help form strategies to remove them.

I hope that you will find this first Burden of Disease report interesting and that it stimulates debate. As mentioned above, it is very much “work in progress”, and represents the findings of our work to date, but I believe that it provides a very useful starting point on which to look at the overall burden of disease from infections and environmental hazards, in this country.

PROFESSOR PAT TROOP
CHIEF EXECUTIVE
1. Introduction

During the 20th Century there were major improvements in the control of infections, safety from radiation sources and reduced pollution. Consequently, health protection is not always considered a big issue. However, the world has changed and the 21st Century has seen the emergence of new problems, including environmental hazards such as pollution from transport, an increased number of chemicals in everyday use, global warming, disposal of waste at landfill sites and building on contaminated land, together with the emergence of new infections such as SARS and avian flu.

This report represents a first step in identifying and quantifying wherever possible the burden of disease for both of these new threats and those areas of health protection which remain a concern, such as respiratory disease, poisons and injuries.

It is increasingly recognised that many diseases are caused or affected by a number of factors, for example asthma has been linked to infections, allergies, both indoor and outdoor pollution, household moulds etc. Thus it is difficult to look at quantifying the impact that each of these factors has on the burden of disease and ways of reducing these types of disease without taking all factors into consideration.

This report has drawn on a wide variety of information to give an overview of the burden of disease before addressing the specific topics of infectious disease, those non-infectious diseases associated with radiation, chemical incidents, poisons and environmental pollution, as well as other areas of concern such as injuries and asthma. Two cross-cutting themes have also been included: children and inequalities. It is recognised that though considerable data and information is included, this report is not fully comprehensive and there are areas which still need to be addressed.

It is intended that this should provide a useful framework to help underpin the strategies of other organisations involved with health outcomes and to raise awareness. The report is for discussion and information and is not definitive but is the first step in what will be a continuing process in collaboration with the many stakeholders and partners of the Health Protection Agency (HPA). This summary report is supported by a number of more detailed papers which are available on request or through the HPA website.

The HPA will use the findings from this report as the focus of discussions with partner and stakeholder organisations to identify priorities for the future and how these should be addressed. Many of these have the responsibility to deliver against some of the areas of concern identified within the report and to tackle the broader public health issues. Therefore it is important that the HPA interacts and works with partners and stakeholders, particularly at a local level.

The Health Protection Agency (HPA) is an independent body which protects the health and well-being of the population. Health protection includes preventing and controlling infectious diseases; reducing the adverse effects of chemical, microbiological and radiological hazards; and preparing for potential or emerging threats.

This report will help identify current and future health protection priorities; inform the future direction of the HPA and provide an evidence base to support future funding, resources and research and development.
2 Key Messages
Despite improvements in health, the evidence here shows that there is still a considerable burden of disease (BoD) from infections and environmental hazards. This is not reflected in the mortality data as health protection issues are increasingly focused on primary care, the community and long-term chronic illness. The cost of this long-term chronic illness is largely unknown and difficult to quantify as it includes the cost to society and individuals, lost work and leisure time, social care costs and quality of life. This is particularly the case for non-infectious diseases as these are often the cause of long term morbidity/chronic disease, are slow to develop and have multiple factors involved.

There is very little data identifying and quantifying the links between environmental hazards and ill health, particularly regarding their cumulative effect and long-term impact. This includes the difficulties of identifying the cause/association behind illnesses such as cancers which may have links to exposure to environmental hazards encountered at an earlier age.

There is still a considerable amount of work to be undertaken to identify the real burden of disease. Traditionally this has been done by looking at specific diseases, however, it is now recognised that as there are so many interactions, multi-factorial and cumulative effects, that a different approach needs to be taken. This could involve looking at settings, such as houses or schools or vulnerable groups such as children or those living in poverty.

This report has identified children’s health and health inequalities as priority areas and as such there are chapters specifically addressing these.

2.1 Key Messages from each chapter

2.1.1 Putting the Burden of Disease (BoD) of health protection into context

In order to understand the BoD relating to health protection issues, this needs to be put into context. This chapter gives a broad overview of the BoD before the more specific areas of the HPA’s remit are considered in greater detail. The key messages reflect the topics in the rest of the report.

- The years of life lost data identifies the health protection areas which impact the young and are preventable: land transport accidents, accidental poisoning, malignant melanomas and asthma.
- Those aged over 65 are involved in more than three quarters of hospital Finished Consultant Episodes; those aged under four are the next most significant age group.

A number of areas for future work have been identified, including research and opportunities for future collaborative projects. Many of these are included in each chapter. One of the key findings has been the identification of the lack of good quality robust evidence, data, information and analysis in the non-infectious disease areas of chemicals, radiation, poisons and environmental hazards; little is known in terms of the burden of disease in these non-infectious health protection areas.
• Annually there are approximately 320 million GP consultations in England and Wales, of these approximately one third are for the under 14s.

• The burden of long term chronic disease is difficult to quantify, this is particularly important for non-infectious diseases as these are often the cause of long term morbidity / chronic disease.

• Trends for morbidity in the community show that both men and women are reporting increased bad or very bad health and longstanding illness or acute sickness; women are reporting more acute sickness than men.

2.1.2 Infections
• The estimated annual cost of treating infectious disease in England is approximately £6 billion:
  - Primary care (GPs) bear the highest burden of costs at £3.5 billion.
  - Hospital admissions costs are around £900 million.
• Around 50% of children’s GP consultations are for infectious diseases.
• The four areas of infectious disease which have the highest cost and prevalence are:
  - Respiratory infections such as colds and 'flu, with approximately 5.5 million GP visits annually, costing £170 million.
  - Infectious Intestinal Disease (IID) such as food poisoning, with 20% of the population annually suffering from an IID (only 3% of these consult their GP).
  - Healthcare Associated Infection (HCAI), these are infections resulting from healthcare interventions, and include MRSA: most costs are associated with an increase in hospital stay, in itself a risk factor.
  - HIV / AIDS: costs £400m pa, largely as ongoing care and treatment but also including spend on prevention.

2.1.3 Radiation
• Radon is a cause of lung cancer and there is an interaction with the lung cancer risk from smoking. Raised levels of radon in the home are linked with lung cancer risks.
• Medical sources form a sizeable part of the ionising radiation exposure of the UK population. This is likely to rise due to the increasing use of CT scans and interventional radiology.
• Exposure to ultraviolet radiation (UVR) causes skin cancers. It is estimated that over 100,000 new skin cancers are diagnosed every year in the UK, including around 7,000 new cases of malignant melanoma, the main cause of skin cancer deaths.
• Public concern about non-ionising radiation is focused on involuntary exposures from power lines, mobile phone base stations and voluntary exposures to mobile phones.
• Natural radiation makes up the majority, 84%, of the annual dose from ionising radiation to the UK population.

2.1.4 Environmental Pollution
• The extent to which environmental pollutants contribute to common diseases is not accurately resolved. However, global estimates conservatively attribute about 8-9% of the total burden of disease to pollution.
• It is difficult to determine the extent of environmentally related disease as current estimates are generally based on very uncertain data and on limited datasets.
• The limited amount of evidence available on the long-term effect of air pollution on children’s lung development seems to indicate that the burden attributable to air pollution may be considerable. Up to 57 children per 1,000 in England and Wales may have long-term lung function affected by air pollution.
In England and Wales 20% of children have asthma and an estimated 30% of acute exacerbations of childhood asthma are related to outdoor air pollution. From the data available it is estimated that 36 children and 30 adults per 1,000 population may have asthma that can be attributable to chemical environmental factors.

There is some evidence of an association between daily concentrations of particles and hospital admissions for treatment of cardiovascular disease. A 1 μg/m³ drop in annual mean PM$_{2.5}$ particles throughout the lifetime of individuals in England and Wales may reduce mortality rate from cardio-vascular disease by 0.1%.

Though far from proven, there are concerns regarding a possible health link to chemical exposure from landfill sites.

2.1.5 Environmental Inequalities

There is increasing evidence that environmental injustice is a real and substantive problem within the UK although the causes, effects and distribution are varied and complex and require further analysis.

A clean and healthy environment is a vital component of public health. Our environment is much healthier than in previous generations and continues to improve.

Environmental quality varies between different regions and communities and there is an inequitable distribution of environmental hazards among children of different social groups and different regions of England and Wales.

2.1.6 Chemical Incidents

Catastrophic chemical releases are rare but there is a burden of low level incidents, with approximately 1,200 reported per annum, which potentially have a significant impact on morbidity.

Large scale industrial processes subject to the Control of Major Accidents and Hazards Regulations (COMAH) are involved in only 1% of reported chemical incidents, suggesting that the specific controls placed upon these sites are effective risk management measures.

During a period of five years it is estimated that 50,000 people have been exposed to chemicals as a result of reported incidents, of which approximately 20% experienced symptoms post exposure.

2.1.7 Poisons

In 2002, around 6,600 deaths were attributable to poisonings or exposures to noxious chemicals (11 per 100,000 population) in the UK.

The cost of poisoning to the NHS in hospital bed days alone is approximately £110 million, excluding the cost of emergency department attendances.

Enquiries to the National Poisons Information Service (NPIS) relating to childhood poisonings mainly concern household products, chemicals and pesticides.

The majority of deaths in the UK from poisoning occur outside of hospital.
2.1.8 Injuries

- Over 17,000 deaths per year are a direct result of injuries, accounting for 3% of all deaths in the UK.
- Annually, injuries lead to 720,000 hospital admissions and 6 million emergency department visits in the UK.
- In adults, injury deaths and hospital admissions are most likely to affect young men (15-44 years), for whom road traffic incidents, self harm and assaults are the main causes.
- Falls and road traffic accidents are the main causes of injuries, both in terms of death and disability burden.
- Falls are a common injury in the young; in the under two year olds falls in the home are the most common injury, whilst falls during sports, exercise and play are more common in older children. Those over 55 are also at particular risk from falls with the outcome more likely to be poorer; substantial disability or death.
- Deprivation based inequalities are larger for injuries than for many other diseases. There are signs that the inequalities gap is widening.
- The most deprived children are more likely to be injured or killed in pedestrian incidents than the most affluent.
- Injuries place a substantial burden on the NHS; the treatment of unintentional injuries costs the NHS about £2 billion a year. Many injuries also have long term effects requiring on-going health care.
- Approximately 5% of health service expenditure is on the treatment of injuries.

2.2 Cross Cutting Areas

2.2.1 Children’s Health

- 1.5 billion Finished Consultant Episodes (FCEs) are attributed to children aged 0-14.
- Approximately one third of all GP consultations are for those aged under 15.
- There is limited data on the impact of environmental hazards on children’s health, data include:
  - Asthma: an estimated 30% of childhood asthma is related to air pollution.
  - Poisons: as many as one quarter of all telephone enquiries to the National Poisons Information Service (NPIS) are in relation to young children and infants.
  - Injuries: it is estimated that 2 million children are taken to hospital after accidents every year.
- Inequalities: children in manual households are more likely to consult GPs than non-manual, especially in the 0-4 age group.

2.2.2 Health Inequalities

- Health inequalities continue to be a major problem and it is difficult to measure changes in these.
- Gastrointestinal infection leading to hospital admission was 2.4 times higher in the poorest fifth of the population than in the most affluent quintile.
- There is a strong, and for some regions a significant, relationship between childhood deprivation and increasing proximity to large industrial processes in England.
- There are gaps in the currently available data, in particular on the impact of environmental hazards.
- It is difficult to evaluate the burden of disease for this area as it is a very complex, often with many factors involved and a long-term impact on health.
3 Putting the Burden of Disease into Context
KEY MESSAGES

• The years of life lost data identify the health protection areas which impact the young and are preventable: land transport accidents, accidental poisoning, malignant melanomas and asthma.

• Those aged 65 and over account for more than three quarters of hospital Finished Consultant Episodes (FCEs); those aged under four are the next most significant age group.

• Annually there are approximately 320 million GP consultations in England and Wales, of these approximately one third are for those aged under 14.

• The burden of long term chronic disease is difficult to quantify. This is particularly important for non-infectious diseases as these are often the cause of long term morbidity / chronic disease.

• Trends for morbidity in the community show that both men and women are reporting increased bad or very bad health and longstanding illness or acute sickness; women report more acute sickness than men.

3.0 Introduction

In order to understand the burden of disease (BoD) relating to health protection issues, this needs to be put into a broader context. This chapter gives an overview of the BoD before the more specific areas of the HPA’s remit: infectious diseases, radiation, environmental hazards, environmental inequalities, chemical incidents, poisons and injuries are considered in more detail in the following chapters.

Data on mortality and morbidity in the health service have been collated, largely from the Department of Health website and the Office of National Statistics. Data on the burden of disease in the community and chronic ill health are included, however this is largely qualitative.

The HPA has assessed the burden of disease by looking at:
• The cost to the health system (economic), e.g. treatment costs; hospital admissions; outbreak control costs; etc
• The cost to health in terms of:
  - Mortality, including years of life lost.
  - Morbidity - GP data.

Taking This Forward

• Look at improving data gathering from primary care sources.

• Improve data on the cost of disease on the community and society.

• Concentrate on those areas which impact the young and may be preventable, such as injuries, poisonings, asthma, skin cancer etc.
3.1 Mortality

Mortality data highlight the fact that the majority of the population are living longer, healthier lives, with 85% living to over 65 years old and nearly 50% to over 80. However, while life expectancy continues to increase as living conditions and healthcare improves, one of the impacts is the increasing gap between life expectancy and healthy life expectancy. In 2001 it was estimated that in Great Britain this gap was between two and five years.

In England and Wales there were approximately 534,000 deaths in 2002, equating to 10.2 / 100,000 population. The percentage of deaths by general International Classification of Diseases (ICD) categories are shown in Figure 3.1. This identifies the directly attributable cause of death and does not include any underlying causes i.e. someone may be identified as dying from a respiratory infection, but there may be an underlying cause, especially in the elderly or vulnerable, such as cancer or heart disease, which makes them more susceptible to infections.
Figure 3.1 highlights how significant the three main causes of mortality are within England and Wales: circulatory disease, cancers and respiratory disease. During the 20th Century these three, together with infectious disease, were the major causes of death; however all except cancer have shown a general downward trend. This is most apparent when looking at infectious diseases; in 1911 these caused 20% of deaths compared to the 1% directly attributable now (i.e. not including deaths where infections are an underlying cause). Those classified as respiratory deaths will include infections such as influenza and pneumonia, which are still a major health protection priority.

A major cause of the dramatic improvement in health over the last 150 years has been the improvement in nutrition, housing quality, reduced overcrowding, waste disposal and other environmental factors together with the use of antibiotics and the introduction of vaccination campaigns; these have particularly contributed to improvements on the burden of infectious diseases.

The mortality rate for the three main causes of mortality, as well as those of interest to this report, is illustrated by age and sex in Figure 3.2. These data demonstrate how the three main causes significantly affect the over 65 year olds. For young people aged 15 to 29, mortality rates were highest for injury and poisoning (41 per 100,000 population for men and 10 per 100,000 for women). In adults aged 30 to 44, the major cause of death for men was injury and poisoning (45 per 100,000 population) and for women, cancers (32 per 100,000 population). For those aged 45 to 64, cancers were the leading cause of death among both men and women, and for those aged over 65 circulatory diseases were the leading cause.
Figure 3.2 2002 Mortality rates in England and Wales
Mortality rates are important but prioritising the reduction of the BoD needs to consider years of life lost. This approach highlights those deaths which occur at a young age. When these data are compared with the percentage of deaths the top two areas (heart and cardiovascular diseases) are consistent in reflecting the number of deaths resultant from these causes. However, land transport accidents, accidental poisoning, malignant melanomas of the skin and asthma which occur in younger age groups have a high impact on years of life lost. As these incidents impact on the young, are preventable and affect society through loss of working life years they should be a focus for future work.

Figure 3.3 also highlights that more men die younger than women, with the total years of life lost to total life to age 85 being 3,193 for men and 2,177 for women in 2002.®
3.2 Morbidity

Morbidity data should provide information on prevalence, severity and age distribution of a disease. Data are not always available for all these criteria but some can be collected from a number of sources such as hospital episode data and General Practice (GP) databases such as the Morbidity Statistics from General Practice. In particular, data and information around morbidity in the community and chronic long-term ill health are difficult to obtain; some data are available from the General Household Survey and the Health Survey for England.

3.2.1 Hospital Episodes Statistics (HES) 6

For the year 2003/04, HES collected more than 13 million records detailing episodes of admitted patient treatment delivered by NHS hospitals in England. These data include Finished Consultant Episodes (FCEs), admissions, bed days, age etc. From this the mean age at treatment was 49, there were over 59 million bed days and 11.7 million admissions of which more than 4 million were emergency. However, these data do not include diseases such as Healthcare Associated Infections, and Sexually Transmitted Infections including HIV which are treated as outpatients.

A Finished Consultant Episode (FCE) is a single treatment episode dealt with by one consultant in the NHS and is independent of the number of days the patient stays in hospital.

The data shown in Figure 3.4 highlights that those aged 65 and over account for more than three quarters of total FCEs. Those aged four and under are the next most significant age group; however this group does include babies born in hospital (approximately 9% of FCEs in this age group).

Figure 3.4 Finished Consultant Episodes by age group per 100,000 population, HES data 2003/04
Figures 3.5 and 3.6 show statistics for FCEs and bed days (excluding day cases), indicating that morbidity data follows the same trend as mortality data with the same three key causes reporting the highest incidences: heart disease, respiratory disease and cancers. Included in these figures are those conditions which are looked at in more detail in the following chapters.

**Figure 3.5** Hospital Episode Statistics for England 2003/04, Finished Consultant Episodes

**Figure 3.6** Hospital Episode Statistics for England 2003/04, Hospital Bed Days
3.2.2 **General Practitioner data (GP)**

Primary care (GPs) bears a significant burden of disease within England and Wales, with approximately 320 billion consultations per annum. There are differences in consultation rates between males and females; in 2003/04 females had an average of five GP consultations per year whereas males had three. In a survey 7 13% of adults and children had seen a GP in the 14 days prior to interview. The rate of consultation also increases with age, with data from the same survey reporting that 12% of adults aged 16-44 had consulted a GP in the 14 day period compared to 20% aged 75 or over.

Data from the General Practitioner Weekly Returns database 8 looking at annual consultation rates per 100,000 population in England and Wales by International Classification of Diseases (ICD) chapter for 2003 are shown in Figure 3.7.

The costs of these have been estimated by taking the figure of an average GP visit of £20 plus an average prescription cost of £18 9. A very rough estimate of the total cost of GP consultations is in the order of £10 billion (Table 3.1).

![Figure 3.7](image-url) **Annual GP consultation rates per 100,000 by ICD Chapter for males and females, 2003**

![Table 3.1](table-url) **Rough estimates of GP consultation cost by ICD chapter**
Figure 3.8 shows the top 20 traditionally reported diseases by number of consultations per 100,000 of the population. This shows the burden that infectious disease has on the GP, as the top four consultations are largely due to infections, and eight out of the 20 are infectious diseases. Respiratory infections are the biggest burden, accounting for four of the top five.

Figure 3.9 shows GP non-infectious consultation data. This highlights the number of GP consultations for non-infectious diseases and can be compared to those which are infectious, which are the majority (see Figure 3.8).

The breakdown of GP consultations in age groups for selected diseases highlights that for most of these diseases the number of consultations for under 14 year olds is much higher than that for other age groups, Figure 3.10.
Figure 3.9: Non-infectious GP consultations per 100,000 population

- Disease of the musculoskeletal system & connective tissue
- Nervous system and sense organs
- Diseases of the circulatory system
- Disease of the skin and subcutaneous tissue
- Symptoms, signs and ill-defined condition
- Injuries
- Disease of the genitourinary system
- Disease of the respiratory system
- Mental disorders
- Disease of the digestive system
- Poisons and radiation
- Endocrine, nutritional, metabolic diseases & immunity disorders
- Neoplasms
- Diseases of the blood and blood forming organs
- Complication of pregnancy, childbirth and the puerperium
- Congenital anomalies
- Complications and medical care
- Certain conditions originating in the perinatal period

Figure 3.10: GP consultations per 100,000 population by age group, 2003
3.2.3 Morbidity in the Community and Chronic Ill Health

There is little information on the costs of morbidity in the community and chronic ill health as this needs to include the cost to society and individuals, lost work and leisure time, social care costs for those with long-term disabilities and quality of life, all of which are difficult to quantify.

In order to assess some of these areas the General Household Survey\(^7\) and the Health Survey for England (HSE)\(^1\) include some qualitative assessments.

### Table 3.iii Trends in health status for men and women, HSE, 2003\(^1\)

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
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<tbody>
<tr>
<td>Prevalence of very good and good general health</td>
<td>77%</td>
<td>74%</td>
</tr>
<tr>
<td>Prevalence of bad or very bad general health</td>
<td>5%</td>
<td>7%</td>
</tr>
<tr>
<td>Reporting longstanding illness</td>
<td>40%</td>
<td>47%</td>
</tr>
<tr>
<td>Reporting acute sickness</td>
<td>12%</td>
<td>15%</td>
</tr>
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</table>

Trends for both men and women are towards increased bad or very bad health, longstanding illness or acute sickness, with women reporting more acute sickness than men. This needs to be put into context: that the health of the population in England and Wales is improving however expectations are higher and people are less tolerant of minor illnesses.

When children and young people were asked about long term illness (Figure 3.11), males of both age groups generally report more longstanding illness than females, except for the 16-24 year age group with skin and digestive problems. The largest reported longstanding illness across all groups was respiratory illness; this is most likely reflecting the increase in prevalence of asthma (see Chapter 6 Environmental Pollution).

There are also inequalities across social classes seen when analysing the incidence of illness, with those from social classes I and II more likely to report very good or good health; this then decreases across the social groups (Figure 3.12).
### Figure 3.11  Types of longstanding illness (rate per 1000)

- Respiratory
- Skin
- Musculoskeletal
- Mental
- Digestive
- Infectious Disease

<table>
<thead>
<tr>
<th>Type</th>
<th>M 0-15 yrs</th>
<th>M 16-24 yrs</th>
<th>F 0-15 yrs</th>
<th>F 16-24 yrs</th>
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<tbody>
<tr>
<td>Rate per 1000</td>
<td>120</td>
<td>110</td>
<td>100</td>
<td>90</td>
</tr>
</tbody>
</table>

### Figure 3.12  Percentage children, between 2-15 reporting 'very good / good' general health

- Social Class I - most affluent
- Social Class V - most deprived

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</thead>
<tbody>
<tr>
<td>I &amp; II</td>
<td>95</td>
<td>94</td>
<td>96</td>
<td>95</td>
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<td>III M</td>
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<td>III M</td>
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<td>90</td>
</tr>
<tr>
<td>IV &amp; V</td>
<td>88</td>
<td>87</td>
<td>89</td>
<td>88</td>
</tr>
</tbody>
</table>
4 Infectious Disease
4 Infectious Disease

4.0 Introduction

The reduction of infectious diseases, through a number of initiatives such as improved hygiene, vaccination programmes and antibiotics, has been one of the success stories of the 20th Century. However, it is still a major problem and costs England approximately £6 billion per annum for treatment, accounting for 10% of the NHS budget of approximately £68 billion (2003/4). The recent emergence and re-emergence of infections such as SARS, HIV and TB continues to highlight the importance of continued awareness and investment in the reduction of infectious diseases.

Before immunisation programmes began, measles claimed approximately 1000 lives in the UK each year. Measles can also cause serious brain damage (20-40% of survivors of brain infection have residual neurological problems), lung infections, deafness and other complications. However, due to the Measles Vaccination Programme, deaths from measles have been mercifully rare in recent years.

Taking This Forward

• Obtain more detailed data on primary care and Healthcare Associated Infections (HCAI), respiratory infections and gastrointestinal disease.

• Undertake epidemiological studies to determine the burden of diseases that have both infectious and non-infectious causes.

• Collect more up-to-date data on the burden of diseases by socio-economic strata.

• Assess costs to patients and the wider society, including quality of life data.

• Improve data on the burden of Sexually Transmitted Infections (STIs).

• Analyse other infections in the same detail that the burden of disease from respiratory infections has been analysed.
The focus in this chapter is on the health and economic burden of infectious diseases to the health service, with only those consultations and hospital admissions directly attributed to infectious diseases or as a result of infection being considered. The four major cancers that may have an infectious origin (liver, stomach, cervical and malignancy of the outer female genitalia) have also been incorporated in the estimated overall burden. These data are underestimated as conditions that may have both an infectious and non-infectious cause are ignored.

Many infections never reach the attention of formal health care services. For example, in one year, one in five individuals will suffer from an infectious intestinal disease, of which only 3% will consult a General Practitioner (GP). This results in a significant burden of lost work and leisure time both in society and on individuals.

4.1 Estimated overall burden of infectious disease

Approximately 10% of all deaths in the UK are attributed to infectious diseases using underlying cause (see page 3.4 for explanation). Respiratory infections account for by far the greatest proportion (61%) of these deaths, amounting on average to some 35,167 deaths per year, mostly (95%) affecting the elderly.

An estimate of the annual cost to the NHS of treating infectious diseases (through GP consultations and hospital admissions) in England is shown in Figure 4.1. The cost to the health service is in the region of £4.4 billion per annum. This increases to around £6 billion when the two major areas of HIV/AIDS and Hospital Acquired Infection treatment (i.e. those infections resulting from a hospital setting only) are included. Data suggest that the burden of infectious diseases largely falls on primary care, with at least 35% of the 256 million GP consultations in England annually being infectious in origin.

Within hospitals roughly 4% of admissions and 5% of bed days are attributable to infectious diseases. The net cost of admissions with a primary diagnosis that is a direct result of infection is approximately £900 million per annum. Although considerable, this is less than the estimated cost of healthcare associated infection (i.e. admissions for other causes which subsequently become infected; this includes gastro-intestinal infections).
Table 4.i The estimated proportion and annual cost to the NHS, by age and rate/100,000 population, of hospitalisations and GP consultations attributed to infections

<table>
<thead>
<tr>
<th></th>
<th>0 – 14 years</th>
<th>15 – 59 years</th>
<th>60 – 74 years</th>
<th>75 + years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GP consultations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for infections %</td>
<td>50%</td>
<td>39%</td>
<td>21%</td>
<td>20%</td>
</tr>
<tr>
<td>rate / 100,000 pop</td>
<td>1,776</td>
<td>1,675</td>
<td>1,267</td>
<td>1,230</td>
</tr>
<tr>
<td>Total cost</td>
<td>£757m</td>
<td>£2,190m</td>
<td>£372m</td>
<td>£207m</td>
</tr>
<tr>
<td>cost / 100,000 pop</td>
<td>£6.9m</td>
<td>£6.1m</td>
<td>£4.7m</td>
<td>£4.6m</td>
</tr>
<tr>
<td><strong>Hospitalisations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for infections %</td>
<td>12%</td>
<td>2%</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>rate / 100,000 pop</td>
<td>1,916</td>
<td>452</td>
<td>754</td>
<td>2,162</td>
</tr>
<tr>
<td>Total cost</td>
<td>£360m</td>
<td>£268m</td>
<td>£99m</td>
<td>£162m</td>
</tr>
<tr>
<td>cost / 100,000 pop</td>
<td>£3.3m</td>
<td>£0.7m</td>
<td>£0.01m</td>
<td>£3.6m</td>
</tr>
</tbody>
</table>

Table 4.i highlights that the majority of the burden from infectious disease is placed on primary care (GPs). This burden also appears to be higher in children, with around 50% of GP consultations attributable to infections in children and costing approximately three quarters of a million pounds per annum in treatment costs. This proportion steadily drops with increasing age, as more chronic non-infectious diseases predominate. Nevertheless, 20% of consultations in the elderly are directly attributable to infectious diseases. A similar pattern occurs for hospital admissions with hospitalisations slightly higher at either extreme of age.

A relationship has been made between socio-economic status and consultations for infectious diseases (with rates being 30-50% higher in class V (unskilled) compared with class I (professional)), and this is fairly consistent with age. Much of this relationship can be explained by increasing rates of respiratory infections in those of lower socio-economic status. This is covered in more detail in Chapter 12; Health Inequalities.
The most important groups of infectious diseases in all age groups in primary care are respiratory infections and infectious intestinal diseases (Figure 4.2). Respiratory infections are estimated to account for more than 20% of all GP consultations in children, and infectious intestinal disease accounts for more than 15%. These two categories also account for the majority of consultations in adults. Sexually Transmitted Infections (STIs) contribute to the least number of GP consultations; however, the majority of these are treated in specialist clinics.
4.2 Breakdown of key infectious disease categories

The most important categories of infectious diseases, both in terms of cost and number of consultations, are infectious intestinal disease, HIV, healthcare associated infections and respiratory infections. The first three are looked at below, while respiratory disease is explored in more detail in Section 4.3.

**Infectious Intestinal Disease (IID)**: comprises a variety of communicable diseases and infections which gain entry by and/or affect the gastrointestinal tract e.g. food poisoning.

**Human Immunodeficiency Virus (HIV)**: is most commonly spread by sexual contact with an infected partner and causes a chronic life-threatening condition ‘Acquired Immune Deficiency Syndrome’ (AIDS) which leaves the infected persons vulnerable to illnesses they would normally resist.

**Healthcare Associated Infections (HCAI)**: (formerly hospital associated infection, broadened to include community infections): infections that arise as a result of healthcare interventions.

**Respiratory Infections**: most commonly transmitted by airborne droplets or nasal secretions and can lead to a wide spectrum of illness; many are seasonal in their activity and tend to circulate at higher levels during the winter months.

4.2.1 Infectious Intestinal Disease (IID)

Most IIDs are self-limiting, of short duration, largely community acquired, do not present to the health service and have the largest impact on daily living in the community. The Food Standards Agency IID study in 2000 found that 20% of England’s population suffered from an IID each year, with 3% presenting to their GP.

This study estimated the cost of IID infections to England as at least £960 million in 2003/04 (inflated from 1994/95 cost quoted in the study). Of this total cost, 37% fell to NHS, 8% to individuals and 56% were employment costs.

Only a small number of people with cases of IID attend hospital. However, those that do are generally serious enough to require admission. During 2003/04 there were 43,000 final consultant episodes, of which 87% were admitted using 147,700 bed days and costing approximately £11.8 million.

GP studies suggest an even higher rate of reporting than the IID study. For instance, Royal College of General Practitioner data for England and Wales in 2003 reports 11,400 / 100,000 attendances for IIDs at the GP, which is approximately 11% of the population (Figure 4.3; RCGP data for 1996-2004 supplied to the HPA).

The 10 year trend, shown in Figure 4.4, indicates a continual decrease in IID GP consultations since 1996; the cause of this trend is unknown.
Figure 4.3  Number of GP consultations for IID per 100,000 population England & Wales 2003, RCGP data

Figure 4.4  10 year trend of mean weekly incidence of IID GP consultations per 100,000 population, England & Wales, RCGP data
Rotavirus is the most common cause of infantile infectious intestinal disease. Almost every child will have an infection before her/his fifth birthday. Infection in adults is uncommon because immunity is long-lasting. It has been estimated that approximately 18,000 children are hospitalised in England and Wales annually due to rotavirus-related disease; this is approximately 50% of children’s IID related hospitalisations.

The majority of IIDs are related to food poisoning. As with all IIDs, the main burden falls to GPs (Figure 4.5), with those aged 1-4 years particularly likely to attend. There is a significant impact on the community from those that do not present to the health service through disruption to work and school attendance in the relevant age groups.

4.3.2 HIV / Sexual Health

HIV continues to be one of the most important communicable diseases in the UK. It is an infection associated with serious morbidity, high costs of treatment and care, significant mortality and a high number of potential years of life lost. Each year, many thousands of individuals are diagnosed with HIV. The infection is still frequently regarded as stigmatising and has a prolonged ‘silent’ period during which it often remains undiagnosed. Highly active antiretroviral therapies have resulted in substantial reductions in AIDS incidence and deaths in the UK.

Overall, approximately 53,000 people are living with HIV in the UK, of which about 27% are undiagnosed. This figure is rising each year as a result of increased numbers of new diagnoses and decreasing deaths due to antiretroviral therapies. Although the percentage of the population living with HIV is low, the cost to the NHS is high. Over the years, especially since the introduction of combination antiretroviral therapies in 1996, costs of in-patient treatment have declined and out-patient costs have increased. A number of studies have investigated the cost of treating a person with symptomatic HIV, with an average of £14,000 per patient a year being accepted as reasonable (Table 4.ii). Thus, the approximate cost in the UK per annum for those diagnosed is £400 million and, if all were diagnosed, £580 million.
The data on the cost of HIV/AIDS includes both ongoing and incident cases, whereas those for other infections tend to reflect incident cases (e.g. the primary reason for the admission). Other things being equal, the costs of HIV/AIDS are probably higher than estimated for the other infections.

The data on GP consultations, on page 3.9, underestimate the burden of STIs as the majority of these are treated in Genito-Urinary Medicine (GUM) clinics. In 2004 there were more than 780,000 new episodes of Chlamydia, gonorrhoea, syphilis, herpes or warts diagnosed in England, Wales and Northern Ireland, which is an increase of approximately 20% since 1999. When both initial appointments (£90 million) and follow-up visits (£75 million) are taken into consideration, this costs the health service approximately £165 million per annum.

The recent trend of increasing prevalence of all STIs is illustrated by gonorrhoea data in Figure 4.6, showing rate of infection, both by sex and over time.

Table 4.ii  Estimates of the costs of HIV/AIDS treatment in England

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual treatment cost per HIV positive patient</td>
<td>average of £14,000</td>
</tr>
<tr>
<td>HIV/AIDS treatment and care allotment 2001/02</td>
<td>£223 million</td>
</tr>
<tr>
<td>GUM spend identified to Health Authorities from AIDS treatment and care allocations 2001/02</td>
<td>£53 million</td>
</tr>
<tr>
<td>HIV prevention spend 2001/02</td>
<td>£55 million</td>
</tr>
</tbody>
</table>

GUM: Genito-Urinary Medicine
The burden of gonorrhoea is highly concentrated within demographic and behavioural risk groups in England and Wales, with young people, men who have sex with men, and ethnic minorities bearing a disproportionate burden of disease.

4.3.3 Healthcare Associated Infections

Healthcare associated infections (HCAI) are those that arise as a result of healthcare interventions, either in patients undergoing interventions or in healthcare workers involved in the interventions. A wide variety of organisms can be transmitted in healthcare settings which, in turn, cause a wide range of different diseases.

Estimating the burden of disease attributable to HCAI is very challenging. For instance, the costs associated with hospital acquired infection are difficult to estimate as most of the additional costs are associated with increased length of stay\textsuperscript{11}, but increased length of stay is itself a risk factor for hospital acquired infections\textsuperscript{12}. Furthermore, most of the studies conducted have been performed in a small number of hospitals, which are then extrapolated to the population as a whole. Consequently, the hospitals in which the studies were performed may not be truly representative. Nevertheless, the studies that are available suggest that HCAI is a significant problem\textsuperscript{11,13} and, although improvements in surveillance may have contributed to increasing reports, data suggest that some HCAI (e.g. \textit{Staphylococcus Aureus} and Methicillin Resistant \textit{Staphylococcus Aureus}; MRSA) may have increased over the past 12 years.

The data represented below in Figure 4.7 demonstrates the rise in the past 12 years in identified cases of both \textit{Staphylococcus Aureus} and MRSA.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4_7.png}
\caption{Rise in cases of both \textit{Staphylococcus Aureus} and MRSA since 1992}
\end{figure}
4.4 Detailed assessment of respiratory infections

Work has been undertaken on breaking down the burden of respiratory disease, which poses the greatest burden of all infectious diseases. This analysis has assessed the burden in terms of NHS Direct calls, primary care consultations, hospital admissions and deaths.

There are difficulties when breaking down the burden of diseases such as respiratory infections as many of the GP consultations are non-specific and never confirmed.

Respiratory diseases have been broken down into the following major organisms:

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td>Pneumonia, ear infections, sinusitis</td>
</tr>
<tr>
<td><em>Mycoplasma pneumoniae</em></td>
<td>Fever, cough, malaise, headache, pneumonia</td>
</tr>
<tr>
<td>Influenza (A &amp; B)</td>
<td>Respiratory viral infection, headache, fever, aching joints, pneumonia</td>
</tr>
<tr>
<td>Respiratory syncytial virus (RSV)</td>
<td>Bronchiolitis, chronic &amp; obstructive pulmonary disease, heart failure, pneumonia</td>
</tr>
<tr>
<td>Rhinovirus</td>
<td>‘common cold’</td>
</tr>
</tbody>
</table>

*Streptococcus pneumoniae* appears to be the leading contributor to the burden of disease, particularly in the elderly. Influenza imposes nearly as great an impact on primary care (particularly in children), but accounts for fewer admissions and deaths, these being mostly in the older age groups.

Respiratory syncytial virus makes a significant contribution to all outcomes and results in a greater number of hospital admissions than influenza, largely in pre-school age children. This analysis has underestimated the number of hospital admissions attributable to respiratory infections as only admissions for influenza-like illnesses were considered. This is currently being investigated.

Tuberculosis (TB) has not been featured specifically in this chapter due to the very small proportion of incidents. Surveillance estimated 274 incidents in 2004, 39% of which occurred in London. The majority of reports were related to healthcare (41%) or educational (30%) settings. During 2002 there were 443 deaths in England from TB including sequelae, mainly in the over 65 age group.

Since NHS Direct started in 1998, and rolled out across England in 2000, data has been collected on disease related calls and used to monitor seasonal variation. Although there is no confirmation of cause of disease, the trends are still useful. *S. pneumoniae* contributes to the largest proportion of respiratory disease related calls to NHS Direct (Table 4.iii), accounting for one third of the cold/influenza related calls and 28% of cough related calls. Influenza accounts for a further 22% of cold/influenza calls and 15% of cough related calls.
The respiratory infections that result in the greatest burden are presented in Table 4.iv. Primary care again bears the greatest burden from respiratory infections, with *S. pneumoniae* contributing the greatest burden in all categories.

### Table 4.iii  Calls to NHS Direct for colds, flu or coughs

<table>
<thead>
<tr>
<th>NHS Direct cold/flu calls (all ages)</th>
<th>Estimated cost (at £15.11/call)</th>
<th>NHS Direct cough calls (all ages)</th>
<th>Estimated cost (at £15.11/call)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total mean annual number of calls</td>
<td>30,373</td>
<td>£450,000</td>
<td>95,289</td>
</tr>
<tr>
<td>Mean annual incidence of calls</td>
<td>Influenza 12.7</td>
<td>27.1</td>
<td></td>
</tr>
<tr>
<td>(per 100,000 of the population of</td>
<td>RSV 25.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>England and Wales) attributable to:</td>
<td>Rhinovirus 4.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Streptococcus pneumonia</em> 19.0</td>
<td>50.5</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4.iv  Annual mean number of events attributable to various respiratory pathogens, England and Wales

<table>
<thead>
<tr>
<th>Streptococcus pneumoniae</th>
<th>RSV</th>
<th>Influenza (A + B)</th>
<th>Mycoplasma pneumoniae</th>
<th>Rhinovirus</th>
<th>Total</th>
<th>Rate/100,000 pop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calls to NHS direct</td>
<td>36,704</td>
<td>13,340</td>
<td>20,975</td>
<td>2,430</td>
<td>73,449</td>
<td>140</td>
</tr>
<tr>
<td>GP consultations</td>
<td>1,669,265</td>
<td>1,110,898</td>
<td>1,430,121</td>
<td>654,630</td>
<td>5,451,148</td>
<td>10,500</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>68,354</td>
<td>35,540</td>
<td>9,967</td>
<td>1,997</td>
<td>115,858</td>
<td>223</td>
</tr>
</tbody>
</table>
4.4.1 GP consultations

The trend in consultation rate for respiratory illness shows seasonal variation with higher incidence in the winter months.

- Approximately 5.5 million consultations a year are attributed to respiratory infections, costing approximately £170 million.
- The highest consultation rates were observed in the 0-4 year age group, see Figure 4.8.
- In the under 15 year olds, the greatest burden of respiratory illness on primary care is attributed to influenza, with 25% of consultations in pre-school children and 43% in 5-14 year olds.
- GP consultation costs per episode of respiratory illness average at £31.24; these costs are lower in patients under 10, largely as a result of reduced prescribing in this age group.

4.4.2 Hospital admissions

The trend in hospital admissions for acute respiratory infections closely follows that of GP consultations (Figure 4.9).

- *S. pneumoniae* accounts for the greatest number of respiratory disease related hospital admissions, averaging 68,354 per annum. The highest admission rates are seen in the elderly, with more than 48,000 admissions for over 65 year olds. There are very few admissions in the under 15 year old age group.
- RSV accounted for approximately half as many admissions as *S. pneumoniae*. A third of pre-school admissions are attributed to RSV infections.
- Influenza accounted for approximately 10,000 admissions between 1996 and 2004, with the highest rates seen in the over 65 year olds.
Overall mortality from influenza-like illness is most closely aligned to *S. pneumoniae* and influenza A.

- Between 1996 and 2004 an average of 114,802 deaths per year were attributed to respiratory infections (*S. pneumoniae* 86,694 and influenza 18,327).

- The majority (47%) of *S. pneumoniae* deaths were recorded as respiratory related. However, nearly as many (42%) were related to circulatory disease.

- 57% of influenza attributed deaths were recorded as related to respiratory disease, with circulatory disease related deaths accounting for 27% (10,477 and 4,890 per year respectively).

4.4.3 Mortality

Mortality by respiratory infection and age is shown in Table 4.v. This includes those deaths which are indirectly attributable to respiratory disease as there is another underlying diagnosis such as cancer, circulatory and other seasonal causes such as infectious and parasitic, endocrine etc., blood diseases, nervous system, digestive or ill defined.

The majority of deaths attributed to respiratory infections occur in the older age groups.

These data are important when considering preventative measures, as deaths in patients with cancers and circulatory disease which are attributed to respiratory illness may not be preventable by measures to control respiratory infections, particularly in the elderly.

Overall mortality from influenza-like illness is most closely aligned to *S. pneumoniae* and influenza A.

- Between 1996 and 2004 an average of 114,802 deaths per year were attributed to respiratory infections (*S. pneumoniae* 86,694 and influenza 18,327).

- The majority (47%) of *S. pneumoniae* deaths were recorded as respiratory related. However, nearly as many (42%) were related to circulatory disease.

- 57% of influenza attributed deaths were recorded as related to respiratory disease, with circulatory disease related deaths accounting for 27% (10,477 and 4,890 per year respectively).
5 Radiation
5 Radiation

5.0 Introduction

Although the harmful effects of ionising radiation are, in many cases, well described, there is little direct data available on the burden of disease caused by radiation. Cases of diseases related to exposure from ionising radiation often arise in the elderly, but may be due to damage sustained many years before. Furthermore, these cannot usually be distinguished from cases due to other causes. This makes the cost to the health service difficult to calculate. In order to mitigate healthcare costs there is a need for greater public understanding of the health risks of radiation and of how exposure can be avoided.

Taking This Forward

- Consider the importance of genetic factors on the risk of disease after exposure to ionising radiation.
- Investigate how childhood cancer rates around nuclear installations compare with rates elsewhere in Britain.
- Assess the benefits of public health campaigns on risks from ultraviolet radiation and research on the mechanisms by which melanoma is induced.
- Quantify the health effects of ionising radiation exposure, including radon in homes.
- Continue to follow-up groups such as radiation workers and research into radiation mechanisms, to strengthen the basis for estimates of low dose risks of ionising radiation.
- Better identify factors that cause high ambient magnetic field levels in homes, and quantify the burden of disease in the UK from symptoms attributed to magnetic fields and radiofrequency (RF) fields.
- Advise on standards of protection for workers and members of the public, for both ionising and non-ionising radiation.
Risks from exposure to radiation in childhood are generally higher than in adulthood; exposure to ultraviolet radiation (UVR) leading to skin cancers and ionising radiation exposure increasing the risk of various types of cancers, particular leukaemia. The risks associated with proximity to nuclear installations and power stations, high voltage power lines, mobile phone masts and the use of mobile phones continue to need investigation.

At the moment public concern is largely focused on non-ionising radiation: exposure from power lines, mobile phones and base stations. Exposures from base stations and power lines are largely involuntary, whereas exposures from mobile phones are voluntary and people continue to use these devices despite health concerns. These anxieties are largely a result of the scientific uncertainty and the possibility of unknown long-term health effects. This can have an indirect impact on the public’s well-being.

For ionising radiation, the public tends to be most concerned about the health risks from sources – such as radioactive discharges and fallout – that make up less than 1% of the average population exposure.

Radiation can be classified into two main categories:

Non-ionising radiation, including: ultraviolet radiation (sunlight), radiofrequency fields (mobile phones) and electric and magnetic fields (power lines).

Ionising radiation, including: cosmic, gamma and x-rays, as well as radiation from radioactive materials. Examples are radon and medical sources such as CT scans.

5.1 Radiofrequency fields (e.g. mobile phone technology)

Public interest and concern about the health effects associated with radiofrequency (RF) fields, particularly in children, has increased since the recent introduction and expansion of mobile telecommunication systems. However, other sources of public exposure to RF, including radio and television signals have been around for a long time. A number of studies have taken place in order to identify the risk of exposure to RF fields and the link to cancer; however the quality of these studies is very variable and no consistent links have been identified. The better studies do not indicate that RF fields increase the risk of cancer, but nor do they rule it out. In particular any long term risks have not yet been identified. Despite concerns about potential health risks, the market continues to grow rapidly as the public continue to choose to use mobile phone technology.

A small percentage of the population may express an increased sensitivity to a range of electric and magnetic fields with symptoms including: skin sensitivity, dizziness, headache and fatigue. This has not been quantified but the symptoms and increased levels of stress and anxiety will contribute to health costs.

The only consistent detrimental effect of mobile phones on health is an increased risk of accidents if used while driving, both during the call and for several minutes afterwards. The risks are similar whether the phone is hand-held or hands-free. In 2003, RoSPA estimated that at least 23 people died in the UK since 1998 in road accidents where mobile phones were been implicated.
5.2 Electric and magnetic fields (e.g. from power lines)

Electric and magnetic fields (EMFs) are an inevitable part of modern life, being produced wherever electricity is used. However, they are also a source of public concern: in particular whether living close to power lines affects the risk of childhood leukaemia. Despite research suggesting an association between magnetic fields and childhood leukaemia, there is no conclusive evidence of a causal relationship. Some individuals attribute symptoms such as tiredness, headache and malaise to EMFs and these together with increased levels of anxiety will contribute to the costs to the health system.

A few houses in the UK have high ambient magnetic fields. Analysis suggests that prolonged exposure to these fields is associated with a small increase, of less than 0.5%, in the absolute risk of leukaemia in children in the UK (an additional two cases compared with 500 cases annually). A recent paper from the UK links homes close to power lines with a raised risk of childhood leukaemia of roughly an extra five cases per year in the UK (about 1% of all cases). This study did not include any measurements of exposure.

Whilst the evidence remains uncertain, power frequency magnetic fields have been classified by the International Agency for Research on Cancer as being “possibly carcinogenic” to humans.

5.3 Sunlight - ultraviolet radiation (UVR)

UVR causes skin cancer which is one of the commonest forms of cancer in the UK. An estimated 100,000 new cases of skin cancers other than malignant melanoma are diagnosed every year in the UK. This disease is most common in the elderly, with 70% of all registered cases occurring in people aged over 65.

Malignant melanoma is a rarer form of skin cancer, but is more likely to be fatal, with approximately 7000 cases diagnosed and 1700 deaths per year. Malignant melanomas are responsible for 1% of all cancer deaths in the UK. Incidence increases with age, but is also relatively high in young people, with melanoma being the second most common cancer in people aged 15-34.

It is more common in women: for every three cases in men, there are four cases in women. Melanoma incidence has more than doubled in England and Wales in the last 20 years (figure 5.1); mortality, however, has levelled off or even fallen in recent birth cohorts.

Figure 5.1 Malignant melanoma, age standardised incidence rates, GB, 1975 - 2001.
Studies indicate that the risk of skin cancer may be related to:
- having a fair complexion
- short, intense exposures of the type arising from sunbathing
- cumulative UVR exposure
- childhood exposure
- having many and irregular moles

Sunbeds are an appreciable source of intense, intermittent UVR exposure. There is no specific evidence for a link between sunbeds and an increased risk of skin cancer, due in part to difficulties in distinguishing risks from sunbeds from risks to sun exposure. However, expert groups all advise against the use of sunbeds for cosmetic tanning purposes.

For many years, Australia has had the highest melanoma incidence and mortality rates in the world. There are signs that the major public health campaigns implemented there during the last quarter of a century are now having some beneficial effect. Although the age-adjusted incidence and mortality rates for Australia continue to rise, cohort analyses show that the overall rise is not reflected in all age groups. In the younger cohorts, who may have been influenced by public health campaigns in recent decades, both incidence and mortality rates for melanoma are dropping.

Public health campaigns in the UK started in earnest in the early 1990s. The UK's current national skin cancer prevention programme, Sun Smart, run by Cancer Research UK, was launched in 2003. The effectiveness and impact of this campaign are monitored using national surveys of people's knowledge, attitudes and behaviour regarding sun exposure and skin cancer.

### Figure 5.2 Average annual dose from ionising radiation to the UK population from all sources

- **Natural 84%**
- **Artificial 16%**
- **50% Radon**
- **15% Medical**
- **0.2% Fallout**
- **<0.1% Discharges**
- **<0.1% Products**
- **12% Cosmic**
- **13% Gamma**
- **9.5% Internal**

5.4 Ionising radiation

We are all exposed to ionising radiation during everyday life. On average 84% of this is from natural sources, including cosmic rays, gamma rays and natural radioactivity within the body. About half of the natural component arises from exposure to radon in homes. After natural radiation, the next largest contribution (15%) comes from medical use, mainly from diagnostic x-rays. Other sources comprise less than 1% of the average annual radiation dose, Figure 5.2. Doses due to radioactive discharges tend to be higher in the vicinity of nuclear or other installations that discharge such material; however, even in these areas, natural sources still contribute the overwhelming majority of the average radiation dose.
There are limited direct data on the health risks from exposure to low doses of ionising radiation. Current estimates of risk are extrapolated from studies of groups exposed to relatively high radiation doses, such as atomic bomb survivors in Japan and patients exposed to radiation as part of medical treatment. Recent studies of radiation workers suggest that current estimates of risks from low doses are not greatly in error, but further follow-up of these groups is important to strengthen the basis for risk estimation.

Research suggests that exposure to ionising radiation may cause several thousand cancer deaths per year in the UK. This is equivalent to a few percent of all cancer deaths. These cancers often arise many years after exposure and cannot be distinguished clinically from those due to other causes.

Radon is a naturally occurring radioactive gas that enters buildings mainly from the ground and can build up in enclosed spaces. Radon makes up about half of the population’s average annual radiation dose. This dose varies between homes throughout the UK, sometimes even within quite small areas. Recent studies have demonstrated raised risks of lung cancer from exposure to radon in homes\textsuperscript{15,16}, even at levels below the current UK Action Level. A recent analysis of data from 13 European studies, including data from the UK, indicated that the effects of radon and smoking multiply together to increase the risk of lung cancer\textsuperscript{15}. This means that the burden of lung cancer from radon is concentrated among smokers. This analysis indicated that about 2% of all cancer deaths in Europe could be due to radon. Work is in progress that should give a better idea of the health impact for the UK. The UK has a well-established programme to identify dwellings where people are at greatest risk and to ensure that measures are built into new buildings in high risk areas to minimise levels.
Medical sources form a sizeable component of the radiation exposure of the UK population, particularly among the elderly. This contribution is likely to continue to rise due to the increasing use of CT scans and interventional radiology. Although CT scans comprise only 7% of all procedures, they account for 47% of the annual collective dose from diagnostic radiology. It has been estimated that about 700 cancer cases per year (roughly one quarter of one percent of all cancer cases, based on 2001 figures) could be attributable to diagnostic x-rays. However, the benefits and lives saved by using this technology far outweigh the small risks associated with the increase in exposure.

5.5 Children

For various types of cancer, the risks from ionising radiation are generally higher for exposure in childhood than for exposure later on in life. Data modelling suggests that the chance over a lifetime of developing a radiation-induced solid cancer if exposed at age 10 may be double that for exposure at age 30. Childhood exposure is also considered to be an important risk factor in skin cancer induced by ultraviolet radiation.

Studies conducted several decades ago when higher dose diagnostic x-rays were used (not used routinely now) indicated roughly a 40% increase in the risk of childhood cancer when received in utero. However, current doses are much lower. Estimates of radiation risks extrapolated from such studies suggest that exposure to natural radiation in childhood and in utero might account for up to roughly 30% of leukaemias in young people, although this has not been demonstrated epidemiologically. As well as variability by age in the risk associated with a given level of radiation dose, there is some indication that the radon doses to tissues and organs may be somewhat higher for infants and children than for adults.

A recent report found no evidence for raised rates in children of either leukaemia and non-Hodgkin lymphoma or other cancers within 25 km of nuclear power stations in the UK. Increased rates that had been found in other studies around some other UK nuclear installations were confirmed in this report. An additional site with an increased rate was identified although this finding differs from an earlier study and needs clarification. In all cases doses due to radioactive discharges from these sites would be much lower than doses from natural radiation and cannot account for any of the observed increased rates on the basis of current knowledge.

While there are reasons to believe that, compared to adults, children might be more vulnerable to the radiofrequency fields associated with mobile phones, there is too little scientific evidence to make any firm conclusions at present, especially regarding any raised risks for cancers of the head and neck.

5.6 Inequalities

There is evidence that the same level of ionising radiation dose poses a higher risk of solid cancers to females than to males. This is particularly the case for radiation-induced breast and thyroid cancers. Estimates of this difference are uncertain and will vary with age and between populations, but has been estimated to be about 40% in Japan.

In contrast, the risk of leukaemia due to ionising radiation exposure appears to be slightly higher for men. Malignant melanoma is slightly more common in women than in men, although it is difficult to know to what extent this difference is explained by any differences in exposure or sensitivity to ultraviolet radiation. More generally, the impact of genetic factors on diseases induced by radiation needs to be ascertained, since relatively sensitive and resistant sub-groups may exist within populations.
6 Environmental Pollution
KEY MESSAGES

• The extent to which environmental pollutants contribute to common diseases is not accurately resolved. However, global estimates conservatively attribute about 8-9% of the total burden of disease to pollution.

• It is difficult to determine the extent of environmentally related disease as current estimates are generally based on very uncertain data and limited datasets.

• The limited amount of evidence available on the long-term effect of air pollution on children’s lung development seems to indicate that the burden attributable to air pollution may be considerable. Up to 57 children per 1,000 in England and Wales may have long-term lung function affected by air pollution.

• In England and Wales 20% of children have asthma; an estimated 30% of acute exacerbations of childhood asthma are related to outdoor air pollution. Around 36 children and 30 adults per 1,000 population may have asthma that is attributable to chemical environmental factors.

• There is some evidence of an association between daily concentrations of particles and hospital admissions for treatment of cardiovascular disease. A 1 \( \mu g/m^3 \) drop in annual mean PM\(_{2.5}\) particles throughout the lifetime of individuals in England and Wales may reduce mortality rate from cardio-vascular disease by 0.1%.

• Though far from proven, there are concerns regarding a possible health link to chemical exposure from landfill sites.

6.0 Introduction

The importance of estimating the burden of disease associated with environmental pollutants is highlighted not only by the current evidence, which indicates some significant but largely unquantified links to ill health, but also by the scale of use of chemicals in our modern society. There are approximately 30,000 chemicals in common use and less than 1% of these have been subject to assessment of toxicity and health risk\(^1\). There is a significant potential for many of these to be dispersed in environmental media.

Taking This Forward

• Focus on generating data on the exposure of the population to common environmental pollutants to address the uncertainty inherent in current estimates.

• Establish an effective national environmental public health tracking system that links environmental chemicals, health, exposure and other factors in order to contribute towards improving the knowledge about the burden of disease attributable to environmental factors.

• Delivery of the World Health Organisation’s (WHO) “Children’s Environment and Health Action Plan for Europe” and the European Union’s “European Environment and Health Strategy”, both of which look to address the impact the environment has on health. Topics such as indoor and outdoor air pollution and chemicals are included in these.
6.3 The extent to which such chemicals may contribute to common diseases is not accurately resolved. However attempts have been made to estimate the environmentally attributable burden of disease globally, focusing on health outcomes for which there is strong evidence of an association with pollutants. Estimates vary but conservatively about 8-9% of the total disease burden may be attributed to pollution².

Environmental pollutants are chemical substances of human origin found in air, water, soil, food or the home environment.

The extent to which such chemicals may contribute to common diseases is not accurately resolved. However attempts have been made to estimate the environmentally attributable burden of disease globally, focusing on health outcomes for which there is strong evidence of an association with pollutants. Estimates vary but conservatively about 8-9% of the total disease burden may be attributed to pollution².

Methods used to estimate the fraction of mortality or morbidity that can be attributed to environmental factors.

This report has reviewed the available data as derived by authoritative organisations and/or experts using one of the following approaches:

1. WHO's assessment of the burden of disease attributable to environmental factors (BODAE) calculated by evaluating the population exposure distributions based on observed exposure levels combined with disease rates. WHO has used this approach to derive environmental fractions for lead.

2. A panel of experts evaluate all the scientific evidence and derive a best estimate of the fraction of the disease that can be attributed to environmental exposure. This approach has been used in the USA to derive the environmentally attributable fraction (EAF) of particular diseases for asthma and cancer. The UK Committee on the Medical Effects of Air Pollution (COMEAP) used a similar approach to estimate fractions attributable to air pollution.

3. Where no authoritative source of information is available, a primary research of the literature can be undertaken and used to estimate the burden of disease. Congenital malformations attributable to the environment and the effects of ambient air pollution on children’s lung function have been derived using this approach.

6.1 The impact of environmental pollution on specific diseases

An overview of the impact of environmental pollution on the three main categories of disease: cardio-vascular, respiratory and cancer is given below. Specific diseases such as asthma and congenital abnormalities are also examined. An overview of other diseases (such as neuro-developmental disorders and allergic diseases) is also provided in the full supporting documentation³.

6.1.1 Cardio-vascular disease

It is estimated that nearly 12,000 deaths could be avoided in 19 towns with a total population of 32 million people if the annual PM10 [particulate matter less than 10 microns in diameter] limit of 20µg/m³ set by the European Commission was achieved⁴. In addition, about 5,500 deaths could be avoided if this limit was further reduced by 5µg/m³ population.

The evidence relating to an association between daily concentrations of particles and numbers of admissions to hospital for treatment of cardiovascular diseases is sufficiently strong to regard this association as more likely than not to be causal.

- COMEAP estimated that if a 1 µg/m³ drop in annual mean PM2.5 particles [particulate matter less than 2.5 microns in diameter] is maintained throughout the lifetime of individuals in England and Wales, there will be a reduction in the mortality rate of 0.1% from cardio-vascular disease. This would account for 0.2 - 0.5 million life years gained or 1.5 to 3.5 days gained per person of the total population.

- A 10 µg/m³ reduction in 24 hour average concentrations in PM10 is likely to be associated with a 0.8% reduction in all age, all cause cardiovascular hospital episodes.

Cardiovascular disease accounts for approximately 1.1 million hospital episodes in England per year, so this could be reduced by around 9,300.

Although these estimates are intended as a rough comparison only, figures do suggest that the gain in life years could be significant.
6.1.2 Cancer

Since occupational exposure to chemicals, cigarette smoking and alcohol consumption are prevalent confounders to environmental exposure in adults, no attempt has been made to quantify the burden of disease attributable to environmental factors (BODAE) for adult cancers. Instead, an attempt has been made to assess the environmentally attributable fraction (EAF) of childhood cancer.

A US expert panel considered that non-genetic factors may cause between 80-90% of cancers and noted that the specific causes of childhood cancer are largely unknown. They concluded that insufficient evidence exists to assign a best estimate of the fraction of childhood cancer specifically attributable to chemicals in the environment\(^5\) and agreed that the correct EAF would be in the range of 5 to 90%\(^6\), due to the reason stated above. In calculating the BODAE for childhood cancer for England and Wales the lowest estimate of 5% has been used below (Table 6.i). Based on this, a total of 62 childhood cancers per year (6 cases per million children) may be attributable to environmental exposure. It should be noted, however, that these are very rough estimates.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Reported Cases</th>
<th>BODAE * (no. of cases)</th>
<th>BODAE/1,000,000 children **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney</td>
<td>73</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>Brain and CNS</td>
<td>308</td>
<td>15</td>
<td>1.5</td>
</tr>
<tr>
<td>NHL***</td>
<td>76</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>Leukaemia</td>
<td>388</td>
<td>19</td>
<td>1.9</td>
</tr>
<tr>
<td>All malignancies (excluding skin)</td>
<td>1243</td>
<td>62</td>
<td>6.3</td>
</tr>
</tbody>
</table>

* An EAF of 5% has been used to estimate the BODAE.
** Assumes there are 9.8 million children in England and Wales
*** Non-Hodgkins Lymphoma

6.1.3 Respiratory Disease

COMEAP has estimated the extent of the short-term effects of air pollutants on health and the number of people affected\(^7\) (Table 6.ii), however, these effects are only likely to occur in those with severe pre-existing disease. They estimated a gain of between 0.007 - 0.02 million life years per µg/m\(^3\) drop in short-term exposure to PM\(_{10}\). Many assumptions were made in these estimates and therefore they are only rough estimates.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Health Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM(_{10})</td>
<td>Deaths brought forward (all cause) 8100</td>
</tr>
<tr>
<td></td>
<td>Hospital admissions (respiratory) brought forward 10500</td>
</tr>
<tr>
<td>SO(_{2})</td>
<td>Deaths brought forward (all cause) 3500</td>
</tr>
<tr>
<td></td>
<td>Hospital admissions (respiratory) brought forward 3500</td>
</tr>
</tbody>
</table>

* PM\(_{10}\): particulate matter generally less than 10 µm in diameter.
Estimated total deaths occurring in urban areas of Great Britain per year are about 430,000.
Estimated total admissions to hospital for respiratory diseases occurring in urban areas of Great Britain per year are about 530,000.

Air pollution may have a long term effect on children’s lung function. European and US studies have shown that air pollution (measured as PM\(_{10}\) and PM\(_{2.5}\)) may reduce lung development in children from the ages of 10 to 18 yrs old. This is likely to be a long term as lung development is usually complete at that age and therefore unlikely to recover. A recent US prospective cohort study found a 6.3% difference in lung growth between children at the lowest and highest levels of exposure to PM\(_{2.5}\).
The burden attributable to air pollution on children’s long-term lung function may be considerable with up to 57 children per 1,000 population being affected in England and Wales (Table 6.iii).

### Table 6.iii. Burden of disease attributable to air pollution in England and Wales

<table>
<thead>
<tr>
<th>Total number children aged 0 - 15*</th>
<th>Urban population as %</th>
<th>Urban pop. children</th>
<th>EAF</th>
<th>BODAE</th>
<th>BODAE per 1,000 population **</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,488,736</td>
<td>89.92</td>
<td>9,431,471</td>
<td>6.3%</td>
<td>594,182</td>
<td>57</td>
</tr>
</tbody>
</table>

* Source: Census 2001 data. ** Estimated from the total population of 10.5 million

The burden attributable to air pollution on children’s long-term lung function may be considerable with up to 57 children per 1,000 population being affected in England and Wales (Table 6.iii).

### 6.1.4 Asthma

Asthma is a common disease with a fairly low mortality. However, it gives rise to a great deal of anxiety, particularly in childhood, when it is a major cause of hospital admission and morbidity. It may be caused by an allergic reaction to inhaled allergens (e.g. house dust mites), the effects of which appear to be aggravated by air pollution (e.g. diesel particulates). There is some evidence for a causal association between asthma and living in close proximity to traffic. However, there is little evidence for a causal association between prevalence/incidence of asthma and air pollution in general. The respiratory health of children, particularly those with asthma, will benefit substantially from a reduction in air pollution, especially that from motor vehicle exhausts. An expert US panel on asthma estimated that 30% of acute exacerbations of childhood asthma (range 10-35%) are environmentally related. By applying this environmentally attributable fraction (EAF) to national data, it is possible to estimate the burden of asthma attributable to chemical pollution. Table 6.iv summarises this information for adults and children (up to 15 years old) who are currently being treated for asthma. This shows that 36 children and 30 adults per 1,000 population may have asthma that can be attributable to chemical environmental factors.

### Table 6.iv Estimation of the burden of disease from asthma attributable to chemical pollution for England and Wales

<table>
<thead>
<tr>
<th>Total Population*</th>
<th>Prevalence Rate</th>
<th>BODAE</th>
<th>BODAE/ 1,000 children or adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children in England and Wales aged 0-15 years currently being treated for asthma</td>
<td>10,488,736</td>
<td>30%</td>
<td>377,594</td>
</tr>
<tr>
<td>Number of adults in England and Wales aged 16 and over currently being treated for asthma</td>
<td>41,553,180</td>
<td>10%</td>
<td>1,246,595</td>
</tr>
</tbody>
</table>

*Source: Census 2001 data. BODAE derived by assuming that 30% of asthma is environmentally related.
The epidemiological evidence base linking asthma to indoor allergens (such as moulds) is as considerable as that relating asthma to outdoor air pollution from chemicals. Therefore, it is likely that the EAF used to obtain the above estimates could be doubled to give a more realistic estimate of the burden of asthma attributable to environmental factors.

6.1.5 Congenital abnormalities

A large UK study revealed that 80% of the UK population reside within 2 km of a landfill site and that the relative risk of a congenitally malformed baby for mothers living close to these sites was 1.01. Similar studies in Europe and Wales give relative risk estimates of 1.33, 1.39 and 1.19 respectively. By assuming that the increase is due to environmental factor and that landfill sites are the only environmentally attributable risk (unlikely in reality) the EAF may be chosen at the mid-range value of 20%.

Using incidence and outcome data for selected congenital anomalies in the Welsh population (as no English data was found) and assuming an EAF of 20%, then the burden of total congenital malformations attributable to environmental pollution would be a gross rate of 8.6 per 1,000 live and still births.

The specific health impact of environmental lead exposure

The release of lead to air in the UK has been considerably reduced following the ban on lead additives in petrol in the 1990s. However, lead is still present in the environment as a result of deposition (particles falling to the ground or washed out by rain) from previous vehicular emissions, old leaded paint and landfill.

In infants and young children, the developing brain is particularly vulnerable to lead. Milder disease outcomes, in particular hypertension in adults and the loss of IQ points and the resultant increase in mild mental retardation in children are of increasing concern at levels of exposure that were previously considered safe.

The WHO has assessed the disease burden from lead exposure for the year 2000 at a global level. They estimated that the loss of IQ points and increase in mild mental retardation (defined as having an IQ score of between 50 and 69) may affect 1.1 persons per 1000 population and 0.5 children (aged 0-4) per 1000 population.
7 Environmental Inequalities
7 Environmental Inequalities

KEY MESSAGES

- There is increasing evidence that environmental injustice is a real and substantive problem within the UK although the causes, effects and distribution are varied and complex and require further analysis.

- A clean and healthy environment is a vital component of public health, our environment is much healthier than in previous generations and continues to improve.

- Environmental quality varies between different regions and communities and there is an inequitable distribution of environmental hazards among children of different social groups and different regions of England and Wales.

7.0 Introduction

While our environment is much healthier than in previous generations and continues to improve, environmental quality varies between different areas and communities. This has been increasingly recognised in European and UK policy initiatives. Understanding the characteristics and distribution of vulnerable populations in communities and their relationship with environmental factors is a fundamental element towards taking this forward. In addition, this intelligence is important in supporting the NHS in its role to assess the potential public health impacts of policies and industrial processes such as those that need authorisation under various regulatory regimes (e.g. the Integrated Pollution Prevention and Control, IPPC, regime).

Taking This Forward

- There is a commitment to develop an effective national environmental public health tracking system that links environmental, health, exposure and social factors such as deprivation to develop effective public health actions preventing or controlling chronic and acute diseases linked to hazards in the environment.

- Work with other key agencies to develop research into an improved understanding of environmental health inequalities and the most effective ways of addressing them.

- Work with other key agencies to ensure strategies for tackling health inequalities recognise environmental factors and ensure that communities are supported and involved in decisions that affect their local environment.
This chapter describes initial work done to quantify the level and extent of specific inequality dimensions (young, deprived and minority ethnic populations) in relation to potential sources of environmental pollution in England and Wales, building on work commissioned by the Environment Agency.\(^4\)\(^5\).

Characterisation of populations in the vicinity of some processes regulated under IPPC in terms of the distribution of children, deprivation and minority ethnic communities has been undertaken.

The designation of a zone of influence in many equity studies has been recognised as essentially arbitrary\(^6\) and in the absence of exposure data cannot represent actual exposure or impact, but rather allow a preliminary indication of the distribution of hazards among the population. Based on the experience of planning authorities and WHO recommendations in relation to landfill sites\(^7\), a buffer zone of 1 km radius was used around each site and populations within these zones selected using postcodes and characterised using data from the 2001 census. Deprivation was assessed using the Index of Multiple Deprivation (IMD).

Analyses were conducted separately for England and Wales as the deprivation scores are derived independently for the two countries and previous work has suggested a very different relationship between deprivation and residential proximity to sites\(^5\).

Definitions

**IPPC**: Integrated Pollution Prevention Control – a regulatory system to ensure that industry adopts an integrated approach to pollution control to provide a high level of protection for the environment and human health. Operators of existing or proposed installations must apply for a permit to operate.

**IPPC Part A1 processes**: industrial activities regulated by the Environment Agency to ensure compliance with relevant environmental standards e.g. hazardous waste landfill sites and incinerators.

**IMD**: Index of Multiple Deprivation – measures deprivation at small area level and combines a number of indicators (e.g. income, employment status, skills and training) in order to derive a single deprivation score for each area.

It is important to recognise that proximity to an industrial site does not necessarily represent an increased exposure. Distance does not account for people’s behaviour such as walking and exercise choices, the local geography and meteorological conditions or the action of the regulator to ensure that environmental standards (e.g. air quality standards) are met. However, some emissions have no effect thresholds, in other words exposure to levels below statutory standards may have an effect in some populations and there are no standards for the majority of environmental chemicals or chemical mixtures. There may also be indirect effects on community health - there is evidence for example that property values are adversely affected by local industry\(^4\).
7.1 Results from this study

- While there are only c.1700 IPPC sites in England and Wales, around 10% (over 1.2 million) of children live within 1 km of such a process.
- There is considerable regional variation, with less than 5% of children in the South West living within 1 km of IPPC sites, compared with 15% in the North West.
- There is a strong, and for some regions a significant, relationship between childhood deprivation and increasing proximity to large industrial processes in England.
- 42% of children in England living within 1 km of a site are in the most deprived quintile compared with 7% from the least deprived (Figure 7.1).
- The more northern regions together with London tend to have higher proportions of the most deprived children living close to IPPC sites (Figure 7.2). Results from this study mirror the relationship between deprivation and the clustering of IPPC processes in the North West, Yorkshire, West Midlands, North East and along the Thames Estuary in London described in work commissioned by the Environment Agency5.
- IPPC processes only represent a small section of total industrial activity. For example, 80% of people live within 2 km of a landfill site in England and Wales8. Surveillance data suggest that chemical incidents are more likely to be associated with lower level processes (see Chapter 8, Chemical Incidents).
- In Wales a different pattern is found, with only 31% of the childhood population within 1 km of a site from the most deprived quintile and over 17% from the least deprived.
- Similar trends in health outcomes have been reported. For example, a report published by the Chief Medical Officer (CMO) in 20019 showed that while relatively affluent populations experienced relatively good and similar levels of health irrespective of region, mortality rates in deprived populations showed a marked north-south trend similar to the trends in levels of childhood deprivation reported here.

Socially and economically disadvantaged people often live in the worst environments e.g. the most deprived parts of England experience the worst air quality and have less access to green space and adequate housing10.

7.2 Taking this forward

It has not been possible to identify / quantify the burden of environmental inequalities on the health of the UK population. However the identification of areas where further work is required and where future research and collaboration should be focused has been one of the key outcomes. These include:

- Development of an effective national environmental public health tracking system that links environmental, health, exposure and social factors, such as deprivation, to develop equitable and effective public health actions to minimise the risk of acute and chronic environmentally related disease. The work is complex and it is recognised that confounding factors including lifestyle choices such as smoking make the assessment of environmental impact on health for the purpose of tracking environmentally-related disease complicated.
- Work with other key agencies (in particular the Environment Agency and the Department for Environment, Food and Rural Affairs; Defra) to develop better understanding of the nature, distribution and causes of environmental inequalities and the most effective and efficient policy interventions.
Note that each quintile has roughly the same population. An equal proportion of the population within each deprivation quintile would be expected to live within each buffer distance if IPPC sites were evenly distributed.

Note that each quintile has roughly the same population. An equal proportion of the population within each deprivation quintile would be expected to live within each buffer distance if IPPC sites were evenly distributed.
8 Chemical Incidents
8 Chemical Incidents

8.0 Introduction

The number and volume of chemicals being used today is steadily increasing. Currently there are 30,000 chemicals in common use with less than 1% of these assessed for toxicity and health risk. Although there are only a small number of chemical incidents reported each year, this means that the impact these chemicals may have on the long-term health of those exposed is largely unknown. Current surveillance following a chemical incident enables the assessment of the extent of environmental exposure and the potential immediate health impact, however longer-term monitoring of the health impacts are not routinely undertaken.

Taking This Forward

- Development of a surveillance system for chemical incidents to include; alerting of emerging hazards, exposure information, causes of incidents, monitoring of long term health impacts and data on vulnerable groups such as children.
- Integration of incident data into an environmental public health tracking system will routinely link chemical exposure and health data in a long term analysis to clarify the impact of environmental chemicals on health.
When considering the health impact of chemical incidents they are often difficult to evaluate because:

- It is often hard to identify which chemicals are being released at the site of an incident, due to the difficult conditions experienced by emergency services or information on chemicals stored on an incident site may not be available.
- Most incidents occur during transportation or at smaller industrial/commercial sites not covered by the major emergency planning legislation. Communities often live in close proximity to these non-regulated sites and therefore may be at risk.

The knowledge gained from incidents is used to provide appropriate advice for future emergencies, improved planning of public safety interventions and can influence the formulation of guidance. A recent example of this has been the provision of guidance aimed at preventing the over-chlorination of swimming pools.

**What is a chemical incident?**

A chemical incident is defined as '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'.

Examples of incidents typically reported include a tanker spill involving sulphuric acid, a factory fire where the roof contained asbestos, carbon monoxide exposure as a result of a faulty office boiler, mercury leaks from broken medical equipment or ammonia from faulty fridges. Larger scale incidents typically involve chemical spills during transportation, industrial accidents, and the contamination of water supplies.
8.1 Summary of chemical incident reporting

There is some information currently available (unpublished HPA data) on reported chemical incidents over the five year period, 1999 – 2004:

- A total of 6,054 incidents were identified in Great Britain, an average of 1,200 incidents per year.
- An exposure of the general population was reported in approximately 50% of incidents affecting over 50,000 people.
- 2% involved the loss of life either as a result of toxicity or indirectly due to a consequential event such as a road traffic accident. An average of 24 deaths occurred per year.
- Around 10,000 people were reported as experiencing symptoms, 20% of those exposed.
- A small number of incidents have involved major potential population exposure. A total of 32 large scale incidents were recorded over the five year period, or an average of about six such incidents per year. An average of about 6,200 people annually reported to have been exposed to large scale incidents.
- The most commonly identified releases were asbestos, carbon monoxide, chlorine, petroleum/oils, smoke, acids and mercury (Figure 8.1).
- Transportation of chemicals (22%) and industrial processes (19%) were the two most frequently reported locations where chemical incidents occurred (Figure 8.2). Incidents in the home (residential) represented 15% of the total number reported.
- At present the potential exposure to chemicals of children is not included in the routine surveillance programme, though 5% of incidents involved educational premises (Figure 8.2). This presents a specific potential risk to children, though is comparatively low in numbers compared to other locations.
- Large scale industrial processes subject to the COMAH Regulations (1999) were involved in only 1% of incidents reported suggesting that the specific controls placed upon these sites are effective risk management measures.

Examples of chemical incidents

1. Ten pupils and staff reported bleaching of clothes and some skin irritation after using a swimming pool which had been over-chlorinated at a school. Health advice included:
   - how to monitor for breathing difficulties and
   - the use of mild emollient to treat the skin irritation.

   This incident did not result in hospitalisation of those involved.

2. A large spillage (8,000-10,000 litres) of a solvent mixture, initially thought to contain isocyanate, occurred in a city centre. The immediate area surrounding the spill, including a school, was evacuated and residents in the remaining areas advised to shelter. The chemical was subsequently identified as being a less hazardous polymer compound than originally thought.

   Five people were taken to hospital following exposure as a precaution but all were discharged.

3. There have been a number of cases in the West Midlands of carbon monoxide poisoning caused by the indoor burning of charcoal amongst East African and Yemeni communities. This practice is widespread in Africa and Asia for heating and the burning of incense, and suicide from charcoal burning has also been reported in Japan. Work is underway to raise awareness of the dangers of burning charcoal, and other solid fuels, in indoor environments.
Figure 8.1  Chemicals most frequently involved in acute incidents reported between 1999-2004 (n=3430)

Note. Data presented includes incidents reported in Great Britain and represents approximately 60% of the total number of incidents. Examples of likely sources of exposure include asbestos from building fires, carbon monoxide from faulty gas heating systems and the over chlorination of swimming pool water.

Figure 8.2  Acute chemical incidents by location between 1999 and 2004
8.2 Taking this forward

There is a recognised gap in the current surveillance of chemical incidents and the associated health impact, especially the longer term chronic effects. Having recognised this, a number of initiatives have very recently been put into place which will greatly improve the knowledge and understanding of the burden of disease resulting from chemical incidents. Data will be available from these in due course.

These are:

- Nationally coordinated incident surveillance that enables the efficient transfer of data from key national agencies such as the HPA, the Environment Agency and Fire Services.
- A central real time on-line system for the reporting of incidents to improve consistency and completeness and enable a more efficient assessment of the effectiveness of the surveillance system.
- The main types of incidents to which the NHS, emergency services and local authorities have to respond has been characterised. The system has been used to prioritise chemical incident briefing notes for public health responders, inform the development of personal protection equipment and identify the causes of some incidents (for example, an increase in reported chlorine releases may be tracked to poor practice in some swimming baths).
- A national programme also enables the UK to contribute surveillance data to international organisations and European member states and will contribute towards developing Europe wide surveillance and alerting systems.

### Development of a national surveillance system

**Public health register of those exposed to the London explosions**

A voluntary register of those people who were physically exposed to the effects of the explosions and the emergency response which followed is being established. The initial assessment of the risk of long-term adverse health effects arising from exposure to chemicals or blood in this incident is low, monitoring the health of those involved will be used to confirm (or otherwise) that this initial assessment was correct. Information will be collected by questionnaire and will be supplemented by environmental sampling at the sites of the explosions to enable an assessment of the exposure to chemicals and blood.

The register will also be used to monitor the psychological impact of the bombings.

Further work is also planned:

- Collaboration between key partners to obtain comprehensive data in line with the best regional practice and actively receiving feedback on how to support organisations in meeting their statutory obligations.
- Ranking of chemical threats to help with the development of resilience to emergencies thereby improving the level of health protection.
- Determining the causes of incidents, which is fundamental to their prevention, through rigorous follow up and analysis on a regular and routine basis.
9 Poisons
9 Poisons

9.0 Introduction

Over the past 40 years the impact of poisoning on acute hospital care provision has increased to just under 1% of all admissions\(^1\).

The developing foetus is subject to the potentially adverse health effects of maternal drugs, regardless of whether the mother has been exposed to therapeutic amounts, has experienced adverse effects or been exposed to potential poisoning. Surveillance systems to document and categorise these problems are currently not comprehensive.

Treatment of possible poisoning or exposure to chemical hazards imposes a considerable burden of work across the health service. A number of on-going initiatives are attempting to create greater harmonisation of data worldwide.

This report focuses on the healthcare burden imposed at hospital level and data on deaths. Detailed data of the impact of poisonings on emergency services and primary care are difficult to interrogate nationally. Information on chronic effects of acute exposure and effects of sub-acute and chronic toxicity is currently not routinely captured.

Taking This Forward

- Work towards improving data collection and surveillance systems to include chronic effects of acute poisoning and sub-acute exposure, as well as primary care and NHS Direct data arising from potential poisoning.
- Develop poisoning prevention strategies that are consistently implemented across the UK to reduce the likelihood of poisoning in the population.
- Develop a poisonings prevention forum to enable information sharing by the specialist groups.
9.1 Mortality

Death certificates in the UK indicate that just over 6,600 deaths are directly attributable to poisoning (Table 9.i)\(^3\)\(^4\)\(^5\). Interpreting causality is sometimes difficult and although poisoning might have contributed to the death of an individual, the direct cause of death may have been attributed to conditions other than poisoning, thereby underestimating the overall number of deaths attributable to poisoning.

<table>
<thead>
<tr>
<th>E &amp; W(^3)</th>
<th>Scotland(^4)</th>
<th>Northern Ireland(^5)</th>
<th>UK Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Rate</td>
<td>No.</td>
<td>Rate</td>
</tr>
<tr>
<td>5925</td>
<td>11.2</td>
<td>460</td>
<td>9.2</td>
</tr>
</tbody>
</table>

Deaths attributed directly to poisoning were due to accidental exposure (30%); deliberate poisoning (43%); and mental or behavioural disorder associated with recreational drug use (27%). Three quarters of acute poisoning deaths in 2001-03 were attributed to exposure to a single drug\(^3\)\(^4\)\(^5\), while there was exposure to multiple drugs in 25% of cases, and alcohol was also co-ingested in around 25% of cases\(^6\).

The burden of disease from poisons is heavy in our society today. The number of deaths and hospital attendances each year in the UK from either accidental or deliberate self-poisoning leaves little room for complacency with regard to the costs to the health service and society as a whole. Many organisations, both statutory and non-governmental are working to reduce the total burden of poisonings.

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**Definition of terms:**

A poison is a substance that can cause injury or death when inhaled, ingested, injected or absorbed\(^2\). Poisoning occurs when a person has been exposed to an excessive dose of such a substance, whether intentionally or unintentionally.

- **Self-poisoning episode:** self-exposure of an individual to an amount of substance associated with a significant potential to cause harm\(^1\). May be accidental or deliberate, fatal or non-fatal\(^2\).

- **Accidental self-poisoning:** an individual unintentionally ingests an agent, most commonly in children, or experiences more of an effect from a substance than planned, e.g. decreased tolerance to heroin following a period of abstinence.

- **Deliberate self-poisoning:** when non-fatal is also called deliberate self-harm, attempted suicide or parasuicide. If death occurs consequent to an episode then the diagnosis becomes one of suicide\(^2\).

Under certain circumstances information about a poisoning or death may not have been sought or established; in such cases the cause of the poisoning will be undetermined.
In 2003, narcotics were associated with 426 deaths, carbon monoxide with 416 deaths, over-the-counter medicines with 123 deaths, methadone with 48 deaths and cocaine with 16 deaths. For 2001 there were 1,037 deaths due to accidental poisoning, 10% of deaths occurred in hospitalised patients and the remainder in the community (Figure 9.1).

Up to 91% of all deaths directly attributable to poisoning occur in people aged under 75 years, indicating that poisoning has a substantial impact on productive life-years. In contrast to most diseases, the major mortality burden arises in the working population of adults aged 15-64 years of age, and only a very small number of deaths are attributed to poisoning in those aged under five.

The number of deaths attributed to different types of poisonings in England & Wales for 2000-03 is shown below (Table 9.iii).

**Table 9.iii  Deaths directly attributed to poisonings England & Wales 2000-03**

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidental poisonings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>609</td>
<td>758</td>
<td>548</td>
<td>560</td>
</tr>
<tr>
<td>Females</td>
<td>227</td>
<td>279</td>
<td>266</td>
<td>275</td>
</tr>
<tr>
<td>Deliberate poisonings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>723</td>
<td>697</td>
<td>604</td>
<td>596</td>
</tr>
<tr>
<td>Females</td>
<td>555</td>
<td>323</td>
<td>341</td>
<td>339</td>
</tr>
<tr>
<td>Altered behaviour due to drug use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>714</td>
<td>685</td>
<td>750</td>
<td>548</td>
</tr>
<tr>
<td>Females</td>
<td>124</td>
<td>113</td>
<td>140</td>
<td>115</td>
</tr>
<tr>
<td>Assault with drugs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>12</td>
<td>12</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Females</td>
<td>4</td>
<td>9</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Undetermined intent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>378</td>
<td>353</td>
<td>312</td>
<td>303</td>
</tr>
<tr>
<td>Females</td>
<td>248</td>
<td>249</td>
<td>222</td>
<td>226</td>
</tr>
<tr>
<td>All poisoning related deaths (rate/100,000 population)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,591 [6.8]</strong></td>
<td><strong>3,478 [6.6]</strong></td>
<td><strong>3,189 [6.0]</strong></td>
<td><strong>2,973 [5.6]</strong></td>
</tr>
</tbody>
</table>

*ICD09 coding; †ICD10 coding. A new coding system was introduced in 2000, which might confound trend analysis between data for 2000 and those obtained in subsequent years.

Note that figures in this table are not comparable with those presented in Table 9.i as this table presents data directly attributable to poisonings (from Part 1 Death Certification) whilst Table 9.i also includes all underlying causes of poisoning.
9.2 Morbidity

In the UK, rates of self-harm rose dramatically from the late 1960s to the early 1970s then decreased in the early 1980s only to rise again by the end of the decade. The majority of self-harm cases involve ingestion of a potential poison (usually pharmaceutical). In most cities in the UK the annual rate of self-harm is about 400/100,000 population. The recent rise has been particularly noticeable in men aged 15-24 years and women aged 25-34 years. Figure 9.2 shows an example in recent trends in male self-poisoning from Scottish hospitals by age. It is recognised that prevalence of deliberate self-harm is highest in areas of greatest social deprivation.

In 2003-04, there were 106,000 Finished Consultant Episodes relating to poisoning in England, 0.8% of the total number. These data suggest that the burden of poisoning annually in England is equivalent to 200 episodes per 100,000 population. However, Scottish hospital data indicate an overall rate of hospital activity related to poisoning of almost 400 per 100,000, double the rate in the England.

In 65% of cases, poisoning was associated with medicines, mental and behavioural effects of drug abuse were associated with 30% of cases, whilst 5% of cases were related to non-medicinal substances. Table 9.iv shows the number of hospital admissions and bed-days used as a consequence of poisoning due to medicine intake. Assuming that the average cost of a NHS bed day is £350 per day, medicine poisoning alone would inflict a financial burden of around £54 million per year for England alone.
<table>
<thead>
<tr>
<th>Category</th>
<th>Number of admissions</th>
<th>Number of admissions /100,000</th>
<th>Bed days used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non opioid painkillers (mainly paracetamol)</td>
<td>40,711</td>
<td>814</td>
<td>62,712</td>
</tr>
<tr>
<td>Psychotropic drugs (e.g. antidepressants and tranquilisers)</td>
<td>18,174</td>
<td>363</td>
<td>25,400</td>
</tr>
<tr>
<td>Medicines for treating epilepsy &amp; Parkinson’s disease</td>
<td>14,684</td>
<td>294</td>
<td>24,550</td>
</tr>
<tr>
<td>Hallucinogens</td>
<td>7,670</td>
<td>153</td>
<td>13,560</td>
</tr>
<tr>
<td>Diuretics (e.g. water tablets)</td>
<td>7,325</td>
<td>147</td>
<td>11,013</td>
</tr>
<tr>
<td>Haematological drugs (e.g. anticoagulants such as antileukaemia or warfarin)</td>
<td>2,043</td>
<td>41</td>
<td>4,218</td>
</tr>
<tr>
<td>Autonomic drugs (e.g. atropine and / or adrenaline)</td>
<td>1,886</td>
<td>38</td>
<td>2,975</td>
</tr>
<tr>
<td>Hormonal drugs (e.g. contraceptive tablets)</td>
<td>1,632</td>
<td>33</td>
<td>3,814</td>
</tr>
<tr>
<td>Cardiovascular drugs (e.g. digoxin, beta-blockers)</td>
<td>1,364</td>
<td>27</td>
<td>4,832</td>
</tr>
<tr>
<td>Antibiotics (e.g. penicillin, etc)</td>
<td>776</td>
<td>16</td>
<td>1,225</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>96,265</strong></td>
<td><strong>1,926</strong></td>
<td><strong>154,299</strong></td>
</tr>
</tbody>
</table>
Figure 9.3 shows that the most frequent substances of abuse associated with hospital admission for poisoning in England are opioids and multiple drug use, while Figure 9.4 shows that chemical exposures associated with hospital admission are mainly due to the inhalation of gases, fumes, carbon monoxide and organic solvents. The treatment of patients from poisoning due to substances of abuse and non-medicinal chemicals will cost the NHS £55 million in bed-days alone.

**Figure 9.3** Most frequent substances of abuse associated with hospital admission in England for poisoning in 2003-04

**Figure 9.4** Most frequent chemical exposures associated with hospital admission in England for poisoning in 2003-04
The overall financial burden for medicines, substances of abuse and chemical exposure is around £110 million per year for England alone, excluding the cost of emergency department attendances. Significantly higher costs than this are incurred for severe poisoning cases that require critical care facilities. Data for Scotland indicates a higher death and hospital discharge rate, suggesting that the true figure in Scotland may be twice as high.

It is possible to monitor trends in medication misuse and the effects that public policy may have on patterns of self-poisoning. An example of this is shown in Figure 9.5, where a reduction in deaths and discharges from Scottish hospitals related to paracetamol overdoses was observed following the introduction of pack-size reduction legislation in 1997.

Nearly half of all poisoning cases reported are caused by accidental poisoning, 40% being deliberate, and the remainder due to medication errors or adverse reactions. Figure 9.6 highlights that for 2004-05 nearly three quarters of all enquiries to TOXBASE relate to pharmaceuticals.

The data in Figure 9.7 show that as many as one quarter of all telephone enquiries to the NPIS were in relation to young children and infants, substantially more than predicted from the proportion of the population in this age-group. Many of these relate to accidental exposures or suspected ingestions to household products, cosmetics or pesticides but are not significant enough to warrant hospital admission.
Figure 9.6  Types of products involved in TOXBASE enquiries 2004-05 (1 year’s data)

Figure 9.7  Telephone Enquiries to NPIS stratified by reported age of patient 2004-05
10 Injuries
10 Injuries

10.0 Introduction

Each year 5.8 million people worldwide die as a result of injuries\(^1\). Over 17,000 injury deaths occur annually in the UK alone. Children and young adults are at greatest risk of injury death and disability, but the risk to older people is also substantial.

**Definition and classification of injury types**

An injury refers to any physical damage or harm to the body caused by an agent or external force, which may be physical (e.g. road accident), thermal, electrical, chemical (e.g. accidental poisoning) or radiant. Injuries can be classified by the intent or purposefulness of occurrence into two categories, intentional and unintentional injuries.

Important injuries are those that:
- present the greatest threat to life
- pose the greatest potential disability burden
- have the highest economic and societal costs
- demonstrate the largest inequalities between social groups

**KEY MESSAGES**

- Over 17,000 deaths per year are a direct result of injuries, accounting for 3% of all deaths in the UK.
- Annually, injuries lead to 720,000 hospital admissions and 6 million emergency department visits in the UK.
- In adults, injury deaths and hospital admissions are most likely to affect young men (15-44 years), for whom road traffic incidents, self harm and assaults are the main causes.
- Falls and road traffic accidents are the main causes of injuries, both in terms of death and disability burden.
- Falls are a common injury in the young: in under two year olds, falls in the home are the most common injury, whilst falls during sports, exercise and play are more common in older children. Those aged over 55 are also at particular risk from falls with the outcome more likely to be worse; substantial disability or death.
- Deprivation based inequalities are larger for injuries than for many other diseases and there are signs that the inequalities gap is widening.
- The most deprived children are more likely to be injured or killed in pedestrian incidents than the most affluent.
- Injuries place a substantial burden on the NHS, with the treatment of unintentional injuries costing the NHS about £2 billion a year. Many injuries also have long term effects requiring ongoing health care.
- Approximately 5% of health service expenditure is on the treatment of injuries.

**Taking This Forward**

- Focus efforts to reduce the burden of injuries on those areas of greatest burden and impact:
  - Children and young adults, in particular road traffic injuries and falls,
  - Falls by the elderly, which is particularly important as the population is ageing,
  - Inequalities from injuries, which appears to continue to widen.
A very small proportion of all injuries are fatal and it is estimated that for every injury death there are 45 hospital episodes, 630 doctor consultations and 5000-6000 minor injuries. Around 6 million emergency department visits each year are for the treatment of injuries, with 720,000 cases needing in-patient treatment. It is estimated that 5% of health service expenditure is on the treatment of injuries.

The mean age of death from land transport accidents alone has been estimated as being 40 and 50 years for male and females respectively. This corresponds to a total of 38 and 10 years of life lost per 10,000 population for males and females respectively up to the age of 85. Similar trends are seen for injury deaths from self-harm where 39 and 10 years per 10,000 population are lost for males and females respectively. When put into context with years of life lost data presented in Figure 3.3, intentional self-harm and land transport accidents have the third and fourth highest rate, with twice as many pre-retirement life years lost to injury compared to coronary heart disease.

A British Medical Association (BMA) report in 2001 suggests that the prevention of each injury death saves around three times more life years than preventing one cancer or vascular death because of the lower average age at which injury occurs.

10.1 Mortality

In 2004 more than half a million people died in England and Wales; 3% of these deaths were due to injury. Males suffer the majority of injury related deaths (61%), regardless of intent and cause, and this is particularly seen amongst the 15-44 year olds, who suffer more than 75% of all injury deaths. The exception is for falls where women carry the highest burden, particularly over the age of 75. The majority of injury deaths were due to unintentional incidents (64%; Figure 10.1), where children and older people are at greatest risk: over 80% of 5-14 year old and 90% of 85+ year old injury deaths occurring as a result of unintentional incidents.

### Figure 10.1 Proportion and actual number of injury deaths by different causes in England and Wales for 2004

- Unintentional (total 11,232)
- Intentional self-harm (total 3,449)
- Event of undetermined intent (total 2,225)
- Other injuries (total 524)
- Assault (total 131)

Total number of injury deaths: 17,561
Figure 10.2 shows the rate of death per 100,000 population in England and Wales for 2004 from all external causes of mortality. Whilst the rate is higher amongst the 75+ year olds, injury death disproportionately affects the 25-44 year olds and is a leading cause of premature death, accounting for more than half the deaths among 15-24 year olds. This does not account for the variation in risks between age groups e.g., those in the 15-24 age bracket are the group most likely to take risks which may result in injuries.

There are many different causes of unintentional injury death, but road traffic accidents (RTAs) (28%) and falls (27%) together account for more than half of all unintentional injury deaths (Figure 10.3). However, there are substantial variations in the age groups at risk from these. For instance, road traffic injuries are highest amongst children and young adults, particularly 15-24 year olds, while falls affect the older age groups, mainly those over 55 years.
Other causes include exposure to inanimate and animate mechanical forces, other accidental threats to breathing, exposure to electric current, radiation and extreme ambient air temperature and pressure, contact with heat and hot substances, contact with venomous animals and plants, exposure to forces of nature and overexertion, travel and privation.

Overall, the male/female distribution of unintentional injury deaths shows little variation between the sexes, the exception being RTAs where more than 80% of deaths are males. However, there are substantial variations by age group; more than 80% of unintentional injury deaths amongst 15-44 year olds are to males.

Fall related injury and death is a particular concern amongst older females (aged 75 and over) and this is one of the few causes of injury death where female deaths (52%) are greater than males. Males are at greatest risk between the ages of 55 and 74, suffering 63% of deaths.

Road traffic injuries:
In 2003, there were approximately 3,300 fatal, 29,000 serious and 18,000 slight road traffic accidents reported. These were estimated to cost over £13,000m. Each pedestrian casualty is estimated to cost £65,790, each pedal cyclist £38,430 and each motor vehicle casualty £37,300.

These valuations were undertaken by the Department for Transport 2004 to estimate values for road traffic accident prevention and include both human and direct economic costs.
10.2 Hospital admission data

Injuries have a significant burden on hospital admissions due to the long lengths of stay required and the frequent need for the injured to be admitted as emergencies, thereby placing immediate pressure on already stretched systems. The average length of stay for an injury Finished Consultant Episode (FCE) is a day longer than the overall average stay and has a 74% emergency admission rate compared to the average 32%\(^6\). In 2003/04 there were a total of 900,000 FCEs attributed to all external causes of injuries, 6% of total FCEs. Of the injury FCEs, almost two-thirds are due to unintentional incidents, mainly falls (Figure 10.4)\(^7\).

Injuries account for 9% of all bed days and 14% of all emergency admissions. The likelihood of hospital admission following an injury is not only affected by the severity, diagnosis and anatomical site of injury, but also by factors such as bed availability, seasonal variations, admission policies and procedures and treatment factors\(^8\). Thus, there is considerable variation in admission rates between hospitals.

There are over 5.7 million bed days taken each year to treat unintentional injuries. By assuming that a bed day costs £350\(^9\), treating unintentional injuries in hospitals will cost a total of £2 billion per year.

Figures 10.4 and 10.5 show FCEs and bed days attributable to unintentional injuries.

Three-quarters of all injuries require emergency admission, but proportions are even higher for self-harm, which has 91% admission rate. RTAs account for a relatively small proportion of hospital admissions, but there is the potential for long term health effects and the impact on quality of life of younger people, who are the group more likely to be involved. Of the RTAs, pedal cyclists account for the greatest proportion of FCEs and emergency admissions,

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**Figure 10.4** Finished Consultant Episodes attributable to unintentional injuries

- Falls: 314,709
- Land transport accidents: 57,905
- Accidental exposure to unspecified factor: 22,916
- Accidental poisoning by and exposure to noxious substances: 6,761
- Other transport accidents: 2,522
- Exposure to smoke, fire and flames: 383
- Accidental drowning and submersion: 45,352
- Total: 373,288
but pedestrian injuries are associated with longer hospital stays and a greater proportion of bed days. As with injury deaths, there are considerable male/female differences, with males accounting for nearly three quarters (68%) of road traffic accident FCEs, rising to 78% for pedal cyclists and 91% for motorcyclists.

Across the broad age groups there are no differences in diagnoses rates until over 75 years old (Table 10.i).

### Table 10.i  All injury diagnoses, HES data 2003/04

<table>
<thead>
<tr>
<th>Age group</th>
<th>Approximate rate / 100,000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 14</td>
<td>1,100</td>
</tr>
<tr>
<td>15 – 59</td>
<td>1,100</td>
</tr>
<tr>
<td>60 – 74</td>
<td>1,300</td>
</tr>
<tr>
<td>75 +</td>
<td>4,313</td>
</tr>
</tbody>
</table>

This data does not show the differences in types of injury at different ages: most non-fatal unintentional injuries in children under two years of age occur as a result of a fall in the home. In older children (0-14 year olds) the most common types of injuries are caused by falls during sport activities, exercise or play. Most pedal cyclist injuries are suffered by the 0-14 year olds (53%) and the 15-59 group account for most injuries in the remaining road traffic accident categories.
Reducing the burden of injuries

- In the UK, child pedestrian deaths have decreased in recent years but this is thought to be due to decreases in exposures of children as pedestrians rather than roads being safer. Government targets are to increase physical activity and decrease obesity therefore it is likely that there will be an associated increase in pedestrian exposure, injury and death. Decreasing traffic congestion, another initiative, is likely to lead to increased traffic speeds, again likely to increase the severity of injuries and likelihood of death.

- The UK’s population is ageing, with the older population healthier and more mobile. This means that injuries will become more important, in particular the number of falls is likely to increase.

10.3 Inequalities and children

Analysis of injury death trends by social class in England and Wales indicates that the risk to the poorest is considerably greater than that to wealthier members of society\(^3\). Amongst 0-15 year olds, unintentional injury rates are considerably higher amongst the most deprived (83 deaths per 100,000) compared to the most affluent (16 deaths per 100,000). The signs are that this inequalities gap has widened, the poorest now being five times more likely to die from an unintentional injury relative to the more affluent\(^3\) (Table 10.ii).

Intentional injury rates, although lower than unintentional injury rates, have an even greater inequalities gap, with those in the lowest social class nine times more likely than the most affluent to die from intentional injuries.

Table 10.ii: Examples of trends in unintentional injury death rates per 100,000 for children (age 0-15 years old) in England and Wales and death rate ratios, by social class group*

| Social class | 1979-83 | | 1989-92 | |
|-------------|---------|---------|---------|
|              | Rate    | Rate ratio | Rate    | Rate ratio |
| I            | 24      | 1.0      | 16      | 1.0      |
| II           | 25      | 1.0      | 16      | 1.0      |
| III         | 24      | 1.0      | 19      | 1.2      |
| IIIIm        | 36      | 1.5      | 34      | 2.1      |
| IV           | 47      | 2.0      | 38      | 2.4      |
| V            | 85      | 3.5      | 83      | 5.0      |

* Adapted from BMA (2001)\(^3\); Injury rate ratios have been estimated by dividing the injury death rate per 100,000 for each social class group by the baseline social class rate (Class I).

Social class I = most affluent; social class V = most deprived
Motor vehicle and pedestrian incidents are a leading cause of death amongst children and adolescents. The most deprived are over five times more likely to be killed in pedestrian incidents than their more affluent counterparts and this inequalities gap appears to be widening. Affluent families have greater access to cars, meaning that these children often walk less.

Hospital admission, particularly in children, is often dependent upon the perceived deprivation status, with judgements being made about the quality of care available at home and the likelihood of return for outpatient treatment. This leads to the most deprived being more readily admitted than the more affluent. This needs to be taken into account when interpreting reported associations between deprivation and hospital admission rates.

An association has been found between deprivation and non-fatal injuries. The Health Survey for England have reported some association between major accident rates and household income, with higher accident rates amongst children (aged 0-15) in lower income families (Figure 10.6) and in households with only one adult. This same study found no association between injuries and socio-economic status amongst young adults (aged 16-24; Figure 10.6). This does however vary between specific injury groups and is an extremely complex relationship.

Figure 10.6 Major annual accident rates, by equivalised household income quintile*

* Adapted from Health Survey for England (2003)
A study undertaken in Wales found substantial differences in the deprivation gradient for 0-14 year olds injured in pedestrian and non-pedestrian road traffic incidents. The most deprived were 2.5 times more likely than the most affluent to be injured as pedestrians (Figure 10.7). However, for non-pedestrian incidents in the same age group, the gradient was minimal, with rates amongst the deprived just 1.3 times the affluent (Figure 10.7).

Figure 10.7 Standardised hospitalisation ratios (SHRs), by deprivation for pedestrian and non-pedestrian road traffic injuries amongst 0-14 year olds*

*Adapted by Lyons et al. (2003)
11 Children’s Health
11 Children’s Health

11.0 Introduction

Children are especially vulnerable to infections and environmental exposures during development and growth, and receive relatively greater exposure than adults due to behaviour patterns, lack of awareness, size and biological metabolisms. This chapter provides an overview of children’s health, as well as information specific to children, which was identified during the development of the preceding chapters. Children’s health has been highlighted throughout this report and has been identified as a priority area in all the specific topics.

In the UK there are approximately 14 million children and young people aged 0-18 years, approximately 23% of the population. The HPA takes children as being from 0-18 years, however the format in which much of the health data are collected varies e.g. the NHS generally uses the age group 0-14.

KEY MESSAGES

- 1.5 billion Finished Consultant Episodes (FCEs) are attributed to children aged 0-14.
- Approximately one third of all GP consultations are for those aged under 15.
- There are limited data on the impact of environmental hazards on children’s health, data includes:
  - Asthma: an estimated 30% of acute exacerbations of childhood asthma is related to outdoor air pollution.
  - Poisons: as many as one quarter of all telephone enquiries to the National Poisons Information Service (NPIS) in relation to young children and infants.
  - Injuries: it is estimated that 2 million children are taken to hospital due to accidents every year.
- Inequalities: children in manual households are more likely to consult GPs than non-manual, especially in the 0-4 age group.

Taking This Forward

- Propose the development of surveillance systems which will monitor the impact on children’s health, both in the short and long term, of health protection issues.
- Improve data and surveillance on the impact of environmental hazards, and chemical incidents on children.
11.1 Mortality data

Childhood mortality has been decreasing since the beginning of the 20th century. Figure 11.1 shows a rapid decrease between 1976 to 1996, which has since slowed down and remained steady. The largest drop has been in the mortality rate of the under one year age group, however this mortality rate is still a major concern.

In the UK during 2002 there were approximately 5,000 deaths of children from birth to 15 years: 3,500 under one year and 1,500 aged 1-15. The major causes of mortality varies between age groups, with congenital malformations and conditions originating in the perinatal period being the main cause up to 12 months, diseases of the nervous system, congenital malformations and injuries in 1-4 years, and neoplasms and injuries in the 5-14 age group.

11.2 Morbidity data

11.2.1 Hospital Episodes Statistics

During 2003/04 approximately 1.5 billion Finished Consultant Episodes (FCEs) were attributed to children aged 0-14, about 13% of FCEs for all ages. It is estimated that of the 14 million accident and emergency (A&E) attendances reported each year, 3.5 million are for children.

The percentage of FCEs (and number) for specific diseases in the under 15 age group in 2003/04, compared to total population, are:

- Intestinal infectious disease, 56% (24,000)
- Acute upper respiratory infections, 78% (71,000)
- Head injuries, 25% (33,000)
- Poisonings, and toxic effects, 9% (8,800) and 28% (2,100) respectively.

![Figure 11.1 Child deaths in age groups – England and Wales](image-url)
11.2.2  **GP data**

Approximately one third of all GP consultations are for patients aged under 15. The top 10 types of GP consultations for children are identified in Figure 11.2. The top four consultation types are the same as for the general population, which are largely for respiratory infections. The following six types are different from those seen in the general population and reflect the more child-specific diseases such as asthma.

![Figure 11.2 GP consultation rates per 100,000 population, 2003](image)

Actual Numbers: Viral Hepatitis <1:0, 1-4:1, 4-14:5; Hand Foot and Mouth Disease: <1:13, 1-4:141, 4-14:33; Meningitis & Encephalitis: <1:12, 1-4:1, 4-14:9.
11.2.3 Longstanding illness

In the Health Survey of England 2002, Health of Children and Young People\(^5\) report, questions were asked about any longstanding illness, disability or infirmity. The results gave the most common complaint as respiratory related (rate per 1000: 123 boys, 99 girls) followed by skin (rate per 1000: 45 boys, 43 girls), with the following two categories being mental health related. A questionnaire looking at chronic health found the following results:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of very</td>
<td>90%</td>
<td>93%</td>
<td>92%</td>
<td>95%</td>
</tr>
<tr>
<td>good and good</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>general health</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reporting lifelong</td>
<td>20%</td>
<td>29%</td>
<td>16%</td>
<td>25%</td>
</tr>
<tr>
<td>illness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reporting acute</td>
<td>10%</td>
<td>14%</td>
<td>10%</td>
<td>14%</td>
</tr>
<tr>
<td>sickness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A report on Health Behaviour in School-aged Children (HBSC)\(^6\) looked at reported versus perceived health issues and found:

- One in five students (21%) report ‘less than good’ health, one in 10 (9%) report not being happy, and one in three (33%) report feeling low each week.
- Students who perceive their family as ‘not well off’ were almost twice as likely to report having less than good health and feeling low at least once a week as those who perceived their family to be ‘well off’.

11.3 Specific topics

11.3.1 Infections

As with the general population, there has been a decline in the incidence of infection in children in recent years. However, these incidences are still important as around 50% of GP consultations for children are attributable to infections. These are largely respiratory and gastrointestinal infections (see Figure 11.3). This proportion steadily drops with increasing age, as more chronic non-infectious diseases predominate. A similar pattern occurs for hospital admissions.
The most common childhood infections are:

- **Respiratory**: Previous figures have shown that respiratory infections are the largest category for both GP consultation (48%) and admissions to hospital. The most common of these are respiratory tract infections, common cold, ear and throat infections.

- **Gastrointestinal**: During the 1990s there was a general increase in reported gastrointestinal infections (GII), mainly in those aged 0-4 years. The types of GII vary between age groups, with the three most commonly reported (campylobacter, salmonella and rotavirus) being responsible for around 30,000 infections in those aged under 20 years in England and Wales each year³.

Areas of concern are the rising rates in:

- Childhood cases of Methicillin-resistant Staphylococcus Aureus (MRSA) and other Healthcare Associated Infections (HCAIs); a collaborative study has recently started to study MRSA bloodstream infection in children.

- Between 1985 and the end of January 2001, 1,101 children aged under 14 years were diagnosed with Human Immunodeficiency Virus (HIV) in the UK³. Of these, 27% are known to have died. Almost all new infections diagnosed in children are acquired from their mother and no new infections resulting from blood transfusion have been identified.

Infections account for 9% of all infant (1-12 months) deaths in England and Wales, rising to 19% in post-neonatal deaths. One of the major causes of death between 1-12 months is Sudden Unexplained Death in Infancy⁷, which accounts for 27% of all deaths in this age group, with an estimated 38% caused by infections. It is recognised that there are a number of risk factors associated with this, including; socio-economic, low birth weight, smoking, single mother and ethnic group.

As well as improvements in hygiene, housing, nutrition and the use of antibiotics leading to a reduction in childhood infections, there have been a number of specific prevention programmes which have been successful, these include:

- the national childhood vaccination programme.

- antenatal screening to reduce the transmission of diseases such as HIV and hepatitis B from mother to child.

**Reducing the cost of infectious disease in children:**

High immunisation uptake levels (85%) for the meningococcal C conjugate vaccine (MCC) in target age groups (between 12 months to 17 years of age) resulted in an 80% reduction in the incidence of meningococcal meningitis group C in these groups within the first 18 months of the start of the immunisation programme.
11.4 Non-infectious diseases

Children are considered as being at greater risk from exposure to environmental hazards due to an undeveloped immune system, extended periods of time spent outdoors and behaviour patterns that bring them into contact with contaminated media.

There are limited data on the impact of environmental hazards, chemical incidents and radiation on children. The development of a surveillance system and further research to address these gaps has been identified in previous chapters as a priority for future development. Data relating to children is collected for poisons and injuries and included here.

The overall GP consultation data for children are shown in Figure 11.2. This demonstrates that the majority of children's GP consultations are infection-related. GP consultations for non-infectious diseases are illustrated in Figure 11.4.

11.4.1 Radiation

For various types of cancer, the risks from ionising radiation are generally higher for exposure in childhood than for exposure later on in life. Data modelling suggests that the chance over a lifetime of developing a radiation-induced solid cancer if exposed at age 10 may be double that for exposure at age 30. Childhood exposure is also an important risk factor in skin cancer induced by ultraviolet radiation (UVR). A recent (limited) study evaluating children's clothing designed to protect them from UVR has shown that: 80% of the samples surveyed had protection factors greater than 15 (the commonly recommended level of protection for sunscreens) 15% had protection factors less than or equal to 10 (the minimum acceptable level of UVR protection during summer in the UK) and 53% had protection factors greater than 50 (a level which allows only 2% transmission of the solar UVR). Clothing should be part of an integrated health information programme to reduce overall UVR exposure.
Estimates of radiation risks extrapolated from studies suggest that exposure to natural radiation in childhood and in utero might account for roughly 30% of leukaemias in young people, although this has not been demonstrated epidemiologically (see chapter 5).

A recent report found no evidence for raised rates in children of either leukaemia and non-Hodgkin lymphoma or other cancers within 25 km of nuclear power stations in the UK. Increased rates that had been found in other studies around some other UK nuclear installations were confirmed in this report. An additional site with an increased rate was identified, although this finding differs from an earlier study and needs clarification. In all cases, doses due to radioactive discharges from these sites would be lower than doses from natural radiation.

While there are reasons to believe that compared to adults children might be more vulnerable to the radiofrequency fields associated with mobile phones, there is too little scientific evidence to make any firm conclusions at present, especially regarding any raised risks for cancers of the head and neck (see chapter 5).

11.4.2 Environmental pollution

A clean and healthy environment is a vital component of public health; this has improved and continues to do so but is changing e.g. increased traffic pollution and the development of buildings on landfill sites.

The effect of environmental pollution on children’s health is difficult to quantify, however the impact on children is potentially great as they are at greater risk from exposure than most adults and there is the potential for cumulative and unknown long-term health issues. There is a commitment to develop an effective national environmental public health tracking system that links environmental, health, exposure and social factors such as deprivation and undertake research into an improved understanding of environmental health inequalities and how to address these.

Most work has been done looking at asthma, one of the most common chronic diseases of childhood. An estimated 30% of the acute exacerbations of childhood asthma are related to outdoor air pollution. From 1994 to 1996, international comparisons showed that teenagers aged 12 to 14 years in Great Britain had some of the highest prevalence of symptoms and diagnoses of eczema, asthma and hay fever; the reasons for this are largely unknown. The impact of these on the health services is borne largely by primary care, with deaths a rare occurrence.

In England and Wales, hospital admission rates for childhood asthma increased substantially during the 1960s (rates trebled among 0–4 years and doubled among 5–14 year olds), 1970s and early 1980s, but declined steadily during the 1990s. In 2000, annual hospital admission rates for asthma were 48 per 10,000 children aged under five years and 16 per 10,000 children aged 5-14 years.

The impact of outdoor air pollution on the health of London’s children:

Outdoor air pollution is responsible for substantial ill health in London children, most particularly exposure to particulate matter. The results indicate substantial morbidity but very little mortality.

In 1999 in 0-15 year olds, there were an estimated:

- 43,000 asthma exacerbations
- 92 asthma hospital admissions
- 64,000 cases of acute bronchitis

Presented at the HPA Annual Conference, 2005.
Local asthma studies have shown:

- In Leicester pre-school children prevalence of recent wheezing went from 12% in 1990 to 26% in 1998, accompanied by a rise from 11% to 18% in the proportion of all children diagnosed with asthma.
- Within England there is a higher prevalence of asthma symptoms outside the major cities. The highest proportion of children reporting a history of asthma was in East Anglia and Oxford (23%) and the lowest was in North Thames (18%).

NPIS: The UK National Poisons Information Service provides clinical information to health professionals on the management of patients exposed to specific poisons.

Data collected by NPIS showed that of the telephone enquiries to NPIS centres in 2004-05, around 24% related to infants (under five years) and 16% to children and young adults aged 5-19 years.

The National Teratology (the study of abnormal development, for example birth defects that are a result of genetic damage) Information Service answers enquiries from health professionals about the potential adverse foetal effects of exposure to drugs and chemicals and collects information on outcomes of pregnancies where exposure may have occurred. This database is still being established, however:

- There were 5,600 enquiries in 2003 (less than 1% of conceptions result in contact).
- Between 2-4% live born infants are affected by some sort of congenital malformation. Of these about 3% are known to result from environmental factors (including maternal drug treatment, occupational and environmental exposures).

An area of increasing concern is young people taking drugs of misuse. A survey of drug misuse among school children in England aged 11-15 years\textsuperscript{13} showed that:

- Prevalence of drug taking in the previous month was around 12%, while prevalence of drug taking in the previous year was around 20%, between 2001-03.
- 1% of pupils took drugs most days, a further 2% took drugs at least once a week, and a further 3% took drugs once or twice a month.

There is limited data on the impact air pollution has on lung function, but it has been estimated that up to 572 / 100,000 children in England and Wales have long term lung function affected by air pollution.

Work has also been conducted looking at the impact of lead on children’s health. Though this has been substantially reduced following the ban on lead additives in petrol in the 1990s, there is still a risk as a result of lead deposition. The developing brain is particularly susceptible to lead; one study has estimated\textsuperscript{12} that 0.5 children per 1000 population aged 0-4 were affected by mild mental loss and that 14,000 DALYs (Disability Adjusted Life Years) were lost as a result of lead exposure across 11 European countries.

11.4.3 Poisons

Children are most likely to suffer from accidental self-poisoning, mainly from ingestion of household products, chemicals or pesticides. These do not often lead to hospital admission though often present at A&E. As many as one quarter of all telephone enquiries to the NPIS are in relation to young children and infants.
As with adults, the two main poisons which affect children are alcohol and tobacco.

**Alcohol**

A survey conducted among school children in England aged 11-15 years in 2003 found that:

- Boys continue to be more likely than girls to have drunk alcohol in the last week (26% compared with 24%). Boys drank an average of 10.5 units in the previous seven days compared with the 8.5 units drunk by girls.
- The average weekly consumption among pupils increased from 5.3 units in 1990 to 9.9 units in 1998.

In 2004, 3,322 children aged 11-15 were admitted to hospital for alcohol-related problems.

**Tobacco**

Results from a survey among young people aged between 11-15 years in England show that:

- Prevalence of regular smoking (at least one cigarette a week) decreased from 10% in 2002 to 9% in 2003, but has remained stable, at between 9% and 11% since 1998.
- There is a sharp increase in prevalence of smoking with age - 1% of 11 year olds smoke regularly compared with 22% of 15 year olds.
- Overall, girls are more likely to be regular smokers than boys; smoking was reported by 16% of 14 year old girls compared with 9% of 14 year old boys.

Smoking is addictive: 82% of smokers took up their smoking habit as teenagers.

11.4.4 **Injuries**

Injuries in children is an area of concern, largely as it has a high impact on both the economy and socially. Department of Trade and Industry (DTI) surveillance reveals that over 2 million children are taken to hospital after accidents every year; about half of these happen at home. Until recently, accidental injury (228) was the biggest cause of death for children aged 1-14, but this has now fallen below the rate of deaths from cancer (307).

Data collated from two main datasets: the Hospital Episode Statistics for England (not inclusive of A&E with no admissions) and the National Mortality Statistics for England and Wales age group 0-14 show:

- Injuries of children account for over 15% of all hospital admissions for injury.
- Over a third of all pedestrian road traffic accidents and over half of all drownings and burns occur in the 0-14 age bracket.
- Little change has occurred in the last six years in children’s injury admissions.
- Deaths from injuries in England & Wales (2001) is low at 2% (approximately 700 deaths of those aged 0-14), but this represents significant years of life lost.
- Injuries often require a significantly longer stay in hospital than for other diseases and may also have long-term impact and disability.
- A strong link between injury mortality and socioeconomic status has been documented, but the link is less clear for non-fatal injuries.

Figure 11.5 shows summary of Hospital Episode Statistics data related to injuries for children based on DH statistics for England 2002/03.
Figure 11.5 Percent of hospital admissions by injury for children aged 0-14 years
11.5 Children’s health inequalities

Information on children’s health inequalities has been included in previous chapters and also in the following chapter on Health Inequalities. Inequalities continued to be an area of concern within England with over 20% of children (2000/01) being categorised as being in low income households\(^{16}\). It is recognised that the chance of being healthy is influenced by social circumstances even before children are born through factors such as smoking during pregnancy and low birth weight.

The General Household Survey\(^{17}\) monitoring self-reported ill health and use of health services reported a tendency towards a higher proportion of children in manual households having a longstanding illness. This also reported that children in manual households are more likely to consult GPs than non-manual, especially in the 0-4 age group.

In general, inequalities in health-related behaviour were much more marked than those in health. This raises questions about the timing of the impact of health behaviour in relation to health at subsequent stages of life.

Hospital admission, particularly in children, is often dependent upon the perceived deprivation status, with judgements being made about the quality of care available at home and the likelihood of return for outpatient treatment. This leads to the most deprived being more readily admitted than the more affluent. This needs to be taken into account when interpreting reported associations between deprivation and hospital admission rates.

11.5.1 Infections

Respiratory infection is associated with inequalities in all age groups, particularly in children. Hospitalisation for respiratory infection showed that admission rates were nearly twice as high for children under five in the most deprived, compared to the least deprived quintile\(^{19}\).

Living conditions in childhood were found to be a powerful predictor of current infection. Infectious agents are increasingly being linked with chronic diseases; for example, *Helicobacter pylori* has been associated with peptic ulcers and gastric cancer\(^{20}\).

Analysis of routine data showed that deaths from infectious or respiratory diseases were 2.5 to 3.0 times higher in children allocated to social class V (most deprived) than to social class I (wealthiest)\(^{21}\). Rarer but more serious infections have also been found to be associated with social inequalities. Meningococcal disease was found to be more common in more deprived households in two case-control studies\(^{22}\).

11.5.2 Environmental inequalities

Environmental quality varies between different regions and communities and there is inequitable distribution of environmental hazards among children of different social groups and different regions of England and Wales.

Further details are in Chapter 7, Environmental Inequalities.

While there are only about 1,700 Integrated Pollution Prevention Control (IPPC) sites in England and Wales, around 10% (over 1.2 million) of children live within 1 km of such a process. There is considerable regional variation with less than 5% of children in the South West and around 15% in the North West living within 1 km. There is also a strong and, for some regions, a significant relationship between childhood deprivation and increasing proximity to large industrial processes in England. An estimated 42% of children who live within 1 km of a part A1 process are in the most deprived quintile compared with 7% from the least deprived (see page 7.3 for definition).

11.5.3 Poisons

There is limited data on inequalities in children and rates of poisoning, however the data in Table 11.i indicates that there are socio-economic issues related to the rates of poisoning.

<table>
<thead>
<tr>
<th>Period</th>
<th>Non-manual</th>
<th>Manual</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979 – 99</td>
<td>0.61</td>
<td>1.41</td>
<td>2.36</td>
</tr>
</tbody>
</table>
11.5.4 Injuries

Considerable work has been undertaken looking at the links between injuries and inequalities. The analysis of injury death trends by social class in England and Wales indicates that the risk to the poorest is considerably greater than that to wealthier members of society. Amongst 0-15 year olds, unintentional injury rates are considerably higher amongst the most deprived (83 deaths per 100,000) compared to the most affluent (16 deaths per 100,000). There are signs that this inequalities gap has widened, with the poorest now being five times more likely to die from an unintentional injury relative to the more affluent.

Intentional injury rates, although lower than unintentional injury rates, have an even greater inequalities gap, with those in the lowest social class nine times more likely than the most affluent to die from intentional injuries. The most deprived are over five times more likely to be killed in pedestrian incidents than their more affluent counterparts and this inequalities gap appears to be widening. Affluent families have greater access to cars, meaning that these children often walk less.

An association has been found between deprivation and non-fatal injuries. The Health Survey for England has reported some association between major accident rates and household income, with higher accident rates amongst children (aged 0-15) in lower income families and in households with only one adult. This study found no association between injuries and socio-economic status amongst young adults (aged 16-24). This does however vary between specific injury groups and is an extremely complex relationship.

Figure 11.6 Road traffic casualties per 100,000 resident population, children (aged 0-15) by area deprivation

[Diagram showing road traffic casualties per 100,000 resident population for different levels of deprivation, with bars for 1998 and 2003.]
12 Health Inequalities
12 Health Inequalities

KEY MESSAGES

- Health inequalities continue to be a major problem and it is difficult to measure changes in these.
- Gastrointestinal infection leading to hospital admission was 2.4 times higher in the poorest fifth of the population than in the most affluent fifth.
- There is a strong, and for some regions a significant, relationship between childhood deprivation and increasing proximity to large industrial processes in England.
- There are gaps in the currently available data on health inequalities, particularly on the impact of environmental hazards.
- It is difficult to evaluate the burden of disease caused by inequalities as it is a very complex area, often with many factors involved and a long-term impact on health.

12.0 Introduction

The health of the population has been improving steadily over the last century. However, the gap between those in the advantaged and disadvantaged groups seen in the main causes of death has widened. This is partly because the overall improvements in health mean that those in disadvantaged groups must have a greater improvement in order to reduce this gap.

It is recognised that those in disadvantaged groups are more likely to die earlier and be in poorer health than the rest of the population. The reasons behind this are complex, with links to social and demographic circumstances: education, occupation, income, housing, sex, ethnicity and location. Lifestyle behaviours such as smoking, drinking, diet and risk taking are also an issue. In January 2005 the Cabinet Office, stated that 8 million people, just over 15% of England’s population, live in deprived areas.

There are a number of Government initiatives aimed at improving health inequalities, including the Choosing Health White Paper, and more specifically Tackling Health Inequalities: A Programme for Action (2003), Department of Health. The target of this was ‘to reduce inequalities in health outcome by 10% by 2010, as measured by infant mortality and life expectancy at birth’.

Taking This Forward

- Making the reduction of health inequalities for infectious diseases and environmental hazards a key part of all health programmes.
- Ensuring surveillance of important diseases can measure trends in health inequalities, so as to measure progress in reducing them.
- Improving characterisation of the major environmental inequalities to identify how best to target health improvement efforts.
- Focusing on priority areas: children living in poverty.
12.1 Regional inequalities

Figure 12.1 shows variations in average years of life lost (highlighting deaths which occur at a young age) across the UK regions. Although there are differences between males and females (as seen across the general population in Chapter 3), there are regional variations in particular between the north and south of England.

Inequalities can be examined in a number of ways: location (e.g. regional variations), socio-economic, vulnerable groups and ethnic groups.
Within regions there are also issues regarding access to health services. The Department of Health’s progress report on Tackling Health Inequalities\(^5\) shows there has been an increase in the number of GPs per head of population since 2002, including the GP numbers in disadvantaged areas. However, there has been no significant narrowing of the gap between most and least deprived areas (Figure 12.2), where there is a greater need for access to GPs, signalled by research showing that children in manual households are more likely to consult GPs relative to non-manual households, especially in the 0-4 age group.

<table>
<thead>
<tr>
<th>ONS Comparison Groups for South East Region Health Authorities</th>
<th>Average Annual Years of Life Lost (per 10,000) Male</th>
<th>Average Annual Years of Life Lost (per 10,000) Female</th>
<th>Average Annual Years of Life Lost (per 10,000) All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Amenity</td>
<td>611.0</td>
<td>396.2</td>
<td>503.6</td>
</tr>
<tr>
<td>Mixed Urban</td>
<td>610.0</td>
<td>391.0</td>
<td>500.5</td>
</tr>
<tr>
<td>Coast and Country Resorts</td>
<td>727.1</td>
<td>448.5</td>
<td>587.8</td>
</tr>
<tr>
<td>Growth Areas</td>
<td>556.2</td>
<td>367.9</td>
<td>462.1</td>
</tr>
<tr>
<td>Most Prosperous</td>
<td>555.6</td>
<td>352.0</td>
<td>453.8</td>
</tr>
</tbody>
</table>

Within regions there are also issues regarding access to health services. The Department of Health’s progress report on Tackling Health Inequalities\(^5\) shows there has been an increase in the number of GPs per head of population since 2002, including the GP numbers in disadvantaged areas. However, there has been no significant narrowing of the gap between most and least deprived areas (Figure 12.2), where there is a greater need for access to GPs, signalled by research showing that children in manual households are more likely to consult GPs relative to non-manual households, especially in the 0-4 age group.
12.2 Socio-economic groups

There is an appreciable difference in chronic sickness across different socio-economic groups and the broad areas of ill-health, as seen in Figure 12.3. This shows the same trends across all three socio-economic groups, with those in the routine and manual group having the highest incidence of chronic sickness across all areas of health.

12.3 Vulnerable groups

Some groups are more vulnerable to health inequalities than others. The very young and those over 75 years of age are particularly vulnerable to infectious diseases and environmental hazards. Also some groups, such as homeless people, sex workers, refugees, travellers (e.g. Romany) and prisoners may suffer greater inequalities than the majority of the population.

Migration and travel. In 2003, 165,500 economic migrants and their dependants, 319,000 students and 49,405 asylum seekers entered the UK. Many are from countries with a high burden of infection such as gastrointestinal illness, sexually transmitted infections and malaria, as well as chronic infections such as HIV and tuberculosis. In 2002:

- 67% of new cases of tuberculosis in the UK occurred in the foreign-born population; 56% of whom developed disease at least five years after arrival.
- 43% of patients newly diagnosed with HIV were known to have been born overseas.
- Hepatitis B data shows that 95% of carriers acquired the infection outside the UK.

A number of notifiable infections are now mostly acquired by UK residents when visiting less developed countries. Immigrants and their children will often visit their country of origin for a number of months to stay with friends and relatives, where they may be exposed to diseases not commonly encountered by tourist or business travellers. Recent immigrants are also less likely to have received routine childhood immunisations, which may leave them at increased risk of diseases.
12.4 Specific topics

12.4.1 Infections

There is evidence of marked social inequalities for common infectious diseases, and the burden is unequally distributed by ethnic group and sexual orientation. Analysis suggests there is a negative correlation between socio-economic status and consultations for infectious diseases (with rates being higher in class V; unskilled compared with class I; professional), and that this relationship was fairly constant with age. Much of this relationship could be explained by increasing rates of respiratory infections in those of lower socio-economic status.

- Gastrointestinal infection leading to hospital admission was 2.4 times higher in the poorest fifth of the population than in the most affluent quintile.
- Hospitalisation for respiratory infection showed that admission rates were nearly twice as high for children under five in the most deprived compared to the least deprived quintile.

A study of gonorrhoea in Leeds found the incidence to be four times higher in the most deprived areas than in the most affluent.

Infectious agents are increasingly being linked with chronic diseases; for example, *Helicobacter pylori* has been associated with peptic ulcers and gastric cancer. Living conditions in childhood were found to be a powerful predictor of current infection.

Consultation rates for respiratory diseases increase with decreasing socio-economic status in all age groups. The average consultation rate in class V (unskilled) was 50% higher than class I (professional).

12.4.2 Radiation

Evidence is not conclusive, but there is a possibility that prolonged exposure to high voltage power lines may lead to a small increased risk of leukaemia among children. It has been estimated that about 4% of children in England and Wales live within 600 m of high voltage lines at birth and children living nearest to these are often disadvantaged. However, some homes not close to power lines also have high ambient magnetic fields.

Figure 12.4 Consultations per 1000 person years for infectious diseases by socio-economic status* and age

![Graph showing consultations per 1000 person years for infectious diseases by socio-economic status and age]
12.4.3 Environmental pollution and inequalities

While our environment is much healthier than in previous generations and continues to improve, environmental quality varies between different areas and communities. There may also be indirect effects on community health - there is evidence for example that property values are adversely affected by locality.

- There is considerable regional variation, with less than 5% of children in the South West living within 1 km of IPPC sites, compared with 15% in the North West.
- There is a strong, and for some regions a significant, relationship between childhood deprivation and increasing proximity to large industrial processes in England.
- 42% of children in England living within 1 km of a site are in the most deprived quintile compared with 7% from the least deprived.

Similar trends in health outcomes have been reported. For example, a report published by the Chief Medical Officer (CMO) in 2001 showed that, while relatively affluent populations experienced relatively good and similar levels of health irrespective of region, mortality rates in deprived populations showed a clear north-south trend markedly similar to the trends in levels of childhood deprivation reported here. Some of the differences in mortality will be due to lifestyle factors such as alcohol consumption and smoking and other confounding factors but there may also be an environmental component.

**Carbon monoxide (CO) exposure:**
Measurements were taken in 237 London homes for around two weeks. These homes were selected from a programme aimed at reducing fuel poverty (those who have to spend more than 10% of their income to heat their home) in East London, with owners typically from the lowest income sector. Data analysis showed that “fuel poor” households have a high number of possibly dangerous gas appliances. CO exposure at relatively low concentration may be a cause of adverse cardiovascular and neurological health effects.

Presented at the HPA Annual Conference, 2005
Appendix A - References

Chapter 3


Chapter 4

Chapter 5


Chapter 6


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Chapter 10

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Health Protection in the 21st Century

Report prepared by the Chief Executive’s Office, Health Protection Agency.

Prof. Pat Troop
Chief Executive, Health Protection Agency

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for co-ordinating this project and
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Raquel Duarte-Davidson, Health Protection Agency
for helping to write this summary report.

Please direct any queries concerning this report to
burdenofdisease@hpa.org.uk

This report and supporting documents are available at
http://www.hpa.org.uk/publications/

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Environmental inequalities: Pat Saunders, Rebecca Gay, Health Protection Agency, Centre for Radiation, Chemical and Environmental Hazards.

Chemical incidents: Brett Jeffery, Pat Saunders, Health Protection Agency, Centre for Radiation, Chemical and Environmental Hazards.


Injuries: Sarah Jones, Sharon Parry, Department of Epidemiology, Statistics and Public Health, Cardiff University.

Many others have helped in the development of this report, in particular, Mike Joffe, Emma Ellison and Stephen Palmer of the Health Protection Agency.

Full references and the methodology used for unpublished analyses are in the supporting documents posted on the HPA website.
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