THE REAL COST OF POOR HOUSING

The relationship between poor housing and poor health has been recognised for a long time, but until recently it has not been possible to estimate the cost to society of poor housing. Although the problems of disease associated with slum living have largely been eradicated in England, a significant number of health and safety hazards in the home remain.

This report highlights weaknesses in existing models of the housing stock and proposes a new model which overcomes them. The model uses data obtained from the English House Condition Survey to illustrate the effects of various scenarios and repair options. It clearly demonstrates that money invested in improving poor housing could have a significant impact on improving health and reducing the financial burden on the NHS.

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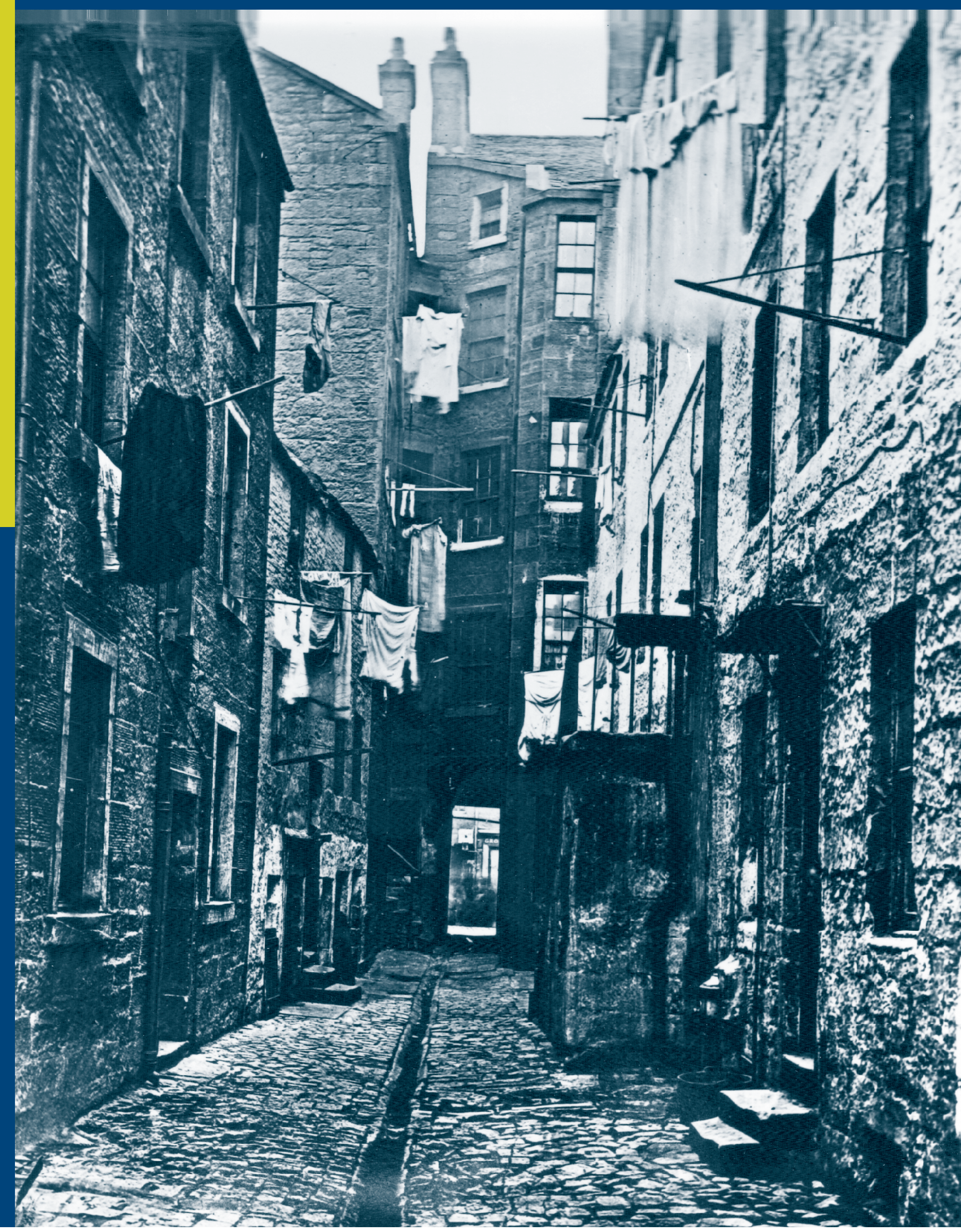

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CONTENTS

ACRONYMS

CIEH	Chartered Institute of Environmental Health
CLG	Department for Communities and Local Government
DWP	Department of Works and Pensions
DALY	disability adjusted life years
EBD	environmental burden of disease
HASS	Home Accident Surveillance System
HHSRS	Housing Health and Safety Rating System
ICD	International Classification of Diseases (WHO)
LARES	Large Analysis and Review of European housing and health Status
NPV	net present value
ONS	Office of National Statistics
RIA	Regulatory Impact Assessment
SAP	standard assessment procedure
SRB	Single Regeneration Budget
WHO	World Health Organization

FOREWORD

As President of the Chartered Institute of Environmental Health, I am delighted to have been asked to write the Foreword to this significant research report, which provides timely evidence that can be used to persuade policy-makers to better direct activity and investment in housing. Despite the recognition that even in the 21st century housing is a key determinant of health, too often it has proved difficult to make the public health case for more concerted action on housing conditions – hence the development of the CIEH HHSRS Costs Calculator.

As the WHO LARES Project has also shown: the home environment; the dwelling itself; the community; and the neighbourhood have significant roles in the housing and health nexus. The Housing Health and Safety Rating System has been developed as a methodology to better assess the risks to health and safety from deficiencies in dwellings and allows interventions to be better focussed. Additionally, it should lead to more coherent strategies to deal with housing conditions, but it also has wider applications in the development of policy, as this research report demonstrates. We often hear calls for a more joined-up approach to policy development – this report underpins why in the arena of housing and public health this is so important. It clearly demonstrates that money invested in improving poor housing could have a significant impact in improving health and reducing the financial burden on the NHS (the most immediate and obvious costs to society of unhealthy housing).

This is an important publication that should not only be used by local housing authorities in developing strategies with Primary Care Trusts so as to better direct scarce resources, but should be essential reading for those at the Government level not just in the Departments of Health, and Communities and Local Government, but particularly those within HM Treasury.

Dr Stephen Battersby
President, CIEH

1 INTRODUCTION

1.1 BACKGROUND

There is a long established, recognised relationship between poor housing and poor health. In Victorian times diseases such as tuberculosis, cholera and typhus were known to be associated with insanitary, cold, damp and overcrowded housing conditions. This led to various public health acts and eventually to the Housing of the Working Class Act, 1890 which was the first attempt to consolidate the law relating to housing. The first national definition of homes that were 'unfit for human habitation' appeared in the Housing Act of 1954 and this remained (with various changes) as the minimum standard of housing in England and Wales until 2006 (the last version, following the 1989 Housing Act, is still applied in Northern Ireland). The problems of disease associated with 'slum' living have largely been eradicated, but there remains a significant number of health and safety hazards in the home, compounded by the fact that the UK has one of the oldest stocks of housing in the developed world, and one of the lowest rates of housing replacement.

Many studies have investigated the relationship between housing and health but, because of the number of intervening variables, it is difficult to demonstrate clear and measurable cause/effect relationships. Nevertheless there is a large and growing body of evidence linking systematically adverse health effects with poor housing conditions. These conditions include dampness, the effects of living in a cold home, household accidents, noise, insecurity, overcrowding and fire safety. Unaffordable housing can also be poor housing and there is compelling evidence linking unaffordable housing to poor health (Zaccheus 2000 Trust, 2005). It must be acknowledged that a number of poor housing conditions (eg overcrowding, inability to heat the home to a reasonable temperature or keep up with the costs of necessary maintenance) often arise as a direct result of high rents, mortgage payments, utility bills etc.

BRE and Warwick University have been involved in the development of the Housing Health and Safety Rating System (HHSRS) which was included in the 2004 Housing

Act. The HHSRS replaced the Dwelling Fitness Standard (under the Housing Act 1985) as the minimum standard for housing in April 2006. The HHSRS produces scores for dwellings based on the statistical risk of 29 health and safety hazards leading to harm to the occupants.

Through the English House Condition Survey (EHCS), which since 2005 has identified and assessed hazard risks under the HHSRS, we are able to quantify the national risk of poor housing. However, up until now, no one has ever had the data to be able to estimate the cost to society of poor housing. Such information is seen as important to support the argument that improving housing makes economic as well as social sense. The information could inform strategies to target housing improvements on those situations which will have the most impact on health where funds are limited, and demonstrate that a little more effort spent on good housing design and improvement could save money (as well as lives) over time. Information on the current and future cost of poor housing will help inform the debate over the University of Oxford's *40% House study* (www.eci.ox.ac.uk), which suggests that a large proportion of the UK's older housing will have to be demolished because it will not be economically viable to make it meet current standards.

1.2 AIMS AND OBJECTIVES

The key objectives of the BRE/University of Warwick project were to:

- review current literature and research on the relationship between hazards in the home and health
- examine the availability and coverage of data sources on housing and health
- review current literature and research on the cost to society of poor housing
- quantify the national risk (England) under the 29 hazards of the HHSRS, in terms of extreme, serious and severe health hazards
- estimate the cost of making the existing English housing stock healthy and safe (to an acceptable level) through analysis of the latest EHCS data
- produce 'cost to society' averages for key HHSRS hazards using Department of Works and Pensions (DWP) data, insurance data, EHCS and other sources.

1.3 SCOPE

This report shows the background information and assumptions made in generating a new interactive spreadsheet model to calculate the costs and benefits associated with the main building-related hazards found in homes in England.

All values used are the best estimates that could be found at the time of the model creation. The model is, however, designed to be flexible so that more up-to-date or accurate values could be used. The conclusions based on these values are therefore likely to be underestimates of the real current day costs, and are at best only representative of the large range of potential costs associated with each hazard.

2 THE EVIDENCE ON LINKS BETWEEN HOUSING AND HEALTH

2.1 RESEARCH AND STATISTICS

Work on collecting and strengthening the evidence on links between health and housing has increased over the last two decades. While there is no doubt about the linkage between poor housing and poor health in the judgement of health professionals working in 'frontline' situations in poorer areas (see for example Ambrose 1996, Part III) the research required to demonstrate the effects is not easy to carry out. A recent discussion of work on urban regeneration and health (Popay, 2001) has drawn attention to the urgent need to move towards a better resourced and systematic research drive on this issue. A subsequent review (Thomson et al., 2002) has found that while there are many thousands of studies linking housing improvement to health gain, only a handful have offered robust evidence about a 'before and after renewal' benefit. This handful does include the 'health gain' work in the context of the Single Regeneration Budget (SRB) regeneration of an area of Stepney carried out by Ambrose and colleagues (1996, 2001 and 2002). This work demonstrated a seven-fold reduction in self-reported ill health following re-housing in better conditions.

Recent work (CLG, 2008) has revised and updated evidence on building health and safety risks, including housing conditions, and the health of users (Mant and Muir Gray, 1986; Cox et al., 1995; Raw et al., 1995 and Raw et al., 2001). There have also been several books and reports concentrating specifically on housing and health (eg Ranson, 1991; Burridge and Ormandy, 1993; Ineichan, 1993; Ambrose, Barlow et al., 1996; BMA, 2003 and Howden-Chapman and Carroll, 2004), and special issues of journals devoted to the housing environment and the well-being of residents (eg *American Journal of Public Health*, 2003 and *Reviews on Environmental Health*, 2004). Many recent studies, notably Marmot et al. (1991), Syme (1994), Sandel et al. (1999), Airey et al. (1999), Coleman (1999), Graham (2000), Attanasio and Emmerson (2001), Gravelle and Sutton (2001) and Jefferis et al., (2002), have explored the multi-faceted links between poor socio-economic status and poor health and educational status. Some of these studies implicate poor housing directly as a factor. For example, according to Sandel et al. (ibid), a deficit of adequate housing has resulted in 21,000 North American children having stunted growth and more than 120,000 being anaemic. They also report that 77% of children in their study, with chronic conditions such as asthma, need improvements to their home as part of their treatment.

There has been much research on the effects on health of low temperatures in the home since the pioneering assessment of the cost of indoor cold (Boardman, 1991). Rudge (2001) has been active in developing a methodology to assess the cost-effectiveness of investment in warmer homes. This seeks to correlate data on low income, building characteristics and admissions to hospital. Baker (2001) from the Centre for Sustainable Energy has produced a review of evidence linking living in a fuel-poor home with increased risk of illness. This shows in particular a strong association between indoor cold and increased risk of strokes, heart attacks and respiratory illness. Evidence is also reviewed on the impact of cold stress causing cardiovascular strain, the increased incidence of dust mites in poorly ventilated homes affecting asthma and eczema, particularly in children, and the effect on mental and physical health of the presence of damp and mould growth in the home. A national campaign has been run by National Energy Action to draw attention to the risks and costs produced by insufficient indoor warmth.

The relationship between inadequate indoor heating and excess winter deaths has been extensively studied (eg Eurowinter Group, 1997). Similarly Wilkinson and colleagues (Wilkinson et al., 2001) concluded that there is an excess of about 40,000 deaths each winter compared to the death rate in non-winter months. In particular, there is a 23% excess of deaths from heart attacks and strokes. Indoor temperatures below 16°C are a particular risk and are most likely to affect old and poorly heated housing with low-income residents. In 37% of lowest income quartile homes, the indoor hall temperature was likely to fall below 16°C when it was below 5°C outside. The authors conclude that there is '…a credible chain of causation which links poor housing and poverty to low indoor temperatures to cold-related deaths.'

The Acheson Report *An Independent Inquiry into Inequalities and Health* (1998) and the annual *Health Surveys for England*, produced by the Department of Health, are among the official publications highlighting the housing/health link. Significantly Acheson stressed the need to address factors outside the NHS itself and some of his recommendations called for measures to reduce poverty and improve education and housing.

In addition to this largely UK-based work, there have been several conferences which have demonstrated the wealth of international studies, including the series of Unhealthy Housing conferences at the University of Warwick in 1986, 1987, 1991, 2003 and 2007; the World Health Organization's symposia on Housing and Health in 2002 and 2004; and sessions in conferences such as Healthy Buildings 2006.

A study commissioned by the UK government provided an opportunity to build on the existing reported research on housing conditions and the links with the health and safety of occupiers (ODPM, 2003). A major part of this study was the analysis of matched databases – a housing and population database and datasets on reported health outcomes – to give details on the prevalence of a wide range of illness, injuries and other health conditions that could be related to housing conditions in England. This study identified 29 potential hazards (Table 1) all of which, to a greater or lesser extent, could be attributable to housing design and/or condition. The work excluded hazards, such as environmental tobacco smoke, attributable solely to occupier behaviour included in Raw et al. (2001) and CLG (2008).

Based on the work for the ODPM, initial estimates suggested that, in England, these hazards were implicated in up to 50,000 deaths from all causes and around 0.5 million injuries and illness requiring medical attention each year. The greatest number of deaths, over 30,000, were linked to problems of excess cold because of energy inefficiency (Wilkinson et al., 2001).

The strength of the evidence linking health outcomes to housing conditions varies. It is strongest, particularly in terms of numbers and outcomes, for accidents resulting in injuries and deaths. The evidence suggests that accidents in the home result in more injuries than accidents at work or on the road.

Unintentional injury led to 10,349 deaths, according to Office for National Statistics (ONS) 2002 death data for

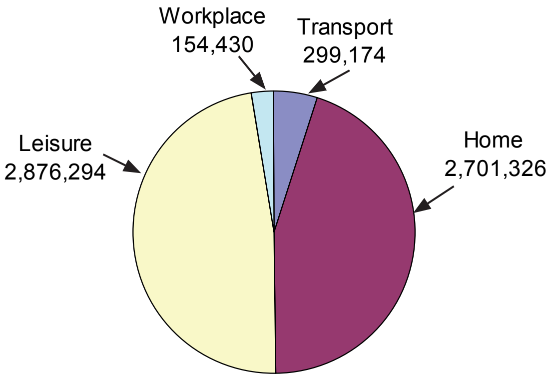


Figure 1: Breakdown of injuries by location.

England and Wales, making this the eighth most common cause of death, accounting for nearly 2% of all deaths (ONS, 2005). Unintentional injuries were in the top 10 leading causes of death across all age groups (Table 2).

The unintentional injury deaths can be split into those relating to vehicle accidents (2,960) and those that occurred in the home (3,547). The remainder include workplace accidents (at least 226, recorded in *Statistics of Fatal Injuries 2002/03* [HSE, 2003]), leisure accidents and those where it is unclear what was involved or where the injury occurred (3,842 in total including workplace). When the data is broken down in this way, unintentional injuries in the home were still the 20th most common cause of death, and in the top 10 causes of death for all age groups up to 55 years of age.

The differentiation between injury types is even more marked when the outcome is not death. Data recorded in the home and leisure accident surveillance system (HASS and LASS) are available up to 2002. Workplace data are recorded in *Health and Safety Statistics Highlights* 02/03 (HSE, 2003) and *Transport Injuries in Road Casualties Great Britain 2002* (Department for Transport, 2003). The number of non-fatal injuries by location is shown in Figure 1, with 45% of the injuries occurring in the home.

***Table 1:* The 29 potential housing hazards (ODPM, 2003)**

Physiological requirements	Psychological requirements	Protection against infection	Protection against accidents
1 Damp, mould growth etc.	11 Crowding and space	15 Domestic hygiene, pests and refuse	19 Falls associated with baths etc.
2 Exce ssive cold	12 Entry by intruders	16 Food safety	20 Falls on the level
3 Excessive heat	13 Lighting	17 Personal hygiene, sanitation and drainage	21 Falls associated with stairs and steps
4 Asbestos and MMF	14 Noise	18 Water supply for domestic purposes	22 Falls between levels
5 Biocides			23 Electrical hazards
6 Carbon monoxide and fuel combustion products			24 Fire
7 Lead			25 Hot surfaces and materials
8 Radiation (radon)			26 Collision and entrapment
9 Uncombusted fuel gas			27 Explosions
10 Volatile organic compounds			28 Position and operability of amenities
			29 Structural collapse and falling elements

Table 2: Top 10 leading causes of death by age group (2002, ONS data)

Rank	01-04	05-09	10-14	15-24	25-34	35-44	45-54	55-64	65+	Grand total
1	Congenital anomalies 97	Malignant neoplasms 96	Malignant neoplasms 108	Unintentional injuries 956	Unintentional injuries 954	Malignant neoplasms 2,646	Malignant neoplasms 8,381	Malignant neoplasms 20,336	Heart disease 115,030	Malignant neoplasms 136,768
2	Malignant neoplasms 82	Unintentional injuries 57	Unintentional injuries 102	Malignant neoplasms 306	Malignant neoplasms 775	Heart disease 1,344	Heart disease 4,351	Heart disease 10,496	Malignant neoplasms 104,038	Heart disease 131,700
3	Unintentional injuries 69	Other diseases of the nervous system 40	Other diseases of the nervous system 44	Suicide 289	Suicide 673	Unintentional injuries 971	Liver disease 1,636	Cerebrovascular 2,363	Cerebrovascular 54,958	Cerebrovascular 59,060
4	Other diseases of the nervous system 49	Congenital anomalies 24	Congenital anomalies 40	Event of undetermined intent 227	Mental and behavioural disorders 450	Liver disease 905	Cerebrovascular 1,141	Bronchitis, emphysema, asthma 1,953	Influenza and pneumonia 31,081	Influenza and pneumonia 32,629
5	Other endocrine, nutritional and metabolic disease 38	Other endocrine, nutritional and metabolic disease 20	Other endocrine, nutritional and metabolic disease 26	Mental and behavioural disorders 200	Event of undetermined intent 367	Suicide 789	Unintentional injuries 824	Liver disease 1,491	Unspecified dementia or senility 24,232	Bronchitis, emphysema, asthma 26,007
6	Meningococcal infection 24	Heart disease 17	Bronchitis, emphysema, asthma 16	Other diseases of the nervous system 117	Heart disease 313	Cerebrovascular 434	Suicide 594	Influenza and pneumonia 821	Bronchitis, emphysema, asthma 23,389	Unspecified dementia or senility 24,323
7	Heart disease 22	Other diseases of the digestive system 9	Event of undetermined intent 12	Heart disease 116	Liver disease 177	Event of undetermined intent 391	Bronchitis, emphysema, asthma 443	Unintentional injuries 730	Other diseases of the digestive system 9,669	Other diseases of the digestive system 10,788
8	Other abnormal clinical and laboratory findings 19	Bronchitis, emphysema, asthma 9	Mental and behavioural disorders 12	Congenital anomalies 73	Other diseases of the nervous system 113	Mental and behavioural disorders 308	Influenza and pneumonia 415	Other diseases of the digestive system 659	Aortic aneurysm 8,138	Unintentional injuries 10,349
9	Other diseases of the respiratory system 17	Event of undetermined intent 8	Heart disease 11	Epilepsy 71	Cerebrovascular 108	Other diseases of the nervous system 187	Other diseases of the nervous system 320	Aortic aneurysm 559	Other diseases of the respiratory system 8,093	Aortic aneurysm 8,890
10	Septicaemia 14	Epilepsy 8	Epilepsy 11	Other endocrine, nutritional and metabolic disease 70	Epilepsy 106	Influenza and pneumonia 181	Event of undetermined intent 300	Other diseases of the nervous system 516	Unintentional injuries 5,686	Other diseases of the respiratory system 8,870
All deaths	551	356	469	2,892	5,078	9,970	21,587	45,454	444,043	530,400

Table 3 summarises how the potential hazards outlined in Table 1 are linked to housing, by highlighting the key housing characteristics giving rise to these hazards and the main health outcomes identified. Many of these health outcomes are not injuries, but include cancer (malignant neoplasms), cerebrovascular problems, and asthma, all of which are some of the leading causes of death (Table 2).

2.2 SOURCES OF DATA ON HOUSING AND HEALTH

The background statistics relating to housing health can be obtained from a large number of sources.

Statistical Evidence to Support the Housing Health and Safety Rating System

Statistical Evidence to Support the Housing Health and Safety Rating System (HHSRS) (CLG, 2003) provides information on accidental home injuries. It provides a detailed breakdown of the numbers and severity of injuries linked to different dwelling features – eg the number of fall injuries and deaths linked to the use of stairs and steps associated with dwellings. The approach adopted for matching and analysing data on other health outcomes was based on probabilities, but these can be used to provide robust estimates of the number of each class of outcome.

English House Condition Surveys (EHCS)

An EHCS has been undertaken every five years (by various organisations, currently BRE) since 1971 with a sample size of around 17,000 in 2001. Since 2002 it has been carried out on around 8,000 dwellings every year and the most recently available data is for 2006/07. These are sample surveys including interviews with householders and a physical survey of dwellings to provide a description of the state of the housing stock. The EHCS provides information on the composition, ownership and condition of the housing stock, the quality of facilities and services, limited information on the occupants' health, accidents and fires in the home, and information of household size and composition. From 2005, the EHCS has also directly measured some of the key hazards covered under the HHSRS.

Fire & Rescue Service returns

Returns are collected on fires attended by the Fire & Rescue Service. Since 2000 the national records have been collated by CLG and the most recently available is for 2004. These national records include records of any fatalities and injuries caused by these fires. This information can supplement and improve the data provided by HASS and the EHCS.

British Crime Survey

The British Crime Survey is a sample survey collected by the Home Office, providing information on burglary and attempted burglary. It also includes information on all fires (including those resulting from arson) whether or not the Fire & Rescue Service attended and whether or not they resulted in death or injury. Again, this can supplement data from HASS, EHCS, and Fire & Rescue Service returns. The most recently available data is from 2004.

Home Accident Surveillance System (HASS)

From 1976 to 2002, domestic accidents were monitored by the collection of case histories from a sample of accident and emergency units in hospitals throughout the UK. The information, collected by the Department of Trade and Industry, includes details of the essential characteristics of accidents such as the product or dwelling feature involved and the type and seriousness of the injury caused. It also includes records for persons who attended the sample accident and emergency units for treatment for injuries caused by accidental fires in the home. Data from HASS was originally used to inform industry, but became useful to safety professionals and health authorities.

Since 2002, there have been no comparative data collected. Now, the only source is from the Hospital Episode Statistics, but this is nowhere near as detailed or accurate.

Hospital Episode Statistics

Hospital Episode Statistics contain records of inpatient admissions for all NHS hospitals in England. These are collated by the Department of Health, and records include the patients' postcodes – which allows matching to housing and population data – and 28 other variables detailing the patient, including diagnosis codes, age and sex. The diagnosis coding follows the *International Statistical Classification of Diseases and Related Health Problems, 10th revision* (ICD-10) (WHO, 2001).

Permission to obtain and use Hospital Episode Statistics is given by the Bellingham Committee.

General Practice Research Database

The General Practice Research Database is held by the ONS. It is the world's largest computerised database of anonymised longitudinal patient records from general practice, containing more than 35 million patient years of data. It can be used to provide data on new GP consultations and is particularly useful in respect of minor health conditions. It contains data from 1987 to 2003. Permission to use the data is given by the Independent Scientific Advisory Committee of the Medicines and Healthcare Products Regulatory Agency and a fee may be charged for the supply of tables or data sets.

Morbidity Survey in General Practice

The national morbidity study gives details of all patient consultations conducted at 60 general practices in England and Wales, collected over a 12 month period, together with socio-economic patient data. The database covers slightly in excess of half a million records and can be used to supplement data from the General Practice Research Database. The most recently available data is for 1994.

Statutory Notification of Diseases

Since the 19th century, doctors in England and Wales have had a statutory duty to report suspected cases of certain infectious diseases through the Notifications of Infectious Diseases system. The responsibility for administering this system is now with the Communicable Disease Surveillance Centre and data are available from the Public Health Laboratory Service website.

Office for National Statistics (ONS)

Mortality data is available from the ONS for England and Wales. The most recent data set is for 2007. As well as containing 15 variables including cause of death, age and sex, the records include the patient's postcode. The diagnosis coding follows the *International Statistical Classification of Diseases and Related Health Problems, 10th revision* (ICD-10) (WHO, 2001). Mortality data relating to accidental causes contain an additional field indicating where the accident occurred. However, this field is not always completed and, if it is, it is not always possible to ascertain whether the accident occurred inside the dwelling or within a building containing the dwelling.

Table 3: **Housing factors and health problems linked to each of the 29 HHSRS hazards**

Hazard	Key housing factors contributing to hazard	Main health problems linked to hazard
Damp and mould growth	– Heating and thermal insulation – Ventilation – Damp proofing – Disrepair allowing water penetration – Exposed water tanks and pipework – Condition and design of water using amenities – Small room sizes/overcrowding	– Respiratory disease – Allergic symptoms (eg asthma, rhinitis) – Infections (mainly fungal) – Nausea and diarrhoea – Depression and anxiety
Excess cold	– Energy efficiency (heating, thermal insulation and fuel) – Dampness – Ventilation	– Cardiovascular conditions – Respiratory diseases – Rheumatoid arthritis – Impaired thermoregulation (hypothermia)
Excess heat	– Thermal insulation – Heating controls – Area and orientation of glazing	– Cardiovascular conditions – Genito-urinary disease
Asbestos and MMF	– Presence of asbestos – accessible position or unsealed – Presence of MMF – accessible position or unsealed – Disrepair to asbestos-based material	– Respiratory problems, pleural disease, lung cancer, mesothelioma – Dermatitis
Biocides	– Use/misuse of chemicals to treat timber and mould growth	– Varies depending on the chemical used
Carbon monoxide and fuel combustion products	– Disrepair to flueless appliances (including cookers) – Inadequate ventilation or flues – Disrepair to flues or ventilation	– Headaches and dizziness to unconsciousness and death – Damage to nervous system – short-term memory loss – Respiratory problems – Aggravation of asthma
Lead	– Lead water pipes – Lead paint	– IQ deficiency – Lead poisoning
Radon (radiation)	– Design and repair of floors	– Lung cancer – Other cancers (leukaemia, skin, gastrointestinal)
Uncombusted fuel gas	– Condition, design and siting of gas supplies and appliances	– Asphyxiation
Volatile organic compounds	– VOC-emitting materials or treatments used – Inadequate ventilation	– Allergic reactions involving eyes, nose, skin and respiratory tract – Headaches, nausea, dizziness and drowsiness
Crowding and space	– Level of occupancy – Size of kitchen in relation to occupancy and use – Sharing of amenities	– Psychological distress – Reduced concentration – Reduced tolerance – Poor hygiene – Increased risk of accidents – Spread of contagious disease
Entry by intruders	– Defensible space – External lighting – Natural surveillance – Locks to windows and doors – Condition of windows and doors – Concierge/entryphone for flats	– Emotional stress (from fear of crime or as a result of burglary) – Injuries from aggravated burglary
Lighting	– Size, shape and position of windows – Obstruction of windows – Adequate artificial lighting and controls	– Depression and psychological conditions – Eye strain
Noise	– Situation of dwelling – Sound insulation – Repair of windows and external doors – Noisy/badly sited equipment or facilities	– Psychological stress – Sleep disorders – Anxiety and irritability – Cardiovascular conditions
Domestic hygiene, pests and refuse	– Repair/design allowing ingress of pests – Refuse space (internal and external) – Refuse chutes (flats)	– Gastro-intestinal disease – Asthma and allergic rhinitis – Emotional distress – Depression and anxiety
Food safety	– Repair/design of sinks, worktops, cooking provision, food storage facilities – Ratio of facilities to occupants – Sharing of facilities	– Food poisoning (mild to fatal)

Table 3 (contd)

Hazard	Key housing factors contributing to hazard	Main health problems linked to hazard
Personal hygiene, sanitation and drainage	– Ratio of facilities to occupants – Adequate supplies of hot and cold water – Disrepair to facilities – Drainage – Sharing of facilities	– Gastro-intestinal illness (mild to fatal) – Anxiety and depression
Water supply for domestic purposes	– Quality of water supply – Water tanks protected against contamination	– Gastro-intestinal illness (mild to fatal) – Legionnaires disease
Falls associated with baths etc.	– Design and condition of baths/showers – Size and layout of bath/shower rooms – Poor lighting/glare	– Physical injury (cuts, swellings, fractures, death) – Deterioration in general health for elderly
Falls on the level	– Trips steps or steep slopes – Uneven surfaces – Disrepair to surfaces – Inadequate drainage of surface water – Poor lighting/glare	– Physical injury (cuts, swellings, fractures, death) – Deterioration in general health for elderly
Falls associated with stairs or steps	– Design and state of repair of stairs/steps – Provision and condition of handrails and guardrails – Poor lighting/glare – Size/design of landings – Projections to stairs at foot of flight	– Physical injury (cuts, swellings, fractures, death) – Deterioration in general health for elderly
Falls between levels	– Design and state of repair of windows – Design and state of repair of balconies – Height above ground – Hardness/projections on ground	– Physical injury (cuts, swellings, fractures, death) – Deterioration in general health for elderly
Electrical hazards	– Age/disrepair of electrical installation – Number and location of socket outlets	– Electric shock (mild to fatal)
Fire	– Location of heater/cooker – Adequacy and repair of heating – State of repair of electrical installation – Number and location of socket outlets – Fire protection to escape routes – Detectors/alarms – Fire fighting equipment	– Inhalation of smoke/fumes (mild to fatal) – Burns (mild to fatal)
Hot surfaces and materials	– Unprotected hot surfaces or flames – Temperature of hot water to taps – Poor layout or inadequate space to kitchen	– Burns and scalds – Psychological distress
Collision and entrapment	– Design, location and disrepair to doors – Design, location and disrepair to windows – Unprotected gaps in banisters – Low headroom, beams or ceilings	– Physical injury (cuts, piercing, trapping, bruising, crushing)
Explosions	– Design and repair of gas supply and appliances – Design and repair of hot water systems – Inadequate or defective LPG storage	– Physical injury (crushing, bruising, fractures, death)
Position and operability of amenities	– Space and layout of kitchen amenities – Space and layout of washing and WC amenities – Design/repair of taps, windows and doors	– Physical injury (strains, sprains, bruises, fractures)
Structural collapse and falling elements	– Structural movement or cracks – Disrepair to external fabric (esp. chimneys and cladding) – Disrepair to internal fabric (esp. ceilings and stairs)	– Physical injury (minor to fatal)

3 DEFINING 'POOR HOUSING'

3.1 OUR DEFINITION

'Poor housing' can be defined in a number of different ways. For the purpose of this report, poor housing has been defined as that which fails to meet the current statutory minimum standard for housing in England. Since April 2006, this minimum standard has been the HHSRS. There are other standards for housing that we could have used to define poor housing eg the government's Decent Homes Standard or Housing Quality Indicators. However, the HHSRS has been chosen because, unlike the others, it is focussed on health outcomes, and its development was informed by a large body of research and statistics on the links between poor housing and health. The HHSRS comprises a risk assessment of 29 health and safety hazards, highlighted in Table 3, which could lead to harm to the occupants; and any property that is assessed as having a Category 1 hazard on any of these matters can be classified as poor housing.

The first large-scale national survey designed to estimate the overall incidence of Category 1 HHSRS hazards in the housing stock was the 2001 EHCS. Although the EHCS has been carried out annually since then, the next attempt to capture this data was in 2005/6 when it was clear that the HHSRS would definitely become the new statutory minimum standard for housing. The data presented in this report come from the 2005/6 and 2006/7 EHCS.

3.2 THE HOUSING HEALTH AND SAFETY RATING SYSTEM IN MORE DETAIL

The HHSRS is a means of identifying defects in dwellings and of evaluating the potential effect of any defects on the health and safety of occupants, visitors, neighbours and passers-by. The system provides a means of rating the seriousness of any hazard, so that it is possible to differentiate between minor hazards and those where there is an imminent threat of major harm or even death. The emphasis is placed on the potential effect of any defects on the health and safety of occupants and visitors, particularly vulnerable people. Altogether 29 hazards are included.

The HHSRS scoring procedure uses a formula to generate a numerical hazard score for each of the hazards identified at the property. The higher the score, the greater is the severity of that hazard. Potential hazards are assessed in relation to the most vulnerable class of person who might typically occupy or visit the dwelling. For example, for falls on stairs the vulnerable group is the elderly (60+ years), for falls on the level it is also the elderly, and for falls between levels it is children under five years old.

The hazard score formula requires the surveyor to make two judgements:

- The likelihood of the occurrence, which could result in harm to a vulnerable person over the following 12 months (the likelihood is to be given as a ratio – eg 1 in 100, 1 in 500).
- The likely health outcomes or harms that would result from the occurrence.

***Table 4:* Classes of harms and weightings used in the Housing Health and Safety Rating System**

Class	Examples	Weightings
Class I	Death, permanent paralysis below the neck, malignant lung tumour, regular severe pneumonia, permanent loss of consciousness and 80% burn injuries	10,000
Class II	Chronic confusion, mild strokes, regular severe fever, loss of a hand or foot, serious fractures, very serious burns and loss of consciousness for days	1,000
Class III	Chronic severe stress, mild heart attack, regular and persistent dermatitis, malignant but treatable skin cancer, loss of a finger, fractured skull, severe concussion, serious puncture wounds to head or body, severe burns to hands, serious strain or sprain injuries and regular and severe migraine	300
Class IV	Occasional severe discomfort, chronic or regular skin irritation, benign tumours, occasional mild pneumonia, a broken finger, sprained hip, slight concussion, moderate cuts to face or body, severe bruising to body, 10% burns and regular serious coughs or colds	10

From any occurrence there may be a most likely outcome, and other possible ones which may be more or less severe. Take a fall from a second floor window as an example. The fall could result in a 60% chance of a severe concussion, but there may also be a 30% chance of a more serious injury and a 10% chance of something less serious. The four classes of harms and associated weightings are listed in Table 4.

From the judgements made by the surveyor, a hazard score can be generated for each hazard as illustrated below, using the falls from buildings example (Table 5).

To provide a simple means for handling and comparing the potentially wide range of scores and avoid placing too much emphasis on the exact numbers, a series of 10 hazard score bands have been devised as shown in Table 6. The falls from building example is therefore classified as Band E.

***Table 5:* Hazard score for falls from buildings**

Class of harm weighting			Likelihood 1 in		Spread of harm (%)		
I	10,000	÷	100	×	0	=	0
II	1,000	÷	100	×	30	=	300
III	300	÷	100	×	60	=	180
IV	10	÷	100	×	10	=	1
					Hazard score	=	**481**

There is currently a large number of worked examples available for training and assessment purposes. The Appendix provides an example of these taken from the surveyor exercises used in the most recent (2007/8) EHCS training exercise. CLG has also published a number of guidance documents detailing the matters to be taken into consideration in assessing each hazard and the average likelihoods and spread of outcomes for each hazard.

***Table 6:* The 10 hazard score bands**

Band	Equivalent hazard scores
A	5,000 or more
B	2,000 – 4,999
C	1,000 – 1,999
D	500 – 999
E	200 – 499
F	100 – 199
G	50 – 99
H	20 – 49
I	10 – 19
J	9 or less

3.3 BACKGROUND TO THE ENGLISH HOUSE CONDITION SURVEY

The EHCS was carried out in 1967 to inform the government about the current condition of the housing stock and to benchmark its housing renewal policies. The survey was repeated in 1971 and every five years after that until 2001. Since 2001, the EHCS has consisted of four main component surveys:

- Physical inspection of the dwelling by a trained surveyor
- Interview with the household
- Assessment of market value by a trained valuer based on details and photographs
- Interview with the landlord where homes are privately rented.

These components are used to form a complete picture of the sampled dwelling and its occupants. The sample is a stratified random sample of all dwellings in England. In 2001 the core sample (where we had complete physical and interview surveys) was around 17,000. From 2002, the survey has consistently achieved just over 8,000 core responses per year.

The physical survey is the key component for this report. It consists of an inspection of the dwelling by a trained surveyor taking, on average, about an hour. From 2001 onwards it has used around 200 different surveyors per year. Inside the dwelling, the surveyor inspects a sample of rooms, recording the type of work needed to floors, ceilings, internal walls and internal doors and what proportion of these require what type of repair. In the kitchen and bathroom, the surveyor records the amenities present and any repair works needed. The type of heating and presence of loft and wall insulation are also recorded. While inside the home, he/she also records any assessments of fitness that relate to the inside of the home. For each of the key elements of the exterior of the dwelling (or block if it is a flat) the surveyor records the material used, its approximate age and the proportions requiring different types of repair work. The surveyor makes a final assessment of all other items of unfitness and assesses specified characteristics and problems in the neighbourhood. For flats he/she also assesses the condition of any common areas (shared landings, staircases etc.). In 2001 and from 2005/6 onwards, the surveyor has also carried out a detailed assessment of at least five HHSRS hazards.

3.4 DWELLINGS WITH SERIOUS HAZARDS IN THE ENGLISH HOUSE CONDITION SURVEY

In 2005/6 and 2006/07, surveyors were asked to rate five hazards directly. These hazards were:

- Falls on the level
- Falls associated with stairs and steps
- Falls between levels
- Fire
- Hot surfaces and materials.

***Table 7:* Methods used to model Housing Health and Safety System hazards using English House Condition Survey data**

Risk	Definition of Category 1 hazard used
Damp and mould growth	Dwelling had been marked as unfit on damp ***and***: 1. If photos of mould from interview were in worst category ***or*** 2. If photos of damp from interview were in worst category ***or*** 3. Property was vacant
Excess cold	SAP rating of less than 35. This threshold was based on modelling carried out by BRE
Carbon monoxide and fuel combustion products	Appliance ventilation in any room is inadequate ***and*** general ventilation in same room is inadequate
Lead	Dwelling located in one of four postcodes based on drinking water quality map of England ***and*** built before 1945 ***and*** with lead piping present either before or after the mains stopcock
Radon (radiation)	Dwelling located in one of the 16 critical postcode sectors based on radon exposure map of England ***and*** was a house built before 1980
Crowding and space	The occupants per habitable room ratio was calculated. If this exceeded two the dwelling had a Category 1 hazard regardless of size. If it was equal to two and the number of habitable rooms was two or more the dwelling also had Category 1 hazard
Noise	Traffic (motorway/road and aircraft/railway) noise were all coded as major problems
Domestic hygiene and pests	Evidence of rats or mice in a kitchen or habitable room which included a kitchen facility
Personal hygiene	There was only one internal WC ***and*** it was declared unfit ***and*** the safety and hygiene of the WC space was declared seriously defective ***and*** the layout was declared seriously defective ***and*** it was marked as seriously defective on cleanability
Electrical hazards	Electrical system needs replacing ***and*** internal repair is seriously defective ***and*** there is services disrepair in at least one room ***and*** whole electrical system is classified as in disrepair
Collision and entrapment	The surveyor noted that there was low headroom in circulation space inside the dwelling

***Table 8:* Specified vulnerable group for each hazard**

Hazard	Most vulnerable group						No vulnerable group
	Under 3	Under 5	Under 14	60 and over	60–64	65 and over	
Damp and mould growth			√				
Excess cold						√	
Carbon monoxide and fuel combustion products						√	
Lead	√						
Radon (radiation)					√		
Crowding and space							√
Noise							√
Domestic hygiene, pests and refuse							√
Personal hygiene, sanitation and drainage		√					
Falls on the level				√			
Falls associated with stairs and steps				√			
Falls between levels		√					
Electrical hazards		√					
Fire				√			
Hot surfaces and materials		√					
Collision and entrapment		√					

***Table 9:* Summary of how the English House Condition Survey collects and models information about Housing Health and Safety System hazards**

Hazard	2005/6 and 2006/7	2007/8
Damp and mould growth	Modelled	Fully measured
Excess cold	Modelled	Modelled
Excess heat	–	–
Asbestos and MMF	–	–
Biocides	–	–
Carbon monoxide and fuel combustion products	Modelled	Flag for extreme risk
Lead	Modelled	Modelled
Radon (radiation)	Modelled	Modelled
Uncombusted fuel gas	–	Flag for extreme risk
Volatile organic compounds	–	–
Crowding and space	Modelled	Modelled
Entry by intruders	–	Fully measured
Lighting	–	Flag for extreme risk
Noise	Modelled	Fully measured
Domestic hygiene, pests and refuse	Modelled	Flag for extreme risk
Food safety	–	Flag for extreme risk
Personal hygiene, sanitation and drainage	Modelled	Flag for extreme risk
Water supply for domestic purposes	–	Flag for extreme risk
Falls associated with baths etc.	–	Fully measured
Falls on the level	Fully measured	Fully measured
Falls associated with stairs or steps	Fully measured	Fully measured
Falls between levels	Fully measured	Fully measured
Electrical hazards	Modelled	Flag for extreme risk
Fire	Fully measured	Fully measured
Hot surfaces and materials	Fully measured	Fully measured
Collision and entrapment	Modelled	Fully measured
Explosions	–	Flag for extreme risk
Position and operability of amenities	–	Flag for extreme risk
Structural collapse and falling elements	–	Flag for extreme risk

These five were chosen because the HHSRS statistics indicated that these would be the most frequent causes of failures under the HHSRS other than those already collected by relevant or proxy data in the physical survey. All dwellings scoring over 1,000 (Band A, B or C) on these items were deemed to have a serious hazard labelled as a Category 1 hazard.

The Appendix gives a worked example of how surveyors would complete the survey form. Two days of the surveyor training sessions from 2005/06 onwards were dedicated to explaining the principles and how the form should be completed, as well as conducting practical and written test exercises with feedback sessions for both the new surveyors and for the refresher training.

An additional 11 hazards were modelled using other data from the physical survey and, in some cases, the interview with occupants. As with the measured hazards, current occupancy was ignored. The assumptions made are summarised in Table 7.

The HHSRS guidance specifies, for most hazards, the group of occupants who are most likely to be at risk from that particular hazard. This 'vulnerable group' has an increased likelihood of an incident happening and/or they would suffer more serious harms as a result of an incident happening (Table 8).

The EHCS surveyors were clearly informed about the most vulnerable group for each hazard, and they were instructed to assess the property, ignoring the current occupancy and assuming that the home was occupied by a member of that vulnerable group. This means that the figures should capture all properties with Category 1 hazards if a vulnerable person were resident. This is a much larger number than the number of properties where a local authority would have to take legal action under the 2004 Housing Act.

In 2007/8 the EHCS survey form has undergone further revisions and surveyors are now required to score a number of hazards that were previously modelled or not covered at all (Table 9).

3.5 DATA QUALITY AND RELIABILITY

The data from the 2005/6 and 2006/7 surveys are more reliable than those from 2001, simply because HHSRS was very new to all surveyors in 2001 and results were always seen as highly provisional. By 2005/6, most surveyors were familiar with HHSRS and many of them were environmental health practitioners who had already received training in the system with their main job. We must also bear in mind that the HHSRS is totally different in overall ethos and method to the old fitness standard that it replaced, and it will take some time for surveyors to get used to operating the HHSRS within the context of EHCS as well as their wider work. Following comments from surveyors and regional managers, the 2006/7 surveyor training sessions focussed heavily on HHSRS fire hazards because this was felt to be the most difficult of the five to assess.

Where data are fully measured the values are robust enough to be used to assess the cost of poor housing.

4 OPTIONS FOR ESTIMATING THE COSTS OF POOR HOUSING

4.1 OVERALL APPROACH

There are two basic types of approach for quantifying the health outcome liability from housing.

Environmental burden of disease (EBD)

EBD starts with the health outcome and attempts to estimate what proportion of this is caused by environmental factors as opposed to other causes (genetic, behavioural etc.). EBD is normally calculated using disability adjusted life years (DALY). In the DALY method, the DALY is the years of life lost because of premature death added to the years of life lived with disability and so effectively one DALY is one year of healthy life lost.

Financial costs to society

This approach attempts to estimate the total costs attributable to different types of accidents and illness. Some progress has been made in relation to both illness and accidents.

The WHO European Centre for Environment and Health has set up a working group that is currently investigating the EBD attributable to housing. This group has recently published a book on housing and health in Europe – the *WHO LARES project* (Ormandy, 2009). To differentiate this project from the European work the emphasis has been placed on the financial costs to society.

4.2 PREVIOUS WORK

General health

Work on the task of measuring the 'exported costs' of poor housing has been developing both in the UK and in some other countries. Lawson (1997), based upon many years of experience as a GP, argues that the NHS spends about one fifth of its clinical budget on trying to cure illness that is actually caused by unemployment, poverty, bad housing and environmental pollution. More specifically, the cost to the NHS of treating ill-health resulting from sub-standard housing has been estimated at £2.4 billion per year (National Housing Federation, 1997). A research team from Kentish Town Health Centre and the Department of Social Medicine at Bristol University conducted a study which aimed to put a cost on the relationship between socio-economic status and GP/practice nurse consultations, and new and repeat prescriptions (Worrall et al., 1997). They also wanted to determine the adequacy of 'deprivation payments' in relation to these costs. They found that the difference in costs for patients in social Classes IV and V together, compared with those in social Classes I and II together, was approximately £150 per person year at risk and that the deprivation payments met only about 50% of the extra workload costs. The costs of primary healthcare, per person year at risk, rose from £107 in social Classes I and II to £256 in IV and V. It is entirely plausible that poor housing is implicated in these differential costs since the housing standard accessible closely reflects socio-economic status.

An article in the Centre for Building Science newsletter (Fisk and Rosenfeld, 1997) argues that recent research literature provides strong evidence that the characteristics of buildings, and their indoor environments, influence the prevalence of adverse health conditions such as asthma, allergies and respiratory disease; and that improvements to these environments could reduce the costs of healthcare and sick leave, and increased worker performance. This would result in an estimated productivity gain, in the US, of $30 to $150 billion annually. The authors argue that if a research investment of $10 million per year were made for five years, the total cost of this would be only 0.2% of the estimated potential productivity gains resulting from better environments.

A pilot study has been carried out by the Low Energy Architecture Research Unit, at the University of North London (Rudge, 2001). The study aims to develop a methodology for evaluating some of the benefits, in particular with regard to improvements in health, that would result from investment in domestic affordable warmth. The study sought to correlate data on low income, building characteristics and admissions to hospital. The overall objective is the development of a monitoring tool for local authorities and health authorities to use.

A BBC online article, entitled *Task force tackles fuel poverty* (http://news.bbc.co.uk/1/hi/scotland/1803550.stm), asserts that fuel poverty is linked to premature death, asthma and other respiratory and coronary diseases and that: "It is estimated that the problem costs the NHS £1 billion annually".

Although the issue has not yet been systematically researched, poverty combined with poor and overcrowded conditions at home may well be a risk factor in the incidence of domestic violence. A recent study (Walby, 2004) has made some progress in assessing the economic costs of domestic violence against women in particular. Walby's research is based on methodology used by the Home Office for costing crime (Brand and Price, 2000), which it is argued is the best and most established way to translate the impact of domestic violence into a monetary cost. A key interim finding of the report is that two women are killed by a partner or ex-partner each week, totalling over 100 a year. The cost of domestic homicide of adult women is estimated to be £112 million a year. In costing a domestic homicide, three types of cost are taken into account:

- lost economic output (£370,000)
- the use of public services including health, criminal justice and victim services (£27,330)
- the human and emotional impact (£700,000).

There is thought to be a link, also not yet adequately explored, between poverty, poor housing and an increased risk of child abuse, something which generates heavy lifetime costs. The National Society for the Prevention of Cruelty to Children included the following in a letter written in 1999 – referred to by the Bishop of Hereford in a debate on an amendment to the Welfare Reform and Pensions Bill moved by Lord Morris of Manchester calling for minimum income standards, (*Hansard*, 1999):

"The pressures involved in coping with inadequate income cause stress, which exacerbates the health problems experienced because of poor diet, inadequate heating and poor housing and increases the likelihood of family tension and breakdown… Child abuse occurs across all classes and the actual causes are complex. Nevertheless, most children on child protection registers are from low income families and the most commonly identified stress factors in all registered cases of child abuse are unemployment and debt."

The issue of the cost of poor housing conditions has been taken up in Australia as policy-makers seek to identify the most cost-effective use of scarce public investment resources. In a background paper entitled *Affordable housing* (Berry, 2002) Berry cites his own previous work on the cost effects of homelessness (Berry et al., 2002). He argues that a major cost to the community, resulting from inadequate housing and 'broader exclusionary forces', is the rising fiscal cost to government in dealing with the resultant social problems. He comments: "This cost will often be difficult to estimate because the effects are usually complex and indirect. Nevertheless, sufficient evidence exists to suggest that by seriously attacking the issue of insufficient affordable housing… government can materially alleviate a range of economic and social problems, while reducing the cost to tax payers, in the longer term." (Berry, 2002, p.6).

There is a weight of evidence building up about the ways in which poverty and poor living conditions contribute to the demand for, and therefore the cost of, health and other statutory services. It is therefore perhaps surprising that a recent report on the long-term funding needs of the NHS (Wanless, 2002) spends comparatively little time considering the ways in which policy interventions, to reduce inequalities and provide better housing, might work to moderate the growth in demand for healthcare provision.

Accidents

There have already been various attempts to calculate the costs to society arising from accidental injuries in the home. According to the *HASS 23rd annual report* (DTI, 2003) there were around 2.7 million home accidents in 2002 that required medical treatment (over 7,600 a day, or around 45 per 1,000 population), and it was estimated that this costs the UK society some £25 billion per year. However, what is not clear is what costs were taken into account in the calculations.

A recent paper on home injuries in the US took into account all costs related to fatal and non-fatal injuries, including costs to victims, families, government, insurers, and taxpayers (Zaloshnja et al., 2005). The total cost of unintentional home injuries to US society was calculated to be at least $217 billion (£116 billion) in 1998; $1.74 million (£0.93 million) per fatal injury and $288,000 (£154,000) for each hospital-admitted non-fatal injury. The largest cost was the value of lost quality of life at $162 billion (£86.6 billion); with medical costs and indirect costs at $22 billion (£11.8 billion) and $33 billion (£17.6 billion) respectively. Relevant for this project was that the most common cause of injury was falls on stairs or steps (16% of all injuries) and the wider category of falls accounted for 44% of the total estimated costs.

For the Netherlands, calculations have been made for the medical costs of all physical injuries (not just accidental home injuries), giving the total as €1.15 billion (£0.8 billion) or 3.7% of the total healthcare costs for 1999 (Meering et al., 2006).

4.3 WHAT TYPES OF COSTS CAN AND SHOULD BE INCLUDED?

This is a key question as some types of costs can be estimated or modelled more reliably than others. One of the most comprehensive reviews of the cost of poor housing (Ambrose, 2001) provides a matrix of costs, categorising them in terms of their measurability – costs that can be quantified 'H'; costs that could be quantified given better data 'M'; and costs that exist but are probably non-quantifiable 'NQ' (Table 10).

Many of the costs classified as 'M' or 'NQ' could be covered by calculating costs associated with reduced quality of life or increasing levels of disability (Zaloshnja et al., 2005, and Sassi, 2006).

Table 10: **A matrix of costs (Ambrose and Randles, 1999)**

	Residents costs	H	M	NQ	External costs	H	M	NQ
Systemic: capital	High annual loss of asset value if property owned	√			High annual loss of asset value if property rented	√		
Systemic: revenue	Poor physical health	√	√		Higher health service costs	√	√	√
	Poor mental health		√	√				
	Social isolation			√	Higher care services costs		√	
	High home fuel bills	√			High building heating costs	√		
	High insurance premiums	√			High insurance payments	√		
	Uninsured contents losses		√					
	Spending on security devices	√			Spending on building security	√		
	Living with repairs needed			√	High housing maintenance costs	√		
	Under-achievement at school			√	Extra costs on school budgets	√		
					Homework classes at school	√		
	Loss of future earnings		√		Loss of talents to society			√
	Personal insecurity			√	High policing costs	√	√	
	More accidents		√		High emergency services costs	√		
	Poor hygienic conditions			√	High environmental health costs	√		
	Costs of moving		√		Disruption to service providers		√	
	Adopting self-harming habits		√		Special healthcare responses	√		
Formalised: capital					Government and EU programmes, SRB, New Deal etc.	√		
Formalised: revenue					'Statements of need'	√		
					Section 42	√		
					HIP statements	√		
					Police funding formula	√		
					Fire and ambulance services funding formulae	√		

H = Quantifiable
M = Quantifiable given better data
NQ = Non-quantifiable.

Table 11: **Summary of the evidence base and data available to estimate the 29 Housing Health and Safety System hazards**

Hazard	Confidence in HHSRS statistical base	EHCS data on housing stock	Mean HHSRS score
Physiological requirements			
Damp and mould growth	Fairly high	Modelled/full assessment from 2007	11
Excess cold	Fairly high	Reliably modelled	926
Excess heat	Low	None	0
Asbestos and MMF	Some for asbestos	None	0
Biocides	Low	None	0
Carbon monoxide and fuel combustion products	Some	Modelled	1
Lead	Some – mainly from the US	Modelled	0
Radon (radiation)	High	Modelled	91
Uncombusted fuel gas	Low	None	0
Volatile organic compounds	Low	None	0
Psychological requirements			
Crowding and space	Fairly low	Modelled	19
Entry by intruders	Some	Some data, full assessment from 2007	11
Lighting	Low	Some data	0
Noise	Some	Modelled, full assessment from 2007	6
Protection against infection			
Domestic hygiene, pests and refuse	Fairly low	Modelled	0
Food safety	Fairly low	Some	2
Personal hygiene, sanitation and drainage	Fairly low	Modelled	1
Water supply for domestic purposes	Low	None	0
Protection against accidents			
Falls associated with baths etc.	Fairly high	None, full assessment from 2007	7
Falls on the level	High	Full assessment	181
Falls associated with stairs or steps	High	Full assessment	134
Falls between levels	High	Full assessment	4
Electrical hazards	Some	Modelled	2
Fire	High	Full assessment	17
Hot surfaces and materials	High	Full assessment	42
Collision and entrapment	High	Modelled/full assessment from 2007	57
Explosions	Low	None	1
Position operability and amenties	Low	None	1
Structural collapse and falling elements	Some	Some	1

4.4 WHICH ASPECTS SHOULD BE FOCUSSED ON?

The project does not attempt to cost the consequences of all the health outcomes arising from housing in poor condition. In selecting which might be included, the likely occurrence of the problem (the 'mean HHSRS score' is a reasonably good proxy measure for this), how reliably it can be estimated from available data on stock condition, and the confidence we have in the HHSRS statistical base, need to be borne in mind. These are summarised in Table 11 where we have highlighted those items in blue that are the strongest candidates for inclusion.

4.5 METHOD OF ESTIMATING THE COST

The method is based on one developed for the evaluation of Sheffield Homes' refurbishment programme (Gilbertson, Green and Ormandy, 2006). The basic stages are:

1. Use EHCS data to identify the number and profile of homes where the HHSRS rating score falls within a specified threshold for those items stated in section 4.4. Initially, this will be all those that have a hazard score of 1,000 or more.
2. Use EHCS data to estimate how far the above properties could be improved (eg to an 'average' level for the stock as a whole or an 'average' level for properties without significant hazards) and the costs of the building work required to achieve this.
3. Use HHSRS statistics on the spread of health outcomes to estimate how many of the dwellings stated in point 1 above are likely to fall into the four outcome categories (extreme, severe, serious and moderate) given current conditions and after improvement works.
4. Use data from other sources on the average total costs to society of each type of outcome to estimate the benefit gained from improving these homes and compare this with the costs of building work itself.

The planned method is perhaps best illustrated by a simple worked example (Table 12). This is taken from provisional EHCS 2005 data for just one hazard – falling on stairs:

- Around 1.7 million homes in England (8%) have an HHSRS score of 1,000 or more on this hazard.
- EHCS data also indicates that the average likelihood of someone falling on the stairs in one of these homes over the next 12 months is 1 in 45.
- This means that someone will sustain an injury from falling on stairs in an estimate 38,000 of these homes.
- Using the HHSRS statistics on the proportion of likely outcomes to estimate how many of these 38,000 would have an extreme, severe, serious or moderate outcome as a result of that fall, gives us our baseline position of the number and type of outcomes which can, when a cost for each has been established, be used to generate a total cost.
- Using EHCS data on the likelihood of an incident across all properties, or across all properties that have scores under 1,000, gives us some indication of how improving the homes with the high scores of 1,000 and above to different levels will affect the number and types of outcomes (and ultimately the cost). For example, if they are improved to a level of 'acceptable given the age of the dwelling', this reduces the total number of outcomes of all types from about 38,000 to around 9,500 with a proportionate reduction in all outcome categories. If we were to improve the stock to a better standard (the average for all homes that have scores less than 1,000) then the total number of incidents in any one year decreases further to about 5,344 (Table 12).

Table 13 includes some indicative estimates of the likely magnitude of these other types of cost. This is an area that requires considerably more research that could follow on from this project.

After lengthy discussions with our partners, it was decided that the model should only include those costs that have direct health consequences, ie the health and care services costs listed under external costs. The inclusion of such costs is preferable because they can be easily justified as 'real' costs, and there are publicly available data that can be used to estimate their magnitude. The costs used in the model will be, therefore, a significant underestimate of the total cost associated with the hazard, excluding in particular the costs to the residents themselves in terms of lost house value and lost future and current earnings.

If we compare these costs to those that we have later derived for the medical and care costs for the

***Table 12:* Simple worked example to calculate health outcomes from falls on stairs**

	Spread of outcomes for falling on stairs from HHSRS statistics (all age groups)					
	Likelihood	No. of dwellings	Extreme	Severe	Serious	Moderate
			1.9%	6.7%	21.7%	69.7%
Before improvements	1 in 45	38,000	722	2,546	8,246	26,486
Improved to 'acceptable' for dwelling age	1 in 180	9,500	181	637	2,062	6,622
Improved to average of those that pass	1 in 320	5,344	102	358	1,160	3,725
Base number of dwellings with scores of 1,000 or more	–	1,710,000	–	–	–	–

Table 13: **Main types of costs not yet covered and possible data sources**

Type of cost	Estimated value	Estimated value and variations
Cost of enforcement action by councils	£2,000	This will vary but is likely to be about this amount on average irrespective of the class of harm. This would cover the costs of inspections and advice from technical staff and administrative support
Costs of moving to more suitable accommodation	£10,000	This will involve stamp duty (where applicable) and fees to estate agents, removal company, surveyors, lenders etc. These are average house moving costs applicable in all cases. This might apply to 1 in 5 households with a Category 1 hazard
Increased spending on benefits	£15,000 per annum	Individuals who are permanently disabled will qualify for a range of benefits to compensate for being unable to work and to purchase care and mobility. This amount is for a single person for a whole year. Where problems are temporary, benefits are likely to be paid but over shorter periods
Lost capital value of house/sale price	£3,000	The 2006 EHCS indicates that this is the average difference between market value with and without repairs for dwellings with Category 1 hazards
Lost future earnings	£26,000 per annum	Based on current median full-time salary. Obviously such a large sum would only apply to people who could never work again (most Class I outcomes). Some reductions are likely for other outcomes as these may restrict the type of occupation/level or hours worked

Table 14: **Indicative rough estimates for total costs resulting from different types of income**

	Costs (£)			
Type of cost	Class I	Class II	Class III	Class IV
Cost of moving	2,000	2,000	2,000	2,000
Enforcement action by councils	2,000	2,000	2,000	2,000
Increased spending on benefits	15,000	5,000	–	–
Lost capital value of house	3,000	3,000	3,000	3,000
Lost future earnings	26,000	5,000	2,000	1,000
Medical and care costs	50,000	20,000	1,500	100
Total cost	**98,000**	**37,000**	**10,500**	**8,100**
% that is medical and care	**51**	**54**	**14**	**1**

Table 15 : **Spread of class of harms for nine hazards (all dwelling figures) and suggested representative value**

	Percentage spread of outcomes			
Hazard	Class I	Class II	Class III	Class IV
Damp and mould	0.0	1.0	10.0	89.0
Excess cold	34.0	6.0	18.0	42.0
Radon (radiation)	90.0	10.0	0.0	0.0
Falls on the level	0.2	13.8	27.3	58.8
Falls associated with stairs and steps	1.9	6.7	21.7	69.7
Falls between levels	0.2	1.8	9.9	88.2
Fire	7.0	2.6	29.1	61.3
Hot surfaces and materials	0.0	1.3	17.8	80.9
Collision and entrapment	0.0	0.1	4.1	95.9

different classes of outcome, we can see that the former far outweigh the latter, especially for Class III and IV outcomes (Table 14).

It should be remembered that most hazards result in a much higher proportion of outcomes falling into Classes III and IV than Classes I and II, and so this needs to be taken into account. Table 15 indicates the percentage of incidents resulting in different classes of harm for nine of the hazards considered in the 2006/07 EHCS. These vary considerably and are noticeably different for excess cold and radon.

We can then apply these percentage outcomes to the total costs in Table 14 to arrive at a typical health and care cost and a typical total cost for each hazard (Table 16). Again, it is clear that there are large differences between hazards; health and care costs are likely to represent less than 10% of the total cost for collision and entrapment, damp and mould, hot surfaces and falls between levels but to represent about half of the total for excess cold and radon.

A further complication in trying to estimate the likely undercount is that some Category 1 hazards are much more common than others (Table 17). This also needs to be taken account of in arriving at a global estimate of the cost underestimation.

By weighting the costs in Table 16 using the proportions of the stock affected in Table 17, we can finally arrive at an overall estimate per dwelling with a Category 1 hazard of around £10,000 for medical and care costs and £25,000 for total costs. This suggests that by taking just the costs of medical treatment and care, we are only accounting for, at most, 40% of the total costs to society of the consequences of poor housing.

Table 16: **Weighted typical costs for different hazards**

Hazard	Health and care (£)	All main sources (£)	% on health and care
Damp and mould	439	8,629	5
Excess cold	18,512	40,832	45
Radon (radiation)	47,000	91,900	51
Falls on the level	3,328	12,931	26
Falls associated with stairs and steps	2,685	12,265	22
Falls between levels	697	9,046	8
Fire	4,518	15,843	29
Hot surfaces and materials	608	8,903	7
Collision and entrapment	177	8,235	2

Table 17: **Numbers of dwellings with Category 1 hazards (EHCS, 2006)**

Hazard	Number of dwellings	%
Damp and mould growth	99,000	0.5
Excess cold	2,430,000	11.1
Carbon monoxide and fuel combustion products	12,000	0.1
Lead	154,000	0.7
Radon (radiation)	96,000	0.4
Crowding and space	23,000	0.1
Noise	9,000	0.0
Domestic hygiene, pests and refuse	82,000	0.4
Personal hygiene, sanitation and drainage	9,000	0.0
Falls on the level	607,000	2.8
Falls associated with stairs and steps	1,755,000	8.0
Falls between levels	332,000	1.5
Electrical hazards	15,000	0.1
Fire	210,000	1.0
Hot surfaces and materials	98,000	0.4
Any of the above hazards*	4,752,000	21.6

* Individual items do not sum to the total because some dwellings have more than one hazard.

5 COST FOR A COST-BENEFIT ANALYSIS

5.1 COST ESTIMATES

All the costs and benefits used in this model are estimates derived to be indicative of the likely costs of the various medical and care costs and the expected costs to repair. They are taken from a variety of sources, providing the most up-to-date figures available, but are likely, in most cases, to underestimate the real costs. The values are therefore used as approximations for current day costs, on the understanding that more accurate data could be fed into the model if and when it becomes available. This underestimate provides a cautious approach to the real costs and allows the conclusions to underestimate the real cost to society.

Table 18: **Fully measured and modelled hazards**

Hazard	Fully measured hazards	Modelled hazards
Damp and mould growth		√
Excess cold		√
Radon (radiation)		√
Falls on the level	√	
Falls associated with stairs and steps	√	
Falls between levels	√	
Fire	√	
Hot surfaces and materials	√	
Collision and entrapment		√

5.2 COST OF HARMS

The estimation of values for cost of harms focusses on nine of the 29 hazards, as these were the ones for which there are the most reliable data on overall incidence of hazards in the housing stock and for which the statistics linking housing and health outcomes are most robust. Five hazards are fully measured and the other four are modelled in EHCS (Table 18).

Since death can be difficult to cost, and the medical costs are often limited with such an outcome, it was decided that death would not be used as the most extreme outcome. Instead the most severe outcome, short of death, that is listed in HHSRS guidance and that is relevant to the particular hazard, would be used. The typical outcomes for each level of each hazard were arrived at by discussion among BRE experts. These were then validated in discussions with external experts. The type of injury or illness was designed to reflect the most vulnerable age group, as specified by HHSRS, and are presented in Table 19.

5.3 TYPICAL COSTS OF TREATMENT

The cost for the typical outcomes listed in Table 19 depends on the type of treatment provided and the care required once the person leaves hospital. There is a considerable amount of data provided by the NHS (see the NHS website details in the References section) on the costs for a number of different procedures, including visits to a GP, to A&E (PSSRU, 2004), costs of dressings, prescriptions (see the British National Formulary website in the References section) as well as hospital treatments. The type of injury or illness was refined to follow the information provided by the NHS, using BRE expert opinion and expert medical advice.

It is recognised that the costs provided by the NHS will vary because different primary care trusts have different unit costs. Often these differences can be significant, for example the difference between the upper or lower quartile unit costs and the mean can be greater than 50%. For this reason, these costs should be taken as indicative, rather than exact. Another cause for caution in using these costs is that the source of some of the data is a few years old and may therefore not reflect current or future values. However, because the likely error in using data that is not up-to-date is less than the variation by area, these values are accepted at face value rather than adjusting for inflation. It is important to realise that some costs would be a one-off charge, such as a simple visit to A&E, but others would be long-term costs, such as any incident causing the person to become quadriplegic. These long-term costs are more likely to arise as a consequence of Class I or II harms.

The range of costs for the outcomes associated with the different hazards and classes of severities is shown in Table 20. It is clear that there are wide ranges in the costs between different hazards for the same class of severity. Much of the differences for Classes I and II are due to the high cost of care that some people require, using

***Table 19:* Typical outcomes for each hazard**

Hazard	Class I	Class II	Class III	Class IV
Damp and mould growth	Not applicable*	Type 1 allergy	Severe asthma	Mild asthma
Excess cold	Heart attack leading to death, after some time in care	Heart attack	Respiratory condition	Occasional mild pneumonia
Radon (radiation)	Death after treatment for lung cancer	Surviving lung cancer	Not applicable*	Not applicable*
Falls on the level	Quadriplegic	Femur fracture	Wrist fracture	Cut or bruise (requiring visit to A&E)
Falls associated with stairs and steps	Quadriplegic	Femur fracture	Wrist fracture	Cut or bruise (requiring visit to A&E)
Falls between levels	Quadriplegic	Head injury	Serious puncture wound to hand	Cut or bruise (requiring visit to A&E)
Fire	Severe burns and smoke inhalation, leading to death, after some time in care	Serious burns and smoke inhalation	Serious burns to hand	Burn to hand
Hot surfaces and materials	Not applicable*	Serious burns	Minor burns	Very minor burn (requiring visit to A&E)
Collision and entrapment	Not applicable*	Punctured lung	Loss of finger	Cut or bruise (requiring visit to A&E)

* HHSRS spread of harms for these hazards indicate 0% fall into this class of harm because these are exceptionally rare or non-existent.

***Table 20:* Estimate for costs fo the NHS of typical outcomes for each hazard and representative costs for each class of harm**

Hazard	Class I (£)	Class II (£)	Class III (£)	Class IV (£)
Damp and mould growth	–	1,998	1,120	180
Excess cold	19,851	22,295†	519	84
Radon (radiation)	13,247	13,247†	–	–
Falls on the level	59,246*	25,424†	745	67
Falls associated with stairs and steps	59,246*	25,424†	745	67
Falls between levels	59,246*	6,464†	1,693	67
Fire	11,754†	7,878†	2,188	107
Hot surfaces and materials	–	4,652	1,234	107
Collision and entrapment	–	3,439	1,536	67
Representative cost	**50,000**	**20,000**	**1,500**	**100**

* Costs after the first year will occur. These costs are not modelled.

† Costs after the first year are likely to occur, as a consequence of the initial illness/incident. These costs are not modelled.

a weekly rate of £433 for residential and nursing care; and intensive home care can easily add many thousands of pounds to the cost, depending on the duration of care required. Because the actual outcome chosen for each hazard/class of harm was typical, but somewhat arbitrary, there is a concern that another outcome which would have been equally valid for that hazard/class of harm combination would have a different cost. For this reason a single value for each class of harm is chosen that represents a reasonable value based on the data collected for all hazards. This value is not arrived at mathematically, due to the reasons outlined previously, but is a figure that is representative and easy to use.

As the figures shown in Table 20 are likely to be approximate, and only relate to one of many possible outcomes for each hazard/severity, a robust approach of taking the same typical values for each severity across all hazards has been adopted.

- Class I, which includes death, permanent paralysis below the neck, malignant lung tumour, regular severe pneumonia, permanent loss of consciousness, and 80% burn injuries, is the most extreme outcome, but can be of a low cost to the NHS if a dead body is found (the Department for Transport figure suggests that the medical and ambulance costs for a fatality are around £840), but of a very high cost to treat someone for quadriplegia. The suggested value is £50,000, but any figure between £840 and £60,000 could be argued for.

- Class II, which includes serious fractures and very serious burns, has a very wide range of costs, but it is suggested a reasonable figure is £20,000.
- Class III, which includes mild heart attack, loss of a finger, severe concussion, serious puncture wounds to head or body, and severe burns to hands, seems to have a range of values centred on £1,500.
- Class IV, due to the comparative lack of severity and associated low cost, has a smaller range of values, and a value of £100 seems reasonable.

It is helpful to compare these values with the class of harm weighting used by HHSRS, given in Table 21.

The HHSRS classes of harm values were arrived at by asking a large sample of people to rate the relative seriousness of a number of health outcomes. The ratios are broadly comparable and exhibit the largest discrepancy for Class I, which is the hardest to cost accurately. The higher ratio used in the HHSRS weighting is largely due to the fact that it will incorporate a number of the other personal and external consequences listed in Table 10. All these will generally far outweigh the costs of medical treatment and care in the first year.

These suggested costs only reflect the cost to the NHS incurred in the first year after the incident/illness. No additional cost has been considered for treatment that is more long term or for care after the first 12 months.

***Table 21:* Representative costs for each class of harm and Housing Health and Safety System weighting values**

	Class I	Class II	Class III	Class IV
Representative cost (£)	50,000	20,000	1,500	100
Representative costs ratios (where Class IV = 10)	5,000	2,000	150	10
Class of harm weighting (HHSRS)	10,000	1,000	300	10

***Table 22:* Estimated cost of mitigating Category 1 hazards resulting from an improvement order (2001 prices) (ODPM 2004b)**

Hazard	Dwelling with Category 1 hazard*	Estimate number resulting in an improvement order	Estimated cost of mitigating hazard (£)	Total costs of mitigating hazards (£)
Damp and mould growth	71,000	2,000	15,600	31,200,000
Excess cold	304,000	8,700	13,570	118,059,000
Carbon monoxide and fuel combustion products	33,000	1,000	720	720,000
Lead	114,000	3,300	6,000	19,800,000
Radon (radiation)	85,000	2,400	600	1,440,000
Crowding and space	3,000	80	500	40,000
Noise	6,000	170	2,800	476,000
Domestic hygiene, pests, and refuse	1,000	40	1,000	40,000
Personal hygiene, sanitation and drainage	0	0	700	0
Falls on the level	297,000	8,500	1,250	10,625,000
Falls associated with stairs and steps	634,000	18,100	2,450	44,345,000
Falls between levels	149,000	4,250	400	1,700,000
Electrical hazards	24,000	700	4,600	3,220,000
Fire	121,000	3,500	6,700	23,450,000
Hot surfaces and materials	100,000	2,900	1,800	5,220,000
Total	**1,943,000**	**55,600**	**0**	**260,335,000**

* These are different to the figures quoted in Table 17 because they use the old EHCS 2001 grossing factor and because the excess cold estimate was based on version 1 HHSRS which were substantially revised for this hazard in version 2.

5.4 COST TO REPAIR

On the other side of any cost-benefit analysis is the cost to remove the hazard, and hence to prevent the treatment costs. The 2005/06 and 2006/07 EHCS collected information on the types of remedial work needed to deal with Category 1 hazards.

The published Regulatory Impact Assessment (RIA) report (ODPM, 2004b) for the 2004 Housing Act contained some estimates of the cost implications of replacing the old fitness standard with the HHSRS. They estimated that the total costs of implementation through improvement orders would be around £260 million (at 2001 prices) based on the figures shown in Table 22 taken directly from Annex 1 of the Regulatory Impact Assessment report.

Total costs in the RIA are a substantial underestimate of the total costs of remedying all hazards, because they only relate to those cases where the local authority is assumed to serve an order on the owner to carry out the works. Their calculations have assumed the same total number of orders as under the old fitness standard, and split these pro rata by the relative frequency of each hazard. Also, orders will tend to deal with the worst cases. It is likely that minor points requiring attention would be dealt with informally by the authority coming to an agreement with the owner to carry out the work within a given time period, eg to install a handrail to the staircase or to have loft and cavity wall insulation installed.

The RIA also calculated assumed average costs per dwelling to remedy the hazards. In the RIA report it is stated that these were derived from using the publicised worked examples and calculating a mean. The authors do acknowledge that these are a very small, and by no means representative, sample. The estimated costs are shown in Table 23.

Using EHCS 2005/6 data to estimate costs for five of the hazards, and a wider appreciation of building prices, produce more reliable estimates. When specifying the work required, EHCS surveyors were instructed that work should aim to reduce the risk to the same as the average for a dwelling of that age and type rather than to meet some ideal or higher standard. Where hazards were modelled from other EHCS data, the costs of the most likely remedial work have been taken. For example, for damp and mould growth, the cost includes all the repairs required to roofs, chimneys, guttering, wall finish and the damp-proof course. The main exception to this is for excess cold, where a very different approach has been applied. With excess cold it is important to be clear about whether to aim to do as little as possible so it is just about acceptable (SAP [standard assessment procedure] no longer below 35) or to aim for a much higher standard. A more sophisticated model has been developed for costing work to remedy this hazard.
This establishes the level of works needed to bring the dwelling up to two different standards: a very basic standard of SAP>35 and a much higher standard of SAP>65. The costs used here only reflect the works needed to bring the SAP rating to over 35. The new model has four main stages:

1. Apply mainstream insulation measures (cavity wall insulation, loft insulation and hot water cylinder insulation where possible)
2. Install new heating system
3. Apply external wall insulation
4. Replace all windows with double glazing.

Table 23: **Unit prices used in the RIA with EHCS based comments**

Hazard	RIA estimated cost (£)	Comments
Damp and mould growth	15,600	This would be enough to put a new DPC, new roof, flashings, rainwater goods and rendering on a fairly large house. Most homes with Category 1 hazards are unlikely to need this scale of work
Excess cold	13,570	EHCS 2005/6 suggests that these costs are far too high. The majority of dwellings can be brought up to a reasonable standard by installing new heating/boilers and improving loft, cylinder and cavity wall insulation (£4,000–£5,000 for an average three bedroom house at 2001 prices)
Falls associated with stairs and steps	2,450	EHCS 2005/6 data suggest that the average is about half this amount and that over 50% of all cases can be remedied for under about £500
Falls between levels	400	EHCS 2005/6 data suggest that these costs are highly variable and that £400 is far too low as an average – it is probably around three times this amount
Electrical hazards	4,600	This is a very high cost for rewiring at 2001 prices – typical costs were around £2,500 for a three bedroom house
Fire	6,700	EHCS 2005/6 data suggest that these costs are very variable although £6,700 appears far too high and the average is probably about half this amount

***Table 24:* Provisional average costs for remedial work**

Hazards	RIA 'average' costs (£) at 2001 prices	RIA 'average' costs (£) at 2005 prices	Suggested average costs of work at 2005 prices (£)
Damp and mould growth	15,600	20,954	5,000
Excess cold	13,570	18,227	4,000
Carbon monoxide and fuel combustion products	720	967	1,000
Lead	6,000	8,059	8,000
Radon (radiation)	600	806	800
Crowding and space	500	672	700
Noise	2,800	3,761	4,000
Domestic hygiene, pests, and refuse	1,000	1,343	1,400
Personal hygiene, sanitation and drainage	700	940	900
Falls on the level	1,250	1,679	1,000
Falls associated with stairs and steps	2,450	3,291	1,100
Falls between levels	400	537	1,500
Electrical hazards	4,600	6,179	4,000
Fire	6,700	8,999	3,100
Hot surfaces and materials	1,800	2,418	2,000

At each stage all improvements are applied and at the end of that stage we compare the resultant SAP rating of the improved dwelling to our target of 35. If it has exceeded that target, no more work is carried out, but if it still falls below the target the next stages are implemented until it meets or exceeds the target. The use of the four stages reflects how improvements normally take place in practice, and also moves from the cheapest measures at stage 1 to the most expensive by stage 4. The 'average' costs obtained in this way conceal a very large degree of variation. Variability is most pronounced for falls on stairs where almost two thirds of all cases could be remedied for less than about £500 and about 10% require spending in excess of £3,000. This high degree of variability in the costs arises because each situation is unique and thus there is no 'standard package' of works to remedy each hazard. Taking falls on stairs as an example, one dwelling may pose Category 1 hazards because some of the upper treads are broken and there is no handrail, and so the remedial work required to repair the treads and fit a new handrail will be relatively cheap. At the other end of the spectrum, the Category 1 hazard may result because the staircase into an attic conversion is dangerously steep and the only remedy is to replace the whole staircase with a much less steep one with all the associated work to internal walls, ceilings and floors.

Suggested new 'average' costs for work to remedy hazards at 2005 prices are shown in Table 24, alongside the original 2001 based RIA prices and their 2005 equivalent. These are based on analysis of the 2005/6 EHCS data.

If we apply these costs to the number of dwellings estimated to have failed the HHSRS in 2001, then the total estimated cost of reducing these hazards to an acceptable level is around £20 billion (Table 25). Around three quarters of the total estimated sum is likely to be taken up with remedying hazards from excess cold, and so any slight change in the estimated cost of this work will have a significant impact on total costs.

Table 25: **Initial estimates of total costs to remedy all Category 1 hazards (2005 prices)**

Hazards	Thousands of dwellings with Category 1 hazards		Cost per dwelling (£)	Total cost £ (thousands)
	Initial estimate	Revised estimate		
Damp and mould growth	72	72	5,000	360,000
Excess cold	3,017	3,017	5,000	15,085,000
Carbon monoxide and fuel combustion products	34	34	1,000	34,000
Lead	113	113	8,000	904,000
Radon (radiation)	84	84	800	67,200
Crowding and space	3	3	700	2,100
Noise	5	5	4,000	20,000
Domestic hygiene, pests, and refuse	2	2	1,400	2,800
Personal hygiene, sanitation and drainage	0	0	900	0
Falls on the level	294	500	1,000	500,000
Falls associated with stairs and steps	632	1,800	1,100	1,980,000
Falls between levels	152	350	1,500	525,000
Electrical hazards	26	25	4,000	100,000
Fire	119	119	3,100	368,900
Hot surfaces and materials	98	98	2,000	196,000
Collision and entrapment	140	140	1,000	140,000
Any hazard	4,111	4,800	Total cost	**20,285,000**

6 MODELLING COST BENEFIT

6.1 SIMPLE MODEL

The 'cost of harms' data can be used to model the costs associated with not remedying any specific hazard in any given year. An early model was developed for the CIEH using the data on the relative likelihood and spread of harms given in the HHSRS guidance, and these costs were then used to provide an estimate of the total cost for a given number of dwellings in a particular area, see Figure 2. This costs calculator is used to estimate the cost of hazards.

The model is perhaps best understood using an example. There were 8.2 million homes claiming winter fuel payment in 2005/06, which is a good estimate for the number of homes containing at least one adult aged 60 or over. This group will be vulnerable to falls on stairs in any one year. Using the known spread of harms for the average house, and the average likelihood of a harm occurring in any one year, the model calculates that the cost to the NHS to treat these stair victims will exceed £61 million a year.

The calculator also applies the estimated cost of repair to these hazards to determine the potential saving to the NHS should these harms be eliminated. In this case, the median cost to repair a stair hazard from EHCS data is £338, making it very cost-effective to treat homes for this hazard. This calculator provides a very useful estimate of the number of potential injuries expected for this hazard in any one year (25,625), the cost to repair these dwellings and the cost saved by the NHS if repairs are carried out. However, this basic model falls short in a number of areas, all of which can be improved upon:

- It includes all dwellings, irrespective of the level of risk actually present
- It assumes work will eliminate all risks
- It does not take account of the large variability in costs to remedy the same hazard
- It takes no account of the timing of the work.

6.2 PROBLEMS AND SOLUTIONS

Which homes should be repaired?

It is impossible to know from the CIEH model which homes require repair, since it is based only on random probabilities. To guarantee that all the homes where harms will occur in the next year are repaired, it may be necessary to repair all the homes. Clearly it would be not a cost-effective option to repair all 8.2 million dwellings occupied by someone aged 60 or over (nearly 40% of the stock) at a cost of £2.7 billion. It also assumes that all 8.2 million homes are typical average properties, but we

bre

HHSRS costs calculator

Number of dwellings: 8,200,000

Hazard: Falls associated with stairs and steps

Affected group: Over 60

Chartered Institute of Environmental Health

	Liklihood 1 in	%	Expected number	Annual cost to NHS (£)
Class I harms	14,545	2.2	564	28,200,000
Class II harms	6,957	4.6	1,179	23,580,000
Class III harms	1,488	21.5	5,509	8,263,500
Class IV harms	446	71.7	18,373	1,837,300
Total all harms	320	100.0	25,625	61,880,800

Estimated total cost of works where an incident is expected	£8,661,250
Ratio remedial works costs/NHS annual costs and (if >1, need more than 1 year for payback)	0.14

Figure 2: Example from the Chartered Institute of Environmental Health Housing Health and Safety Rating System costs calculator.

know that many households containing older people will be very different from the average. For example, some people will be at higher risk and some of these homes will be bungalows. Additional information may help to target the repair costs, but this is not provided by the CIEH model.

Using the HHSRS system allows us to target the homes at greatest risk of harms occurring from these hazards, namely those with a Category 1 score. Dwellings that achieve this status, especially if they are occupied by a vulnerable person, will require action to reduce the risk. The proportion of dwellings at risk has been estimated using the EHCS data, as shown for five hazards, in Table 26. The risk of harm in Category 1 dwellings has been determined for the five fully measured hazards in the EHCS, providing a value for the average likelihood score applied to Category 1 dwellings, and a spread of harms.

Local authorities can use their own condition surveys to pinpoint homes where people may be at risk of harm and direct their resources effectively. For example they may have a budget to tackle 100 dwellings for a particular hazard, or £100k to spend on repairs in the next financial year. The model needs to be able to demonstrate the cost savings at this local authority level as well as at the national level.

How much risk of harm is removed by repairs?

The CIEH model assumes that the repairs will completely eliminate the probability of harm in those dwellings where the repairs are applied. Given that even the homes built to current building regulations will have some inherent risk for some hazards, this estimate of risk reduction is exaggerated. The repair costs used are the median costs, since the distribution of costs are not normally distributed but rather weighted to the lower costs. However, such repair costs will be insufficient to cover the repairs in over 50% of the properties where there is a high risk of harm. The repair costs are estimated from the EHCS repairs to dwellings with Category 1 hazards, and were intended to reduce the hazard to an acceptable level. This was defined as the 'average' for the age and type of the dwelling, and not the 'optimum' as defined by current building regulations.

Since the repair costs found in the EHCS data are for repairs to an 'acceptable' level, the HHSRS guidance data on the risk for average dwellings can be used as the expected risk when the repairs are complete. The average risks are shown in Table 27.

From this average data it can be seen that the risk of harm from falls on stairs, falls on the level and hot surfaces are still quite high, even for the average property. This will limit the effectiveness of the repairs, so that the benefit to the NHS will only be the difference between dwellings at the Category 1 level of risk and those at an average level of risk.

***Table 26:* Dwellings with Category 1 risk of harm from the fully measured hazards**

Hazard	Likelihood 1 in	Probability of harm at different severities				Base with Category 1
		Class I	Class II	Class III	Class IV	
Falls between levels	32	0.022	0.1	0.215	0.663	332,000
Falls on the level	32	0.005	0.215	0.464	0.316	607,000
Falls associated with stairs and steps	32	0.046	0.215	0.316	0.423	1,755,000
Fire	100	0.215	0.046	0.316	0.423	210,000
Hot surfaces and materials	18	0.005	0.046	0.316	0.633	98,000

***Table 27:* Dwellings with 'average' risk of harm from the fully measured hazards**

Hazard	Likelihood 1 in	Probability of harm at different severities			
		Class I	Class II	Class III	Class IV
Falls between levels	1,693	0.002	0.018	0.099	0.881
Falls on the level	135	0.002	0.138	0.273	0.587
Falls associated with stairs and steps	245	0.019	0.067	0.217	0.697
Fire	4,760	0.07	0.026	0.291	0.613
Hot surfaces and materials	182	0.00	0.013	0.178	0.809

***Table 28:* Dwellings with 'average' risk of harm from the fully measured hazards**

Hazard	Average cost to repair (£)		
	Cheapest 20%	Cheapest 50%	All
Falls between levels	99.19	332.41	1,276.25
Falls on the level	99.06	238.14	1,045.59
Falls associated with stairs and steps	119.54	243.41	1,084.00
Fire	79.28	950.43	3,311.63
Hot surfaces and materials	81.00	106.66	2,199.50

How much should the repairs cost?

The CIEH model assumes that the cost to repair is one fixed amount for each hazard, which equates to the median cost of repairs calculated from the EHCS data. While this is an appropriate figure to use as an initial estimate it is clearly an underestimate of the expected costs.

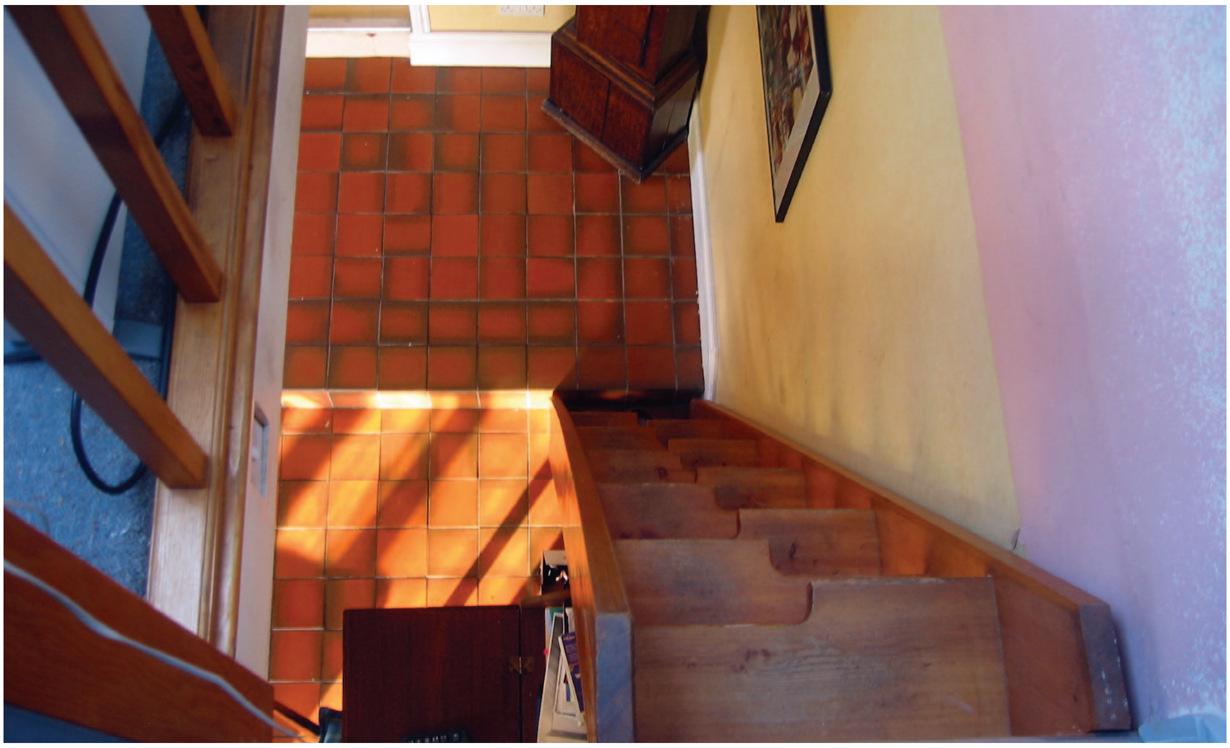
Other values for the repair costs are available from the same data. By using the arithmetic average it is possible to estimate the total cost of expected repairs to bring Category 1 hazards to an acceptable level. However, this can be quite high for some hazards, eg fire. Estimates for the average costs to repair the cheapest 50% and the cheapest 20% have also been calculated (Table 28). It would be possible to use other figures if this was thought to be necessary.

When should the repairs be implemented?

The CIEH model assumes that all the repairs are conducted up front to eliminate the risk. This would prove impossible to implement in practice for some hazards. A cost benefit model needs to consider different scenarios. For example what would be the cost to the NHS if nothing were done, or if only 10% of dwellings were repaired each year for 10 years.

It is worth realising at this point that the benefit from making the suggested repairs is cumulative over time. That is to say the benefit in reduced risk to the NHS is an annual benefit, and this will continue into the next year and the year following that. Similarly, the cost of doing nothing is cumulative with time, in that those dwellings where no repairs are conducted will continue to cost the NHS in subsequent years until repairs are made. Any cost benefit model should therefore be time-dependent, and demonstrate a payback period for repairs.

In addition, the model could be adjusted to take into account the difference in value with time. The most obvious consideration would be a net present value (NPV) calculation, which compares the money saved against compound interest that could have been gained by putting the repair money into a bank account earning interest. This method is used widely in government finance models and projections. While repairs could be justified under different grounds, this is a purely economical way of considering the risk over time. Other changes would include a variation in the value of the benefits to the NHS with time, or in the cost of repairs with time.



Input criteria	Value
Hazard	Falls associated with stairs and steps

Input criteria	Value
Scenario	No change
Total number of properties to repair	Use population values
Time period for repair	10 years
Proportion to repair	All
Benefit variance	Equal each year
NPV discount rate	7%

Population variables	Value
Number of Category 1 hazards	1,755,000
Average cost to repair	£1,084
Total cost to repair	£1,902,420,000
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	245
Average benefit to NHS by repairing	£211

Scenario dependent variables	Value
Time period	0 years
Annual number of properties to repair	–

Results	Value
Payback period	5.1 years
Cumulative payback period	Never
Total all cost over 25 years	£9,276,244,453
Total benefit over 25 years	£–
Period for NPV to become positive	Never

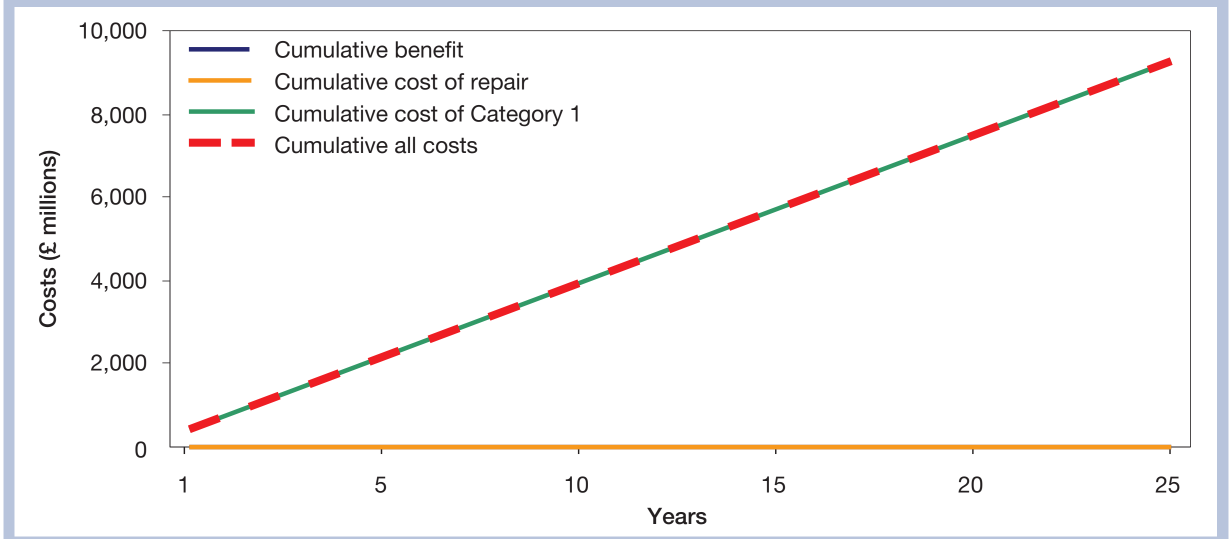


Figure 3: Cost-benefit model with no repairs: Falls associated with stairs and steps.

6.3 AN IMPROVED MODEL

An improved model was therefore required to take account of all these issues. The model was developed in Excel and used the EHCS derived data for five hazards. While clearly the model is more complicated than the CIEH model (Fig. 2), the flexibility it provides makes it more applicable to practical applications since it is possible to change all the following:

- The hazard to be considered
- The scenario to be applied (all up front, annual payment, no change)
- The number of properties that can be repaired
- The proportion of properties to repair (all, cheapest 20%, cheapest 50%)
- Flexibility in value of costs and benefits
- Different discount rates for NPV calculations.

In Figure 3 the scenario 'no change' has been applied, which means that no money is allocated to repairing any of the Category 1 falls on stairs. In the top right of Figure 3 the total number of hazards is shown, along with the average cost to repair. The total cost to repair all the Category 1 falls on stair hazards in England is calculated as £1.9 billion.

Input criteria	Value
Hazard	Falls associated with stairs and steps

Input criteria	Value
Scenario	All up front
Total number of properties to repair	Use population values
Time period for repair	10 years
Proportion to repair	All
Benefit variance	Equal each year
NPV discount rate	7%

Population variables	Value
Number of Category 1 hazards	1,755,000
Average cost to repair	£1,084
Total cost to repair	£1,902,420,000
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	245
Average benefit to NHS by repairing	£211

Scenario dependent variables	Value
Time period	1 year
Annual budget for repair	£1,902,420,000
Annual number of properties to repair	1,755,000
Average cost to repair	£1,084

Results	Value
Payback period	5.1 years
Cumulative payback period	6 years
Total all cost over 25 years	£1,902,420,000
Total benefit over 25 years	£9,276,244,453
Period for NPV to become positive	7 years

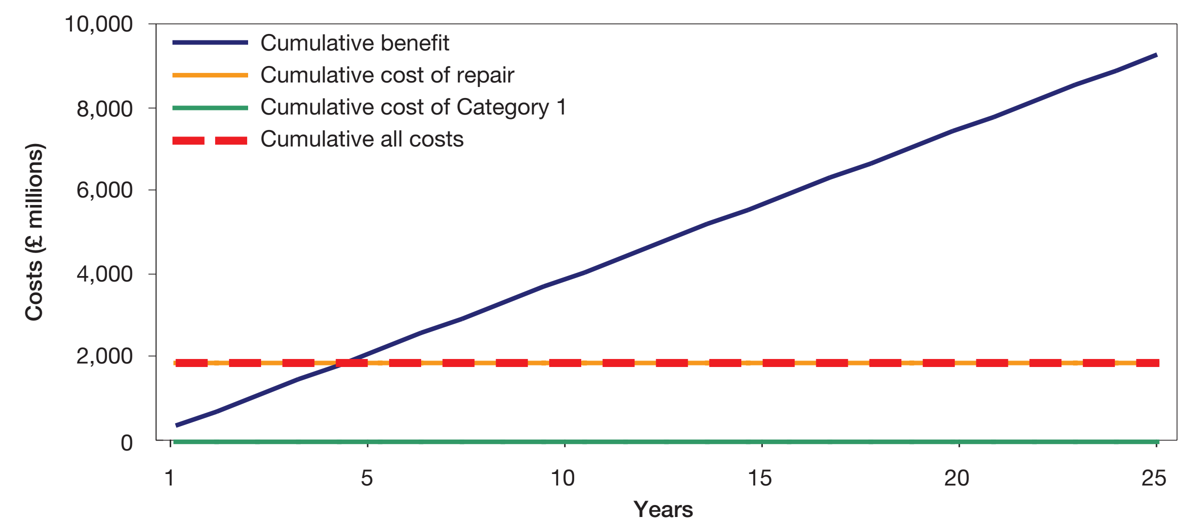


Figure 4: Cost-benefit model with all repairs up front: Falls associated with stairs and steps.

Since the average cost of repair is £1,084 and the average benefit is £211, it is easy to calculate a basic payback period, shown on the right as 5.1 years. In this scenario there is no benefit from the repairs, and so the cost to the NHS remains each year creating a cumulative cost. In this example the cost in lost benefit to the NHS of not doing anything is calculated to be over £9 billion in 25 years.

By changing the scenario (Fig. 4) it is possible to consider all the costs up front, in a similar way to that applied to the CIEH model. The annual budget to repair is therefore equivalent to the total cost to repair for England, ie £1.9 billion in the scenario dependent variables section in Figure 4. Also here is the number of properties that will be repaired and the average cost to repair. Now on the chart the blue cumulative benefit line is visible. Where it crosses the red dotted line a cumulative payback period has been achieved, which when rounded up to the nearest whole year is six years. In this scenario (all up front) the cumulative payback period is actually equivalent to the simple payback period. The NPV calculation is also quite favourable with all the costs up front, becoming a positive payback in just seven years. This implies that the scenario is a sensible option, with a cumulative benefit of over £9 billion in 25 years, for a cost of £1.9 billion.

Input criteria	Value
Hazard	Falls on the level

Population variables	Value
Number of Category 1 hazards	607,000
Average cost to repair	£1,046
Total cost to repair	£634,673,130
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	135
Average benefit to NHS by repairing	£140

Input criteria	Value
Scenario	All up front
Total number of properties to repair	1,000
Time period for repair	10 years
Proportion to repair	All
Benefit variance	Equal each year
NPV discount rate	7%

Scenario dependent variables	Value
Time period	1 year
Annual budget for repair	£1,045,590
Annual number of properties to repair	1,000
Average cost to repair	£1,046

Results	Value
Payback period	7.5 years
Cumulative payback period	8 years
Total all cost over 25 years	£1,045,590
Total benefit over 25 years	£3,506,792
Period for NPV to become positive	10 years

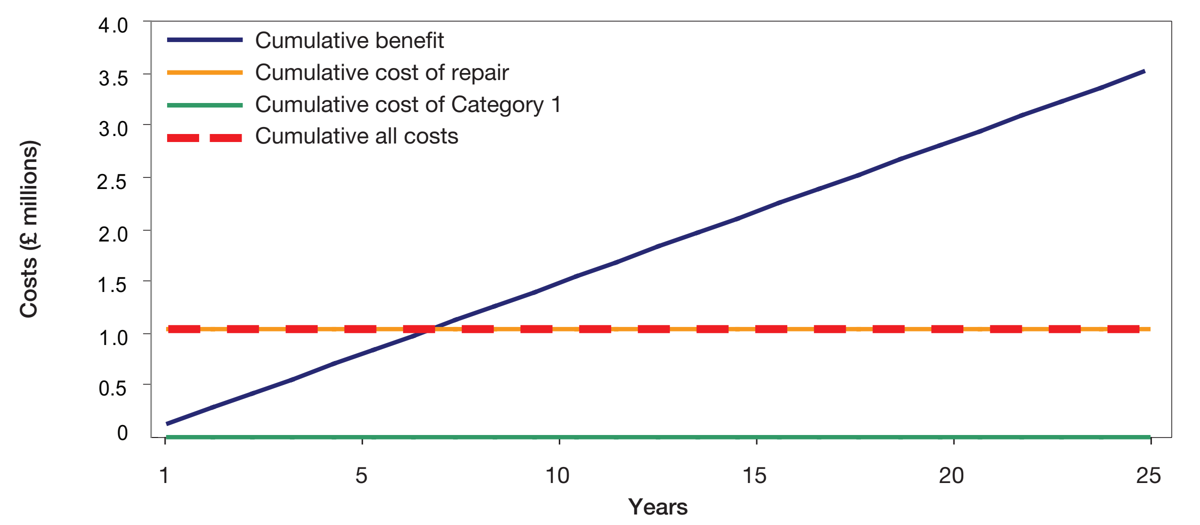


Figure 5: Cost-benefit model with all repairs up front for a single local authority: Falls on the level.

As suggested, this model can be applied to a smaller number of Category 1 dwellings, perhaps those found in a single local authority. For example, if they found 1000 homes with a Category 1 falls on the level hazard present, they could apply this model as in Figure 5.

Repairing homes with falls on the level risks is also cost-effective using this scenario, with a payback period of 7.5 years. Since the local authority illustrated in Figure 5 has only 1,000 dwellings to repair, the annual budget is just over £1 million, substantially less than the £634 million required to repair all the estimated Category 1 falls on the level hazards for England. In this case, a local NHS would benefit by £3.5 million over 25 years for an initial outlay of just over £1 million. The NPV payback period is 10 years. The model can be applied in a similar manner for each of the five hazards for which we have data. Additional hazards can be added as more fully measured hazards are determined with the 2007/08 EHCS.

Input criteria	Value
Hazard	Falls associated with stairs and steps

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	10,000
Time period for repair	10 years
Proportion to repair	All
Cost variance	Equal each year
Benefit variance	Equal each year
NPV discount rate	7%

Population variables	Value
Number of Category 1 hazards	1,755,000
Average cost to repair	£1,084
Total cost to repair	£1,902,420,000
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	245
Average benefit to NHS by repairing	£211

Scenario dependent variables	Value
Time period	10 years
Annual budget for repair	£1,084,000
Annual number of properties to repair	1,000
Average cost to repair	£1,084

Results	Value
Payback period	5.1 years
Cumulative payback period	15 years
Total all cost over 25 years	£20,354,097
Total benefit over 25 years	£43,341,997
Period for NPV to become positive	21 years

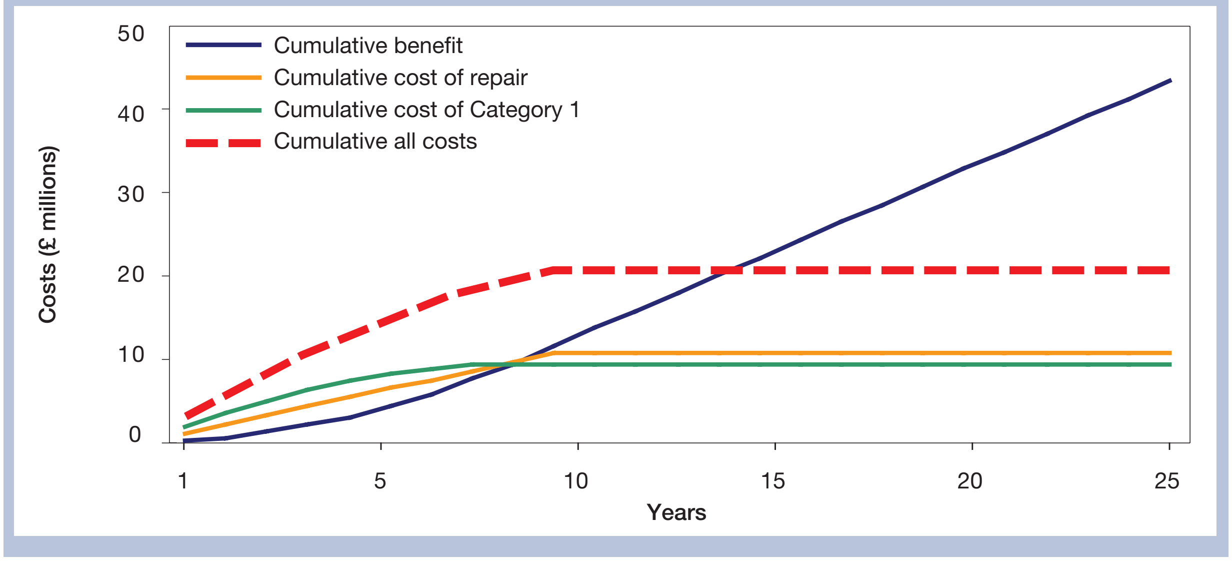


Figure 6: Cost benefit model with annual payments over 10 years for a single local authority: Falls associated with stairs and steps.

The last scenario currently entered into the model (other scenarios could be considered if necessary) allows the local authority, or other body, to consider spreading the costs over a number of years. Going back to the falls on stairs example, the cost of repairs can be spread equally over 10 years, and hence 10% of the homes with Category 1 hazards are repaired each year. This will mean that there is a cost of repair, and a cost to the NHS through unrealised benefit, for those dwellings that have not been improved. Figure 6 shows how this accumulates over the 25 years if there are 10,000 such dwellings to repair. The annual cost is calculated at just over £1 million repairing 1,000 dwellings each year. While this scenario is easier to manage in terms of annual costs, it does reduce the total benefit to the NHS, as each year there are some dwellings that have not been repaired. The cumulative payback period now extends from six years (all up front) to 15 years, and the NPV payback, at 7% interest, is 21 years. Even in this scenario the benefits over 25 years are more than double the cost. By extending the time period for repairs too far, the benefits do not always outweigh the costs.

Input criteria	Value
Hazard	Falls associated with stairs and steps

Population variables	Value
Number of Category 1 hazards	1,755,000
Average cost to repair	£1,084
Total cost to repair	£1,902,420,000
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	245
Average benefit to NHS by repairing	£211

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	10,000
Time period for repair	20 years
Proportion to repair	All
Cost variance	Equal each year
Benefit variance	Equal each year
NPV discount rate	7%

Scenario dependent variables	Value
Time period	20 years
Annual budget for repair	£542,000
Annual number of properties to repair	500
Average cost to repair	£1,084

Results	Value
Payback period	5.1 years
Cumulative payback period	25 years
Total all cost over 25 years	£30,925,316
Total benefit over 25 years	£32,770,778
Period for NPV to become positive	Never

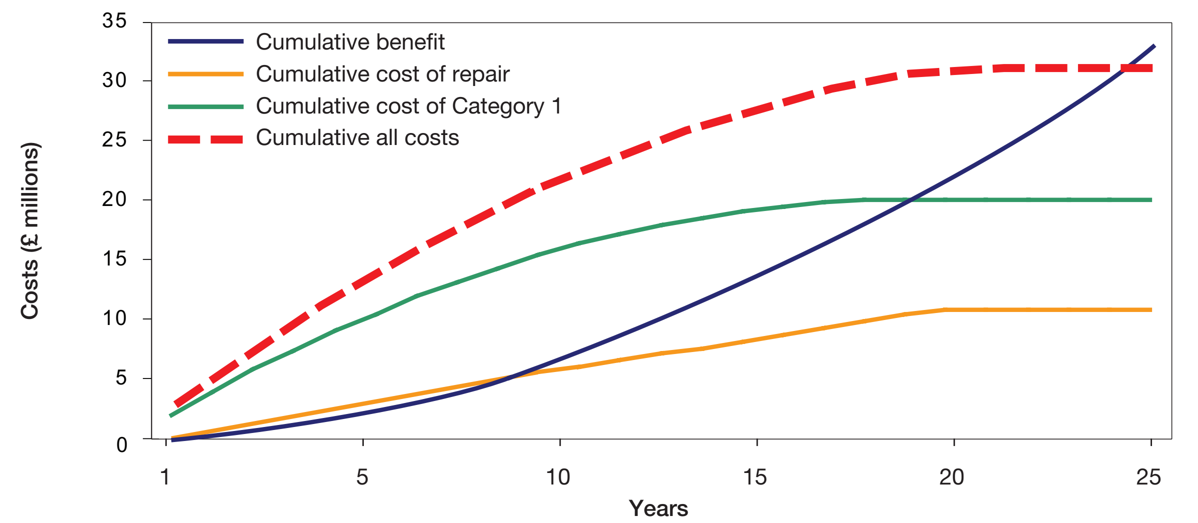


Figure 7: Cost benefit model with annual payments over 20 years for a single local authority: Falls associated with stairs and steps.

In Figure 7 the annual repairs are extended over 20 years repairing 500 dwellings a year. In this scenario the benefits exceed the costs, after 25 years, but an NPV calculation (putting the same money on interest at 7%) implies that the repairs will not be cost-effective.

Input criteria	Value
Hazard	Falls associated with stairs and steps

Population variables	Value
Number of Category 1 hazards	1,755,000
Average cost to repair	£1,084
Total cost to repair	£1,902,420,000
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	245
Average benefit to NHS by repairing	£211

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	10,000
Time period for repair	20 years
Proportion to repair	All
Cost variance	Decreasing each year
Percentage cost variance	1%
Benefit variance	Increasing each year
Percentage benefit variance	1%
NPV discount rate	3%

Scenario dependent variables	Value
Time period	20 years
Annual budget for repair	£542,000
Final year's budget for repair	£447,783
Annual number of properties to repair	500
Average cost to repair	£1,084

Results	Value
Payback period	5.1 years
Cumulative payback period	23 years
Total all cost over 25 years	£31,212,777
Total benefit over 25 years	£38,369,675
Period for NPV to become positive	27 years

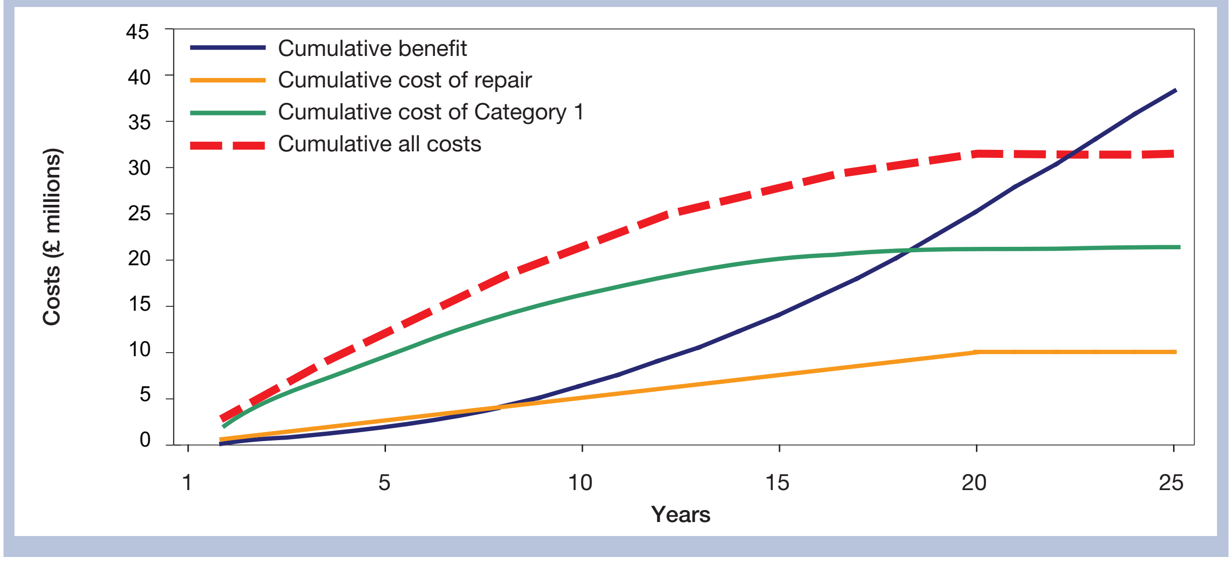


Figure 8: Cost benefit model with revised annual payments over 20 years for a single local authority: Falls associated with stairs and steps.

This can all change if the interest available from the bank is lower and if the costs or benefits vary over time. For example, if the NPV discount rate is reduced to 3%, the costs decrease each year by 1% and the benefits to the NHS increase each year by 1%, (Fig. 8), the cumulative payback period decreases to 23 years and the NPV becomes positive after 27 years. Notice also that the annual budget for repair decreases under this scenario from £542,000 to just under £448,000.

Input criteria	Value
Hazard	Falls associated with stairs and steps

Population variables	Value
Number of Category 1 hazards	1,755,000
Average cost to repair	£1,084
Total cost to repair	£1,902,420,000
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	245
Average benefit to NHS by repairing	£211

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	Use population values
Time period for repair	10 years
Proportion to repair	Cheapest 20%
Cost variance	Equal each year
Benefit variance	Equal each year
NPV discount rate	7%

Scenario dependent variables	Value
Time period	10 years
Annual budget for repair	£4,195,854
Annual number of properties to repair	35,100
Average cost to repair	£120

Results	Value
Payback period	0.6 years
Cumulative payback period	10 years
Total all cost over 25 years	£375,903,340
Total benefit over 25 years	£1,521,304,090
Period for NPV to become positive	11 years

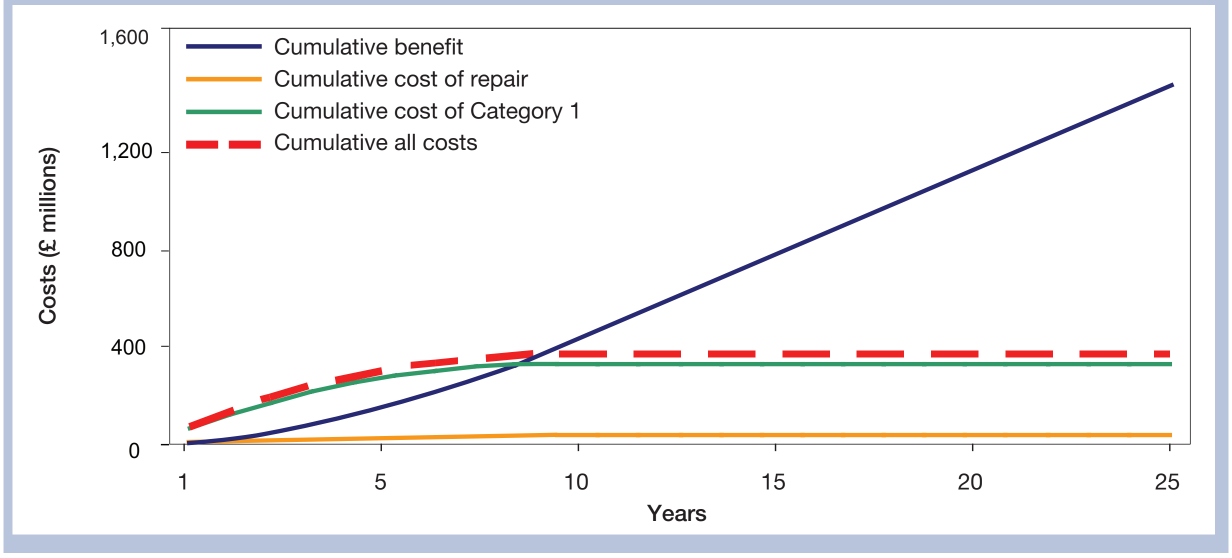


Figure 9: Cost-benefit model with annual payments over 10 years, cheapest 20%: Falls associated with stairs and steps.

The final variation left in the model provides the option to tackle a proportion of the repairs, for example the cheapest 20% of repairs. In this case fewer dwellings are considered for repair, which affects the overall benefit as well as reducing the cost (Fig. 9). When compared to Figure 6, the cumulative payback period is reduced from 15 years to 10 years, as the average cost to repair is just £120. Similarly the NPV payback period decreases from 21 years to 11 years. This scenario does not consider the costs associated with not carrying out repairs on the more costly 80%, which will clearly still burden the NHS. These more expensive repairs would still need to be considered at some point.

Input criteria	Value
Hazard	Falls between levels

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	Use population values
Time period for repair	10 years
Proportion to repair	All
Cost variance	Equal each year
Benefit variance	Equal each year
NPV discount rate	7%

Population variables	Value
Number of Category 1 hazards	332,000
Average cost to repair	£1,276
Total cost to repair	£423,715,000
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	1,693
Average benefit to NHS by repairing	£109

Scenario dependent variables	Value
Time period	10 years
Annual budget for repair	£42,371,500
Annual number of properties to repair	33,200
Average cost to repair	£1,276

Results	Value
Payback period	11.8 years
Cumulative payback period	21 years
Total all cost over 25 years	£585,983,630
Total benefit over 25 years	£739,223,760
Period for NPV to become positive	Never

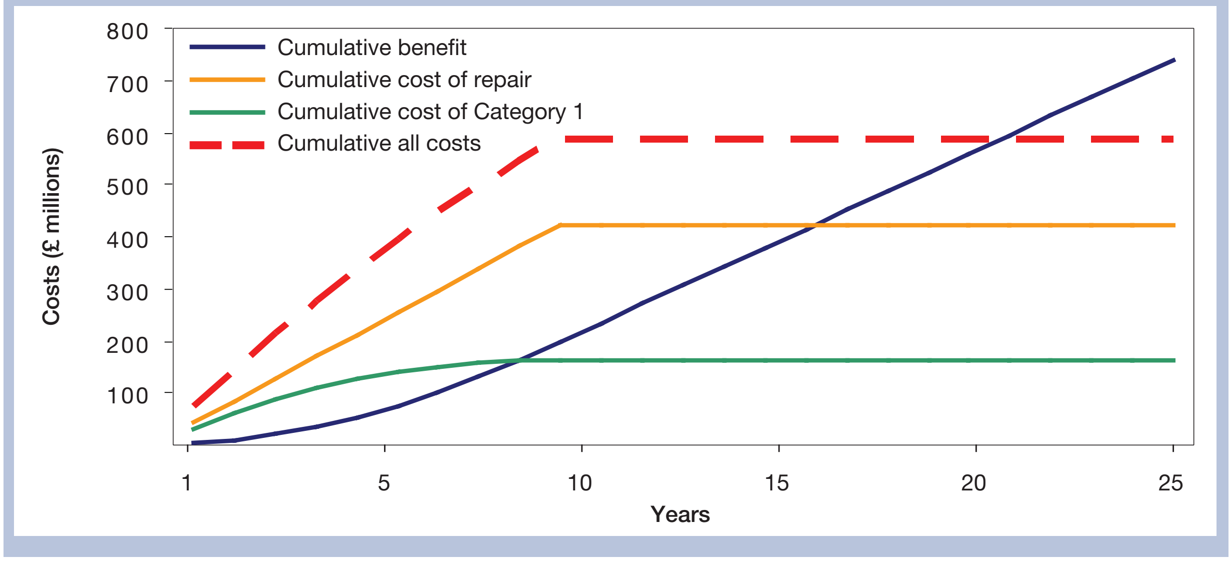


Figure 10: Cost benefit model with annual payments over 10 years: Falls between levels.

6.4 COMPARING HAZARDS

Using this model, the five hazards can be compared to determine priorities for repairs. In each case a simple 10 year annual payment approach has been taken, considering a national cost to repair.

Figure 10 shows the cost benefit for repairing all dwellings at risk of harm from falls between levels. The cumulative payback period is 21 years, and is not effective with a 7% NPV calculation. Figure 11 applies the same characteristics for falls on the level and Figure 12 for falls on stairs. Both are cost-effective repairs, with NPV paybacks at 7% of 30 and 21 years respectively. Neither fire (Fig. 13) nor hot surfaces (Fig. 14) are cost-effective with a 7% NPV calculation. Other comparisons could be made, eg fire and hot surfaces become cost-effective if you only repair the cheapest 50% of Category 1 hazards.

Input criteria	Value
Hazard	Falls on the level

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	Use population values
Time period for repair	10 years
Proportion to repair	All
Cost variance	Equal each year
Benefit variance	Equal each year
NPV discount rate	7%

Population variables	Value
Number of Category 1 hazards	607,000
Average cost to repair	£1,046
Total cost to repair	£634,673,130
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	135
Average benefit to NHS by repairing	£140

Scenario dependent variables	Value
Time period	10 years
Annual budget for repair	£63,467,313
Annual number of properties to repair	60,700
Average cost to repair	£1,046

Results	Value
Payback period	7.5 years
Cumulative payback period	17 years
Total all cost over 25 years	£1,017,825,188
Total benefit over 25 years	£1,745,470,484
Period for NPV to become positive	30 years

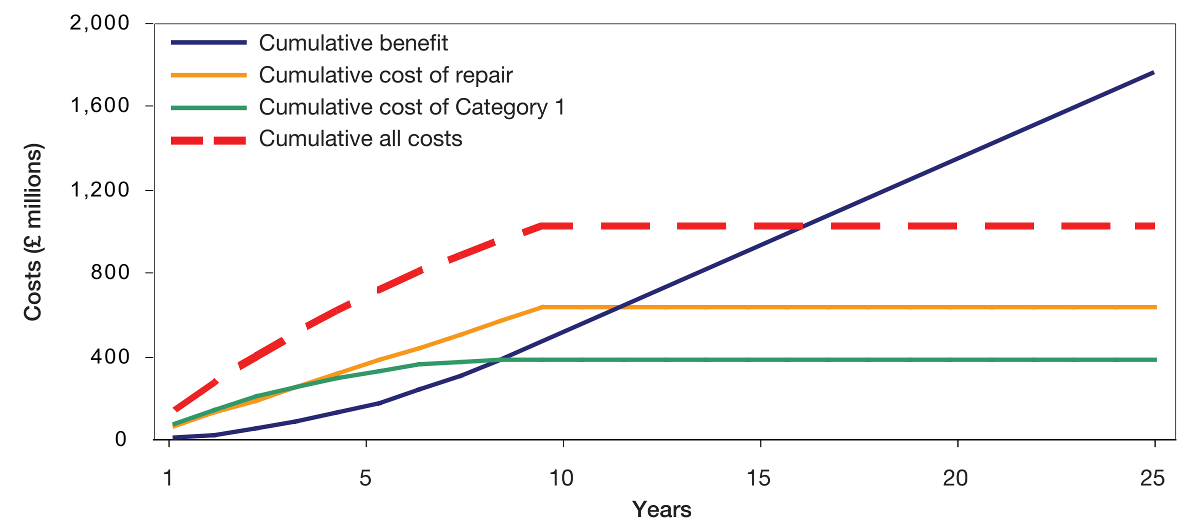


Figure 11: Cost benefit model with annual payments over 10 years: Falls on the level.

Input criteria	Value
Hazard	Falls associated with stairs and steps

Population variables	Value
Number of Category 1 hazards	1,755,000
Average cost to repair	£1,084
Total cost to repair	£1,902,420,000
Probability of Category 1 hazardous event	32
Probability of population average hazardous event	245
Average benefit to NHS by repairing	£211

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	Use population values
Time period for repair	10 years
Proportion to repair	All
Cost variance	Equal each year
Benefit variance	Equal each year
NPV discount rate	7%

Scenario dependent variables	Value
Time period	10 years
Annual budget for repair	£190,242,000
Annual number of properties to repair	175,500
Average cost to repair	£1,084

Results	Value
Payback period	5.1 years
Cumulative payback period	15 years
Total all cost over 25 years	£3,572,144,002
Total benefit over 25 years	£7,606,520,452
Period for NPV to become positive	21 years

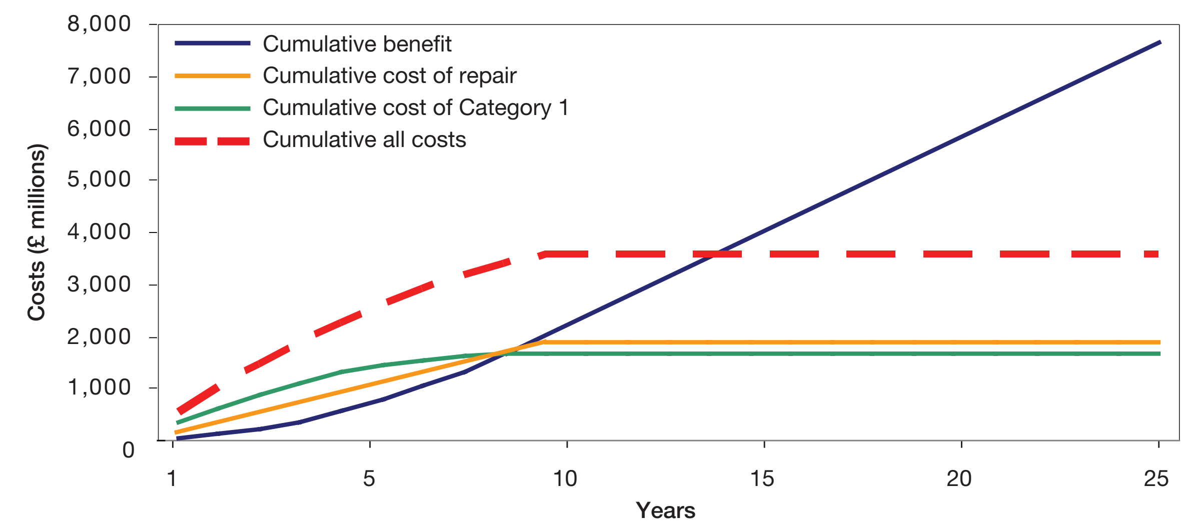


Figure 12: Cost benefit model with annual payments over 10 years: Falls associated with stairs and steps.

Input criteria	Value
Hazard	Fire

Population variables	Value
Number of Category 1 hazards	210,000
Average cost to repair	£3,312
Total cost to repair	£695,442,300
Probability of Category 1 hazardous event	100
Probability of population average hazardous event	4,760
Average benefit to NHS by repairing	£121

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	Use population values
Time period for repair	10 years
Proportion to repair	All
Cost variance	Equal each year
Benefit variance	Equal each year
NPV discount rate	7%

Scenario dependent variables	Value
Time period	10 years
Annual budget for repair	£69,544,230
Annual number of properties to repair	21,000
Average cost to repair	£3,312

Results	Value
Payback period	27.4 years
Cumulative payback period	37 years
Total all cost over 25 years	£809,705,919
Total benefit over 25 years	£520,534,264
Period for NPV to become positive	Never

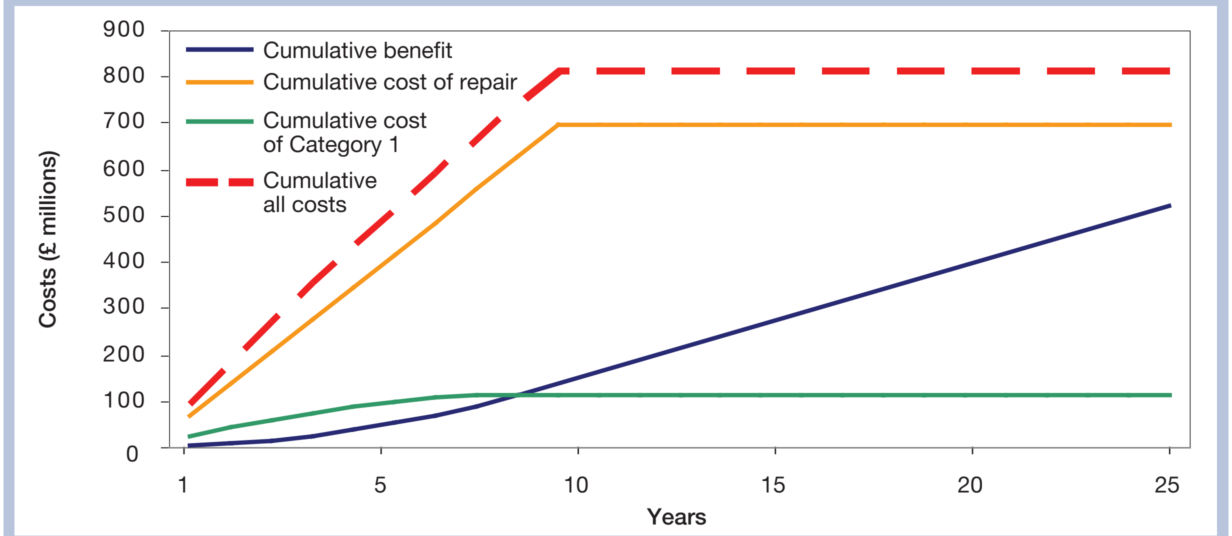


Figure 13: Cost benefit model with annual payments over 10 years: Fire.

Input criteria	Value
Hazard	Hot surfaces and materials

Input criteria	Value
Scenario	Annual payment
Total number of properties to repair	Use population values
Time period for repair	10 years
Proportion to repair	All
Cost variance	Equal each year
Benefit variance	Equal each year
NPV discount rate	7%

Population variables	Value
Number of Category 1 hazards	98,000
Average cost to repair	£2,200
Total cost to repair	£215,551,000
Probability of Category 1 hazardous event	18
Probability of population average hazardous event	182
Average benefit to NHS by repairing	£92

Scenario dependent variables	Value
Time period	10 years
Annual budget for repair	£21,555,100
Annual number of properties to repair	9,800
Average cost to repair	£2,200

Results	Value
Payback period	24 years
Cumulative payback period	34 years
Total all cost over 25 years	£255,906,862
Total benefit over 25 years	£183,843,369
Period for NPV to become positive	Never

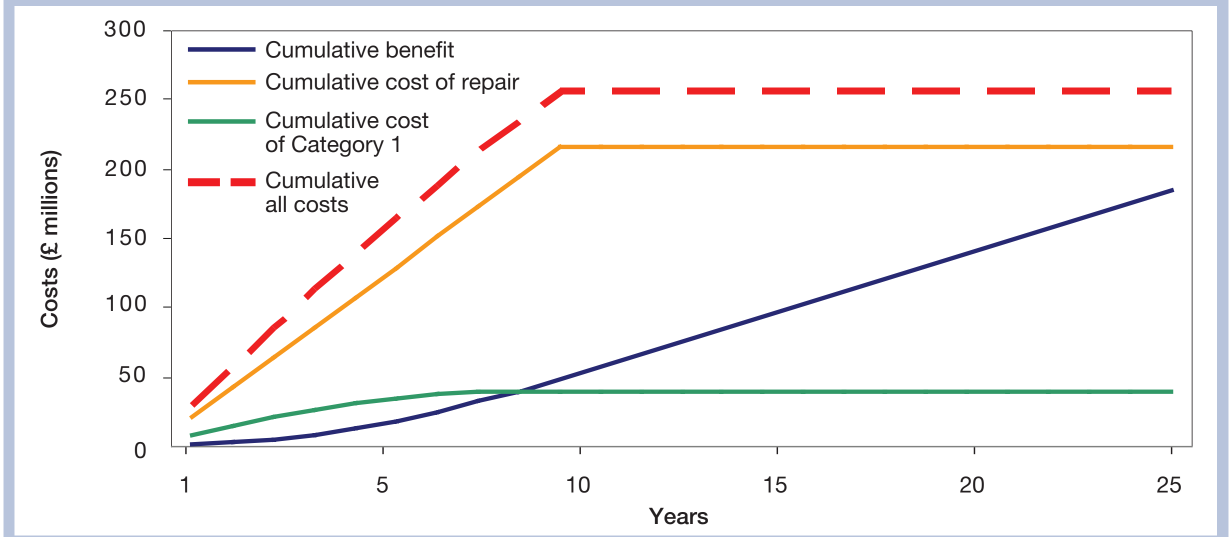


Figure 14: Cost benefit model with annual payments over 10 years: Hot surfaces and materials.

7 TOTAL COST OF POOR HOUSING

The data obtained from the EHCS and the HHSRS model can provide an initial estimate for the total cost of poor housing (Table 28).

The number of dwellings with Category 1 hazards is taken from Table 17. This is multiplied by the estimated total cost to repair from the EHCS data, which implies that it would cost in excess of £17.6 billion to remove all the Category 1 hazards from dwellings in England. For the hazards that were fully measured, we have a value for the average likelihood of Category 1 hazard scores (scores over 1,000). For all the other hazards the likelihood band that just provides a Category 1 hazard has been used with the average spread of harms. This implies a minimum likelihood, rather than the average for each hazard, underestimating the average risk of harm. Using the difference between this likelihood and the average likelihood for the whole stock an estimate for the total annual benefit to the NHS can be calculated, which in this case is just over £600 million. Put another way, this is the cost to the NHS each year if the repairs are not made.

Using this information, the direct payback period for all hazards can be calculated to be 29 years, if the repairs are all made up front.

It should be noted that the above calculation is particularly sensitive to the Category 1 average likelihood estimate for excess cold. This is mainly due to the very high number of homes estimated to have a Category 1 hazard score. If the average likelihood were reduced to 1 in 100, the savings per annum would increase to over £900 million and the payback would be 20 years. It might be better to remove the excess cold hazard from the calculation. This reduces the total cost to repair to £6 billion. The savings per annum would be £580 million and the payback period would be just over 10 years.

It should also be remembered that the direct costs to the NHS used in this calculation, at best, only account for 40% of the total cost to society. By multiplying this saving up to 100%, the payback for all hazards would be reduced from 29 years to 12 years, and without excess cold would be reduced from 10 years to four years.

***Table 28:* Total cost of poor housing estimate**

Hazard	Number of dwellings	Total cost to repair	Category 1 likelihood	Hazard score	Average likelihood	Savings per annum to the NHS
Damp and mould growth	99,000	£495,000,000	5	1,000	464	£8,794,064
Excess cold	2,346,502	£11,717,151,475	320	1,099	380	£21,433,443
Carbon monoxide and fuel combustion products	12,000	£12,000,000	2	1,000	1,250	£970,923
Lead	154,000	£1,232,000,000	3	1,533	58,400	£21,815,546
Radon (radiation)	96,000	£76,800,000	560	1,625	10,000	£7,605,943
Crowding and space	23,000	£16,100,000	100	1,553	8,000	£2,008,466
Noise	9,000	£36,000,000	3	1,533	900	£1,270,750
Domestic hygiene, pests and refuse	82,000	£114,800,000	1	1,000	5,585	£7,902,858
Personal hygiene, sanitation and drainage	9,000	£12,600,000	6	1,560	7,750	£1,208,064
Falls on the level	607,000	£634,673,130	32	1,273	135	£85,144,902
Falls associated with stairs and steps	1,755,000	£1,902,420,000	32	2,419	245	£371,049,778
Falls between levels	332,000	£423,715,000	32	1,222	1,693	£36,059,696
Electrical hazards	15,000	£60,000,000	18	1,632	16,869	£2,264,248
Fire	210,000	£695,442,300	100	2,295	4,760	£25,391,915
Hot surfaces and materials	98,000	£215,551,000	18	1,095	182	£8,967,969
Any of the above hazards*	4,752,000	£17,644,252,905	–	–	–	£601,888,565

* Individual items do not sum to the total because some dwellings have more than one hazard.

8 CONCLUSIONS AND RECOMMENDATIONS

The cost benefit model proposed uses the data obtained from the EHCS in a very effective way, illustrating the effects of various scenarios and repair options. It allows all the EHCS measured hazards to be compared, illustrating repair solutions which provide direct benefit to the NHS through reduced injury rates and treatment costs.

Using this model as a method for calculating the total cost of poor housing, it can be estimated that Category 1 hazards in homes are costing the NHS in excess of £600 million per year. The total cost to society may be greater than £1.5 billion per annum.

The model is limited by the data available in the currently published versions of the EHCS. Accurate information is only available for the five hazards that have been fully measured in the 2005/06 and 2006/07 EHCS datasets and the data for other hazards have to be estimated. In the 2007/08 data accurate information will be extended to 10 hazards, potentially improving the quality of the model.

The model currently considers three scenarios: no change, all up front and annual payment. The model could be extended to include other scenarios if required. These three scenarios can be moderated by selecting to repair only a proportion of dwellings that are cheaper to repair, the cheapest 20% for example. In doing so the actual cost to the NHS is underestimated, since the cost associated with not repairing the other 80% has not been considered. It may be necessary to include the other proportion in the cost benefit analysis model, perhaps as another scenario where more costly repairs are tackled in future years on the back of benefits obtained.

The number of homes with a Category 1 hazard of excess cold dominates the model. The costs of repairs are high and the average for the stock is currently estimated to be little better than a Category 1 hazard with a hazard score of 926. Given the amount of home improvements made in recent years to reduce energy consumption, it is highly likely that this average likelihood value for the stock has reduced significantly. In addition, the average likelihood for Category 1 hazards is not measured. If it were, it is likely that the value would be much higher than the 1 in 320 needed to obtain a Category 1 hazard. The model would benefit greatly from a more accurate rating for likelihood of harm from excess cold under both these situations. Alternatively, estimates of likelihood against SAP rating could be made using professional judgment.

The data provided in the model suggests that money spent wisely on improving homes could save the NHS millions of pounds per year, and would also provide health benefits to individuals, perhaps even saving lives. The HHSRS method has proved to be a good tool for targeting limited resources on the most cost effective solutions.

REFERENCES

Acheson (1998). An Independent Inquiry into Inequalities and Health. The Stationery Office, London.

Airey C et al (1999). National Survey of NHS Patients – Coronary Heart Disease. National Centre for Social Research, Picker Institute Europe, Oxford.

AJPH (American Journal of Public Health) (2003). Special issue: Built Environment and Health, volume 93, no. 9.

Ambrose P (1996). I Mustn't Laugh Too Much: Housing and Health on the Limehouse Fields and Ocean Estates in Stepney. Health and Social Policy Research Centre, University of Brighton.

Ambrose P (2000). A Drop in the Ocean: The Health Gain from the Central Stepney SRB in the Context of National Health Inequalities. Health and Social Policy Research Centre, University of Brighton.

Ambrose P (2001). Living Conditions and Health Promotion Strategies. Journal of the Royal Society for the Promotion of Health, 121.1. pp 9–15.

Ambrose P (2002). Second Best Value: The Central Stepney SRB – How Non-joined up. Government Policies Undermine Cost-effectiveness in Regeneration. Health and Social Policy Research Centre, University of Brighton.

Ambrose P, Barlow J et al (1996). The Real Cost of Poor Homes. Royal Institution of Chartered Surveyors, London.

Ambrose P, MacDonald D (2001). For Richer, For Poorer: Counting the Costs of Regeneration in Stepney. Health and Social Policy Research Centre, University of Brighton.

Ambrose P, Randles J (1999). Looking for the Joins: A Qualitative Study of Inter-agency Working in Holly Street and Hackney. Centre for Urban and Regional Research, University of Sussex.

Attanasio O, Emmerson C (2001). Differential Mortality in the UK. Working paper. IFS Working Papers (W01/16). The Institute for Fiscal Studies, London.

Baker W (2001). Fuel Poverty and Ill Health – A Review. The Centre for Sustainable Energy, Bristol.

Berry M (2002). Affordable Housing. A Project for the Brotherhood of St Laurence in partnership with the Committee for Economic Development. Australian Housing and Urban Research Institute, Melbourne.

Berry M, Dalton T, Horn M, Berman G (2002). Systematic Review of the Cost Effectiveness and Cost Benefit Studies of Homelessness. Australian Housing and Urban Research Institute, Melbourne.

BMA (2003). Housing and Health: Building for the Future. British Medical Association, London.

British National Formulary (BNF) website (www.bnf.org).

Boardman B (1991). Fuel Poverty. Bellhaven Press, London.

Brand S, Price R (2000). The Economic and Social Costs of Crime. Home Office Research Study 217. Home Office, London.

Burridge R, Ormandy D (eds) (1993). Unhealthy Housing: Research, Remedies and Reform. E and FN Spon, London.

Chartered Institute of Environmental Health (CIEH) (2008). Good Housing Leads To Good Health: A toolkit for environmental health practitioners. CIEH, London.

CLG (2004). Housing Health and Safety Rating System. Guidance (version 2). www.communities.gov.uk/archived/publications/housing/ihousinghealth. CLG, London.

CLG (2006). English House Condition Survey – Technical Report (2004 edition). CLG, London.

CLG (2008). Review of Health and Safety Risk Drivers BD2518. www.communities.gov.uk/publications/planningandbuilding/reviewhealthsafety. CLG, London.

CLG (2009). English Housing Survey, Surveyor Briefing Manual, part 3: Housing Health and Safety Rating System. CLG, London.

Coleman M (1999). Cancer Survival Trends in England and Wales 1971–1995: Deprivation and NHS region. Office for National Statistics, London.

Cox S J, O'Sullivan EFO (eds) (1995). Building Regulation and Safety. IHS BRE Press, Bracknell.

DTI (2003). Road Casualties Great Britain 2002. www.dft.gov.uk/pgr/statistics/datatablespublications/accidents/casualtiesgbar/roadcasualtiesGB2002.pdf. DTI, London.

DTI (2003). 24th (final) Report of the Home and Leisure Accident Surveillance System: 2000, 2001 and 2002 data. DTI/Pub 7060/3k/12/03/NP URN 03/32. DTI, London.

Eurowinter Group (1997). Cold Exposure and Winter Mortality from Ischaemic Heart Disease, Cerebrovascular Disease, Respiratory Disease and All Causes in Warm and Cold Regions of Europe. The Lancet, volume 349, no. 9062, May 10.

Fisk W, Rosenfeld A (1997). Improved Productivity and Health from Better Indoor Environments. Centre for Building Science Newsletter, Summer 1997.

Gilbertson J, Green G, Ormandy D (2006). Decent Homes Better Health: Sheffield Decent Homes Health Impact Assessment. CRESR, Sheffield Hallam University.

Graham H (ed) (2000). Understanding Health Inequalities. Open University Press, Maidenhead.

Gravelle H, Sutton M (2001). Income Related Inequalities in Self-assessed Health in Britain 1979–1995. Centre for Health Economics, University of York.

HSE (2003). Statistics of Fatal Injuries 2002/03. www.hse.gov.uk/statistics/overall/fatl0203.pdf.

HSE (2003). Health and Safety Statistics Highlights 02/03. www.dft.gov.uk/pgr/statistics/datatablespublications/accidents/casualtiesgbar/roadcasualtiesGB2002.pdf.

Hansard (1999). Debate On An Amendment to the Welfare Reform and Pensions Bill Moved by Lord Morris of Manchester Calling for Minimum Income Standards. 11 October 1999, Column 162.

Howden-Chapman P, Carroll P (2004). Housing & Health: Research, Policy and Innovation. Steele Roberts, Wellington,New Zealand.

Ineichen B (1993). Homes and Health: How Housing and Health Interact. E & FN Spon, London.

Jefferis B, Power C, Hertzman C (2002). Birth Weight, Childhood Socio-economic Environment and Cognitive Development in the 1958 Birth Cohort Study. British Medical Journal, 10 August 2002.

Lawson R (1997). Bills of Health. Radcliffe Medical Press, Oxford.

Mant D, Muir Gray JA (1986). Building Regulation and Health. IHS BRE Press, Bracknell.

Marmot M, Davey Smith G, Stansfield S, Patel C, North J (1991). Health Inequalities Among British Civil Servants: The Whitehall 11 Study. The Lancet.

Meering WJ, Mulder S, van Beeck EF (2006). Incidence and Costs of Injuries in The Netherlands. European Journal of Public Health, volume 16, no. 3, 271-277.

National Housing Federation (1997). Housing for Health. National Housing Federation, London.

NHS data downloaded from: www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4070195

ODPM (2003). Statistical Evidence to Support the Housing Health and Safety Rating System, volumes I, II, and III. ODPM, London.

ODPM (2004). Housing Health and Safety Rating System – Guidance (version 2). ODPM, London.

ODPM (2004). Regulatory Impact Assessment for the 2004 Housing Act. ODPM, London.

ODPM (2005). Regulatory Impact Assessment: Housing Act 2004 – Part 1: Housing Conditions. ODPM, London.

ONS (2005). Deaths by Age, Sex and Underlying Cause, 2002 Registrations. Health Statistics Quarterly 18 HSQ18DT2.

Ormandy (ed) (2009). Housing and Health in Europe: The WHO LARES project. Routledge, London.

Popay J (2001). Regeneration and Health: A Selective Review of Research. King's Fund, London.

PSSRU (2004). Unit Costs of Health and Social Care 2004, compiled by Lesley Curtis and Ann Netten. Personal Social Services Research Unit. Download from www.pssru.ac.uk/pdf/uc2004/uc2004.pdf.

Ranson R (1991). Healthy Housing: a Practical Guide. E & FN Spon, London.

Raw GJ, Hamilton RM (eds) (1995). Building Regulations and Health. IHS BRE Press, Bracknell.

Raw G J, Aizlewood C E, Hamilton R M (eds) (2001). Building Regulation, Health and Safety. IHS BRE Press, Bracknell.

RenvH (Reviews on Environmental Health) (2004). Special issue: Housing, Health and Well-being, volume 19, nos 3–4.

Rudge J (2001). Developing a Methodology to Evaluate the Outcome of Investment in Affordable Warmth. LEARN, University of North London, Eaga Partnership Charitable Trust.

Sandel M et al (1999). There's No Place Like Home: How America's Housing Crisis Threatens our Children. Housing America, San Francisco.

Sassi F (2006). Calculating QUALYs, comparing QUALY and DALY Calculations, Advance Access Publication. Oxford University Press in association with the London School of Hygiene and Tropical Medicine.

Syme S (1994). The Social Environment and Health. Daedalus Journal of American Academy of Arts and Sciences, Health and Wealth, volume 123 (Fall) no. 4: pp 79–86.

Thomson H et al (2002). Housing Improvement and Health Gain: A Summary and Systematic Review. MRC Social and Public Health Sciences Unit, Occasional Paper 5.

Walby S (2004). The Cost of Domestic Violence. DTI Women and Equality Unit, London.

Wanless D (2002). Securing our Future Health: Taking a Long Term View. HM Treasury, London.

Worrall A, Rea J, Nicholas P, Ben-Shlomo Y (1997). Counting the Cost of Social Disadvantage in Primary Care: Retrospective Analysis of Patient Data. British Medical Journal, 314:38 (4 January).

Wilkinson P et al (2001). Cold Comfort: The Social and Environmental Determinants of Excess Winter Death in England, 1986-1996. Policy Press, Bristol.

Zacchaeus 2000 Trust (2005). Memorandum to the Prime Minister on Unaffordable Housing, Z2K Trust. Downloaded from www.z2k.org/Memorandum%20to%20the%20Prime%20Minister%20on%20Unaffordable%20Housing.pdf.

Zaloshnja E, Miller TR, Lawrence BA, Romano E (2005) The Cost of Unintentional Home Injuries. American Journal of Preventive Medicine 2005; 28(1).

APPENDIX

Worked examples for Housing Health and Safety Rating System assessments

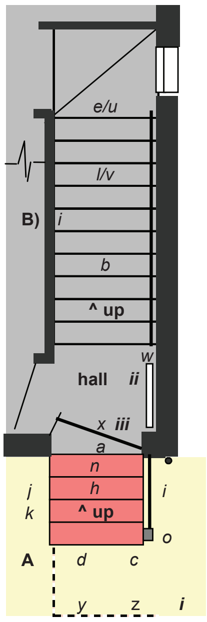
FALLING ON STAIRS ETC

HHSRS VERSION 2

Vulnerable group	Persons aged 60 years or over	**Multiple locations**	**Yes**	No
Related hazards	None	**Secondary hazards**	**Yes**	No

A Front door steps

A/B Plan



B) Main stairs

C) Steps at gate

DESCRIPTION OF HAZARD/S

Dwelling: 1930s, Semi-detached house

A) **Front door steps:** These are of smooth painted concrete and have no top 'landing'. The bottom riser is high and uneven (300 mm max). There is a wobbly tubular steel handrail on one side but no guarding at all, despite the narrow width. There is no external porch light and little street lighting.

B) **Main stair:** The main internal stairs have two winders at the top and are moderately steep. There is a handrail only along the outside wall of the straight flight. There is a projecting radiator in the small hall and some glass in the front door close to the foot of the stairs.

C) **Steps at gate:** The steps close to the front gate are of rough spalling concrete. They have high uneven risers and a narrow tread. There is a crude rotten timber handrail but no guarding.

LIST OF RELEVANT MATTERS

	LIKELIHOOD	A	B	C
a	Tread lengths	1	1	2
b	Riser heights	3	1	2
c	Variation in T&Rs	3	1	2
d	Nosing length	-	-	-
e	Poor friction quality	3	-	1
f	Openings - in stairs	-	-	-
g	Alternating treads	-	-	-
h-i	Lack/height handrails	3	2	2
j-l	Lack/height guarding	3	-	1
m	Stair width	2	-	-
n	Length of flight	-	1	-
o-q	Inadequate lighting etc	3	-	3
r	Door/s onto stairs	-	-	-
s	Inadequate landing	3	-	-
t	Construction/repair	2	-	3
u	Thermal efficiency	2	-	1

	OUTCOMES	A	B	C
a	Length of flight	-	1	-
b	Pitch of stairs	-	2	-
c	Projections etc #	-	2	3
d	Hard surfaces #	2	1	2
e	Construction/repair	2	-	3
f	Thermal efficiency	3	-	2

	# Secondary hazards	A	B	C
i	Concrete kerb	2	-	-
ii	Projecting radiator	-	2	-
iii	Glass in front door	-	1	-
iv	Condition of paths	3	-	2

Key 3 Seriously defective 1 Not satisfactory
2 Defective - Satisfactory/NA

Figure 15: Falls on stairs Housing Health and Safety Rating System version 2 (English Housing Condition Survey, 2007/08).

COMPLETION OF SECTION 22 OF EHS

LIKELIHOOD

Falling on stairs etc.

Significantly higher than average: Y N

Likelihood of a person over 60 having a fall leading to harm

					Average	Average Pre 1919					
		1800	1000	560	320	180	100	56	32	18	6	2

Justification The main stairs are assessed as giving the same likelihood of a major fall as the average for inter-war houses, (i.e. around 1 in 320), the limiting handrail provision cancelling out any benefits of the broad winders. However, the added presence of the front access steps – particularly dangerous in icy weather and at night – substantially increases the overall annual probability of such a fall – to 1 in 18.

OUTCOMES

Likely outcome if a person over 60 should fall

Class 1 Extreme %	0.1	0.2	0.5	1	2.2	4.6	10	21.5	31.6	46.4	100
Class 2 Severe %	0.1	0.2	0.5	1	2.2	4.6	10	21.5	31.6	46.4	100
Class 3 Serious %	0.1	0.2	0.5	1	2.2	4.6	10	21.5	31.6	46.4	100

Justification The stairs are designed to be carpeted but the resulting lower harms are offset by the small hall, projecting radiator and single glazing in the door, albeit this is not at low level. However, the presence of the external front door steps and steps near the front gate, both flanked by rough tarmac and a concrete curb, significantly increase the risk of a fatal or severe fall occurring, particularly in cold weather or at night.

Likelihood Class 1 Outcome	1 in 1800	1 in 1000	1 in 560	1 in 320	1 in 180	1 in 100	1 in 56	1 in 32	1 in 18	1 in 6	1 in 2
0.1%							E	D	C	B	A
0.2%						E-	E	D	C	B	A
0.5%						E	E	D	C	B	A
1.0%						E	E+	D	C	A-	A
2.2%				F	E-	E	D	C	B	A	A
4.6%				E-	E	D	C	B-	B	A	A
10.0%			E-	E	D	C	B-	B	A	A	A
21.5%		E	E	D	C	B	B	A	A	A	A
31.6%		E	D	C	C	B	A	A	A	A	A
46.4%	E	E	D	C	B	B	A	A	A	A	A
100%	D	C-	C	B	A	A	A	A	A	A	A

ACTION REQUIRED

Justification Replacing the steps to the front door and at the gate with steps satisfying current Building Regulations and British Standards and fitting a porch light and a full handrail on both sides of the main stair would give a more average likelihood of a major fall and an average spread of health outcomes, and thereby a rating closer to the average.

Action required

Action required?	Action	Coded elsewhere?		Quantity	
Y	Install handrail	Y	N	Metres:	0.5
Y	Install balustrade	Y	N	Metres:	
Y	Cover dangerous balustrade/guarding	Y	N	Metres:	
Y	Repair/replace internal staircase (S5)	Y			
Y	Redesign internal, common or external staircase (design, not condition)		N	Number:	
Y	Repair/replace external/common staircase (S9)	Y			
Y	Repair/replace external steps (S11, S18)	Y	N	Number:	
Y	Cover slippery stairs	Y	N	Flights:	
Y	Repair/replace/provide additional lighting (S5, S9, S11)	Y	N	Number:	1
Y	Remove obstacle		N	Number:	1

Figure 16: Completion of Section 22 of English Housing Survey form (English Housing Condition Survey, 2007/08).

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