European Agency for Safety and Health at Work

Estimating the cost of accidents and ill-health at work:

A review of methodologies

Technical Annex

European Risk Observatory

European Agency for Safety and Health at Work

Table A2.1 Methods for estimating number of work-related accidents and ill-health cases

Author (Date) Country Industry	Type of accident/ ill health	Number of accidents/ cases of ill health (relative percentage)	Method	Assumptions	Time period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
Ayres (2010) **UK** **Multi-industry**	Illnesses: Asthma	Caused by latex or glutaraldehyde: 7 (male) 21 (female) Caused by isocyanates: 104 (male) 4 (female) Caused by flour or grain: 45 (male) 28 (female) Not caused by exposure: 286 (male) 136 (female)	Total asthma cases recorded from various data sources. The data is not available broken down by agent, gender and occupational simultaneously. Some information is available for incidence of occupational asthma by agent and separately by occupation. No information is available by gender specifically for occupational asthma though some information is available for work related and occupational disease. Best estimates have been taken based on the collective information	100% of those exposed to isocyanates are men, 63% of those exposed to flour or grain are men and 24% of those exposed to latex or gluteralderhyde are men. Assumes that within the same job and exposure the risk of occupational asthma is the same in men and women.	2003	Survey of Work-related and Occupational Respiratory Disease (SWORD) scheme, OPRA (occupational physicians) and Labour Force Survey (LFS)	Cites paper suggesting incident cases of occupational asthma underestimated by 1/3rd	Not available	Proportions are guesses	Not available
Bejean (2004) **France** **Multi-industry**	Illnesses: Cardiovascular disease caused by stress	135,573 (8.6%) (men) 15,246 (1.9%) (female)	Total cases in the French population multiplied by the proportion of cases attributable to work-related stress.	Not available	2000	Institut National de la Santé et de la Recherche Médicale (INSERM)	Assumption leads to an underestimation of the cost of CVD	Not available	Not available	Not available
Bejean (2004) **France** **Multi-industry**	Fatal illnesses: Cardiovascular disease caused by stress	1,344 (11.1%) (male) 292 (7.5%) (female)	Total cases in the French population multiplied by the proportion of cases attributable to work-related stress.	Distribution by age assumed identical to that of persons who died of CVD.	2000	Institut National de la Santé et de la Recherche Médicale (INSERM)	Assumption leads to an underestimation of the cost of CVD	Not available	Not available	Not available

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Bejean (2004) **France** **Multi-industry**	Illnesses: Depression caused by stress	86,763 (13.8%) (male) 70,642 (4.8%) (female)	Total cases in the French population multiplied by the proportion of cases attributable to work-related stress.	Assumed that the prevalence of depression was stable between 1997-2000	2000	Le Pape and Lecomte 1996	Not available	Not available	Not available	Not available
Bejean (2004) **France** **Multi-industry**	Fatal illnesses: Depression caused by stress	610 (13.8%) (male) 74 (4.8%) (female)	Total cases in the French population multiplied by the proportion of cases attributable to work-related stress.	Assumed that the prevalence of depression was stable between 1997-2000	2000	Institut National de la Santé et de la Recherche Médicale (INSERM)	Not available	Not available	Not available	Not available
Bejean (2004) **France** **Multi-industry**	Illnesses: MSD, back pain caused by stress	981 (12.7%) (male) 671 (8.7%) (female)	Total cases in the French population multiplied by the proportion of cases attributable to work-related stress.	No deaths were recorded from MSD and back pain	2000	Institut National de la Santé et de la Recherche Médicale (INSERM)	Not available	Not available	Not available	Not available
Biddle (2004) **USA** **Multi-industry**	Fatal injuries	103,845	Data taken from the National Traumatic Occupational Fatalities dataset, from 1980-1997, for workers 16 years or older. Only fatalities within the civilian workforce were used for this study. Information about age at death, race, sex, occupation at time of death and age if individual had survived were also collected to help calculate the present value of future earnings.	* Participation rate in the labour force eliminated from model as descendents were employed at time of death. * Calculations were ceased after the age of 67 to reflect retirement.	18 years	National Traumatic Occupational Fatalities (NTOF)	Not reported	* Theoretical approach is easy to understand, calculate and data are inexpensive to acquire.	Not available	Two data sets are available for occupational fatal injuries: the NTOF and the Bureau of Labour Statistics (BLS) Census of Fatal Occupational Injuries (CFOI). Both datasets vary in characteristics of decedents; therefore the model should be expanded to calculate the lifetime costs of CFOI fatalities.

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Boonen et al (2002) **Netherlands Belgium and France** **Multi-industry**	Illnesses: Ankylosing spondylitis (chronic inflammatory disease of the axial skeleton)	11,250 patients in NL; 43,062 in F; 7,646 in B Sample size of 216 starting the study: 135 Dutch, 54 French, 27 Belgian; 209 finishing the study: 130 Dutch, 53 French, 26 Belgian (Prevalence of 0.075%).	Prevalence estimate in Western Europe multiplied by population for each of the three countries.	Not available	2 year observational study, patients included between September 1996 and March 1997, last follow up patient was evaluated in April 1999.	Not available	Not available	Not available	Not available	Not available
HSE (2010) 2010/11 update **UK** **Multi-industry**	Minor injuries	368,000	Self-reports of newly occurring cases/incidence cases. Estimates from the LFS are subject to sampling error (as are all survey estimates). To minimise this sampling error and ensure a sufficiently large sample several years of data were pooled. For ill health three years' worth of data were combined.	Not available	2009/10-2011/12	Labour Force Survey (LFS)	Not available	* Data is incidence based. * Designed to capture current working conditions.	* People on long term sick lasting more than a year but who still expect to return to work are not captured. * Only most serious illness per year per person captured. * LFS counts 'people' rather than 'cases' which underestimates the amount of time off for people who suffered more than once incidence in a year.	Not available

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HSE (2010) 2010/11 update **UK** **Multi-industry**	Injuries (RIDDOR reportable injuries)	144,000 (major) 271,000 (over 3 days)	Self-reports of newly occurring cases/incidence cases. Annual average estimate was used to smooth out the random year-to-year variation. For injuries, as it was required to disaggregate the estimates according to RIDDOR definitions, it was only possible to use data from 2006/07 onwards. On 1 April 2012, RIDDOR regulations were amended such that only major injuries and absences over seven days are reportable, rather than over three days as previously. As this occurred after the period that the 2010/11 model is based on, the definition of 'RIDDOR reportable' relates to definitions of RIDDOR reportable injuries applied in 2010/11 i.e. major injuries and absences over three days.	Not available	2009/10-2011/12	Reporting of Injuries, Diseases and Dangerous Occurrences (RIDDOR)	Not available	* Data is incidence based. * Designed to capture current working conditions.	* Only the most recent injury captured.	Not available

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HSE (2010) 2010/11 update **UK** **Multi-industry**	Fatal injuries	165	Self-reports of newly occurring cases/incidence cases. Annual average estimate was used to smooth out the random year-to-year variation. For injuries, as it was required to disaggregate the estimates according to RIDDOR definitions, it was only possible to use data from 2006/07 onwards.	Not available	2009/10-2011/12	Reporting of Injuries, Diseases and Dangerous Occurrences (RIDDOR)	Not available	Data is incidence based. Designed to capture current working conditions.	Only the most recent injury captured.	Not available
HSE (2010) 2010/11 update **UK** **Multi-industry**	Illnesses	222,000 (Stress, depression or anxiety) 163,000 (Musculoskeletal disorders) 115,000 (Other illnesses)	Self-reports of newly occurring cases/incidence cases or ill health. Estimates from the LFS are subject to sampling error (as are all survey estimates). To minimise this sampling error and ensure a sufficiently large sample several years of data were pooled. For ill health three years' worth of data from 2005/06 was combined.	Not available	2009/10-2011/12	Labour Force Survey (LFS)	Not available	Data is incidence based. Designed to capture current working conditions.	People on long term sick lasting more than a year but who still expect to return to work are not captured. Only most serious illness per year per person captured. LFS counts 'people' rather than 'cases' which underestimates the amount of time off for people who suffered more than once incidence in a year.	The LFS is good for estimating the incidence of work-related injuries and common ill health conditions, but is limited when measuring long latency conditions such as occupational cancers or chronic obstructive pulmonary disease (COPD). This is because LFS estimates are based on an individual's self-assessment of the link between their newly occurring ill health and their work.

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HSE (2010) 2010/11 update **UK** **Multi-industry**	Illnesses & injuries: Withdraw permanently from the workforce due to illness or injury	16,000	This information has only been collected on the LFS since 2008/09 and reflects the number of workers who in 2010/11 expected never to return to work as a result of their workplace injury or work related ill health.	Not available	2010/11	Labour Force Survey (LFS)	Not available	* Data is incidence based. * Designed to capture current working conditions.	The injury or ill health may not necessarily be a new case, and therefore some cases of withdrawals will be based on previous working conditions.	The LFS is good for estimating the incidence of work-related injuries and common ill health conditions, but is limited when measuring long latency conditions such as occupational cancers or chronic obstructive pulmonary disease (COPD). This is because LFS estimates are based on an individual's self-assessment of the link between their newly occurring ill health and their work.
Koningsveld (2001) **Netherlands** **Multi-industry**	Illnesses & injuries:	% of absences work-related for a specific condition (disability information also available): Infectious diseases: 0.1% Neoplasms: 0.2% Endocrine diseases: <0.1% Diseases of the blood: <0.1% Mental and behavioural disorders: 11.5% Diseases of the nervous system: 0.5% Diseases of the circulatory system: 0.9% Diseases of the respiratory system: 0.3% Diseases of the digestive	Researchers used a literature survey and expert judgment to estimate the percentage of work-related ill health/ accidents from the overall disease costs	Percentages describing the part of the costs related to work were not updated, as they assumed this would not influence the outcome. Also, no new information had become available.	2001	Based on the method presented by Koningsveld and Mossink in 1997	*Self-employed people not included.	*Work-relatedness largely based on expert judgment	Based on relatively old data.	Information regarding work-relatedness should be collected for the different diseases.

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		system: 0.1% Diseases of the genitourinary system: 0.1% Pregnancy and childbirth: 0.1% Diseases of the skin and subcutaneous tissue: 0.2% Diseases of the musculoskeletal system and connective tissue: 14.7% Congenital anomalies: 0% Injuries: 1%								
Leigh et al (2001) **USA** **Multi-industry**	Fatal injuries	660	From CFOI data for 1992, it was estimated that the percentage of fatal occupational injuries in California was 10.36%. This percentage was then applied to the 1993 national estimate of fatal occupational injuries (6,371 deaths).	Not available	Annual	* Census of Fatal Occupational Injuries (CFOI) * National estimates	National estimates are used instead of CFOI, as the latter may have an under count of minorities.	* Data used is incidence based and follows each case for 2 years.	Injury numbers only apply to 1992. If present trends continued, number of injuries would decline, while average length of time away from work would expand.	Not available

Author (Date) Country Industry	Type of accident/ ill health	Number of accidents/ cases of ill health (relative percentage)	Method	Assumptions	Time period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
Leigh et al (2001) **USA** **Multi-industry**	Non-fatal injuries	1.6 million	From BLS annual survey data for 1992, it was estimated that the percentage of non-fatal occupational injuries in California was 12.3%. This percentage was then applied to the national estimate for non-fatal occupational injuries (13.3million). This results in 1.6 million cases of non-fatal workplace injuries for California. The authors then further categorize these into disabling and non-disabling injuries. An injury that results in at least one work day lost is classed as disabling. All others are non-disabling. For California, an adjustment was made due to the potential underreporting of disabling and non-disabling estimates from BLS data, on which the % of injuries is based on. National estimates for disabling and non-disabling are 40% and 60% respectively. The California adjustment allowed for 45% and 55% respectively, increasing the number of people who will be eligible for indemnity benefit.	National estimates rely on 2 assumptions: 1) injury rate for persons and firms excluded from the BLS survey (farmers, domestics, self-employed, government workers) is the same as the rate for private firms included in the annual survey 2) Firms face an economic incentive to underreport (see underreporting for estimates)	Annual	Bureau of Labour Statistics (BLS) annual survey National estimates	National estimates assume underreporting of 20% for disabling injuries and 35% for non-disabling injuries.	Data used is incidence based and follows each case for 2 years.	Assumptions around percentages for disabling and non-disabling injuries are different to the national averages. This is due to the authors assuming that California is more generous when allowing disability injuries to qualify for WC Injury numbers only apply to 1992. If present trends continued, number of injuries would decline, while average length of time away from work would expand.	Not available

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Leigh et al (2001) **USA** **Multi-industry**	Fatal illnesses	7,079	Population Attributable Risk (PAR) method. In this method, the percentages of deaths in major disease categories are attributed to occupational exposures. No access to source.	Decedents aged 24 and under are ignored for all categories of deaths and for circulatory diseases. Decedents older than 64 are also excluded.	Annual	Not available	Not available	* Data used is incidence based and follows each case for 2 years.	Illness analysis - Job related reproductive problems omitted. Full extent of hearing loss underestimated Assumed no deaths or illness due to worry about layoffs. No diseases allowed for anyone under 25. Did not account for sick building syndrome. Circulatory diseases were limited to people under 65. Therefore 1% of circulatory diseases were attributed to job exposures.	Not available

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Leigh et al (2001) **USA** **Multi-industry**	Non-fatal illnesses	133,000	Population Attributable Risk (PAR) method. In this method, the percentages of deaths in major disease categories are attributed to occupational exposures. No access to source.	Not available	Annual	* BLS Annual Survey * Federal Occupation compensation program (OWCP) Leigh et al (2000) * Adult Blood Lead Epidemiology and Surveillance (ABLES) program	Not available	* Data used is incidence based and follows each case for 2 years.	* Illness analysis - Job related reproductive problems omitted. Full extent of hearing loss underestimated. Assumed no deaths or illness due to worry about layoffs. No diseases allowed for anyone under 25. Did not account for sick building syndrome. Circulatory diseases were limited to people under 65. Therefore 1% of circulatory diseases were attributed to job exposures *In the BLS data, self-employed, government workers and small farms are excluded. Also there is an economic incentive to underreport	Not available

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Rikhardsson et al (2004) **Denmark** **Multi-industry**	Non-fatal injuries	270	The number of cases was derived from company data based on absences from the workplace of at least one day. Data collection forms were sent and workshops took place in nine Danish companies covering the service industry, the construction industry and the production industry. Accidents were categorised into the following: Serious accident (absence between 35-361 days) Less serious accident (absence between 2-114 days) Typical accident (2-21 days) These categories were defined based on the length of absence and the frequency of occurrence of similar accidents. This study looked at 9 types of accidents for each category (totalling 27 types of accident). Full breakdown of accidents is not given.	Not available	1 year	Company data	Not available	The method, in itself can be used by other companies to assess the cost burden of different types of occupational accident.	*There are overlaps in the length of absence for some categories, as different definitions were adopted by some companies. * Choice of actual accidents was left to companies based on the selection criteria sent to them by research team. Lack of consistency in definitions of accidents could lead to inaccuracies in the total cost burden of the different categories of accidents. * Due to the nature of the method and sample, results cannot be generalised, as it is specific to the companies surveyed.	Not available

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Romero et al (2010) **Ecuador** **Multi-industry**	Injuries & illnesses	Not given - theoretical approach/tool developed by oil industry	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Safe Work Australia (2012) **Australia** **Multi-industry**	Injuries	259,800 compensated; 190,900 uncompensated; 450,700 total	Incident approach, combines details of new workers' compensation cases for the reference year for non-fatal cases (from NDS, see data sources column) with estimates from the WRIS (see data sources), Safe Work Australia for non-fatal non-compensated incidents and fatal injuries (separate datasets). Broken down by five categories of severity (ranging from short absence <5 days to fatality) & compensated/uncompensated status.	Excludes those who lost only part of a shift or no time off. Assumes distribution of incidents by severity category (i.e. length of absence) in the WRIS data similar to the distribution for compensated (NDS) claims (estimated to be conservative).	1 year: 2008-09 financial year	* NDS: National Dataset for compensation based statistics, 2nd edition * WRIS: Australian Bureau of Statistics (ABS) Work Related Injuries Survey	Not available	Not available	Not available	Not available
Safe Work Australia (2012) **Australia** **Multi-industry**	Illnesses	63,800 compensated; 106,900 uncompensated; 170,700 total	As above except: * Disease fatalities assumed to be a similar level to previous study. * Additional estimates of disease morbidity (as this is known to be unreported often in both other Table atasets): morbidity estimates for 4 key diseases (work-related) from various sources: neoplasm, asthma, respiratory disease, heart disease.	Excludes those who lost only part of a shift or no time off. Assumes distribution of incidents by severity category (i.e. length of absence) in the WRIS data similar to the distribution for compensated (NDS) claims (estimated to be conservative).	1 year: 2008-09 financial year	As above plus: * Disease fatalities: National Occupational and Health and Safety Commission, 2004 [2003 draft report referenced] Additional estimates of disease morbidity: * Fritschi and Driscoll, Cancer due to occupation in Australia, Aust NZ J Public Health 2006; Vol 30 * Australian Safety and Compensation Council * Australian Institute of Health and Welfare	Not available	Not available	Not available	Not available

Table A2.2 Methods for estimating economic costs

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
Ayres (2010) UK Multi-industry Asthma	Workers and families -> Productivity costs	cenario analysis: Construction of an evidence based model of new occurrence/diagnosis of occupational asthma To predict the effects on an individual's ability to work and their wider life including the use of health services Based on hypothetical male and female employee developing occupational asthma having been exposed to one of three typical exposures: isocyanates; latex or glutaraldehyde (healthcare workers); flour or grain. 6 scenarios altogether Willingness-to-pay method: approximated by estimating cost of component parts: direct (resource) costs, indirect (opportunity) costs, quality of life (human) costs Summed, avoiding double counting Dimensions: reduction in net income	25% of cases: individual remains in same job, same employer: 30% of these will experience a 20% reduction in take home salary 25% of cases: same employer, switch jobs: 20% of these will experience a 20% reduction of salary 15% of cases: change employer: 85% of these will experience a reduction in salary of 50% 15% of cases: individual retires from workfroce (100% reduction of take-home salary)	Unit costs: Average reduction in net income: Caused by latex or glutaraldehyde: £5,935 male; £2,535 female Caused by isocyanates: £3,030 male; £1,735 female Caused by flour or grain: £2,535 male; £1,555 female	GBP 2004 / 1 year	Survey of Work-related and Occupational Respiratory Disease (SWORD) scheme and Labour Force Survey	Not given	Costing model includes the wider costs of illnesses (pain and suffering - quality of life costs) which are not usually included in cost of illness studies Includes costs of sufferers and friends and family COI studies cost the existing patterns of diagnosis, treatment and rehabilitation without questioning the relative net benefit of other possible uses of those resources Approach used allows more accurate assessment of new cases occurring during the time period	Study uses 6 hypothetical cases to estimate the costs and effects rather than actual patient data Costs of workplace modification were not estimated as such costs are site specific and one off Costs of lawsuits not included Costs of insurance not included	New strategies involving government and employers need to be developed to reduce the financial and health burden from occupational asthma
Ayres (2010) UK Multi-industry Asthma	Workers and families -> Quality of life losses	As above; dimensions: human costs of ill-health and expected mortality one-off cost	As above	Unit costs for all causes:• Human costs of ill health: £191.50 (both sexes) • Expected mortality cost (one off): £112.50 male, £87.50 female	GBP 2004 / 1 year	As above	Not given	As above	As above	As above

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Ayres (2010) UK Multi-industry Asthma	Workers and families -> Health care costs	As above; dimensions: planned GP (General Practice) visits, unplanned GP visits, annual spend on medication, average annual costs of hospital inpatient services, annual average costs of outpatient services, average travel costs to engage in healthcare services, prescription charges	As above	Unit costs (all causes): Planned GP visits: £16.50 Unplanned GP visits: £21 Annual spend on medication: £20.50 Average annual costs of hospital inpatient services: £95 Annual average costs of outpatient services: £12 Average travel costs to engage in healthcare services: £8 Prescription charges: £20.50	GBP 2004 / 1 year	As above	Not given	As above	As above	As above
Ayres (2010) UK Multi-industry Asthma	Workers and families -> Administration costs	As above; dimensions: annual savings in commuting costs as a result of being absent from work	As above. Assuming 4.1 (average of 3.5 and 4.7) days sick leave per year	Unit costs (all causes): Annual savings in commuting costs: £18	GBP 2004 / 1 year	As above	Not given	As above	As above	As above

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
Ayres (2010) UK Multi-industry Asthma	Government -> Health care costs	As above; dimensions: general practice (planned), general practice (unplanned), medication (net), hospital admissions, and outpatient services	As above	Unit costs (all causes) GP (planned): £16.50 GP (unplanned): £21.50 Medication (net): £84.50 Hospital admissions: £99 Outpatient services: £11	GBP 2004 / 1 year	As above	Not given	As above	As above	As above
Ayres (2010) UK Multi-industry Asthma	Government -> Administration costs	As above; dimensions: administration costs for industrial injuries benefits, DWP (Department of Work and Pensions) administration (SSP, Statutory Sick Pay) and DWP administraiton (IB (Incapacity Benefit) and IIDB (Industrial Injuries Disablement Benefit)	As above	Unit costs (all causes): DWP admin (SSP): £6• DWP admin (IB & IIDB): £378 male, £371 female	GBP 2004 / 1 year	As above	Not given	As above	As above	As above

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res (2010) UK Multi-industry Asthma	Government -> Productivity costs	As above; dimensions: net incapacity benefit and industrial injuries disablement benefit, and statutory sick pay	As above	Unit costs: Caused by latex or glutaraldehyde: disablement benefit: £1,525 male; £1,610 female Caused by isocyanates: disablement benefit: £1,610 male; £1,665 female Caused by flour or grain: disablement benefit: £1,635 male; £1,685 female All causes: statutory sick pay: £28.50	GBP 2004 / 1 year	As above	Not given	As above	As above	As above

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
Ayres (2010) UK Multi-industry Asthma	Employers -> Productivity costs	As above; dimensions: cost of sickness absence, one-off labour turnover cost	As above	Unit costs: Caused by latex or glutaraldehyde: sickness absence: £299 male; £152 female. One-off labour turnover cost £325 (both sexes) Caused by isocyanates: sickness absence: £185 male, £127 female. One-off labour turnover cost £232 (both sexes) Caused by flour or grain: sickness absence: £160 male; £115 female. One-off labour turnover cost: £195 (both sexes)	GBP 2004 / 1 year	As above	Employer costs underestimated as: • Costs of workplace modification were not estimated because site-specific and one-off Costs of lawsuits not included Costs of insurance not included	As above	As above plus: • Costs of workplace modification were not estimated as such costs are site-specific and one-off; costs of lawsuits not included; costs of insurance not included	As above

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Ayres (2010) UK Multi-industry Asthma	Society -> Productivity costs	As above; dimensions: total indirect costs (annual), total indirect costs (one-off) and total direct resources costs	As above	Unit costs: Caused by latex or glutaraldehyde: total indirect costs (annual): £7,979 male; £4,517 female. Total indirect costs (one-off): £437 male; £412 female Caused by isocyanates: total indirect costs (annual): £5,045 male; £3,747 female. Total indirect costs (one-off): £345 male; £320 female Caused by flour or grain: total indirect costs (annual): £4,550 male; £3,575 female. Total indirect costs (one-off): £306 male; £282 female All causes: total direct resources costs: £626 (both sexes)	/	As above	Not given	As above	As above	As above

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
Bejean (2004) France Multi-industry Illnesses: Stress-related cardiovascular disease, depression and musculoskeletal disorders & back pain	Employers -> Productivity costs	Hypothesis 1: Measures lost output from the number of years of life lost (compared with the retirement age) Evaluated by multiplying the number of days off work for each illness by GDP/person/day Presented as cost of sick leave	Discounted 5% and growth rate of 2%	Cardiovascular disease (CVD), (caused by stress): €35.1 million Depression (caused by stress): €218.4 million Musculoskeletal disorders (MSD) & back pain: €25.6 million	Euro 2000 / 1 Year	CVD: Letouzey et al 1996 Depression: Le Pape and Lecomte 1996	Costs of early retirement would add 1/3 to the costs Back pain share of costs are very low because of under recognition by health insurance institutions of the occupation-related causes of these conditions	Not available	Cost of early retirement induced by occupational stress should be included (lack of data).	Further research should disaggregate by sex and occupation Future research should adopt an incidence rather than prevalence approach

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
Bejean (2004) France Multi-industry Illnesses: Stress-related cardiovascular disease, depression and musculoskeletal disorders & back pain	Workers and families -> Productivity costs	Hypothesis 1 (see above)& Hypothesis 2: Measures costs related to premature death from monetary valuation of lost years of lifer Assumes retirement years also valuable, so all time periods monetised by average GDP per capita per time period Total no. of years lost taken by difference between age at time of death and mean life expectancy of population in question	H1: Discounted 5% and growth rate of 2% H2: Value of a year of life = wealth created per person per year (mean GDP/person for 2000). Discounted 5% and growth rate of 2%	H1: CVD: €269.6 million Depression: €205.2 million H2: CVD: €632.2 million Depression: €321.8 million N.B. 0 costs for MSD & back pain with this method	Euro 2000 / 1 Year	CVD: Letouzey et al 1996 Depression: Le Pape and Lecomte 1996 MSD & back pain: Not given		Not available	Not available	Better knowledge of the medical cost of MSD and back pain is a prior condition to obtaining a more precise estimate of occupational stress

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Bejean (2004) France Multi-industry Illnesses: Stress-related cardiovascular disease, depression and musculoskeletal disorders & back pain	Government -> Health care costs	CVD: Hospital care expenses (medicine, surgery, rehabilitation, emergency services) and ambulatory care (fees, pharmacy, biology, imagery, paramedical transport) Method from Letouzey et al (1996) in French (unsupported language)• Depression: Similar approach to CVD. Method from Le Pape and Lecomte (1996) in French (unsupported language) MSD & back pain: Derived from national statistics (specifics not given)	Change in price of medical goods and services = change in consumer goods prices (+11.03% between 1993-2000 from INSEE figures) Structure of health spending is stable for the cover of CVD & depression The increased prevalence of CVD & depression affects changes in spending proportionately (+13.3% between 1993 -2000	CVD: €83.3 million Depression: €328.5 million MSD & back pain: €1.5 million	Euro 2000 / 1 Year	• CVD: Letouzey et al 1996 Depression: Le Pape and Lecomte 1996 MSD & back pain: National Health Insurance Fund	MSD & back pain: Only contains data on conditions classified as occupation-related; no general information on general prevalence of disease. No. of cases, cost of medical care, lost production for sickness leave substantially underestimated.	Study includes a broader scope of diseases related to occupational stress than previous studies	• No intangible costs (not comparable with studies that include these) Costs are very sensitive	• Further research should use several convergent epidemiological studies determining as reliably as possible the value of relative risk for each illness Better knowledge of the medical cost of MSD and back pain is a prior condition to obtaining a more precise estimate of occupational stress

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Biddle (2004) USA Multi-industry Fatal injuries	Workers and families -> Productivity costs	Wage components of the cost of illness model used (Human Capital Approach): Base wages: defined as median annual earnings before taxes & other deductions, taken directly from the Current Population Survey, presented in current dollars, inflation-adjusted, by detailed occupation, sex and age. Where data were unavailable for a specific occupation the next hierarchical method was substituted Value of employee benefits: added to base wage to represent market value of a worker. Benefits were presented as a % of payroll, (did not include paid rest periods, lunch, wash up time, travel time, clothes changing time, payment for time not worked e.g. vacations, sick leave, etc.). Values presented as nominal before tax dollars for each industry group, inflation-adjusted. • Base wages & benefits were adjusted by economy-wide productivity gains (wage rise in concert with productivity growth) and lifecycle growth (salary growth due to worker experience) over time, based on historical data: the latter calculated by wage of initial age group subtracted from the wage of the next age group, divided by initial age group wage: daily values by age and sex multiplied by 365 for annual values; inflation-adjusted Lost household production (nonmarket costs): calculated with time diary data; categories include household production, providing care, hygiene & personal care, leisure, employment,	Only medical costs considered for direct costs Current dollars converted to constant dollars to allow for aggregation across differing years of death For wage calculations, no. of deaths assumed to be approximately the same in each month (as a result wage growth rate calculations reduced by 1/2) A long-term economic growth rate was employed, as decedents wages are predicted for up to 50 years	No unit costs available	/	Base wages: Current Population Survey (CPS) - Database source. Employee benefits: US Chamber of Commerce annual survey of employee benefits Lifecycle growth: US Department of Labor - Database Source Lost household production: National Human Activity Pattern Survey Dollar value of a day: BLS (Bureau	Not mentioned	Theoretical approach is easy to understand, calculate and data are inexpensive to acquire	• Human capital approach ignores and individual's preferences Reliance on market earnings to represent value of life Wage calculations do not account for second or multiple job information for the decedent Wage calculations do not include a mechanism for identifying changes in career that may have occurred had the worker lived • Use of time diaries for estimating cost of lost household production may have questionable validity as relies on self-reported data • Exclusion of direct cost categories such as administration and legal due to lack of recent data	Not available

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		education. Market replacement value of time based on hourly wages + employers' legally required benefit costs. By age and sex in 1998 dollars, inflation-adjusted 3% discount rate used as suggested by all agencies within the US Dept of Health and Human Services				of Labour Statistics) Occupational Employment Statistics				

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		group, inflation-adjusted. Base wages & benefits were adjusted by economy-wide productivity gains (wage rise in concert with productivity growth) and lifecycle growth (salary growth due to worker experience) over time, based on historical data: the latter calculated by wage of initial age group subtracted from the wage of the next age group, divided by initial age group wage: daily values by age and sex multiplied by 365 for annual values; inflation-adjusted Lost household production (nonmarket costs): calculated with time diary data; categories include household production, providing care, hygiene & personal care, leisure, employment, education. Market replacement value of time based on hourly wages + employers' legally required benefit costs. By age and sex in 1998 dollars, inflation-adjusted 3% discount rate used as suggested by all agencies within the US Dept of Health and Human Services	employed, as decedents wages are predicted for up to 50 years						estimating cost of lost household production may have questionable validity as relies on self-reported data • Exclusion of direct cost categories such as administration and legal due to lack of recent data	
		By age and sex in 1998 dollars, inflation-adjusted 3% discount rate used as suggested by all agencies within the US Dept of Health and Human Services								

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Boonen et al (2002) Netherlands, Belgium and France Multi-industry Illness: Ankylosing spondylitis	Society -> Productivity costs	Study focuses on "international differences in work disability and sick leave in AS" • Patients filled out an economic questionnaire on AS-related health resource use every 2 months; on sociodemographic data every 6 months Economic questionnaires adapted by country Income self-reported, in categories with €500 range, or could provide exact data Cost of illness analysis designed as prevalence-based, prospective, disease-specific Refers only to societal costs associated with loss of paid production: included patients 16-65 working or willing to work (so work disabled included, retired/students/voluntarily unemployed not) Productivity costs calculated by both friction cost method and human capital approach Production value per work day calculated by incident self-reported gross wage per month ("if applicable, adapted for the number of contractual work days per month and the income out of work disability" according to each country's benefit scheme)	4 month friction period, based on the Netherlands	All costs for Netherlands (n=58), Belgium (n=15), France (n=40) respectively. €/patient/year: Friction costs (those in a paid job): €1,257; €428; €476 Friction costs (all patients): €557, €324, €274 Human capital absence costs: €688, €336, €309 Human capital disability costs: €8,174; €2,854, €3,300 Human capital total costs: €8,862; €3,188; €3,609	Euro 1998 / 2 years	• Eurostat for "national figures on population size for each age and sex category, employment, unemployment, work disability, days of sick leave, income, educational level, professional class, and national expenditure on social security" OECD 2000 Health Data; national & European statistical data & local Ministries of Health and/or Social Affairs to	Not available	• Identifies that the country a patient lives in can make a significant difference to costs, perhaps because of different social security systems (affecting incentives to leave/stay in the labour force, for disability and/or absences) and/or economic prosperity, suggesting generalising across countries may not be accurate	Not available	• Comparable reference data across countries needed

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						supplement/compare data				
		human capital approach Production value per work day calculated by incident self-reported gross wage per month ("if applicable, adapted for the number of contractual work days per month and the income out of work disability" according to each country's benefit scheme)								
Boonen et al (2002) Netherlands, Belgium and France Multi-industry Illness: Ankylosing spondylitis	Employers -> Productivity costs	Study takes societal perspective (see above) but includes data on friction cost for those in a paid job, which could be used as estimate for employer productivity costs	4 month friction period, based on the Netherlands	Friction costs (for those in a paid job): €/patient/year: €1,257 for NL, €428 for France; €476 for Belgium	Euro 1998 / 2 years	See above	Not available	See above	Not available	See above

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HSE (2010) 2010/2011 update UK Multi-industry	Workers and families -> Productivity costs	This includes the loss of gross earnings due to absence from work (both short-term absence in the current year, and absences in future years for those whose illness or injury leads to their permanent withdrawal from the workforce), net of replacement income such as sick pay and state benefits. Future lost earnings (and benefits received) are expressed in terms of their discounted present value	Current year lost earnings	Gross loss of earnings: £4,015 million Less sick pay income: (£1,031 million) Less state benefits income: (£1,771 million) Less saved tax and National Insurance: (£778 million) Net loss of income: £435 million	GBP 2010 / 1 year	Annual Survey of Hours and Earnings	Labour Force Survey (LFS) counts 'people' rather than 'cases' which underestimates the amount of time off for people who suffered more than one incidence in a year	Not available	Aggregate costs are shown before sources of replacement income such as sick pay and state benefits are taken into account	Data for long-latency illnesses are not going to be captured by the LFS - future research building on models developed by Imperial University and recent HSE research should make feasible the inclusion of the costs of other long latency diseases such as cancer and COPD
HSE (2010) 2010/2011 update UK Multi-industry	Workers and families -> Insurance costs	Compensation represents lump sum payments to individuals made from claims against Employers' Liability (EL) insurance cover, a compulsory insurance for all employers (other than the government). Data provided by the Association of British Insurers (ABI) gives the total value of such claims, though only a proportion of this total will result to current injury and new illness cases	There's no estimate of the proportion that results to current injury and new illness cases and how it may vary over time. It is therefore taken as the compensation payments to individuals the total payment made under EL insurance. Further, this value has been held constant for the years 2006/07 to 2010/11 (in 2010 prices)	£1,033 million	2010 prices, constant since 2006/07	Association of British Insurers (ABI)	Not available	Not available	As above	As above

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HSE (2010) 2010/2011 update UK Multi-industry	Workers and families -> Health care costs	This reflects financial costs to individuals such as out of pocket medical expenses and travel costs to hospital.		£122 million	GBP 2010 / 1 year	Personal Social Services Research Unit (PSSRU) and expert opinion	Not available	Not available		LFS does not record healthcare visits so must be estimated by expert opinion
HSE (2010) 2010/2011 update UKMulti-industry	Workers and families -> Administration costs	The main administrative cost to the individual or their friends and family is the time spent initiating and managing claims for sick pay and state benefits, and compensation and insurance payouts.		£20 million	GBP 2010 / 1 year	Annual Survey of Hours and Earnings	Not available	Not available	Not available	As above
HSE (2010) 2010/2011 update UK Multi-industry	Workers and families -> Quality of life losses	Willingness-to-pay method: Variation on the Department for Transport value of preventing a fatality by Gorden and Risley (1999) - adjusted further for new dataset	Fatal injuries use male average earnings as most workplace fatalities are male	£7,664 million.	GBP 2010 / 1 year	Full description available at Annex 3 of the detailed methodology report www.hse.gov.uk/research/rrhtm/rr897.htm	Not available	Not available		Evidence is still indicative only - model is not sensitive enough to very small amounts of time off - a better model more suited to workplace injuries and illnesses, possibly built on HSE research into 'harm index'
HSE (2010) 2010/2011 update	Employers -> Productivity costs	• 90% of employers offer occupational sick leave All employees earning at least £84/week entitled to statutory sick leave for 28 weeks Self-employed calculated by multiplying	• Waiting period for employees to qualify for sick leave not included in the model 13% of cases are self-employed and therefore offer no	OSP + SSP + NI contributions (employers) less reimbursement from HMRC	GBP 2010 / 1 year	Chartered Institute of Personnel and Development	The HSE key facts document for 2005/08 reports that the average number of	Not available	CIPD study potentially has lower response rate than other surveys	Not given

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UK Multi-industry All types of accident & injury		the absence profiles by sick pay rates & eligibility criteria Production disturbance calculated as needing half a day of manager time for work reorganisation to redistribute the sick/injured employee's work (+29% typical non-wage costs)	occupational sick pay Assume employers wait 28 weeks before recruiting a replacement for a sick/injured employee HMRC scheme for compensating excess NI payments for sick pay uses 18% of HMRC fund	under percentage threshold scheme: £1,155 million Work reorganisation costs (up to 12 months sick time): £56 million Recruitment costs of temporary workers to cover >6 month absences: £57 million		(CIPD)	working days lost per worker per year due to work related absence as 1.5; whereas in the CIPD survey says 8.4.			
HSE (2010) 2010/2011 update UK Multi-industry All types of injury & illness	Employers -> Administration costs	Three administrative points approach	• Assumes administrative burden occurs at beginning, middle and end of the absence period. (OSP/SSP & compensation claims) • Assumes that files are 25% of legal costs	• Admin costs: £21 million • Investigations and prosecutions: £46 million	GBP 2010 / 1 year	Annual Survey of Hours and Earnings (admin costs) and HSE (legal proceedings)	Figures for investigations do not include railway related incidents prosecuted by the Office of Rail Regulation	Not given	Not given	Not given

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HSE (2010) 2010/2011 update UK Multi-industry All types of injury & illness	Employers -> Insurance costs	• Average of 3 years' cost of employer's liability insurance premiums (2005-2007), to smooth in-year underwriting losses and gains and updated to 2010 prices • Private medical insurance premiums	• Employer's Liability insurance is compulsory for all employers (except the government)	• Employer's Liability Insurance Premiums: £1,756 million • Private medical insurance premiums: £54 million	GBP 2010 / 1 year	Association of British Insurers	Not available	Not available	Not available	Not available
HSE (2010) UK Multi-industry All types of injury & illness	Government -> Productivity costs	Bottom up aggregate of replacement income & lost tax/NI revenue using data available in the public domain: 1. Identified different sources of income 2. Determined what proportion of the fatality and self-report cases are able to claim against each type of replacement income (eligibility, take up rates, tiered payment rates) 3. Determined whether replacement income is paid on basis of duration or in terms of lost working time 4. Current year - Multiplied time away from work by appropriate daily rate and proportion of population assumed to claim it 5. Future years - multiplied number of years claimed by the appropriate yearly rate and proportion of population assumed to claim and discount to the present day using the HM Treasury discount rate: only available for fatalities and those who never return to work	Assumed that workers who do not permanently withdraw from workforce are able to return to their normal jobs at their pre injury/ill health salary level	Benefits payments: £1771 million Reductions in income tax and national insurance receipts: £654 million	GBP 2010 / 1 year	Department of Work and Pensions	Not available	Not available	Not available	Not available

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HSE (2010) UK Multi-industry All types of injury & illness	Government -> Administration costs	Three administrative points approach	Assumes administrative burden occurs at beginning, middle and end of the absence period. (OSS/SSP & compensation claims) Local authority investigation costs are assumed to scale pro-rata according to the number of convictions they secure Assumes that files are 25% of legal costs	• Admin costs: £25 million • Investigations and prosecutions: £36 million	GBP 2006 / 1 year	Annual Survey of Hours and Earnings (admin costs) and HSE (legal proceedings)	Not available	Not available	Not available	Not available
HSE (2010) UK Multi-industry All types of injury & illness	Government -> Health care costs	• PSSRU unit costs for GP (General Practice) consultations, A&E consultations, inpatient and outpatient treatment episodes • Separated out the different medical conditions captured in the LFS sample and using published data combined with expert judgement to estimate the whole life treatment costs for each disease	It includes the cost of ambulance, hospital and clinical costs, general practitioner consultations and prescription costs.	Total costs: £585 million	GBP 2010 / 1 year	PSSRU & expert opinion	Not available	Not available	Not available	Not available
HSE (2010) UK Multi-industry All types of injury & illness	Society -> Productivity costs	The net cost to society is the gross loss of earnings from the absent worker	The firm directly affected by the absent worker seeks to maintain its output The transfer costs associated with sick pay, tax, NI and benefits all cancel each other out	£4,015 million	GBP 2010 / 1 year	Annual Survey of Hours and Earnings	Not available	Not given	Not given	Not given

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Koningsveld (2003) Netherlands Multi-industry Injuries & illness	Society -> Productivity costs	• Costs related to worker absence and worker disability were calculated. Differentiation for different diseases is made	Not available	Worker absence: salary costs (general % absence in NL * work related absence)= 3,754 milion euro Worker disability: payment * (general % disability in NL * work related disability) = 3,227 million Euro; (Toeslagenwet (Dutch social security supplements): €52 million, Supplementation WAO (disability insurance) 300 € million)	Euro 2001 / 1 year	Koningsveld et al 1997	• Self-employed persons not included • Costs of accidents not included • Costs of company performance not included	• Special attention towards double counting of costs • When the author was not certain or costs were missing, these costs are included provisionally, pending better information	• Doesn't include potential loss of productivity after an illness or accident • Overlap in the WAO (disability insurance system) and WW (unemployment benefits) not considered, so could result in wrong assumptions • The possibility that early pension occurs before disability not included	Not available

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Koningsveld (2003) Netherlands Multi-industry Injuries & illness	Society -> Health care costs	• Use of database and corrections for work-relatedness	• Corrections made for labour participation for men and women The extent of work-relatedness of selected diseases described in the report is based on expert judgement Workers in the WAO (disability insurance system) are included All costs made in a given year are related to that year (i.e. future costs not included: not the incidence method)	• Medical cost estimated for workers in the WAO (disability insurance system): €92 million • Medical cost estimated for workers at work: €833 million	Euro 2001 / 1 year	Polder et al 2002	• Self-employed persons not included • Costs of accidents not included • Only the working population included, so long latency disease could be underestimated as diseases that begin after working age are not included	As above	Not available	Not available
Koningsveld (2003) Netherlands Multi-industry Injuries & illness	Employers -> Administration costs	• Administration costs of disability: costs related to OSH and enforcement; costs related to external occupational hygienists based on indirect data (based on workforce); cost of internal occupational hygienists based on Bex et al (2002); costs related to OSH for employers; costs related to research OSH	n/a	Administration costs related to absence (only worker-related costs included): €105 million costs related to external occupational hygienists: €859 million; internal occupational hygienists: €735 million; related to OSH for employers:	Euro 2001 / 1 year	Koningsveld et al 1997	• Self-employed persons not included • Costs of accidents not included	As above	Not available	Not available

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Koningsveld (2003) Netherlands Multi-industry Injuries & illness	Government -> Administration costs	• grant of subsidy for OSH research;	n/a	€21.8 million granted as subsidies; REA subsidy €740 million	Euro 2001 / 1 year	Koningsveld et al 1997	• Self-employed persons not included Costs of accidents not included	As above	Not available	Not available
Koningsveld (2003) Netherlands Multi-industry Injuries & illness	Society -> Administration costs	Administration costs of absence based on costs related to Vangnet ZW (Dutch health benefits for those without employer benefits) Administration costs of disability: costs related to OSH and enforcement; grant of subsidy; costs related to external occupational hygienists based on indirect data (based on workforce); cost of internal occupational hygienists based on Bex et al (2002); costs related to OSH for employers; costs related to research OSH	n/a	Administration costs related to absence (only worker-related costs included): €105 million Administration costs related to disability (only worker-related costs included): WAO (disability insurance) implementation, €280 million; toeslagenwet (social security supplements), €5 million; liability costs of asbestos, €2.6 million; liability costs of work-related diseases,	Euro 2001 / 1 year	Koningsveld et al 1997	Self-employed persons not included Costs of accidents not included	As above	Not available	Not available

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				€10.4 million; OSH and enforcement €42 million; €21.8 million granted as subsidies; REA subsidy €740 million; costs related to external occupational hygienists: €859 million; internal occupational hygienists: €735 million; related to OSH for employers: €800 million; related to OSH research: €73 million						

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Koningsveld (2003) Netherlands Multi-industry Injuries & illness	Society -> Insurance costs	Based on database	All costs made in a given year are related to that year (i.e. future costs not included: not the incidence method)	Costs related to WAO hiaat (disability insurance programme): (only worker-related costs included): €508 million	Euro 2001 / 1 year	Koningsveld et al 1997	• Self-employed persons not included • Costs of accidents not included • Only the working population included, so long latency disease could be underestimated as diseases that begin after working age are not included	As above	Not available	Not available
Leigh et al (2001) USA Multi-industry Injuries (fatal and non-fatal)	Government -> Health care costs	Estimates of numbers of injuries are multiplied by estimates of average costs in a book by Telles & Fox (no access) Every state has a workers' compensation (WC) insurance system Disabling injuries divided into the categories used by WC insurance, so they can be matched to average WC cost figures. Categories used were: death, permanent total (PT), permanent partial (PP), temporary total and partial combined (TTP) and medical only.	Adjustments made to make up for the lack of WC coverage for all injuries as well as the greater medical expense associated with WC as opposed to non WC injuries. (Adjustments not described or referenced in the paper)	$5.40bn	USD 1993 / 1 year	Telles & Fox (1997)	Not available	* Use of worker compensation (WC) data avoids problems with calculated estimates * The year of data, 1992, WC was paid for almost 100% of claims. Avoids assumptions around deductibles and copayments * Data used are incidence based and follow each case for 2 years * Simple calculation methodology employed	* Injuries and illnesses - no damage costs included for injuries that would eventually lead to arthritis. No effect considered for dull repetitive work on producing dementia. * Whole paper: No pain or suffering costs included	Not available
Leigh et al (2001) USA	Government -> Administration costs	• 31% overhead for WC admin is based on a ratio of premiums to benefits paid for WC insurers minus 1. 15% is taken directly from the literature (see data sources). This figure is an	Assumes a WC insurance administration overhead of 31% and an "all other" (incl. Private health	Medical admin: $0.82bn Indemnity	USD 1993 / 1 year	• WC insurance : Nelson (1993) • All other:	Not available	As above	As above + * Assumed 31% WC administrative cost estimate, however another study estimated it should be	Not available

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Multi-industry Injuries (fatal and non-fatal)		average percentage of insurance admin associated with paid claims (1994). These percentages are applied to the total cost of medical expenses minus "out of pocket" expenses which are equivalent to 18.4%. An out of pocket expense is defined as the medical costs paid directly by patients • Admin costs for indemnity payments are calculated to 47% of lost wages	insurance, Medicare & medi-cal) overhead of 15% Admin costs for indemnity payments are assumed to be 47% of lost wages. The national average is 50%. 50% is generally assumed by labour economists in the US. California rate is reduced to reflect the difference between WC systems for the state and nationally.	admin: $0.90bn		Cutler (1994)			38%. All of these would lead to underestimation of costs	
Leigh et al (2001) USA Multi-industry Injuries (non-fatal)	Workers and families -> Productivity costs	• Calculation for lost wages relies on the average amount of indemnity dollars paid for each WC category (see above). Lost wages calculated by dividing benefits (indemnity payments) by the wage replacement rates • Fringe benefits are calculated as 23.3% above wages, taken directly from a study (see data sources). Fringe benefits include employer-funded health, dental, life and unemployment insurance, child care, social security contributions and pensions Home production losses are taken directly from a study (see data sources) Same proportion for fatal and non-fatal injuries assumed. Ratio of home production losses to lost wages is 0.138	Wage replacements rates assumed to be 0.35 (PT), 0.45 (PP), 0.55 (TTP). (No reference to how these figures have been assumed)	• Lost earnings: $8.66bn • Fringe benefits: $1.82bn • Home production: $1.15bn	USD 1993 / 1 year	• Telles & Fox (1997) • Fringe benefits: Jacobs (1997) • Home production losses: Douglas et al (1990)	Not available	As above	As Government -> Health care costs	Not available

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Leigh et al (2001) USA Multi-industry Fatal injuries	Workers and families -> Productivity costs	• Present value calculation of wages for someone the same age and gender of the deceased. This composition is taken from the Census of Fatal Occupational Injuries (CFOI) Californian wages are estimated to be 14.2% above the national average, so figures adjusted for this Home production losses are taken directly from a study (see data sources) Same proportion for fatal and non-fatal injuries assumed. Ratio of home production losses to lost wages is 0.138	Assumes that people who die would have earned what others of the same age and gender earn	• Lost earnings: $0.32bn • Fringe benefits: $0.08bn • Home production: $0.04bn	USD 1993 / 1 year	• CFOI Home production losses: Douglas et al (1990)	Not available	• Data used is incidence based and follow each case for 2 years • Simple calculation methodology employed	As above	Not available
Leigh et al (2001) USA Multi-industry Injuries (fatal and non-fatal)	Employers -> Administration costs	• Assumes hiring, training and disruption costs proportional to 1992 national estimate for training costs compared with national costs for wage losses, which is 3.39%	Not available	$0.29bn	USD 1993 / 1 year		Not available	As above	As above	Not available
Leigh et al (2001) USA Multi-industry Fatal	Government -> Health care costs	• Ratio of hospital days calculated: total no. days spent by patients with a primary diagnosis for the attributable occupational diseases divided by total hospital days for all diseases and injuries. • This ratio is then multiplied by national estimates of medical spending, and by a correction factor to account for California's contribution to national	• Chose to omit Program administration and net cost of public health insurance from the national cost of medical spending as they believe it is an underestimate. Another study, Cutler (1994) estimate	$0.89bn	USD 1993 / 1 year	• National medical expenditure: National Centre for Health Statistics (NCHS) • Hospital days:	Not available	As above	As above	Not available

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
illnesses		health expenditures.	these costs can be 15% of the total medical cost and so this has been used instead.			National Hospital Discharge Survey • Admin costs: Cutler (1994)				
Leigh et al (2001) USA Multi-industry Fatal illnesses	Workers and families -> Productivity costs	• Standard present value calculations. Multiplied by California's contribution to employment and wage adjustment National disease specific ratios for morbidity costs to direct costs (taken from Rice et al) were calculated. (also adjusted for California). National estimates are not given or referenced		Lost earnings: $0.61bn Fringe benefits: $0.15bn Home production: $0.08bn	USD 1993 / 1 year	• Age, gender & disease-specific mortality data: NCHS • Life table estimates, earnings & labour force participation: BLS (Bureau of Labor Statistics)	Not available	As above	As above	Not available
Leigh et al (2001) USA Multi-industry Non-fatal illnesses	Government -> Health care costs	• National estimates for medical costs of non-fatal diseases are multiplied by a Californian factor (related to the state's contribution to total illnesses reported in the BLS)		$0.47bn	USD 1993 / 1 year	BLS	Not available	As above	As above	Not available

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Leigh et al (2001) USA Multi-industry Non-fatal	Government -> Administration costs	As above		Medical admin: $0.07bn Indemnity admin: $0.03bn	USD 1993 / 1 year	BLS	Not available	As above	As above	Not available
Leigh et al (2001) USA Multi-industry Non-fatal illnesses	Workers and families -> Productivity costs	• Lost earnings, fringe benefits and home production losses are multiplied by the Californian contribution to indirect costs of injuries as well as blood lead adjustment factor (adjusted downward to reflect the Californian blood lead level standard for poisoning).	• Assumes BLS illness data is similar to BLS injury data	Lost earnings: $0.32bn Fringe benefits: $0.06bn Home production: $0.04bn	USD 1993 / 1 year	• BLS illness and injury data • Adult Blood Lead Epidemiology and Surveillance (ABLES) program	Not available	As above	As above	Not available
Rikhardsson et al (2004) Denmark Multi-industry Injuries (non-fatal)	Employers -> Productivity costs	Systematic accident cost analysis (SACA): method based on activity mapping, where company costs are seen as being caused by the activities of employees and managers. Evaluated in terms of an accident to identify costs. Cost categories used are: time (hours related to accident where wages are paid for no work effort); materials and components (acquired/lost due to accident); external services (temporary replacements, consultants, legal support); other (more infrequent costs, e.g. fines & rehabilitation)	• Costs do not include material damage to equipment etc. (Authors felt these costs do not arise because of the accident itself but are related to the equipment)	Average costs: Serious accident: $10,300 Less serious accident: $3,800 Typical accident: $1,050	USD 2000 / 1 year	Company data	Not reported	• Simple for managers to apply, as reflects traditional accounting systems • Can illustrate and visualize the value created by the OSH department by preventing accidents	• Does not include material damage costs• No unit costs given for each type of activity identified, only a percentage of the total costs of each type of accident• Perspective is only that of the employer, does not take into account the perspective of the employee	Not available

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		• 6 activity groups identified for costing: absence of injured employee (65% of total cost of accident); communication activities (4%); administration (payroll, health and safety regulation, reporting requirements) (13%); operation disturbance (training, co-worker overtime, revenue loss) (14%); prevention initiatives (purchase of machine components, training) (3%) & other, including fines and gifts to injured employees						• Due to accounting systems, some costs related to unexpected occupational accidents are not registered separately and cannot be identified, this method allows for those costs to be identified.		

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Romero et al (2010) Ecuador Multi-industry tool developed by oil industry Injuries & illnesses	Employers -> Productivity costs	To include (in the tool): Direct & indirect costs Event details, including: people directly involved and those involved in any work to do with the incident (e.g. health & safety, legal costs) or who suffer any loss of productivity (e.g. damage to machinery interrupting process); loss of property; radiation; environmental effects etc Direct wage costs for all injured/ill: for those off work Ecuadorian legislation says 75% of salary paid by Social Security Institute (IESS) once disability >1 day/24 hours, so include only 25% For temporary replacement, include replacement cost + salary of replacement worker(s) Indirect wage costs: "the salaries of the personnel involved in the investigation, disclosure, discussion and prevention of the incident or accident." Include cost of sanctions and penalties; material damage; cost of lost business; first aid costs; medical care; transportation costs; securing the area (including evacuation and rescue); damage to third parties	Cost data taken from international models and adapted to Ecuadorian requirements Takes European Community classifications for time needed for investigation: simple investigation (1.5 hours); standard investigation (6.5 hours); detailed investigation (27 hours)	One case study given but no generalisable reported results	Not applicable	• NTP 540 and 594, National Institute for Occupational Safety and Health, Spain (for developing methodology) European Community ["Incident Cost Calculator Software"]	Not available	Not available	Not available	Not available

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
		Incident or accident." • Include cost of sanctions and penalties; material damage; cost of lost business; first aid costs; medical care; transportation costs; securing the area (including evacuation and rescue); damage to third parties								
Romero et al (2010) Ecuador Multi-industry tool developed by oil industry Injuries & illnesses	Employers -> Administration costs	Recommends including all administrative costs	• As above	Not applicable	Not applicable	As above	Not available	Not available	Not available	Not available

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Safe Work Australia (2012) Australia Multi-industry Injuries & illnesses	Employers -> Productivity costs	Lost productivity from absent workers, lost potential output Conceptual cost groups: production disturbance costs (PDC, short-term until production restored to pre-incident levels - worker returns or is replaced); human capital costs (HCC: long run costs e.g. loss of potential output, occurring after production restored to pre-incident levels) Friction cost method for PDC (assumes structural unemployment allows replacement of worker if necessary after a frictional period); human capital approach for long-term costs General Methods (whole paper): Incident approach: lifetime costs of new cases occurring during the reference year (future costs discounted to present values) Costs subcategorised by severity level (5 categories: short absence, long absence, partial incapacity, full incapacity, fatality); compensated/uncompensated status; disease or injury	PDC costs max. Of 4 weeks lost time covering period between incident and replacement Assumes workers' compensation premiums paid by employers are considered transfer cost to society (so not included as cost to employers) General Assumptions (whole paper): • Ex-post approach to assigning costs (i.e. after the incident) •Assumptions deliberately conservative Does not include costs "that cannot be specifically related to injury or illness to employees (such as damage to property and loss of company image)" Expected future costs of new cases proxy for cost in the reference year of cases already in the system at start of year	Unit costs - all employers' costs (injury): • Short absence: $630 • Long absence: $7,950 • Partial incapacity: $16,160 Full incapacity: $16,970 Fatality: $25,000 Average: $3,930 Unit costs - all employers' costs (illness): • Short absence: $770 • Long absence: $9,910 Partial incapacity: $12,170 • Full incapacity: $63,350 • Fatality: $63,350 • Average: $9,670	AUD (assumed, given as $) 2008/09 / 1 year	Main sources: • NDS (National Dataset for Compensation Based Statistics) ABS (Australian Bureau of Statistics) • CPM (Comparative Performance Monitoring Report)	Not available	Not available	• Only one side of the work health & safety cost equation, i.e. doesn't include costs of complying with regulations and prevention activities Difficult to measure productivity drops, so based on absence General Limitations (whole paper): Incident cost not as accurate in theory as prevalence basis but latter tends to underestimate as relies on data already in 'the system' at a given point during reference year Not exhaustive of all possible cases and combinations of absence and capacity: assumes capacity reduced once 6 month absence reached	Not available

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
			Assumes current treatment costs good predictor of type & level of future costs Assumes capacity reduced at 6 months absence as no reliable indicator of return to work status (capacity) Assumes negligible contribution to total costs if no absence from work so not included							

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
		Costs subcategorised by severity level (5 categories: short absence, long absence, partial incapacity, full incapacity, fatality); compensated/uncompensated status; disease or injury	deliberately conservative Does not include costs "that cannot be specifically related to injury or illness to employees (such as damage to property and loss of company image)" Expected future costs of new cases proxy for cost in the reference year of cases already in the system at start of year Assumes current treatment costs good predictor of type & level of future costs Assumes capacity reduced at 6 months absence as no reliable indicator of return to work status (capacity) Assumes negligible contribution to total costs if no absence from work so not included	• Average: $9,670					already in 'the system' at a given point during reference year • Not exhaustive of all possible cases and combinations of absence and capacity: assumes capacity reduced once 6 month absence reached	

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Safe Work Australia (2012) Australia Multi-industry Injuries & illnesses	Employers -> Administration costs	Recruitment & retraining costs Fines and penalties from breaches of work health and safety Other administrative costs (e.g. for compensation schemes, investigations, legal costs) General Methods (see above)	• General Assumptions (see above)	• As above	AUD (assumed, given as $) 2008/10 / 1 year	As above	Not available	Not available	Only one side of the work health & safety cost equation, i.e. doesn't include costs of complying with regulations and prevention activities Difficult to measure productivity drops, so based on absence General Limitations (see above)	Not available
Safe Work Australia (2012) Australia Multi-industry Injuries & illnesses	Workers and families -> Productivity costs	• Loss of current and future earnings • Human capital costs (HCC: long run costs e.g. loss of potential output, occurring after production restored to pre-incident levels) • Human capital costs for workers calculated as residual between total human capital loss and deadweight loss to society from taxation and welfare redistribution; as a measure of lost future productivity, largely driven by prevailing wage rate • General Methods (see above)	• General Assumptions (see above)	Unit costs - all workers' costs (injury): Short absence: $140 Long absence: $3,160 Partial incapacity: $453,410 Full incapacity: $1,438,420 Fatality: $1,300,000 Average: $46,090 Unit costs - all workers' costs (illness) Short	AUD (assumed, given as $) 2008/11 / 1 year	As above	Not available	Not available	Does not include cost of pain and suffering - earlier study did in appendix (National Occupational Health and Safety Commission, 2004 [2003 draft report referenced]) General Limitations (see above)	Not available

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
				absence: $190 Long absence: $3,210 Partial incapacity: $446,250 Full incapacity: $1,213,290• Fatality: $796,380 Average: $163,530						
Safe Work Australia (2012) Australia Multi-industry Injuries & illnesses	Workers and families -> Health care costs	• Medical costs (uncompensated); costs of carers, aids, modifications (uncompensated) • General Methods (see above)	• General Assumptions (see above)	• As above	AUD (assumed, given as $) 2008/12 / 1 year	As above	Not available	Not available	• Does not include cost of pain and suffering - earlier study did in appendix (National Occupational Health and Safety Commission, 2004 [2003 draft report referenced]) • General Limitations (see above)	Not available

Author (Year) Country Industry Type of injury/ /illness	**Cost type & Perspective**	**Method**	**Assumptions**	**Value**	**Base Price Year / Time Period**	**Data sources**	**Under-reporting**	**Strengths**	**Limitations**	**Evidence gaps and recommendations for future research**
Safe Work Australia (2012) Australia Multi-industry Injuries & illnesses	Society -> Productivity costs	Workers' compensation premiums paid by employers or payments to injured/incapacitated workers' compensation jurisdictions treated as a transfer cost to society Loss of potential output and revenue General Methods (see above)	• General Assumptions (see above)	Unit costs - all society (/government) costs (injury): Short absence: $1,930 Long absence: $16,840 Partial incapacity: $59,830 Full incapacity: $1,582,680 • Fatality: $725,000 • Average: $19,630 Unit costs - all society (/government) costs (illness): Short absence: $2,710 Long absence: $10,060 Partial incapacity: $35,020 Full incapacity: $835,990 • Fatality: $217,190 • Average: $27,200	AUD (assumed, given as $) 2008/13 / 1 year	As above	Not available	Not available	• General Limitations (see above)	Not available

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
				incapacity: $835,990 • Fatality: $217,190 • Average: $27,200						
Safe Work Australia (2012) Australia Multi-industry Injuries & illnesses	Government -> Productivity costs	• Cost of providing social welfare programs • General Methods (see above)	• General Assumptions (see above)	• As above	AUD (assumed, given as $) 2008/14 / 1 year	As above	Not available	Not available	• General Limitations (see above)	Not available
Safe Work Australia (2012) Australia Multi-industry Injuries & illnesses	All perspectives -> Total costs	• Overall total includes human capital costs; not friction costs • Includes costs from all other Safe Work Australia entries in this table	• Uses human capital approach for total not friction costs, as "while some lost potential is likely to be 'picked-up' by previously unemployed workers entering the labour force, it will not be entirely replaced."	All perspectives, both injuries & disease: AU$60.6 billion (4.8% of GDP ($1,253.1 billion)); of which injuries are $30.7 billion, 51% Averages per incident, all costs - injuries: Short Absence: $2,700 Long Absence:	AUD (assumed, given as $) 2008/15 / 1 year	As above	Not available	Not available	• All Safe Work Australia limitations from above	Not available

Author (Year) Country Industry Type of injury/ /illness	Cost type & Perspective	Method	Assumptions	Value	Base Price Year / Time Period	Data sources	Under-reporting	Strengths	Limitations	Evidence gaps and recommendations for future research
				$27,950 Partial Incapacity: $529,410 Full Incapacity: $3,038,070 Fatality: $2,050,000 Average: $69,650						
Safe Work Australia (2012) Australia Multi-industry Injuries & illnesses	All perspectives -> Total costs	• Overall total includes human capital costs; not friction costs • Includes costs from all other Safe Work Australia entries in this table	• Uses human capital approach for total not friction costs, as "while some lost potential is likely to be 'picked-up' by previously unemployed workers entering the labour force, it will not be entirely replaced."	Averages per incident, all costs - illness: Short Absence: $3,670 Long Absence: $23,170 Partial Incapacity: $493,440 Full Incapacity: $2,064,070 Fatality: $1,076,920 Average: $200,400	AUD (assumed, given as $) 2008/15 / 1 year	As above	Not available	Not available	• All Safe Work Australia limitations from above	Not available