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Productivity estimation in economic evaluations of occupational health and safety interventions: a systematic review¹

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1. *Supplementary tables*
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Table S1: search strategy PubMed

Economic evaluation	Workplace setting	Productivity
"Costs and Cost analysis" [mh:noexp]	employer* [tiab]	Absenteeism [mh:noexp]
"Costs and Cost Analyses" [tiab]	employee* [tiab]	Efficiency [mh:noexp]
"Cost Analysis" [tiab]	worker* [tiab]	Presenteeism [mh:exp]
"Cost Analyses" [tiab]	"Workplace" [mh:noexp]	"sickness presence" [tiab]
"Cost Comparison" [tiab]	Workplaces [tiab]	"productivity lost" [tiab]
"Cost Comparisons" [tiab]	"Work Location" [tiab]	"productivity loss" [tiab]
"Cost-Minimization Analysis" [tiab]	"Work Locations" [tiab]	"time lost" [tiab]
"Cost Minimization Analysis" [tiab]	Work-Site [tiab]	"lost productivity" [tiab]
"Cost-Minimization Analyses" [tiab]	"Work Site" [tiab]	"productivity loss" [tiab]
"Cost Measures" [tiab]	Work-Sites [tiab]	"Sick Leave" [mh:noexp]
"Cost Measure" [tiab]	"Work Place" [tiab]	"Disability Leave" [tiab]
"Cost Allocation"[mh:noexp]	"Work Places" [tiab]	"Disability Leaves" [tiab]
"Cost Allocation" [tiab]	"Job Site" [tiab]	"Sick Days"
"Cost Apportionment" [tiab]	"Job Sites" [tiab]	"Illness days" [tiab]
"Cost-Benefit Analysis"[mh:noexp]	Worksite [tiab]	"illness day" [tiab]
"Cost-Benefit Analyses" [tiab]	Worksites [tiab]	"medical leave" [tiab]
"Cost Benefit Analysis" [tiab]	"Industry" [mh:noexp]	
"Cost Benefit Analyses" [tiab]	"Employment, Supported" [mh:noexp]	
"Cost Effectiveness" [tiab]	"supported employment" [tiab]	
"Cost-Benefit Data" [tiab]	"Return to work" [mh:noexp]	

<p> “Cost Benefit Data” [tiab] “Cost-Utility Analysis” [tiab] “Cost Utility Analysis” [tiab] “Cost-Utility Analyses” [tiab] “Economic Evaluation” [tiab] “Economic Evaluations” [tiab] “Marginal Analysis” [tiab] “Marginal Analyses” [tiab] “Cost Benefit” [tiab] “Costs and Benefits” [tiab] “Benefits and Costs” [tiab] “Cost-Effectiveness Analysis” [tiab] “Cost Effectiveness Analysis” [tiab] “Cost Control” [mh:noexp] “Cost Controls” [tiab] “Cost Containment” [tiab] “Cost Containments” [tiab] “Cost savings” [mh:noexp] “Cost saving” [tiab] “Deductibles and Coinsurance” [mh:noexp] Deductibles [tiab] Coinsurance [tiab] Health care costs [mh] “Health Care Cost” [tiab] “Health Costs” [tiab] “Health Cost” [tiab] “Healthcare Costs” [tiab] “Healthcare Cost” [tiab] “Medical Care Costs” [tiab] “Medical Care Cost” [tiab] “Treatment Costs” [tiab] “Treatment Cost” [tiab] “Direct Service Cost” [tiab] “Drug Costs” [tiab] </p>	<p> Return-to-Work [tiab] “Back to Work” [tiab] Back-to-Work [tiab] “Workplace violence” [mh:noexp] Workplace Violences [tiab] “Government Employees” [mh:noexp] “Government Employee” [tiab] “Government Officials” [tiab] “Government Official” [tiab] “Employee Incentive Plans” [mh:noexp] “Employee Incentive Plan” [tiab] “Occupational Health Services” [mh:noexp] “Occupational Health Service” [tiab] “Employee Health Service” [tiab] “Employee Health Services” [tiab] “Employment-Based Services” [tiab] “Employment Based Services” [tiab] “Employment-Based Service” [tiab] “Occupational Health” [mh:noexp] “Industrial Hygiene” [tiab] “Industrial Health” [tiab] “Occupational Safety” [tiab] “Employee Health” [tiab] OHS [tiab] “Occupational Health and Safety” [tiab] “Occupational Medicine” [mh:noexp] “Industrial Medicine” [tiab] “Accidents, Occupational” [mh:noexp] “Occupational Accidents” [tiab] “Occupational Accident” [tiab] “Industrial Accidents” [tiab] “Industrial Accident” [tiab] “Occupational Injuries” [mh:noexp] </p>	
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<p> “Drug Cost” [tiab] “Employer Health Costs” [tiab] “Employer Health Cost” [tiab] “Hospital Cost” [tiab] “Health Expenditures” [mh] “Health Expenditure” [tiab] “Direct Expenditure” [tiab] “Direct Expenditures” [tiab] “Out-of-Pocket Expenditure” [tiab] “Out-of-Pocket Expenditures” [tiab] “Out-of-Pocket Payments” [tiab] “Out of Pocket Payments” [tiab] “Out-of-Pocket Payment” [tiab] “Out-of-Pocket Costs” [tiab] “Out of Pocket Costs” [tiab] “Out-of-Pocket Cost” [tiab] “Out-of-Pocket Spending” [tiab] “Out of Pocket Spending” [tiab] “Out-of-Pocket Expenditures” [tiab] “Out of Pocket Expenditures” [tiab] “Out-of-Pocket Expenditure” [tiab] “Out-of-Pocket Expenses” [tiab] “Out of Pocket Expenses” [tiab] “Out-of-Pocket Expense” [tiab] Expenditure [tiab] Expenditures [tiab] “Indirect Expenditure” [tiab] “Indirect Expenditures” [tiab] “Capital Expenditure” [tiab] “Health Benefit Plans, Employee” [mh:noexp] </p>	<p> “Occupational Injury” [tiab] “Occupational Diseases” [mh:noexp] “Occupational Disease” [tiab] “Occupational Illnesses” [tiab] “Occupational Illness” [tiab] “Occupational Asthma” [tiab] “Occupational Asthmas” [tiab] “Burnout, Professional” [mh:noexp] “Asthma, occupational” [mh:noexp] “Dermatitis, Occupational” [mh:noexp] “Occupational Dermatitis” [tiab] “Occupational Exposure” [mh:noexp] “Occupational Exposures” [tiab] “Air Pollutants, Occupational” [mh:noexp] “Occupational Air Pollutants” [tiab] “Health Promotion” [mh:noexp] “Promotion of health” [tiab] “health promotions” [tiab] “health campaign” [tiab] “Healthy People Programs” [mh:noexp] “Health People Program” [tiab] “Weight Reduction Programs” [mh:noexp] “Weight reduction programs” [tiab] “weight reduction program” [tiab] “Weight loss programs” [tiab] “weight loss program” [tiab] “Noise, occupational” [mh:noexp] “Occupational noise” [tiab] “occupational noises” [tiab] “Occupational dentistry” [mh:noexp] “occupational dentistry” [tiab] “Occupational health physicians” [mh:noexp] “Occupational Health Physician” [tiab] </p>	
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	<p> “Company Physicians” [tiab] “company physician” [tiab] “Occupational health nursing” [mh:noexp] “Task performance and analysis” [mh:noexp] “Time and motion studies” [mh:noexp] “time studies” [tiab] “time study” [tiab] “Work simplification” [mh:noexp] “work simplifications” [tiab] “work performance” [mh:noexp] “Work Performances” [tiab] “Performance at Work” [tiab] “Job Performance” [tiab] “Job Performances” [tiab] “work schedule tolerance” [mh:noexp] “Work Schedule Tolerances” [tiab] “Work Capacity Evaluation” [mh:noexp] “Work Capacity Evaluations” [tiab] “Rehabilitation, Vocational” [mh:noexp] “Vocational rehabilitation” [tiab] “Vocational rehabilitations” [tiab] “Occupational therapy” [mh:noexp] “occupational therapies” [tiab] </p>	
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Table S2: Characteristics of the included studies (n=90) and the interventions they studied. [BA = (uncontrolled) before-after study; CBA = controlled before-after study; CE = compensation expenses; CEA = cost-effectiveness analysis; CEA LT = cost-effectiveness analysis with lost-time in natural units (e.g. cost per absence day avoided); CUA = cost-utility analysis; DAM = decision-analytic modelling; FCA = friction-cost approach; HCA = human-capital approach; HCT = historical controlled trial; PCS = prospective cohort study; RCS = retrospective cohort study; RCT = (cluster) randomized controlled trial]

Reference	Country	Perspective	Sector / industry	Intervention type	Economic evaluation method	Study design type	Productivity method
(39)	USA	Employer	Patient population	Chronic disease management type 2 diabetes	CEA	RCT	HCA
(40)	Canada	Employer (inferred)	Health care	Overhead ceiling lifts for reducing musculoskeletal injury	CEA	PCS	indirect costs by direct cost multipliers; CEA LT; direct use of compensation expenses
(41)	The Netherlands	Employer; societal	Multiple	Return to work intervention for workers with common mental disorders	CEA	RCT	FCA; HCA
(42)	Russia	Employer	Transport	Influenza vaccination health working adults	CEA	PCS	output based method
(43)	USA	Employer (inferred)	Multiple	Obesity management worksite health promotion program	CEA	BA	HCA (with compensation expenses)
(44)	USA	Employer	Information technology	Intervention to reduce work-family conflicts	CEA	RCT	HCA (with compensation expenses)

(45)	The Netherlands	Employer	Patient population	Work style and physical activity intervention for computer workers	CEA	RCT	HCA
(46)	UK	Employer (inferred)	Multiple	Structured workplace health improvement program through awards	CEA	BA	CEA LT
(47)	UK	Healthcare provider or insurance (inferred)	Patient population	Telephone-based sickness absence service	CEA	BA	HCA
(48)	Denmark	Societal	Patient population	Coordinated and tailored work rehabilitation for workers with musculoskeletal disorders	CEA	RCT	HCA
(49)	China	Employer	Health care	Influenza vaccination health care workers	CEA	RCS	CEA LT
(50)	USA	Employer	Multiple	Post-offer pre-placement nerve conduction screening for carpal tunnel syndrome	CEA	BA	direct use of compensation expenses
(51)	UK	Healthcare provider or insurance; employer	Services	Financial incentive for increasing physical activity in the workplace	CUA	quasi-experiment	EQ-5D based productivity estimation
(53)	Canada	Employer	not applicable	Return to work for short-term disability leave related to mental disorder	CEA	DAM	HCA
(52)	Canada	Employer	not applicable	Stigma program to address mental illness in the workplace	CEA	DAM	HCA
(54)	Canada	Employer	missing	Collaborative mental health care program for people receiving short term disability benefits for psychiatric disorders	CEA	quasi-experiment	CEA LT

(55)	USA	Employer	Multiple	Communication and employer-physician coordination program for return to work	CEA	quasi-experiment	direct use of compensation expenses
(56)	The Netherlands	Societal; employer	Multiple	Participatory ergonomics programme	CEA	RCT	FCA
(57)	France	Employer (inferred)	Health care	Influenza vaccination health care workers	CEA	PCS	missing
(58)	Sweden	Healthcare provider or insurance (inferred)	Patient population	Multimodal rehabilitation approach with physical and cognitive behavioural component	CEA	RCT	HCA (with social security expenditures)
(59)	USA	Employer	not applicable	Pre-employment nerve conduction testing to screen for carpal tunnel syndrome	CEA	DAM	direct use of compensation expenses
(60)	UK; Germany	Employer	not applicable	Screening and treatment for depression in the workplace	CUA	DAM	HCA
(61)	USA	Employer (inferred)	not applicable	Multiple work environment scenarios (increasing ventilation rates, air economizers, temperature control, reducing dampness)	CEA	DAM	HCA (with compensation expenses)
(62)	The Netherlands	Societal; employer	Multiple	Web-based guided self-help for employees with depressive symptoms	CUA	RCT	FCA; HCA
(63)	USA	Employer (inferred)	Multiple	Health risk management program	CEA	BA	HCA
(64)	The Netherlands	Societal	missing	Collaborative care intervention for major depressive disorder	CUA	RCT	FCA
(65)	USA	Employer (inferred)	Transport	Hypertension educational and awareness program	CEA	BA with DAM	HCA
(66)	The Netherlands	Societal; employer	Construction	Lifestyle intervention for construction workers at risk of cardiovascular disease	CEA	RCT	HCA

(67)	Brazil	Employer	Manufacturing	Work conditions modifications: noise, protective equipment, provision of chairs, working hours	CEA	PCS	HCA; output based method
(68)	The Netherlands	Employer	Health care	Influenza vaccination health care workers	CEA	BA with DAM	FCA
(69)	Canada	Societal; employer	Post corporation	Naturopathic approach to prevention of cardiovascular disease	CUA	RCT	HCA
(70)	The Netherlands	Employer	Transport	Graded activity intervention for sick-listed workers with non-specific low back pain	CEA	RCT	HCA
(71)	Canada	Employer	missing	Collaborative mental health care program for people receiving short term disability benefits for psychiatric disorders	CEA	quasi-experiment	CEA LT
(72)	The Netherlands	Societal	Multiple	Prevention program for low back pain	CUA	RCT	HCA
(73)	Denmark	Societal; healthcare provider or insurance	Patient population	Brief and multidisciplinary intervention for return to work in sick-listed patients with low back pain	CEA	RCT	HCA (with compensation expenses) / direct use of compensation expenses
(74)	Sweden	Partial societal perspective: sickness absence + disability pensions	Patient population	Orthopaedic manual therapy and exercise versus multidisciplinary rehabilitation program for neck and back pain patients	CEA	CBA (matched control)	HCA

(75)	Sweden	Societal	Patient population	Systematic co-operation between employer, occupational health service and social insurance office	CEA	CBA (matched control)	HCA
(77)	Singapore; USA	Employer	Multiple	Noise reduction through renewed equipment	CEA	BA	HCA
(76)	USA	Employer	Health care	Safe resident handling program in nursing homes (training + patient handling devices)	CEA	BA	employee turnover costs + direct use of compensation expenses
(78)	India; USA	Societal; employer	Manual material handling	Ergonomic training intervention among delivery porters	CEA	BA	HCA
(79)	Belgium	Societal; healthcare provider or insurance	not applicable	Hepatitis a vaccination	CUA	DAM	HCA
(80)	Canada	Employer (inferred)	Administration	Comprehensive workplace wellness intervention with health risk assessment	CEA	BA	HCA
(81)	UK	Societal	Multiple	Workplace physical activity intervention	CUA	RCT	HCA
(82)	USA	Employer	Services	Worksite obesity prevention	CEA	RCT	HCA; multiplier approach
(83)	The Netherlands	Societal; employee; employer	Manufacturing	Respiratory disease interventions in bakery workers	CEA	DAM	HCA
(84)	The Netherlands (+ models for Belgium; England; France;	Societal; healthcare provider or insurance	Patient population	Return to work intervention for cancer survivors	CEA	DAM	HCA

	Germany; Italy; Sweden)						
(85)	USA	Societal; employer	Transport	Peer-based workplace substance abuse prevention	CEA	BA	HCA
(86)	USA	Employer (inferred)	missing	Health risk assessment and employee wellness program	CEA	CBA (matched control)	CEA LT
(89)	The Netherlands	Societal	Health care	Interventions to promote work functioning by targeting mental health complaints among nurses	CEA	RCT	HCA
(88)	The Netherlands	Societal; employer	Services	Intervention to improve cooperation between sick-listed employees and their supervisors	CUA	RCT	FCA
(87)	The Netherlands	Employer	Health care	Preventive intervention among nurses at elevated risk of mental health complaints	CEA	RCT	HCA
(90)	Sweden	Societal	Patient population	Multi-professional rehabilitation programme for persistent musculoskeletal-related pain	CEA	CBA (matched control)	HCA
(91)	USA	Employer (inferred)	Education	Health promotion program (telephone counselling, walking encouragement, self-help programs, nurse helpline) with risk assessment	CEA	CBA (matched control)	CEA LT
(92)	Sweden	Employer (inferred)	Manufacturing	Worksite health promotion program with organisational changes	CEA	PCS	output based method
(93)	The Netherlands	Societal; employer	Multiple	Workplace intervention for sick-listed employees with distress	CUA	RCT	FCA; HCA
(94)	USA	Employer (inferred)	Patient population	Brief intervention for at-risk drinking	CEA	RCT	HCA; multiplier approach

(95)	The Netherlands	Employer	Construction	Prevention program (individual training, instrument to raise awareness of rest breaks, empowerment training sessions)	CEA	RCT	HCA
(96)	USA	Employer (inferred)	Health care	Stepping stones to wellness program, including biometric screening, participation incentives, and education	CEA	BA	HCA
(97)	Denmark	Societal; employee; employer	Construction	Prevention and management of injuries	CEA	quasi-experiment	HCA
(98)	UK	Healthcare provider or insurance	Patient population	Physiotherapy support for occupational health services	CUA	BA	CEA LT
(99)	USA	Societal	Patient population	Influenza vaccination	CEA	DAM	HCA
(100)	The Netherlands	Societal; employer	Police	Guideline-based care for workers with mental health problems	CEA	RCT	FCA; HCA
(101)	The Netherlands	Societal	Health care	Lumbar supports for home care workers with recurrent low back pain	CEA	RCT	HCA
(102)	The Netherlands	Not stated	Patient population	Adjuvant occupational therapy for work-related major depression	CEA	RCT	HCA
(103)	USA	Employer (inferred)	Construction	Battery-powered tools for direct-bury line workers	CEA	BA	HCA; direct use of compensation expenses
(104)	Turkey	5(societal)	Education	Migraine treatment	CEA	BA	CEA LT
(105)	UK	Not stated	Health care	Intensive case management for return to work	CEA	CBA	CEA LT

(106)	USA	Societal; employer	Health care	Pneumococcal polysaccharide vaccine among healthcare workers during an influenza pandemic	CUA	DAM	CEA LT
(107)	The Netherlands	Societal; employer	Multiple	Rsi quickscan intervention: risk assessment combined with ergonomic advice	CEA	RCT	FCA
(108)	UK	Societal; healthcare provider or insurance; employer	not applicable	Interventions to return employees to work following long-term sickness absence due to musculoskeletal disorders	CUA	DAM	FCA; HCA
(109)	The Netherlands	Societal	Patient population	Occupational therapy in parkinson's disease	CUA	RCT	FCA
(110)	Finland	Healthcare provider or insurance	Multiple	Risk assessment and occupational health service consultation	CEA	RCT	CEA LT
(111)	USA	Employer (inferred)	Military	Norovirus vaccination	CEA	DAM	CEA LT
(112)	USA	Societal	Patient population	Early versus delayed functional restoration for chronic disabling occupational musculoskeletal disorders	CEA	CBA (matched control)	HCA
(113)	The Netherlands	Not stated	Patient population	Rehabilitation using high-intensity physical training and long-term return-to-work in cancer survivors	CEA	CBA (matched control)	CEA LT
(114)	Canada	Societal	Health care	Peer coaching for overhead lift use in the long-term care sector	CEA	HCT	HCA; direct use of compensation expenses
(115)	Canada	Employer	Manufacturing	Participatory ergonomics programme	CEA	BA	HCA; output based method

(116)	Canada	Employer (inferred)	Health care	Influenza vaccination health care workers	CEA	RCS	CEA LT; HCA
(117)	The Netherlands	Societal	Patient population	Vocational rehabilitation in patients with chronic rheumatic diseases	CUA	RCT	HCA
(119)	The Netherlands	Societal; employer	Administration	Mindfulness-based worksite intervention	CEA	RCT	FCA
(118)	The Netherlands	Societal; employer	Health care	Worksite vitality among older hospital workers	CEA	RCT	FCA
(120)	The Netherlands	Societal	Patient population	Effects of timing of interventions for low back pain on cost-effectiveness	CEA	DAM	FCA
(121)	The Netherlands	Societal	Patient population	Postural exercise therapy versus physiotherapy in computer screen-workers with early non-specific work-related upper limb disorders	CUA	RCT	FCA
(122)	The Netherlands	Societal	Services	A weight control program with e-mail and telephone counselling	CUA	RCT	FCA
(123)	The Netherlands	Societal; employer	Multiple	Occupational health care guideline for prevention of weight gain	CUA	RCT	FCA; HCA
(124)	The Netherlands	Societal; healthcare provider or insurance	Patient population	Participatory return-to-work intervention for sick-listed workers due to musculoskeletal disorders	CUA	RCT	HCA
(125)	Sweden	Employer (inferred)	Health care	Reduced work hours and physical exercise intervention	CEA	quasi-experiment	output based method
(126)	USA	Employer (inferred)	Oil company	Disability management program	CEA	BA	HCA

(127)	USA	Employer (inferred)	Utility company	Comprehensive workplace health promotion program	CEA	RCS	HCA
(128)	USA	Employer	not applicable	Influenza vaccination clinics	CEA	DAM	HCA

BA = (uncontrolled) before-after study; CBA = controlled before-after study; CE = compensation expenses; CEA = cost-effectiveness analysis; CEA LT = cost-effectiveness analysis with lost-time in natural units (e.g. cost per absence day avoided); CUA = cost-utility analysis; DAM = decision-analytic modelling; FCA = friction-cost approach; HCA = human-capital approach; HCT = historical controlled trial; PCS = prospective cohort study; RCS = retrospective cohort study; RCT = (cluster) randomized controlled trial

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