Economic analyses of mental health and substance use interventions in the workplace: a systematic literature review and narrative synthesis

Claire de Oliveira, Edward Cho, RuthAnne Kavelaars, Margaret Jamieson, Buddy Bao, Jürgen Rehm

Mental illness and substance use disorders in the workplace have been increasingly recognised as a problem in most countries; however, evidence is scarce on which solutions provide the highest return on investment. We searched academic and grey literature databases and additional sources for studies that included a workplace intervention for mental health or substance abuse, or both, and that did an economic analysis. We analysed the papers we found to identify the highest yielding and most cost-effective interventions by disorder. On the basis of 56 studies, we found moderate strength of evidence that cognitive behavioural therapy is cost-saving (and in some cases cost-effective) to address depression. We observed strong evidence that regular and active involvement of occupational health professionals is cost-saving and cost-effective in reducing sick leave related to mental health and in encouraging return to work. We identified moderate evidence that coverage for pharmacotherapy and brief counselling for smoking cessation are both cost-saving and cost-effective. Addressing mental health and substance misuse in the workplace improves workers' wellbeing and productivity, and benefits employers' bottom line (ie, profit). Future economic analyses would benefit from the consideration of subgroup analyses, examination of longer follow-ups, inclusion of statistical and sensitivity analyses and discussion around uncertainty, and consideration of potential for bias.

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Introduction

According to WHO, mental illnesses were the leading cause of years of life lost to disabilities in 2016.[1] Depression alone caused almost a third of this burden.[1] Depending on the estimation method, the global economic burden of mental illness was estimated to be either US$2·5 trillion in 2010 increasing to $6·1 trillion in 2030 (by use of the human capital approach) or $8·5 trillion in 2010 increasing to $16·5 trillion in 2030 (by use of the statistical life approach).[2] Most of this burden is due to absenteeism, presenteeism, and lost productivity.

Workplaces that promote mental health and support individuals with mental illnesses are more likely than workplaces that do not to reduce absenteeism and presenteeism, increase productivity, and might benefit from the resulting economic gains.[3] Thus, in addition to understanding whether workplace interventions are effective, employers are keen to understand whether their investments are cost-saving (ie, the financial benefits exceed the investment costs and thus the return on investment is positive) or cost-effective (ie, the effects on mental health or quality of life present good value for the money invested), or both.

There is a growing body of international evidence that initiatives around promotion, prevention, and early intervention can provide positive returns on investment.[4,5] However, evidence is scarce on which solutions provide the highest return on investment; as a result, few employers have adopted these initiatives.[6] Previous reviews have reported few studies on mental health interventions in the workplace, most of which were of low quality; moreover, these reviews have not examined substance use.[3,7]

The objectives of this Review are to provide a comprehensive overview of the existing literature on interventions targeting mental health and substance use disorders in the workplace that have measured the resulting economic or financial return. Additionally, we aim to provide a list of the highest yielding and most cost-effective interventions by disorder.

Methods

Search strategy and selection criteria

We included all studies that examined mental health or substance misuse, or both, examined workplace interventions targeting employed adults (aged 18 years or older), and included an economic analysis. We used the population, intervention, control, outcomes, and study design (known as PICOS) criteria to guide the development of the search strategy. Our population included all employed adults with a mental health or substance use disorder, or both, and excluded unpaid workers, and individuals related to workers (eg, spouses). The intervention had to target mental health or substance misuse, or both, improve an outcome related to work, and be provided in a workplace or be sponsored by the employer. Studies were excluded if the intervention was implemented at a jurisdictional level. All studies on workplace interventions of supported employment or accommodation were excluded as these have different objectives than generic workplace interventions. The comparator had to be usual care or no care; studies without a control or comparison group were excluded (except studies with pretest and post-test analyses of the same population). Outcomes included effect on mental health or substance misuse, or both; outcomes related to work, such as productivity; and economic or

financial-related outcomes, such as return on investment. Studies were excluded that did not assess mental health or substance misuse, or that examined disorders related to sleep (eg, insomnia). The study design had to include an economic analysis and a measurement of change in mental health or substance misuse; by measuring an outcome either before intervention and after intervention in a case-control study or pretest and post-test in a study of the same population.

We searched literature published in English, French, German, Portuguese, Spanish, and Korean between Jan 1, 2000, and Dec 31, 2018, to ensure that studies were still relevant to practices and treatments in the workplace, which are constantly evolving. Relevant studies were identified through structured searches in peer-reviewed academic literature databases; structured searches in grey literature databases; and searches in other sources, such as Google and Google Scholar, relevant websites related to mental health or workplace (appendix pp 1–5), or both, hand search of relevant journals (appendix p 6), hand search of references included in key papers and reviews (ie, snowballing), and studies identified by content experts (ie, individuals with expertise or who had published on the topic; appendix pp 7–9).

See Online for appendix

Structured searches were done in PubMed, MEDLINE, Embase, CINAHL, PsycINFO, Web of Science Core Collection, Scopus, EconLit, Business Source Premier, Health Business Elite, NHS Economic Evaluation Database, Health Technology Assessment Database, Database of Abstracts of Reviews of Effects, Cochrane Library, Open Grey, Grey Literature Report, PsycEXTRA, ProQuest Dissertations and Theses, National Technical Information Service, and the Health Management Information Consortium database. Search terms or strings were developed on the basis of five concepts: population or workplace; intervention; disorders related to mental health or substance use; outcomes related to work; and economic or financial-related outcomes. The full list of search terms can be found in the appendix (appendix p 10).

After the removal of duplicates, groups of two independent reviewers screened titles and abstracts and a third reviewer was assigned to resolve any disagreements, if and where necessary. Articles were excluded either because they examined the wrong population, did not focus on mental health or substance use, or did not include a full economic analysis, or a combination. All reviews that met the inclusion criteria were also retrieved and used later during the snowballing process. Subsequently, all relevant full text articles were retrieved and screened by groups of two reviewers to confirm eligibility; a third reviewer was brought in, if and where necessary. Rayyan QCRI was used to manage references and to screen titles and abstracts.

For more on **Rayyan QCRI** see https://rayan.qcri.org

Quality assessment

All relevant studies were appraised for reporting and methodological quality by groups of two independent reviewers, with a third reviewer assigned to resolve any disagreements. We used the Consolidated Health Economic Evaluation Reporting Standards (CHEERS)[8] checklist to ascertain reporting quality. This checklist includes 24 items, which are equally weighted (appendix pp 14–16). The following categories were used to score each checklist item: yes (adequately reported), partial (partly reported), no (not reported), and not applicable (appendix p 22). The Quality of Health Economic Studies (QHES)[9] checklist was used to ascertain methodological quality because it has good construct validity and reliability,[10] and is easy to use.[11] This checklist includes 16 items, answered as yes or no, and each item is assigned a weight ranging from 1 to 9, depending on the item's importance in an economic analysis or evaluation. The sum of the weights ranges between 0 (extremely poor quality) and 100 (excellent quality). The QHES checklist states that researchers should use yes or no responses, suggesting that each item should be scored only with full points or no points at all. Nonetheless, some studies have used partial scoring.[12] We found that the all or nothing approach was not reasonable for checklist items that included more than one question. Therefore, we decided to implement the partial scoring method used by Yong and colleagues,[12] which we modified to address some limitations. For example, modification occurred in one instance in which we felt a mistake was made in Yong and colleagues' paper[12] and in another instance in which we included additional partial scoring. A copy of the modified checklist can be found in the appendix (appendix pp 17–19). Regardless of full or partial scoring method, all raters should be aware of the scoring rule chosen and inter-rater reliability should be checked for the first several studies assessed (Chiou CF, independent advisor, personal communication). The methodological quality of each study was assessed by applying the four categories suggested by Ofman and colleagues[9] and Spiegel and colleagues:[13] extremely poor quality (QHES scores: 0–24), poor quality (QHES scores: 25–49), fair quality (QHES scores: 50–74), and high quality (QHES scores: 75–100). Ultimately, the overall quality of each study was based on the QHES checklist, given that most studies did well on the CHEERS checklist (appendix p 22). Both checklists were tested on a sample of six studies by two independent reviewers who subsequently met to discuss how well each checklist captured relevant aspects of the study. Once data quality assessment was completed, the reviewers met to discuss consensus on the final scores; a third reviewer was assigned to resolve any disagreements.

Data extraction

Data extraction was done only on studies deemed high quality because we felt that evidence synthesis should be based on studies done in accordance with the required

elements of a proper economic analysis or economic evaluation. The data extraction tool was developed by the research team and based on the Cochrane good practice data extraction form. The tool included the following categories: general information (title, author, and year of publication; study quality, based on the QHES score; country of study; setting or industry; firm size; and study population); details of the intervention (study design; description of intervention; comparator; and type of intervention); economic analysis (perspective and type of economic analysis done); and outcomes (effect on mental health or substance use disorder, or both, work-related effect, and economic or financial effect) and main findings. The tool was first tested on a random sample of six studies by groups of two independent reviewers who subsequently met to discuss how well the data extraction tool captured the relevant data elements; refinements were then made if and where required. Once the tool was finalised, groups of two independent reviewers extracted the data from all studies and then met to discuss consensus on the relevant information to be extracted; a third reviewer was assigned to resolve any disagreements.

Data analysis and evidence synthesis

The studies included in this Review covered interventions that focused on various mental health and substance use disorders in different industries and countries. Given the heterogeneity of studies, we were not able to do a meta-analysis. Hence, we did a narrative synthesis supplemented by an analysis on high-quality studies only, stratified by disorder where possible. The existing evidence was synthesised by use of Slavin's best evidence synthesis approach,[14,15] which compares evidence from different sources and bases the strength of a relationship between variables on the quality, quantity, and consistency of evidence available. This approach has been used in previous work on workplace interventions.[16] We ranked evidence on the basis of a scale with four levels: strong (three or more studies must report consistent findings), moderate (two studies must report consistent findings), limited (findings are only available from one study), and mixed evidence (findings from existing studies are contradictory). Each stratum of studies was evaluated against the criterion for the highest level; if this criterion was not met, the criterion for the next highest level was considered. The process continued through each level of evidence until the prespecified criterion was met.

This Review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement[17] and is registered with PROSPERO, number CRD42019137421.

Results

Study selection

After all citations were merged and duplicates were removed, our search produced 11 018 unique records, of which 708 full texts were assessed, and 56 studies were included in the final Review (figure; appendix pp 20, 21).

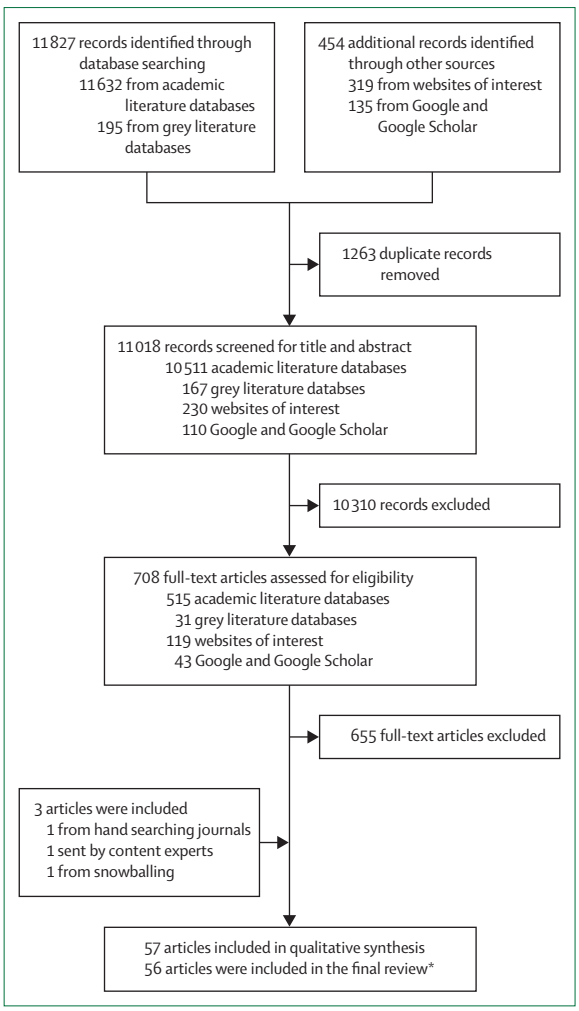

Figure: **Study profile**
*Two articles were considered one study as they assessed the same intervention.

Most interventions focused on depression, smoking, or multiple mental health disorders. The highest proportion of studies was done in the USA (23 [41%] of 56), followed by the Netherlands (9 [16%]). Many studies did not specify the setting or industry and many did not state firm size. A large portion of studies included a randomised controlled trial or modelling, or both, and evaluated either secondary or tertiary interventions. Most studies looking at depression focused on cognitive behavioural therapy (CBT), whereas studies on smoking typically examined coverage for pharmacotherapy for smoking cessation. The highest proportion of studies adopted an employer perspective (18 [32%] of 56) but some studies adopted both employer and societal perspectives (7 [13%]); the economic analysis typically used was a cost–benefit analysis. Regarding outcomes related to the workplace, most studies focused on

	General information		Intervention details (study design, description of intervention, comparator,* and type of intervention†)	Economic analysis		Outcomes and key findings		
	QHES score	Setting or industry, firm size,‡ and study population		Perspective	Type of economic analysis	Effect on mental health or substance use disorder	Work-related outcome and effect	Economic or financial outcome and effect
Depression								
Evans-Lacko et al (2016)[20]	91·5	Hypothetical cohort of employees with population characteristics based on 2013 administrative data of 4·1 million employed and insurance individuals in German labour force (n=500); setting and firm size not reported	Modelling study comparing psychotherapy (secondary), pharmacotherapy (tertiary), and combined therapy against each other§	Employer	Cost-effectiveness analysis	Gains in QALYs in pharmacotherapy (+1·26), psychotherapy (+1·30), and combination (+1·31)	Productivity gains from reduced absenteeism and presenteeism (per 500 workers) were €37 404·00 ($46 495·33) and €62 097·00 ($77 189·94) for pharmacotherapy and €38 180·00 ($47 459·29) and €62 097·00 ($77 189·94) for psychotherapy	ICER with pharmacotherapy as the base was €22 225·00 per QALY ($27 626·77) for psychotherapy and €121 800·00 per QALY ($151 403·10) for combination therapy; pharmacotherapy resulted in the lowest QALY gain and was the least expensive; psychotherapy and combination therapy resulted in nearly identical QALY gains, but psychotherapy was less expensive (CIs not reported)
Geraedts et al (2017)[25]	85·0	Employees from diverse work settings in the Netherlands who scored >16 on the depression scale CES-D and were not on sick leave (n=131); firm size not reported	RCT comparing a web-based programme with problem-solving and CBT elements (n=116; 51 complete records, 65 incomplete records; secondary) with usual care (n=115; 55 complete records, 60 incomplete records)	Societal and employer	Cost-effectiveness analysis and cost-utility analysis; cost-effectiveness analysis, cost-utility analysis, and return on investment analysis	Significant reduction in depressive symptoms in the intervention group measured by the CES-D scale; patients in the intervention group improved by 12·0 points on average compared with the control group, who had an average improvement of 9·9 points on the 60 point scale; no significant improvement in QALYs (−0·001, 95% CI −0·040 to 0·040)	Absenteeism costs were higher by €236·00 ($300·22) while presenteeism costs were lower by €1278·00 ($2198·04) in the intervention group; total benefits from improved health, absenteeism, and presenteeism during follow-up were €793·00 (95% CI −7176·00 to 8039·00; $1008·72, 95% CI −9127·88 to 10 225·36)	ICER from the societal perspective for the intervention group was €314·00 ($399·78) per CES-D point, indicating that a 1 point decrease in depressive symptoms was associated with a cost-saving of €314·00 ($399·78); ICER for the cost-utility analysis was €532 959·00 ($677 915·41) per QALY; ICER from the employer's perspective for the intervention group was €224·00 ($284·79) per CES-D point; ICER for the cost-utility analysis was €382 354·00 ($486 347·92) per QALY; net benefit was on average €508·00 (95% CI −7029·00 to 8160·00; $645·98, 95% CI −8941·11 to 10 379·72); benefit–cost ratio was 2·8 (95% CI −25·7 to 27·6); ROI was 178% (95% CI −2466 to 2863)
Goorden et al (2014)[37]	80·0	Employees in the Netherlands who reported being ill for 4–12 weeks because of mental illness, who screened positive for depressive symptoms on the PHQ-9 (n=126); setting and firm size not reported	RCT comparing collaborative care treatment from an occupational physician care manager (n=65; tertiary) with usual care (n=61)	Societal	Cost-effectiveness analysis	Mean utility scores improved by 0·17 in the intervention group and by 0·24 in the usual care group after 12 months; both groups had improvements in quality of life, but the average QALY gain was higher in the usual care group (−0·05, 95% CI −0·11 to 0·00)	Presenteeism and absenteeism rates declined in both groups, with no significant difference between the intervention and control groups	Health-care costs were €3874·00 (95% CI 2778·00–5718·00; $4760·00, 95% CI 3413·60–7027·09) in the collaborative care group and €4583·00 (95% CI 3108·00–6794·00; $5617·81, 95% CI 3819·56–8349·15) in the care as usual group; usual care had an ICER of €14 598·00 ($18 711·12) per QALY relative to collaborative care
Lo Sasso et al (2006)[26]	84·5	US national sample of employees employed in various positions by companies from 12 community primary care practices across the USA (n=198); firm size not reported	RCT comparing enhanced depression management, involving screening, counselling, or antidepressants, and care management (n=96; secondary) with usual care (n=102)	Employer	Cost–benefit analysis	Not measured	Employer benefits resulting from improved productivity and reduced absenteeism were $2144·00 ($3126·50) per employee in the first year and $5489·00 ($8004·17) per employee in the second year	Based on a firm size of 1000, the total net benefits after 2 years were $286 594·00 ($417 919·27) and the costs were $95 007·00 ($138 542·10), yielding an ROI of 302% or 3·02 over 2 years (CIs not reported)

(Table 1 continues on next page)

	General information		Intervention details (study design, description of intervention, comparator,* and type of intervention†)	Economic analysis		Outcomes and key findings		
	QHES score	Setting or industry, firm size,‡ and study population		Perspective	Type of economic analysis	Effect on mental health or substance use disorder	Work-related outcome and effect	Economic or financial outcome and effect
(Continued from previous page)								
Wang et al (2006)[18]	93·5	Hypothetical cohort of US employees aged 40 years in multiple settings; sample size and firm size not specified	Modelling study comparing screening, CBT, and care management via telephonic programmes (secondary) with usual care	Societal and employer	Cost-utility analysis and cost–benefit analysis	Improvement of 0·002 QALYs in the intervention group compared with the usual care group (not significant)	Productivity gains from reduced absenteeism and presenteeism were $21 961·00 ($29 195·80) per 1000 employees after 5 years; in 5 years the company saves $5362·00 ($7128·19) per 1000 employees ($5·36 [$7·12] per employee) as a result of reduced turnover (includes costs of hiring and training a new employee)	ICER of $19 976·00 ($26 556·30) per QALY compared with usual care; the intervention cost employers an additional $26 915·00 ($35 781·43) after 5 years and resulted in a benefit of $29 810·00 ($39 630·32), equating to a cumulative net benefit of $2895·00 ($3963·11) per 1000 employees over 5 years
Multiple mental health disorders (primary and secondary interventions)								
Ebert et al (2016)[30]	82·5	Employees in Germany >18 years of age (n=164) with a score ≥22 on the perceived stress scale; setting and firm size not reported	RCT comparing internet-based stress management intervention (n=132; secondary) with usual care (n=132)	Employer	Cost–benefit analysis and cost-effectiveness analysis	Intervention group had higher rates of patients classified as symptom-free (ie, stress-free) than usual care group	Presenteeism days and costs were lower in the intervention group (€1345·79; $1672·88) than in the usual care group (€1655·00; $2057·58) as were absenteeism days and costs (€1578·00 [$1961·87] for intervention *vs* €1756·00 [$2182·60] for usual care)	Net benefit was €181·00 per person (95% CI −643·00 to 1042·00; $225·36, 95% CI −798·80 to 1295·05), ROI was 0·6 (95% CI −2·2 to 3·5), and benefit–cost ratio was 1·6 (95% CI 1·2–4·5); ICER was −€521·00 per symptom-free employee (95% CI −3123·00 to 1900·00; −$647·53, 95% CI −3881·30 to 2361·66), showing the cost-effectiveness of the intervention
Hengel et al (2014)[31]	82·0	Employees at six different construction companies in the Netherlands that specialise in house, commercial, or industrial building (n=293); firm size not reported	Cluster RCT comparing prevention by education (n=171; primary) with usual care (n=122)	Employer	Cost-effectiveness analysis and cost–benefit analysis	Self-reported general mental health showed a small improvement in the intervention group (baseline prevalence of 55·0–54·2%) at 12 month follow-up	Work ability decreased in the intervention group at 12 month follow-up (baseline prevalence of 15·8–15·3%)	Net benefit per employee of €641·00 (95% CI −24·00 to 1411·00; $865·17, 95% CI −32·41 to 1905·53); benefit–cost ratio was 6·4:1·0 with a 544%, or 5·44, ROI; ICER was €5243·00 ($7081·89) per 1 point decline in work ability in the intervention group (less efficacious and less costly than usual care); a 1 point improvement in mental health saved the employer €642·00 ($867·48) in the intervention group compared with the control group
Lavelle et al (2018)[23]	86·0	Active duty US military service members with PTSD or depression (n=666); firm size was large	RCT comparing stepped psychosocial treatment and routine monitoring (n=332; 320 completed the study; secondary) with usual care (n=334; 309 completed the study)	Societal	Cost-effectiveness analysis	Primary PTSD and depression outcomes showed significant small to moderate improvements over 12 months in the intervention group compared with the control group	Intervention group had 3 fewer lost workdays per year than the control group, equating to productivity savings of $1255·00 ($1331·33) for treatment relative to control	ICER of $49 346·00 ($52 340·82) per QALY for intervention compared with usual care, with a 58% probability that the intervention is cost-effective at a willingness-to-pay threshold of $100 000·00 ($106 070·08)

(Table 1 continues on next page)

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(Continued from previous page)								
Noben et al (2015)[41]	77·0	Nurses in the Netherlands working with similar work demands and work conditions in one Dutch academic medical centre (n=413); health-care setting with a large firm size	Pragmatic cluster RCT comparing health survey feedback and consultation with an occupational physician (n=207; secondary intervention) with screening only (n=206; primary intervention)	Employer	Cost–benefit analysis	Targeted outcomes included one or a combination of distress, work-related fatigue, risky drinking, depression, anxiety, and PTSD (not measured)	Cost reductions due to greater productivity from reductions in presenteeism and absenteeism were €715·00 (95% CI 226·00–1023·00; $931·54, 95% CI 253·15–1332·87) in the occupational physician condition relative to the control condition	Net savings of €244·00 per nurse ($317·97; CI not reported) when only absenteeism is regarded, and €651·00 (95% CI 167·00–1135·00; $848·19, 95% CI 217·64–1479·51) when presenteeism is also taken into account; corresponds to an ROI of 5–11
Noben et al (2014)[24]	85·0	Nurses in the Netherlands working with similar work demands and work conditions in one Dutch academic medical centre (n=617); health-care setting with a large firm size	Pragmatic cluster RCT comparing health survey feedback and consultation with an occupational physician (n=207; secondary intervention) or referral to a web-based mental health programme (n=204; secondary intervention) with screening only (n=206; primary intervention)	Societal	Cost-effectiveness analysis	Targeted outcomes included one or a combination of distress, work-related fatigue, risky drinking, depression, anxiety, and PTSD (not measured)	Significant improvement in work functioning occurred in each group at 6 month follow-up: control (20%), occupational physician (24%), e-mental health (16%)	Median ICER for the occupational physician *vs* control was dominant (cost savings of €5049·00 [$6580·22] per treatment responder); ICER for e-mental health *vs* control was estimated at €4054·00 ($5283·63) per treatment responder (CIs not reported)
Multiple mental health disorders (tertiary interventions)								
Arends et al (2013)[34]	81·5	Employees in the Netherlands aged 18–63 years with common mental disorder diagnosis (n=158) were recruited by occupational physicians; setting and firm size not reported	Cluster RCT comparing occupational health intervention with a focus on solving potential problems at work after RTW (n=80; tertiary) with usual care (n=78)	Employer	Cost–benefit analysis and cost-effectiveness analysis	Targeted outcome was general mental health (not measured)	Mean incidence of recurrent sickness absence during 12 months follow up was lower in the intervention group than the usual care group by 24% (95% CI 3–45); no significant differences were found between the two groups regarding cost of productivity loss	Cost–benefit analysis from the employer's perspective showed that the mean cost difference for occupational health services was in favour of the control group; mean costs were €800·00 (95% CI 678·00–922·00; $992·51, 95% CI 841·24–1143·78) higher in the intervention group compared with the control group; cost-effectiveness analysis with incidence of recurrent sickness absence as effect measure showed an ICER of €10 960·00 ($13 600·37) per percent of prevented recurrent sickness absence episode

(Table 1 continues on next page)

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(Continued from previous page)								
Dewa et al (2009)[33] and Dewa and Hoch (2014)[32]¶	82·0	Employees in Canada in a financial or insurance setting (n=126); employees with a disability related to psychiatric disorders were referred to the intervention; employees who were on short-term disability leave related to psychiatric disorders in the year before the programme implementation and who would have met the screening criteria for the intervention were referred to usual care; firm size was large	Quasi-experimental design comparing collaborative care by a psychiatrist and a primary care physician (n=75; tertiary) with usual care (n=51)	Employer	Cost-effectiveness analysis and cost–benefit analysis	Targeted outcome was general mental health (not measured)	With the intervention, for every 100 people there could be more people returning to work (n=23), fewer people transitioning to long-term disability leave (n=24), and 1600 more workdays (16 fewer short-term disability days × 100 people)	With the intervention, for every 100 people there could be more than $50 000·00 ($68 688·74) in disability benefit savings ($503·00 [$692·29] per person × 100 people; CIs not reported); incremental net benefit for the programme is $2127·00 ($1641·58) per reduction of a short-term disability day; breakeven point occurs when the average short-term disability episode is reduced by at least 7 days (CIs not reported)
Lokman et al (2017)[27]	84·0	Employees in the Netherlands aged ≥18 years, sick-listed for 4–26 weeks with symptoms of common mental disorders visiting their occupational physician (n=220); firm size was small and medium; setting not reported	Cluster RCT comparing eHealth module aimed at improving the self-efficacy of employees (n=131; tertiary) with usual care (n=89)	Societal, employee, employer, health care	Cost–benefit analysis	The intervention group had a higher quality of life at months 6, 9, 12 follow-up with a difference in utility derived from quality of life of 0·04, 0·08, and 0·04, respectively	The intervention group had lower average monthly absenteeism costs at all follow ups; cost was €233·00 ($303·31) at 3 months, €435·00 ($567·26) at 6 months, €551·00 ($717·76) at 9 months, and €546·00 ($711·58) at 12 months; intervention group had lower average monthly presenteeism costs only at 12 months follow up; cost was –€191·00 (–$249·28) at 3 months, –€175·00 (–$228·45) at 6 months, –€53·00 (–$68·69) at 9 months, and €168·00 ($219·19) at 12 months	The incremental net benefits were €4210·00 ($5486·61) with an ROI of 14·0; net benefits were €658·00 ($857·45); incremental net benefits reported €3187·00 ($4154·74) per employee per year and an ROI of 10·6; net benefits were negative with additional costs of €234·00 ($304·85) per employee

(Table 1 continues on next page)

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(Continued from previous page)								
Rebergen et al (2009)[21]	88·0	Dutch police force employees on sick leave because of mental disorder (n=240); firm size not reported	RCT comparing guideline-based care by occupational physicians (n=125; tertiary) with usual care (n=115)	Societal and employer	Cost-effectiveness analysis and cost–benefit analysis	Targeted outcomes were depression, anxiety, and stress (not measured)	No significant differences between the groups in mean sick leave days	ICER was –$1413·00 (–$2093·85) per 1 day reduction in sick leave with a great probability of lower costs but equal treatment outcomes, illustrating the cost-effectiveness of the intervention; according to the cost–benefit analysis, the estimated net benefit of the intervention in terms of reducing productivity loss costs was €3582·00 ($5307·56; CIs not reported)
Taimela et al (2007)[36]	80·0	Employees from one corporation in Finland with high risk of sickness absence, based on results from a self-reported questionnaire (n=418); 49% were employed in construction and 51% in building repair, service, and maintenance; firm size not reported	RCT comparing feedback of health survey results and consultation by occupational physician or nurse (n=209; tertiary) with usual care (n=209)	Health care	Cost-effectiveness analysis	Depression and stress tended to be more prevalent in the control group than in the intervention group at 12 month follow-up (not significant); in terms of health outcomes, the intervention seems to be weakly dominant (produces the same efficacy at a lower cost)	No difference in self-rated working ability or perceived changed in working ability between the groups	The intervention was dominant as it was more cost-saving and efficacious than usual care; the saving was €43·00 and €17·00 ($62·51 and $24·70) per sickness absence day avoided by use of the available direct cost data and imputed total cost data, respectively (CIs not reported)
van Oostrom et al (2010)[22]	87·0	Employees from multiple settings in the Netherlands who reported being ill for 2–8 weeks because of distress (n=145); firm size not reported	RCT comparing stepwise formulation of a RTW plan under the guidance of a RTW coordinator (n=73; tertiary) with usual care (n=72)	Employer and societal	Cost–benefit analysis, cost-effectiveness analysis, and cost-utility analysis	No significant differences between groups in QALYs and RTW subgroup of employees with intention to RTW	No significant differences between groups in QALYs and RTW subgroup of employees with intention to RTW	Cost–benefit analysis from the employer's perspective indicated a significantly higher cost (€584·00; $798·02) of occupational health services in the workplace intervention group; ICER was €627·00 ($856·68) per 1 day reduction in sick leave, illustrating that the intervention was more costly than the control group to produce the same effect; ICUR was €184 562·00 ($252 260·55) per QALY

All currencies (including dollars) are given with the 2018 US$ value immediately after for ease of comparison. QHES=Quality of Health Economic Studies. ICER=incremental cost-effectiveness ratio. ICUR=incremental cost-utility analysis. CES-D=Center for Epidemiologic Studies Depression Scale. RCT=randomised controlled trial. PHQ-9=Patient Health Questionnaire. QALY=quality-adjusted life year. ROI=return on investment. CBT=cognitive behavioural therapy. PTSD=post-traumatic stress disorder. RTW=return to work. *Placebo applies only to drug interventions. †Primary intervention (prevention before an illness occurs); secondary intervention (reduce the impact of an illness that has already occurred); tertiary intervention (lessen the impact of an ongoing illness with lasting effects). ‡Small (1–99 employees); medium (100–499 employees); large (>500 employees). §The relative cost-effectiveness for antidepressants, CBT, and combination treatment for employees with depression was estimated. ICERs were calculated with pharmacotherapy as the base. ¶Two articles were considered one study as they assessed the same intervention.

Table 1: **Details of mental health studies that were high quality**

absenteeism, followed by presenteeism. The main economic or financial outcomes reported were either return on investment, net monetary benefit, or incremental cost-effectiveness ratio.

Quality assessment and data extraction

In short, on the basis of the QHES checklist scores, we identified 23 studies of high quality,[18–41] 25 of fair quality,[42–66] seven of poor quality,[67–73] and one of extremely poor quality (appendix pp 23–25).[74] Data were extracted on all studies that were deemed high quality (tables 1, 2).

Evidence synthesis

Evidence was synthesised by disorder. Given the small number of studies, the heterogeneity of interventions, and the availability of information, we were not able to synthesise the evidence by firm size, industry, sector, or country. Among the high quality studies, we identified five studies that examined depression; 11 studies that examined multiple outcomes, such as post-traumatic stress disorder, depression, anxiety, stress, or mental health in general; six studies that examined smoking; and one study that examined alcohol use (table 3).

For depression, we found moderate evidence that workplace interventions, including CBT interventions and interventions based on CBT and care management (ie, increased coordination, regular follow-up, and management of the patient's care plan), are cost-saving to treat depression in workers. In both types of intervention, returns on investment were greater than \$0, thus providing employers a net return. In some cases, CBT interventions with care management provided higher returns than CBT without care management. For example, for CBT interventions without care management, one study showed a return on investment of \$1·78 (95% CI –24·66 to 28·63) for every dollar invested per employee after 1 year,[25] whereas another study showed a modest return on investment of \$0·25 (no CIs were reported) for every dollar invested after 27 months.[20] By contrast, for every dollar invested in workplace CBT interventions with care management, studies reported a larger return on investment than CBT alone, varying between \$0·39 (no CIs were reported)[26] and \$3·35 (95% CI 0·42 to 5·53)[37] per employee after 1 year. We identified limited evidence that interventions that included CBT or CBT with care management were cost-effective. We also found limited evidence that CBT with pharmacotherapy, care management alone, and pharmacotherapy coverage alone were cost-saving to treat depression.[18,20]

For other mental health disorders, studies were too heterogeneous to synthesise and, therefore, were organised by type of intervention: primary and secondary interventions, and tertiary interventions. Given the small number of studies, the evidence for primary and secondary interventions was limited. For example, one study from Germany reported limited evidence that internet-based management interventions were cost-saving and cost-effective to alleviate stress in employees at a health insurance firm.[30] Regarding tertiary interventions, we identified strong evidence that, to reduce sick leave because of mental health disorders (eg, depression, stress, or anxiety, or a combination) and encourage return to work, regular and active involvement of occupational physicians and nurses in workplace interventions is cost-saving and cost-effective.[21,27,36] All three studies completed an economic evaluation alongside a randomised controlled trial. One study, in the Netherlands, reported a modest return on investment of \$0·87 (95% CI –0·87 to 1·34) for every dollar invested per employee after 1 year,[21] as a result of reduced sick leave days because of depression, anxiety, and stress; another study examining an intervention at small firms and medium firms in the Netherlands noted a higher return on investment of \$10·63 (no CIs were reported).[27] The third study, done in Finland, did not provide sufficient data to estimate a return on investment but showed a saving of €17·00–43·00 (2018 US\$24·70–62·51) per avoided sickness day because of depression and stress.[36] We found limited evidence for all other tertiary interventions.

For tobacco smoking cessation, we identified moderate evidence that varenicline is more cost-saving and cost-effective compared with bupropion. For example, one study showed that, compared with bupropion, for every dollar invested in varenicline, employers received \$0·84 per employee after 1 year.[40] Another study noted substantially higher returns on investment per employee; \$4·00 after 2 years, \$8·80 after 5 years, and \$16·70 after 10 years (no CIs were reported).[28] Additionally, we found moderate evidence that, to address smoking cessation, bupropion is more cost-saving and cost-effective compared with nicotine replacement therapy. One study showed that, compared with nicotine replacement therapy, for every dollar spent on bupropion, employers received \$2·07 per employee after 1 year (no CIs were reported).[29] Another study did not provide enough information to calculate the return on investment.[38] Finally, we identified moderate evidence that, to address smoking cessation in the workplace, brief (ie, <10 min) counselling is cost-saving and cost-effective. Although one study found a return on investment of \$2·92 (95% CI 0·84–8·12) after 1 year for every dollar spent,[35] another study noted a return on investment of \$1·19 (no CIs were reported) per female employee and \$5·08 (no CIs were reported) per male employee over 10 years.[19] We found limited evidence for other interventions related to smoking cessation.

For alcohol, we identified limited evidence that prevention and treatment programmes for alcohol use[39] are cost-saving and cost-effective to address alcohol problems in workers.

	General information		Intervention details (study design, description of intervention, comparator,* and type of intervention†)	Economic analysis		Outcomes and key findings		
	QHES score	Setting or industry, firm size,‡ and study population		Perspective	Type of economic analysis	Effect on mental health or substance use disorder	Work-related outcome and effect	Economic or financial outcome or effect
Smoking								
Halpern et al (2007)[28]	84·0	Hypothetical cohort of employees with default population characteristics representing the US population at large, all derived from various national-level sources (n=10 000); multiple settings; firm size not reported	Modelling study looking at provision of benefit coverage of prescription smoking cessation aids (varenicline, bupropion, and nicotine replacement patch; tertiary) compared with no cessation benefit coverage	Employer and health care	Analysis of return on investment	Number of additional cessations with coverage at 10 years was 324·5	Targeted outcome was absenteeism (not measured)	Combined health and workplace savings per person who smokes were between $200·00 ($257·16) and $300·00 ($385·74) at 5 years, $722·00 ($928·35) and $960·00 ($1234·38) by 10 years, and $1748·00 ($2247·59) to >$2300·00 ($2957·34) by 20 years; over the 20 year period, total savings were projected to range from approximately $2·7 million ($3·5 million; education or health) to almost $7·4 million ($9·5 million; wholesale or retail); ROI at year 10 ranged from 194% to 254%; IRR at 10 years ranged from 39·0% to 60·0%; by 20 years, the IRR considering just health-care costs ranged from 5·5% to 12·1%, whereas the IRR for both health-care and workplace costs ranged from 43·0% to 61·0%
Halpern et al (2007)[38]	77·5	Hypothetical cohorts of people who smoke in the US belonging to a private health plan (n=1000), a state Medicaid plan (n=1000), or an employee group (n=1000); setting and firm size not reported	Modelling study looking at provision of smoking cessation aids (varenicline, bupropion, or NRT; tertiary) compared with no aid	Not reported	Analysis of return on investment	Cessation rates were assumed from the literature; at 10 years rates were 20·0% for varenicline, 17·5% for buproprion, 16·0% for NRT, and 14·0% for no aids	Targeted outcomes were productivity and absenteeism (not measured)	Varenicline resulted in the greatest cost savings; At 10 years, varenicline compared with NRT has IRR of 371·0 and ROI of 34·0, and compared with no aid had IRR of 199·0 and ROI of 16·7; bupropion was dominated by varenicline, hence no ROI reported (CIs not reported)
Jackson et al (2007)[49]	77·5	1025 healthy people who smoke (≥10 cigarettes per day) in the USA aged 18–75 years with <3 months of smoking abstinence in the past year, who were recruited via advertising; participant information used from an RCT published in another study (Gonzales et al, 2006);[75] setting and firm size not reported	Modelling study comparing provision of smoking cessation drugs (varenicline [n=352] or bupropion [n=329]) with placebo (n=344); tertiary intervention	Employer	Cost–benefit analysis	At 12 month follow-up, quit rates were 21·9% for varenicline, 16·1% for bupropion (generic), 16·1% for bupropion (brand), and 8·4% for placebo	The total cost savings at 12 months to the employer per employee who quit smoking was $5390·00 ($6713·75; including savings from reduced absenteeism and presenteeism less the cost of medical care and insurance)	At 12 month follow-up, net benefits per employee for each comparator were $540·60 ($750·56) for varenicline, $269·70 ($335·94) for bupropion (generic), $150·80 ($187·84) for bupropion (brand), and $81·80 ($101·89) for placebo

(Table 2 continues on next page)

	General information		Intervention details (study design, description of intervention, comparator,* and type of intervention†)	Economic analysis		Outcomes and key findings		
	QHES score	Setting or industry, firm size,‡ and study population		Perspective	Type of economic analysis	Effect on mental health or substance use disorder	Work-related outcome and effect	Economic or financial outcome or effect
(Continued from previous page)								
Javitz et al (2004)[35]	81·5	Members of a large health maintenance organisation in Seattle, WA, USA (n=1524); setting and firm size not reported	RCT comparing various doses of bupropion in combination with either access to a cessation specialist or tailored mailing (tertiary); participants were assigned to 150 mg (n=382) or 300 mg (n=383) bupropion once every day and proactive telephone calls, or to 150 mg (n=381) or 300 mg (n=378) bupropion once every day and tailored mailing§	Employer	Analysis of return on investment	At 12 month follow-up, cessation rates were 31·4% for 150 mg and proactive telephone calls, 33·2% for 300 mg and proactive telephone calls, 23·6% for 150 mg and tailored mailing, and 25·7% for 300 mg and tailored mailing	Targeted outcome was productivity (not measured)	Employer benefit per successful quitter was $3745·00 (95% CI 2884–5768; $5228·06, 95% CI 4026·40–8052·02); net benefits to the employer per enrollee for each intervention were $569·00 ($749·17) for 150 mg and proactive telephone calls, $548·00 ($764·84) for 300 mg and proactive telephone calls, $353·00 ($493·17) for 150 mg and tailored mailing, and $343·00 ($478·51) for 300 mg and tailored mailing; proactive telephone calls had a higher net benefit than tailored mailing with insignificant differences across dosing groups; ROI was 292·0 and IRR was 31·4 for 150 mg and proactive telephone calls, ROI was 194·0 and IRR was 24·1 for 300 mg and proactive telephone calls, ROI was 297·0 and IRR was 31·7 for 150 mg and tailored mailing, and ROI was 166·0 and IRR was 21·6 for 300 mg and tailored mailing
Nielsen and Fiore (2000)[29]	83·5	Participant information used from an RCT published in another study (Jorenby et al, 1999);[76] 893 generally healthy people who smoked (≥15 cigarettes per day) who were aged ≥18 years, motivated to quit smoking, weighed at least 45·4 kg, and could speak English; setting and firm size not reported	Modelling study comparing provision of smoking cessation aids (bupropion [n=244], NRT [n=244], or combination [n=245]; tertiary) with placebo (n=160)	Employer	Cost–benefit analysis	At 12 month follow-up, the quit rates were 30·3% (95% CI 24·6–36·5) for bupropion, 16·4% (95% CI 12·0–21·6) for NRT only, 35·5% (95% CI 29·5–41·9) for combination, and 15·6% (95% CI 10·4–22·2) for placebo	Targeted outcomes were productivity and absenteeism (not measured)	Employer benefit per successful quitter was $1654·00 ($2547·66); at 12 month follow-up, net benefits for each comparator per quitter were $338·16 ($520·92) for bupropion only, $26·26 ($41·99) for NRT only, $178·17 ($274·45) for combination, and $258·02 ($397·47) for placebo

(Table 2 continues on next page)

	General information		Intervention details (study design, description of intervention, comparator,* and type of intervention†)	Economic analysis		Outcomes and key findings		
	QHES score	Setting or industry, firm size,‡ and study population		Perspective	Type of economic analysis	Effect on mental health or substance use disorder	Work-related outcome and effect	Economic or financial outcome or effect
(Continued from previous page)								
Weng (2013)[19]	93·0	Hypothetical cohort of UK female (n=1000) and male (n=1000) people who currently smoke in the workplace who are aged ≥35 years, moving through transition states until retirement (aged 65 years); multiple settings were included; firm size not reported	Modelling study looking at brief advice, individual counselling with an occupational nurse, and NRT and individual counselling with occupational nurse (tertiary), compared with no intervention and against each other¶	Employer	Analysis of return on investment and cost-effectiveness analysis	After 30 years, quit rates were (men/women) 8·0%/9·8% for no aid, 21·4%/24·5% for brief advice, 24·3%/28·8% for individual counselling, and 26·0%/30·6% for NRT with counselling	On average, people who currently smoke miss 12·53 work days per year (mean) compared with only 9·79 days missed by people who used to smoke or people who have never smoked; this translates into a 6-month forgone production cost of £612·57 ($961·62) for men and £469·71 ($737·35) for women who smoke, compared with £478·71 ($751·49) and £366·99 ($576·11) for people who used to smoke and people who have never smoked	ROI for each comparator was (men/women) 5·08/1·19 for brief advice, 1·00/–0·28 for individual counselling, and –0·02/–0·65 for NRT with counselling; ICER (cost per quitter) for each comparator was (men/women) brief advice: –£2859·75/–£678·12 (–$4489·26/–$1064·52), £3623·66/£4298·60 ($5688·45/$6747·97) for individual counselling, and £17 457·81/£19 837·79 ($27 405·41/$31 141·52) for NRT and counselling; most cost-effective strategy is dependent on budget constraints; each strategy can be most cost-effective under particular conditions; brief advice if the budget constraint was £4872·00 ($7648·11) per male employee and £2197·00 ($3448·87) per female employee; individual counselling if the budget constraint was £4977·00 ($7812·94) per male employee and £2381·00 ($3737·72) per female employee; NRT and individual counselling if the budget constraint was £5259·00 ($8255·62) per male employee and £2743·00 ($4305·98) per female employee
Alcohol								
Quanbeck et al (2010)[39]	77·5	Based on alcohol use screening data for 19 372 patients from clinics within 100 miles of Madison, WI, USA; setting and firm size not reported	Simulation model comparing before and after screening for problem drinking, followed by consultations if positive (tertiary)	Employer	Cost–benefit analysis	The assumption of 57% effectiveness of the intervention in eliminating problem drinking in employees was derived from a previous study that assessed the societal perspective of the economic impact of the programme[27]	Reduction in absenteeism produced savings of $175·00 ($201·44) and reduction in presenteeism produced savings of $823·00 ($947·75) per employee	By subtracting costs for implementing the intervention from benefits in productivity gains, net present value was $771·00 ($887·55) per employee; benefit–cost ratio was 4·4:1·0 ($997·00:$227·00 [$1147·64:$261·63]; CIs not reported)

All currencies (including dollars) are given with the 2018 US$ value immediately after for ease of comparison. ICER=incremental cost-effectiveness ratio. IRR=internal rate of return. NRT=nicotine replacement therapy. PTSD=post-traumatic stress disorder. QHES=Quality of Health Economic Studies. RCT=randomised controlled trial. ROI=return on investment. *Placebo applies only to drug interventions. ‡Small (1–99 employees); medium (100–499 employees); large (>500 employees). †Primary intervention (prevention before an illness occurs); secondary intervention (reduce the impact of an illness that has already occurred); tertiary intervention (lessen the impact of an ongoing illness with lasting effects). §The economic measures of each combination were assessed and compared against each other. There was no control. ¶The interventions were not directly compared against each other: instead, the author assessed which intervention produced the greatest economic benefits when compared with no intervention.

Table 2: **Details of substance use studies that were high quality**

Discussion

The goal of this Review was to provide a comprehensive list of the highest yielding and most cost-effective mental health and substance use interventions in the workplace. We identified 56 relevant studies, less than half of which were considered high quality. Our Review suggests that workplace interventions to prevent or treat depression are cost-saving (although not always cost-effective), interventions to address sick leave related to mental health and encourage return to work are both cost-saving and cost-effective, and pharmacotherapy and counselling for smoking cessation in the workplace provide cost savings and are cost-effective.

Our findings are in line with other reviews. Hamberg-van Reenen and colleagues[3] found a few relevant studies, most of which were of poor quality. They noted that worksite interventions that prevented or treated mental health problems might be cost-effective, whereas interventions promoting return to work, which included a full economic evaluation aimed at employees with depression, did not seem to be cost-effective. We noted that interventions with CBT aimed at employees with depression are cost-saving but not always cost-effective, whereas regular and active involvement of occupational health professionals in interventions related to mental health that promote return to work is both cost-saving and cost-effective. Subsequently, Nogues and colleagues[7] provided an update on Hamberg-van Reenen and colleagues' review,[3] and critically appraised the literature on the potential barriers to workers participating in such interventions, such as stigma related to mental illness and disclosure in the workplace. Nogues and colleagues[7] showed that investing in workplace mental health treatment and tertiary prevention interventions tends to yield a positive return on investment for employers of 1000 employees or more, in short time horizons, and with employees' participation rates less than 50%. However, Nogues and colleagues[7] did not find any studies that included an economic evaluation of workplace interventions with a focus on workplace accommodation or stigma. We also noted that investing in workplace mental health treatment and tertiary prevention interventions provides a positive return on investment and identified no studies with a focus on stigma.

There have also been reviews on economic evaluations of workplace polices for smoking cessation.[78,79] A rapid review showed that, from the employer's perspective, bupropion is a cost-beneficial (ie, the health benefits outweigh the financial costs) intervention for smoking cessation, regardless of whether counselling was provided.[78] Moreover, this rapid review found that both nicotine replacement therapy, and a smoking cessation consultation with a pharmacist and patient participation in a formal smoking cessation programme provided the greatest net benefit for employers. Our Review supports

	QHES score	Evidence
Depression		
CBT alone		
Evans-Lacko et al (2016)[20]	91·5	Moderate evidence that CBT alone is cost-saving to treat depression in the workplace, but limited evidence that it is cost-effective
Geraedts et al (2015)[25]	85·0	Moderate evidence that CBT alone is cost-saving to treat depression in the workplace, but limited evidence that it is cost-effective
CBT in combination with care management*		
Goorden et al (2014)[37]	80·0	Moderate evidence that this combination is cost-saving to treat depression in the workplace, but limited evidence that it is cost-effective
Lo Sasso et al (2006)[26]	84·5	Moderate evidence that this combination is cost-saving to treat depression in the workplace, but limited evidence that it is cost-effective
CBT in combination with pharmacotherapy		
Evans-Lacko et al (2016)[20]	91·5	Limited evidence that this combination is cost-saving to treat depression in the workplace
Care management alone		
Wang et al (2006)[18]	93·5	Limited evidence that care management alone is both cost-saving and cost-effective to treat depression in the workplace
Pharmacotherapy alone		
Evans-Lacko et al (2016)[20]	91·5	Limited evidence that pharmacotherapy alone is cost-saving to treat depression in the workplace
Multiple mental health disorders (primary and secondary interventions)		
Sickness absenteeism prevention programmes		
Hengel et al (2014)[31]	82·0	Limited evidence that programmes aimed at preventing sickness absenteeism (eg, by educating employees on the importance of rest breaks and self-empowerment) are both cost-saving and cost-effective to improve mental health in construction workers
Prevention and amelioration programmes		
Noben et al (2014)[24]	85·0	Limited evidence† that prevention and amelioration programmes (eg, involving mental health screening, personalised feedback, and consultation with an occupational physician) are both cost-saving and cost-effective to reduce productivity losses due to poor mental health and risky drinking in nurses
Noben et al (2015)[41]	77·0	Limited evidence† that prevention and amelioration programmes (eg, involving mental health screening, personalised feedback, and consultation with an occupational physician) are both cost-saving and cost-effective to reduce productivity losses due to poor mental health and risky drinking in nurses
Stepped psychosocial treatment in combination with routine monitoring		
Lavelle et al (2018)[23]	86·0	Limited evidence that this treatment and monitoring is both cost-saving and cost-effective to address PTSD and depression among military members
Internet-based stress management interventions		
Ebert et al (2016)[30]	82·5	Limited evidence that interventions are both cost-saving and cost-effective to manage stress among employees at a health insurance firm
Multiple mental health disorders (tertiary interventions—ie, return to work)		
Regular, active involvement of occupational health professionals (physicians and nurses)‡		
Lokman et al (2017)[27]	84·0	Strong evidence that involvement of occupational health professionals throughout the intervention is both cost-saving and cost-effective to reduce mental health-related sick leave and encourage return to work
Rebergen et al (2009)[21]	88·0	Strong evidence that involvement of occupational health professionals throughout the intervention is both cost-saving and cost-effective to reduce mental health-related sick leave and encourage return to work

(Table 3 continues on next page)

	QHES score	Evidence
(Continued from previous page)		
Taimela et al (2007)[36]	80·0	Strong evidence that involvement of occupational health professionals throughout the intervention is both cost-saving and cost-effective to reduce mental health-related sick leave and encourage return to work
Structured occupational physician guidance after returning to work		
Arends et al (2013)[34]	81·5	Limited evidence that this guidance is not cost-effective to reduce recurrent mental health-related sickness absence
Stepwise intervention in addition to the standard guideline-based care		
van Oostrom et al (2010)[22]	87·0	Limited evidence that this intervention and care combination is not cost-effective to reduce mental health-related sick leave
Collaborative care approach involving a psychotherapist and a primary care physician		
Dewa et al (2009)[33] and Dewa and Hoch (2014)[32]§	82·0	Limited evidence that a collaborative care approach is cost-effective to reduce mental health-related sick leave among employees
Smoking		
Brief counselling		
Javitz et al (2004)[35]	81·5	Moderate evidence that brief counselling is both cost-saving and cost-effective to reduce smoking in the workplace
Weng (2013)[19]	93·0	Moderate evidence that brief counselling is both cost-saving and cost-effective to reduce smoking in the workplace
Varenicline *vs* bupropion¶		
Halpern et al (2007)[28]	84·0	Moderate evidence that varenicline is more cost-saving and cost-effective to reduce smoking compared with bupropion
Jackson et al (2007)[40]	77·5	Moderate evidence that varenicline is more cost-saving and cost-effective to reduce smoking compared with bupropion
Bupropion *vs* nicotine replacement therapy		
Halpern et al (2007)[28]	84·0	Moderate evidence that bupropion is more cost-saving and cost-effective to reduce smoking compared with nicotine replacement therapy
Nielsen and Fiore (2000)[29]	83·5	Moderate evidence that bupropion is more cost-saving and cost-effective to reduce smoking compared with nicotine replacement therapy
Low dose *vs* high dose of bupropion		
Javitz et al (2004)[35]	81·5	Limited evidence that providing lower doses is more cost-saving and cost-effective to reduce smoking in the workplace compared with higher doses
Benefit coverage of smoking cessation pharmacotherapy		
Halpern et al (2007)[38]	77·5	Limited evidence that providing employee coverage for smoking cessation pharmacotherapy is more cost-saving and cost-effective to reduce smoking compared with not providing coverage
Alcohol		
Prevention and treatment programmes		
Quanbeck et al (2010)[39]	77·5	Limited evidence that these programmes (such as screening, brief intervention, and referral to treatment programme) are both cost-saving and cost-effective to address alcohol problems in the workplace

QHES=Quality of Health Economic Studies. CBT=cognitive behavioural therapy. *Increased coordination, regular follow up, and management of the patient's care plan. †Noben et al (2015)[41] used the same data as Noben et al (2014)[24] but evaluated the same intervention from a different perspective and with a different comparator. The comparator data were drawn from Noben et al (2014)[24] as well. As a result, evidence is limited despite use of results from two studies. ‡One of the three papers did not report sufficient data to calculate the return on investment. Instead, it reported a cost-saving of approximately $36·62–$55·96 per 1 day reduction in sickness absence (no confidence intervals reported). §Two articles were considered one study as they assessed the same intervention. ¶Bupropion and varenicline are drugs used to support smoking cessation and treat nicotine addiction.

Table 3: **Summary of the evidence for treatment by disorder**

these findings. We also found that varenicline was a cost-effective option for smoking cessation, in line with other work.[80]

All studies were done in high-income countries, in particular in the USA and the Netherlands. Community access to routine mental health and substance misuse interventions varies across countries. For example, in some countries, such as the UK, CBT is readily available through programmes funded by the government, which might help to decrease the need for workplace CBT programmes for depression. However, in jurisdictions where CBT is not provided by the public health care system or those without universal health coverage, there might still be some advantages in providing access to CBT via the workplace. Moreover, alongside the implementation of workplace interventions, it is important that internal organisational changes occur to ensure workplace mental health initiatives are successful. Most studies examined in this Review did not describe any organisational change that occurred internally to facilitate the success of initiatives. However, other work has suggested that senior and midlevel management should be actively involved to foster a sense of comfort among employees in bringing forward their mental health concerns;[81–84] managers need training in recognising and providing support for staff with mental health concerns;[85–88] companies need to identify specific organisational needs and goals before taking on new policies;[82,89] and workplace cultures need to respect employees' mental health and wellbeing.[90,91] We did not find any studies that examined the return on investment or cost-effectiveness related to these changes. Finally, it is important to ensure that there are policies in place that address workplace bullying, as bullying could increase the risk of depression, anxiety, or substance misuse in workers, and could override the effectiveness of well-intentioned workplace initiatives.

This Review focused only on interventions delivered in the workplace. Some initiatives have also been rolled out at the jurisdiction level (ie, state-wide). For example, one study examined the effect of a policy preventing smoking in the workplace across Minnesota state, USA, and showed that this kind of policy was more cost-effective than free nicotine replacement therapy programmes.[92] Another study examined the effect of a suicide prevention strategy on the economic cost of suicide in the construction industry in New South Wales state, Australia.[93] The authors estimated that the strategy would result in 0·40 fewer deaths by suicide, 5·93 fewer episodes of self-harm per year, and annual cost savings of approximately AUS$3·66 million.

Despite a comprehensive search of the literature, we did not find any studies that examined other mental health or substance use disorders in the workplace, such as self-harm or suicidal ideation, problem gambling, opioids, and cannabis. Opioids and cannabis are likely to

gain importance in the workplace given the current opioid misuse epidemic in many high-income countries and the legalisation of cannabis in Canada, Uruguay, and some states in the USA.

Generally, most studies included the CHEERS checklist items. However, there were a few items on the QHES checklist that most studies did not provide, such as the inclusion of subgroup analyses; the discussion around potential bias in data sources and analysis; and the inclusion of statistical or sensitivity analyses, or both, and discussion around uncertainty, or where the analysis could be improved, such as the choice of follow-up time to account for the various costs and outcomes (few studies looked beyond 1 year) and the use of an appropriate discount rate. Moreover, many studies estimated only return on investment; although this measure tends to be preferred by employers, it does not account for many aspects of health consequences.[93] The incremental cost-effectiveness ratio addresses this limitation and thus is preferred.[94] Overall, most studies adopted the employer perspective, which is in line with the recommended approach when doing economic evaluations of workplace interventions.[93]

This Review is not without limitations. Given the heterogeneous nature of the studies, it was challenging to synthesise the literature, namely by firm size, industry or setting, or country. To assess the quality of the studies, we used the CHEERS and QHES checklists. Although both have been used in previous systematic reviews, these checklists have disadvantages. For example, the CHEERS checklist provides equal weighting for all items (which led to the use of a second checklist),[8] whereas the application of the QHES checklist requires some interpretation by researchers.[11] Moreover, although the cutoff scores to categorise studies were based on previous work, other definitions might be possible, which could have changed our findings. Finally, we cannot guarantee that some relevant studies were not missed, namely studies from the grey literature. Nonetheless, our study included a longer time frame and a more comprehensive search strategy than previous reviews; we considered literature published in other languages besides English, we searched many academic and grey literature databases, and we explored other potentially relevant sources of information, such as websites and content experts.

These findings will be of value to employers, policy makers in the workplace and health fields, and other interested stakeholders looking for solutions to address mental health or substance misuse in the workplace. This work will also be relevant to researchers doing economic evaluations of workplace interventions focusing on mental health or substance misuse, or both. Despite various high-quality studies, there are still areas that would benefit from improvement, such as the consideration of subgroup analyses, examination of longer follow-up times to account for costs and outcomes, inclusion of statistical and sensitivity analyses and discussion around uncertainty, and consideration of potential for bias in data sources and analyses. Moreover, future work should seek to understand the risk factors associated with poor mental health in the workplace, such as stigma and workplace bullying, and the organisational change required to implement successful workplace interventions, such as endorsement and support from senior and midlevel management.

Contributors

CdO and JR conceived and designed the study. CdO drafted the original protocol. EC and BB selected the articles and EC, RAK, MJ, and BB assessed quality and extracted the data. CdO wrote the first draft. All authors provided comments and revisions on drafts of the Review.

Declaration of interests

We declare no competing interests.

Data sharing

We are happy to share all data collected for this Review, including data extraction tables. These data will be available from the publication date. Please contact the corresponding author if you would like to see any data that are not included in the Review or appendix.

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References

1 WHO. Global health estimates 2016: disease burden by cause, age, sex, by country and by region, 2000–2016. Geneva: World Health Organization, 2018. https://www.who.int/healthinfo/global_burden_disease/estimates/en/index1.html (accessed Aug 15, 2019).

2 Bloom DE, Cafiero ET, Jané-Llopis E, et al. The global economic burden of noncommunicable diseases. Geneva: World Economic Forum, 2011.

3 Hamberg-van Reenen HH, Proper KI, van den Berg M. Worksite mental health interventions: a systematic review of economic evaluations. *Occup Environ Med* 2012; **69:** 837–45.

4 Mental Health Commission of Canada. Why investing in mental health will contribute to Canada's economic prosperity and to the sustainability of our health care system. Ottawa: Mental Health Commission of Canada, 2014. https://www.mentalhealthcommission.ca/English/media/3104 (accessed Aug 15, 2019).

5 Roberts G, Grimes K. Return on investment—mental health promotion and mental illness prevention. London: University of Western Ontario, Mar 31, 2011. https://cpa.ca/docs/File/Practice/roi_mental_health_report_en.pdf (accessed Aug 15, 2019).

6 Evans-Lacko S, Knapp M. Global patterns of workplace productivity for people with depression: absenteeism and presenteeism costs across eight diverse countries. *Soc Psychiatry Psychiatr Epidemiol* 2016; **51:** 1525–37.

7 Nogues S, Finucan J. Economic evaluations of workplace mental health interventions: a critical review. *Can J Adm Sci* 2018; **35:** 551–62.

8 Husereau D, Drummond M, Petrou S, et al. Consolidated health economic evaluation reporting standards (CHEERS) statement. *BMJ* 2013; **346:** f1049.

9 Ofman JJ, Sullivan SD, Neumann PJ, et al. Examining the value and quality of health economic analyses: implications of utilizing the QHES. *J Manag Care Pharm* 2003; **9:** 53–61.

10 Au F, Prahardhi S, Shiell A. Reliability of two instruments for critical assessment of economic evaluations. *Value Health* 2008; **11:** 435–39.

11 Watts RD, Li IW. Use of checklists in reviews of health economic evaluations, 2010 to 2018. *Value Health* 2019; **22:** 377–82.

12 Yong YV, Shafie AA. Economic evaluation of enhanced asthma management: a systematic review. *Pharm Pract (Granada)* 2014; **12:** 493.

13 Spiegel BM, Targownik LE, Kanwal F, et al. The quality of published health economic analyses in digestive diseases: a systematic review and quantitative appraisal. *Gastroenterol* 2004; **127:** 403–11.

14 Slavin RE. Best-evidence synthesis: an alternative to meta-analytic and traditional reviews. *Educ Res* 1986; **15:** 5–11.

15 Slavin RE. Best evidence synthesis: an intelligent alternative to meta-analysis. *J Clin Epidemiol* 1995; **48:** 9–18.

16 Tompa E, Dolinschi R, de Oliveira C, Irvin E. A systematic review of occupational health and safety interventions with economic analyses. *J Occup Environ Med* 2009; **51:** 1004–23.

17 Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 2009; **6:** e1000097.

18 Wang PS, Patrick A, Avorn J, et al. The costs and benefits of enhanced depression care to employers. *Arch Gen Psychiatry* 2006; **63:** 1345–53.

19 Weng SF. The health and economic costs of smoking in the workforce. PhD thesis, University of Nottingham, 2013. https://eprints.nottingham.ac.uk/27653 (accessed Aug 12, 2019).

20 Evans-Lacko S, Koeser L, Knapp M, Longhitano C, Zohar J, Kuhn K. Evaluating the economic impact of screening and treatment for depression in the workplace. *Eur Neuropsychopharmacol* 2016; **26:** 1004–13.

21 Rebergen DS, Bruinvels DJ, van Tulder MW, van der Beek AJ, van Mechelen W. Cost-effectiveness of guideline-based care for workers with mental health problems. *J Occup Environ Med* 2009; **51:** 313–22.

22 van Oostrom SH, Heymans MW, de Vet HC, van Tulder MW, van Mechelen W, Anema JR. Economic evaluation of a workplace intervention for sick-listed employees with distress. *Occup Environ Med* 2010; **67:** 603–10.

23 Lavelle TA, Kommareddi M, Jaycox LH, Belsher B, Freed MC, Engel CC. Cost-effectiveness of collaborative care for depression and PTSD in military personnel. *Am J Manag Care* 2018; **24:** 91–98.

24 Noben C, Smit F, Nieuwenhuijsen K, et al. Comparative cost-effectiveness of two interventions to promote work functioning by targeting mental health complaints among nurses: pragmatic cluster randomised trial. *Int J Nurs Stud* 2014; **51:** 1321–31.

25 Geraedts AS, van Dongen JM, Kleiboer AM, et al. Economic evaluation of a web-based guided self-help intervention for employees with depressive symptoms: results of a randomized controlled trial. *J Occup Environ Med* 2015; **57:** 666–75.

26 Lo Sasso AT, Rost K, Beck A. Modeling the impact of enhanced depression treatment on workplace functioning and costs: a cost-benefit approach. *Med Care* 2006; **44:** 352–58.

27 Lokman S, Volker D, Zijlstra-Vlasveld MC, et al. Return-to-work intervention versus usual care for sick-listed employees: health-economic investment appraisal alongside a cluster randomised trial. *BMJ Open* 2017; **7:** e016348.

28 Halpern MT, Dirani R, Schmier JK. Impacts of a smoking cessation benefit among employed populations. *J Occup Environ Med* 2007; **49:** 11–21.

29 Nielsen K, Fiore MC. Cost-benefit analysis of sustained-release bupropion, nicotine patch, or both for smoking cessation. *Prev Med* 2000; **30:** 209–16.

30 Ebert DD, Kahlke F, Buntrock C, et al. A health economic outcome evaluation of an internet-based mobile-supported stress management intervention for employees. *Scand J Work Environ Health* 2018; **44:** 171–82.

31 Hengel KMO, Bosmans JE, Van Dongen JM, Bongers PM, Van der Beek AJ, Blatter BM. Prevention program at construction worksites aimed at improving health and work ability is cost-saving to the employer: results from an RCT. *Am J Ind Med* 2014; **57:** 56–68.

32 Dewa CS, Hoch JS. Estimating the net benefit of a specialized return-to-work program for workers on short-term disability related to a mental disorder: an example exploring investment in collaborative care. *J Occup Environ Med* 2014; **56:** 628–31.

33 Dewa CS, Hoch JS, Carmen G, Guscott R, Anderson C. Cost, effectiveness, and cost-effectiveness of a collaborative mental health care program for people receiving short-term disability benefits for psychiatric disorders. *Can J Psychiatry* 2009; **54:** 379–88.

34 Arends I, Bultmann U, van Rhenen W, Groen H, van der Klink JJ. Economic evaluation of a problem solving intervention to prevent recurrent sickness absence in workers with common mental disorders. *PLoS One* 2013; **8:** e71937.

35 Javitz HS, Swan GE, Zbikowski SM, et al. Return on investment of different combinations of bupropion SR dose and behavioral treatment for smoking cessation in a health care setting: an employer's perspective. *Value Health* 2004; **7:** 535–43.

36 Taimela S, Justen S, Aronen P, et al. An occupational health intervention programme for workers at high risk for sickness absence. Cost effectiveness analysis based on a randomised controlled trial. *Occup Environ Med* 2008; **65:** 242–48.

37 Goorden M, Vlasveld MC, Anema JR, et al. Cost-utility analysis of a collaborative care intervention for major depressive disorder in an occupational healthcare setting. *J Occup Rehabil* 2014; **24:** 555–62.

38 Halpern MT, Dirani R, Schmier JK. The cost effectiveness of varenicline for smoking cessation. *Manag Care Interface* 2007; **20:** 18–25.

39 Quanbeck A, Lang K, Enami K, Brown RL. A cost-benefit analysis of Wisconsin's screening, brief intervention, and referral to treatment program: adding the employer's perspective. *WMJ* 2010; **109:** 9–14.

40 Jackson KC, Nahoopii R, Said Q, Dirani R, Brixner D. An employer-based cost-benefit analysis of a novel pharmacotherapy agent for smoking cessation. *J Occup Environ Med* 2007; **49:** 453–60.

41 Noben C, Evers S, Nieuwenhuijsen K, et al. Protecting and promoting mental health of nurses in the hospital setting: is it cost-effective from an employer's perspective? *Int J Occup Med Environ Health* 2015; **28:** 891–900.

42 Yu S, Glozier N. Mentally healthy workplaces in NSW: a return-on-investment study. Sydney: SafeWork NSW, Oct 19, 2017. https://www.safework.nsw.gov.au/__data/assets/pdf_file/0011/320132/Mentally-healthy-workplaces-A-return-on-investment-study-August-2017-SW08735.pdf (accessed Aug 12, 2019).

43 Hitt D, Tahir T, Davies L, et al. Economic assessment of a workplace cognitive behaviour therapy service. *Ment Health Pract* 2016; **19:** 25–31.

44 Phillips R, Schneider J, Molosankwe I, et al. Randomized controlled trial of computerized cognitive behavioural therapy for depressive symptoms: effectiveness and costs of a workplace intervention. *Psychol Med* 2014; **44:** 741–52.

45 Boyd R, Hunt A, Ortiz R. An economic analysis of workplace interventions that promote mental wellbeing in the workplace. London: The National Institute for Health and Care Excellence, 2007. https://www.nice.org.uk/guidance/ph22/evidence/economic-analysis-of-workplace-interventions-that-promote-mental-wellbeing-in-the-workplace-67280509 (accessed Aug 12, 2019).

46 Miller TR, Zaloshnja E, Spicer RS. Effectiveness and benefit-cost of peer-based workplace substance abuse prevention coupled with random testing. *Accid Anal Prev* 2007; **39:** 565–73.

47 Callander EJ, Lindsay DB, Scuffham PA. Employer benefits from an early intervention program for depression: a cost-benefit analysis. *J Occup Environ Med* 2017; **59:** 246–49.

48 Matrix Insight. Economic analysis of workplace mental health promotion and mental disorder prevention programmes and of their potential contribution to EU health, social and economic policy objectives. Nov 1, 2012. http://www.mentalhealthpromotion.net/?i=portal.en.enmhp-news.2900 (accessed Aug 12, 2019).

49 Henke RM, Head MA, Kent KB, Goetzel RZ, Roemer EC, McCleary K. Improvements in an organization's culture of health reduces workers' health risk profile and health care utilization. *J Occup Environ Med* 2019; **61:** 96–101.

50 Lerner D, Adler D, Hermann RC, et al. Impact of a work-focused intervention on the productivity and symptoms of employees with depression. *J Occup Environ Med* 2012; **54:** 128–35.

51 Milligan-Saville JS, Tan L, Gayed A, et al. Workplace mental health training for managers and its effect on sick leave in employees: a cluster randomised controlled trial. *Lancet Psychiatry* 2017; **4:** 850–58.

52 Mehay S, Webb NJ. Workplace drug prevention programs: does zero tolerance work? *Appl Econ* 2007; **39:** 2743–51.

53 Iijima S, Yokoyama K, Kitamura F, Fukuda T, Inaba R. Cost-benefit analysis of comprehensive mental health prevention programs in Japanese workplaces: a pilot study. *Ind Health* 2013; **51:** 627–33.

54 Lerner D, Adler DA, Rogers WH, et al. A randomized clinical trial of a telephone depression intervention to reduce employee presenteeism and absenteeism. *Psychiatr Serv* 2015; **66:** 570–77.

55 KPMG. Investing to save: the economic benefits for Australia of investment in mental health reform. Canberra: Mental Health Australia, May 2018. https://mhaustralia.org/publication/investing-save-kpmg-and-mental-health-australia-report-may-2018 (accessed Aug 12, 2019).

56 Birnbaum HG, Cremieux PY, Greenberg PE. Management of major depression in the workplace: impact on employee work loss. *Dis Manag Health Outcomes* 2000; **7:** 163–71.

57 Hargrave GE, Hiatt D. The EAP treatment of depressed employees: implications for return on investment. *J Workplace Behav Health* 2005; **19:** 39–49.

58 McCraty R, Atkinson M, Lipsenthal L, Arguelles L. New hope for correctional officers: an innovative program for reducing stress and health risks. *Appl Psychophysiol Biofeedback* 2009; **34:** 251–72.

59 PwC. Creating a mentally healthy workplace-return on investment analysis. Sydney: Australian Government National Mental Health Commission,. March, 2014. https://www.headsup.org.au/docs/default-source/resources/beyondblue_workplaceroi_finalreport_may-2014.pdf (accessed Aug 12, 2019).

60 Osilla KC, dela Cruz E, Miles JN, et al. Exploring productivity outcomes from a brief intervention for at-risk drinking in an employee assistance program. *Addict Behav* 2010; **35:** 194–200.

61 Bittman B, Bruhn KT, Stevens C, Westengard J, Umbach PO. Recreational music-making: a cost-effective group interdisciplinary strategy for reducing burnout and improving mood states in long-term care workers. *Adv Mind Body Med* 2003; **19:** 4–15.

62 Makrides L, Smith S, Allt J, et al. The healthy lifeworks project: a pilot study of the economic analysis of a comprehensive workplace wellness program in a Canadian government department. *J Occup Environ Med* 2011; **53:** 799–805.

63 Vogt J, Leonhardt J, Pennig S. Critical incident stress management in air traffic control and its benefits. *Air Traffic Control Q* 2007; **15:** 127–56.

64 Goetzel RZ, Tabrizi M, Henke RM, et al. Estimating the return on investment from a health risk management program offered to small Colorado-based employers. *J Occup Environ Med* 2014; **56:** 554–60.

65 Musich S, McCalister T, Wang S, Hawkins K. An evaluation of the Well at Dell health management program: health risk change and financial return on investment. *Am J Health Promot* 2015; **29:** 147–57.

66 Jerdén L, Lindholm L, Weinehall L. Cost-effectiveness of a personal health document in different distribution settings. *Health Promot J Aust* 2008; **19:** 125–31.

67 Knapp M, McDaid D, Parsonage M. Mental health promotion and mental illness prevention: the economic case. London: Department of Health, 2011. https://eprints.lse.ac.uk/39300/1/Mental_health_promotion_and_mental_illness_prevention%28author%29.pdf (accessed Aug 22, 2019).

68 Bedell W, Kaszkin-Bettag M. Coherence and health care cost-RCA actuarial study: a cost-effectiveness cohort study. *Altern Ther Health Med* 2010; **16:** 26–31.

69 Vaananen-Tomppo I, Janatuinen E, Tornqvist R. All well at work? Evaluation of workplace-based early rehabilitation in the Finnish State administration. *Int J Rehabil Res* 2001; **24:** 171–80.

70 Morneau Shepell. EAP improves health status and productivity, and demonstrates a positive ROI. Toronto: Morneau Shepell, 2011. https://www.shepellfgi.com/pdf/Report_Impact_on_Health_and_Prod_EN.PDF (accessed Aug 22, 2019).

71 Halpern DF. How time-flexible work policies can reduce stress, improve health, and save money. *Stress Health* 2005; **21:** 157–68.

72 McDaid D, Park Al, Knapp M. Commissioning cost-effective services for promotion of mental health and wellbeing and prevention of mental ill-health. London: Public Health England, 2017. https://www.lse.ac.uk/business-and-consultancy/consulting/assets/documents/commissioning-cost-effective-services-for-promotion-of-mental-health-and-wellbeing-and-prevention-of-mental-ill-health.pdf (accessed Aug 22, 2019).

73 Kono Y, Hosaka T. Economic evaluation of an occupational mental health program: decision analysis of salary compensation and medical expenses. *Asian Pac J Dis Manag* 2008; **2:** 77–82.

74 d'Ettorre G. Job stress and needlestick injuries: which targets for organizational interventions? *Occup Med (Lond)* 2016; **66:** 678–80.

75 Gonzales D, Rennard SI, Nides M, et al. Varenicline, an α4β2 nicotinic acetylcholine receptor partial agonist, vs sustained-release bupropion and placebo for smoking cessation: a randomized controlled trial. *JAMA* 2006; **296:** 47–55.

76 Jorenby DE, Leischow SJ, Nides MA, et al. A controlled trial of sustained-release bupropion, a nicotine patch, or both for smoking cessation. *N Engl J Med* 1999; **340:** 685–91.

77 Fleming MF, Mundt MP, French MT, Manwell LB, Stauffacher EA, Barry KL. Brief physician advice for problem drinkers: long-term efficacy and benefit-cost analysis. *Alcohol Clin Exp Res* 2002; **26:** 36–43.

78 York Health Economics Consortium. A rapid review of: the cost-effectiveness of National Health Services treatments for smoking cessation in England. London: National Institute for Health and Clinical Excellence, 2006. https://www.nice.org.uk/guidance/ph10/documents/economic-review-nhs-treatments2 (accessed Aug 22, 2019).

79 Kahende JW, Loomis BR, Adhikari B, Marshall L. A review of economic evaluations of tobacco control programs. *Int J Environ Res Public Health* 2009; **6:** 51–68.

80 Faulkner M. Smoking cessation: an economic analysis and review of varenicline. *Clinicoecon Outcomes Res* 2009; **1:** 25–34.

81 Park KO, Wilson MG, Lee MS. Effects of social support at work on depression and organizational productivity. *Am J Health Behav* 2004; **28:** 444–55.

82 Brown SK, Bain P, Freeman M. Employee perceptions of alcohol and drug policy effectiveness: policy features, concerns about drug testing, and the key role of preventative measures. *Drugs (Abingdon Engl)* 2008; **15:** 145–60.

83 Van der Heijden BI, Mulder RH, Konig C, Anselmann V. Toward a mediation model for nurses' well-being and psychological distress effects of quality of leadership and social support at work. *Medicine* 2017; **96:** e6505.

84 Evans-Lacko S, Knapp M. Is manager support related to workplace productivity for people with depression: a secondary analysis of a cross-sectional survey from 15 countries. *BMJ Open* 2018; **8:** e021795.

85 Richmond R, Kehoe L, Heather N, Wodak A. Evaluation of a workplace brief intervention for excessive alcohol consumption: the workscreen project. *Prev Med* 2000; **30:** 51–63.

86 Grant AM, Curtayne L, Burton G. Executive coaching enhances goal attainment, resilience and workplace well-being: a randomised controlled study. *J Posit Psychol* 2009; **4:** 396–407.

87 Thompson AH, Jacobs P, Moffatt J, Waye A. Delivery and evaluation of a mental health promotion intervention for Alberta workplace supervisors and managers. Edmonton: Institute of Health Economics, September, 2013. https://www.ihe.ca/publications/delivery-and-evaluation-of-a-mental-health-promotion-intervention-for-alberta-workplace-supervisors-and-managers (accessed Aug 12, 2019).

88 Stansfeld SA, Kerry S, Chandola T, et al. Pilot study of a cluster randomised trial of a guided e-learning health promotion intervention for managers based on management standards for the improvement of employee well-being and reduction of sickness absence: GEM study. *BMJ Open* 2015; **5:** e007981.

89 Beyond Blue. Developing a workplace mental health strategy: a how-to guide for organizations. Hawthorn: Beyond Blue, 2018. https://www.headsup.org.au/docs/default-source/resources/393615_1117_bl1833_acc-2.pdf?sfvrsn=f5cf264d_4 (accessed Aug 22, 2019).

90 Burton WN, Conti DJ. Depression in the workplace: the role of the corporate medical director. *J Occup Environ Med* 2008; **50:** 476–81.

91 Ong MK, Glantz SA. Free nicotine replacement therapy programs vs implementing smoke-free workplaces: a cost-effectiveness comparison. *Am J Public Health* 2005; **95:** 969–75.

92 Doran CM, Ling R, Gullestrup J, Swannell S, Milner A. The impact of a suicide prevention strategy on reducing the economic cost of suicide in the New South Wales construction industry. *Crisis* 2016; **37:** 121–29.

93 Tompa E, Culyer A, Dolinschi R. Economic evaluation of interventions for occupational health and safety: developing good practice. Oxford: Oxford University Press, 2008.

94 Neumann P, Sanders G, Russell L, Siegel J, Ganiats T. Cost-effectiveness in health and medicine, 2nd edn. Oxford: Oxford University Press, 2016.