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REVIEW ARTICLE

Economic evaluations of Internet interventions for mental health: a systematic review

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Background. Internet interventions are assumed to be cost-effective. However, it is unclear how strong this evidence is, and what the quality of this evidence is.

Method. A comprehensive literature search (1990–2014) in Medline, EMBASE, the Cochrane Central Register of Controlled Trials, NHS Economic Evaluations Database, NHS Health Technology Assessment Database, Office of Health Economics Evaluations Database, Compendex and Inspec was conducted. We included economic evaluations alongside randomized controlled trials of Internet interventions for a range of mental health symptoms compared to a control group, consisting of a psychological or pharmaceutical intervention, treatment-as-usual (TAU), wait-list or an attention control group.

Results. Of the 6587 abstracts identified, 16 papers met the inclusion criteria. Nine studies featured a societal perspective. Results demonstrated that guided Internet interventions for depression, anxiety, smoking cessation and alcohol consumption had favourable probabilities of being more cost-effective when compared to wait-list, TAU, group cognitive behaviour therapy (CBGT), attention control, telephone counselling or unguided Internet CBT. Unguided Internet interventions for suicide prevention, depression and smoking cessation demonstrated cost-effectiveness compared to TAU or attention control. In general, results from cost-utility analyses using more generic health outcomes (quality of life) were less favourable for unguided Internet interventions. Most studies adhered reasonably to economic guidelines.

Conclusions. Results of guided Internet interventions being cost-effective are promising with most studies adhering to publication standards, but more economic evaluations are needed in order to determine cost-effectiveness of Internet interventions compared to the most cost-effective treatment currently available.

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Key words: anxiety, cost-effectiveness, depression, Internet interventions, substance abuse, suicidal behaviour.

Introduction

Mental health disorders place a psychological burden on sufferers, and constitute a large economic burden for society, due to their prevalence, chronicity, association with productivity loss, sick leave and increased healthcare utilization (Wittchen *et al.* 2000; Kessler *et al.* 2005). The indirect and direct costs of depression alone have been estimated at $50 billion and $26 billion, respectively, in the USA in 2000 (Wade & Häring, 2010). Healthcare resources are limited and will likely be further constrained as demand and costs grow (Karanikolos *et al.* 2013). In light of these challenges, healthcare programmes need to place more emphasis on ensuring cost-effectiveness, alongside therapeutic effectiveness for mental health concerns. Cost-effectiveness analysis (CEA) is a tool for investigating the net gains in relation to the incremental costs of a given treatment compared to an alternative (Saha *et al.* 2001).

Internet interventions have demonstrated effectiveness for depression (Richards & Richardson, 2012) and harmful alcohol use (Riper *et al.* 2014), while there is accumulating evidence for interventions targeting anxiety (Arnberg *et al.* 2014), sleep disturbance (Ritterband *et al.* 2009), smoking cessation (Civljak *et al.* 2014) and suicidal ideation (Van Spijker *et al.* 2014). These interventions are likely to reduce health service delivery costs compared to conventional face-to-face therapy, as they generally involve minimal or no contact with mental health professionals.

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Internet interventions are therefore assumed to be cost-effective, but it is unclear how strong this evidence is, and what the quality of this evidence is. To answer these questions, systematic reviews are needed.

Previous reviews examining economic evaluations of Internet interventions have focused solely on physical illnesses (Tate *et al.* 2009), mood and anxiety disorders (Arnberg *et al.* 2014) or Internet interventions based on cognitive behaviour therapy (CBT) (Hedman *et al.* 2012*b*). Therefore we aimed to (1) systematically review the available literature on economic evaluations of evidence-based Internet interventions for mental health symptoms or disorders (depression, anxiety, severe health anxiety, harmful alcohol use, smoking cessation, sleep disorders, suicidal ideation); and (2) to review the quality of economic evaluations of Internet interventions.

Method

Search strategy and study selection

A comprehensive literature search of bibliographical databases [PubMed including Medline, EMBASE, the Cochrane Central Register of Controlled Trials, PsycINFO, NHS Economic Evaluations Database (NHS EED), NHS Health Technology Assessment (NHS HTA) Database, and the Office of Health Economics Health Economic Evaluations Database (OHE HEED), Compendex and Inspec] was conducted for relevant articles published between 1990 to 31 July 2014. Terms indicative of Internet-based economic evaluations and mental health disorders were used, with the search limited to 'humans', 'English', and 'peer-reviewed journals' (see Appendix 1 for the full search string).

The identified titles and abstracts were screened for eligibility by two independent researchers (T.D., K.P. or M.B.). Full text copies of all potentially relevant papers, or papers where the abstract provided insufficient detail to determine eligibility, were obtained, screened, and discarded from further analyses if they met exclusion criteria. References of earlier reviews, and reference lists of the included primary articles, were also examined. Data extraction of relevant articles was completed by two independent researchers (T.D. and K.P. or M.B.), with any disagreements resolved through discussion. Randomized controlled trials (RCTs) examining the economic evaluations of Internet-based mental health symptoms or disorders (depression, anxiety, severe health anxiety, harmful alcohol use, smoking cessation, sleep disorders, suicide ideation), compared with a control group, were included. The control group could consist of treatment-as-usual (TAU), another recognized treatment, wait-list or an attention control group. All age groups were included. Only full economic evaluations in which both the cost and consequences of two or more interventions are compared were included in this review. Partial evaluations in which only cost-outcome descriptions were provided were excluded. Studies were excluded if mental health symptoms/disorders were not an outcome, and/or if the focus intervention was not delivered online (e.g. computer-based interventions). Modelling studies were excluded because of methodological differences compared to trial-based economic evaluations (e.g. estimated and synthesized data instead of observational data) which could influence internal validity. Studies were also excluded if the intervention featured only very minimal Internet delivery, or if the intervention targeted a somatic disorder (e.g. irritable bowel syndrome). Conference abstracts, protocol papers, case-studies, non-peer-reviewed papers and non-English papers were also excluded.

Quality assessment

Study quality was assessed with the Drummond 35-item checklist (Drummond & Jefferson, 1996). This tool has been widely used in systematic reviews to assess the quality of economic evaluations (Chen *et al.* 2012; Rodgers *et al.* 2012) and considers a broad range of factors including: the study question; selection of alternatives; form of evaluation; effectiveness data; benefit measurement and valuation of costs and consequences; costing; modelling; adjustments for timing of costs and benefits; allowance for uncertainty; clear presentation of results. Since we have excluded modelling studies, items 20 and 21 regarding 'modelling' were not applicable. The study question was rated favourably if authors mentioned hypothesis, research question or objectives/aims. Effectiveness data was rated favourably if the authors provided a brief summary addressing the points in the Drummond guidelines (Drummond & Jefferson, 1996) (selection of study population, method of allocation of subjects, blinding, whether analysed by intention to treat (ITT), effect size with confidence intervals) and a reference to the published source. One author (T.D.) completed the checklist for each study, which was then reviewed by another author (M.B. or B.L.). None of the authors rated papers to which he/she had contributed.

Outcome measures

Outcome measures for the CEA included treatment response (reduction of depression symptoms, anxiety symptoms, alcohol use, smoking behaviour, sleep disorders, suicidal behaviour and self-harm) as assessed with validated mental health scales. The outcome measure for the cost-utility analysis (CUA) was the

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number of quality-adjusted life years (QALYs) or years lived with disability (YLD) gained as a result of the intervention. Other outcome measures are health-adjusted life expectancies (HALEs) health-adjusted life years (HALYs) or disability-adjusted life years (DALYs), but QALYs are the most common measure used.

Economic evaluation estimates

CEA results are usually summarized in cost-effectiveness ratios (CER), where the costs in the numerator are related to a single common measure of effectiveness in the denominator (e.g. abstinence from alcohol/smoking; Kraemer, 2008). When comparisons between two interventions are made using this ratio, this is called the incremental cost-effectiveness ratio (ICER). The ICER gives an estimate of the cost for one additional unit of improvement when administering the experimental treatment compared to the control treatment (Bencic *et al.* 2006) using the formula

$$(TC_x - TC_y)/(TQ_x - TQ_y),$$

where TC_x is the average cost of the experimental intervention, TC_y is the average cost of the control intervention, TQ_x is the proportion of clinically improved participants in the intervention and TQ_y is the proportion of clinically improved participants in the comparison intervention. Cost-effectiveness can also be presented in terms of cost for 1 year gained living with disability (YLD) averted (Muennig, 2007). Cost-utility ICERs refers to the cost of 1 quality of life year (QALY) gained in the experimental treatment compared to the control condition (Hedman *et al.* 2011).

In economic evaluations, costs can be determined from several perspectives, including the societal perspective, the third-party payer perspective, the employer perspective and the patient perspective. The perspective taken by the evaluation determines what costs are relevant to, and subsequently included in, the analysis. For example, in the societal perspective (coined the 'decision-maker approach' in Drummond *et al.* 2005), health sector costs, other sector costs, patient/family costs and productivity losses are included. In the perspective of the third-party payer perspective, however, only health sector costs are included. For more details, refer to Drummond *et al.* (2005). The willingness to pay (WTP) gives an indication for the acceptability of the experimental treatment compared to the alternative treatment from a cost-effectiveness point of view by assigning an arbitrary WTP (Muennig, 2007). The principle behind this analysis is that society's WTP for one additional case of improvement determines to which extent a treatment that gives net benefits at higher net costs can be regarded as cost-effective. The threshold of what is considered value for money, which is specified using (among others) QALYs, differs per country. In the UK, for example, the National Institute of Clinical Evidence (NICE) uses a threshold (a WTP) of between £20000 and £30000 per QALY (Mihalopoulos & Chatterton, 2014). Each economic evaluation study can suffer from several types of uncertainty (e.g. sampling uncertainty). To deal with this type of uncertainty, bootstrap analyses can be conducted. Using bootstrapping techniques with replacement n (often 1000) times a random sample is drawn from the original dataset, resulting in 1000 slightly different samples and thus slightly different ICERs. Of these 1000 ICERs, the percentage can be calculated with (1) more effects and lower costs (dominant); (2) with less effects and lower costs; (3) with more effects and higher costs and (4) with less effects and higher costs (inferior) (Smit *et al.* 2013).

Statistical analyses

Where data were available, main outcomes of cost-effectiveness and CUA (CER, ICER, YLD) using ITT analyses at follow-up were reported. ICERs were reported in local currency. In addition, in order to compare ICERs of CUAs across studies, ICERs were converted into pounds Sterling (£) using purchasing power parity exchange rates with 2012 as reference year (the average year of publication of the included studies) (Exchange-rates.org; World Bank Data, 2014). Due to the heterogeneity of the costing methods and the interventions, a formal meta-analysis could not be conducted.

Results

Selection and inclusion of studies

A total of 6602 abstracts were examined ($N = 5846$ abstracts in total, after removal of duplicates). Potentially eligible full-text papers ($N = 236$) were retrieved for further consideration, of which 220 were excluded. Sixteen trials met inclusion criteria. There was an excellent inter-rater agreement between the two raters (Cohen's kappa: $\kappa = 0.83$). Fig. 1 details a flowchart of the screening process.

Characteristics of included studies

A total of 14 031 participants were recruited across 16 studies. Target disorders included depression ($n = 4$), smoking ($n = 3$), social phobia (three studies describing two trials), harmful alcohol use ($n = 2$), panic disorder ($n = 1$), health anxiety ($n = 1$), anxiety ($n = 1$) and suicidal ideation ($n = 1$). Most studies used CBT as the therapeutic mode of the experimental intervention, and featured support from a coach or therapist. Comparative treatments included group CBT (CBGT),

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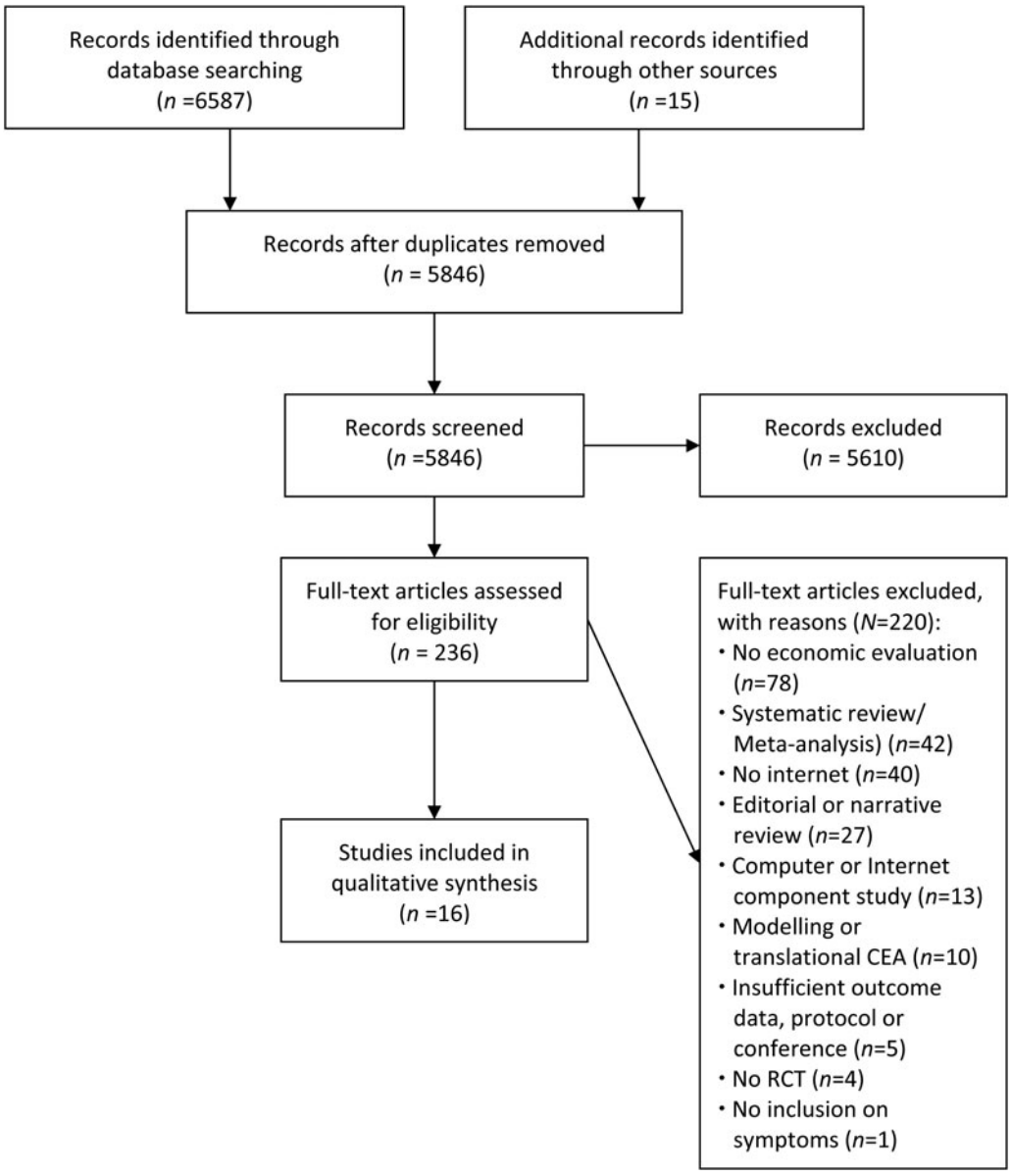

Fig. 1. PRISMA flowchart.

attention-placebo, TAU, unguided Internet intervention, Internet intervention plus telephone support, and Internet-based problem solving therapy (IPST). Five studies included a third comparison intervention, either TAU, wait-list control, attention control, or telephone counselling. The intervention lengths varied between 4 weeks and 6 months.

Clinical effectiveness

All Internet interventions except two (Wallace *et al.* 2011; Phillips *et al.* 2014) demonstrated significant reductions over time in the primary or secondary outcome measures. Similar effects were obtained when Internet interventions were compared to active comparisons (Bergström *et al.* 2010; Hedman *et al.* 2011; Javitz *et al.* 2011; Smit *et al.* 2013), while two studies found stronger clinical effects for guided *v.* unguided Internet interventions (Blankers *et al.* 2011; Graham *et al.* 2012). Four interventions showed significant symptom reductions when Internet interventions were compared to attention controls or TAU (Warmerdam *et al.* 2008; Hollinghurst *et al.* 2010; Hedman *et al.* 2012*a*; van Spijker *et al.* 2014). However, two studies did not find a significant reduction in alcohol consumption or depression symptomatology compared to attention placebo, respectively (Wallace *et al.* 2011; Phillips *et al.* 2014). Two studies demonstrated similar effects when

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comparing Internet interventions with TAU (Gerhards *et al.* 2010; Smit *et al.* 2013).

Economic evaluations

Of the 16 included studies, ten papers describing nine trials took a societal perspective (Gerhards *et al.* 2010; Hollinghurst *et al.* 2010; Warmerdam *et al.* 2010; Hedman *et al.* 2011, 2012*a*, 2014; Javitz *et al.* 2011; Blankers *et al.* 2012; van Spijker *et al.* 2012; Smit *et al.* 2013), one study took a third-party payer perspective (Graham *et al.* 2012) and one study adopted a healthcare provider perspective (Hollinghurst *et al.* 2010). In five studies, the perspective was not mentioned, but societal perspectives (Nordgren *et al.* 2014) or health insurance perspectives (Titov *et al.* 2009; Bergström *et al.* 2010; Wallace *et al.* 2011) could be inferred. In one study (Phillips *et al.* 2014), the perspective could not be deduced.

Table 1 provides an overview of main health economic outcomes of the included studies. Notably, the majority of studies reported both CEA and CUA, while six studies performed only CEA. All CUA studies used QALYs as their primary outcome measure, all assessed with EQ-5D (EuroQol Group, 1990). As expected, the CEA studies expressed outcomes differently, using scores of, among others, the Alcohol Use Disorders Identification Test (AUDIT; Saunders *et al.* 1993) and the Beck Depression Inventory (BDI; Beck *et al.* 1996). One CEA used YLD as the primary outcome measure. The time horizon of the included studies varied between 6 weeks to 18 months, with the majority being 6 months in length, and one single 4-year follow-up study (Hedman *et al.* 2014).

Depression

From a cost-effectiveness perspective, guided Internet ICBT and guided IPST showed high probabilities of being more cost-effective compared to wait-list (Warmerdam *et al.* 2010). CUA, however, led to modest results regarding the cost-effectiveness of Internet interventions. With an ICER of £19 371 and £9873 for 1 additional QALY, ICBT and IPST, respectively, had a 50% likelihood of being more acceptable than wait-list. Uncertainty analysis demonstrated that the interventions produced more effects at higher costs compared to wait-list. In one study (Hollinghurst *et al.* 2010), guided ICBT had better outcomes but at higher costs compared to TAU, with a 50% likelihood of ICBT being more cost-effective in terms of QALYs than TAU at ICER = £19 322 per QALY threshold. For ICERs in local currency, please see Table 1. Unguided ICBT produced similar effectiveness against lower costs compared to TAU (Gerhards *et al.* 2010). ICBT had a 65% probability of being cost-effective compared to TAU at a WTP of £0 (Gerhards *et al.* 2010). One study examining unguided ICBT on work-related performance and other outcomes, including depression, found no differential effects or cost-effects compared to a psycho-educational control condition (Phillips *et al.* 2014).

Anxiety disorders (including health anxiety)

Guided ICBT generated a societal economic gain (being more clinically efficacious at a lower societal cost) for health anxiety (Hedman *et al.* 2012*a*), social anxiety (Hedman *et al.* 2011), panic disorder (Bergström *et al.* 2010) and anxiety disorder in general (Nordgren *et al.* 2014), compared to attention controls or CBGT, at post-test or 3–6 months' follow-up. However, in a 4-year follow-up study on social anxiety (Hedman *et al.* 2014), ICBT and CBGT yielded similar results in terms of cost-effectiveness. In a study targeting social anxiety (Titov *et al.* 2009), the cost for 1 year gained living with disability (YLD) averted was lower in ICBT compared to CGBT treatment at follow-up. At WTP $0 for an additional case of improvement, ICBT demonstrated a 64% and 81% probability of being cost-effective compared to attention control and CBGT, respectively (Hedman *et al.* 2011, 2012*a*). However, at 4-year follow-up, the probability of ICBT being cost-effective compared to CGBT for social anxiety diminished from 81% to 62% at WTP £0. In the CUA, guided ICBT for health anxiety had a 67% probability of being cost-effective if society would pay £0 for one gained QALY at post-test or follow-up, whereas social anxiety had a 81% probability, of being cost-effective if society would pay £0 for one gained QALY at post-test. These interventions (Hedman *et al.* 2011, 2012*a*, 2014; Nordgren *et al.* 2014) dominated their controls, leading to better outcomes at lower costs. Each QALY gained in ICBT for health anxiety generated a societal earning of £6688 compared to attention control at post-test. Each QALY gained in ICBT to reduce social anxiety generated a societal earning of £ 11 307 compared to CBGT at 6 months' follow-up, but cost-effectiveness results diminished to a 50% probability at ICER = £4660 for one additional QALY. For anxiety disorders in general (Nordgren *et al.* 2014), ICBT had a 90% probability of being cost-effective at WTP £0. Each QALY gained in ICBT for anxiety generated a societal earning of £4732 compared to an active wait-list (similar to TAU) at post-test. For ICERs in local currency, please see Table 1.

Alcohol misuse

Guided ICBT+ (CBT enhanced with other therapeutic techniques, such as motivational interviewing or behavioural self-control) compared to unguided ICBT+ to reduce alcohol consumption generated a societal economic cost at follow-up (Blankers *et al.* 2012).

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Table 1. *Economic evaluations of Internet interventions at follow-up (intention-to-treat)*[a]

Author (year); country	Target	Trial	Treatment arms (*n*); delivery period	Effect or utility outcome	Cost categories included (cost-perspective)	Health economic results	Time horizon
Nordgren *et al.* 2014; Sweden	Anxiety	RCT	(a) E-mail guided ICBT (*n* = 50) (b) Active wait-list control group (*n* = 50) Delivery period: 10 weeks	CORE-OM and EQ-5D	Direct intervention costs (costs of therapists), healthcare costs, participant costs, productivity costs (NR, but inferred societal perspective)	**Cost-effectiveness analysis** ICER = −$1824, indicating lower costs and larger clinical effects in ICBT compared to active wait-list at post-test **Cost-utility analysis** ICER = −$7523, that is, greater health gains in terms of QALY gained were generated for less costs by ICBT compared to active wait-list at post-test (converted ICER = −£4732) **WTP** ICBT had a 90% probability of being cost-effective compared to wait-list control if the society would pay $0 for one gained QALY. If society were willing to pay $3000 for one additional QALY, the probability of ICBT being cost-effective would be 95%	10 weeks
Bergström *et al.* 2010; Sweden	Panic disorder (w/wo agora-phobia)	RCT	(a) E-mail guided ICBT (10 modules) (*n* = 53) (b) CBGT (*n* = 60) Delivery period: 10 weeks	PDSS	Direct intervention costs (NR, but inferred health insurance perspective)	**Cost-effectiveness analysis** ICER not reported. CER=CBGT €516 (0.63 responders) *v.* €143 (0.60 responders) for iCBT at post-test. CER CBGT €500 (0.65 responders) *v.* €121 for ICBT (0.71 responders) at follow-up. ICBT had superior cost-effectiveness ratios compared to CBGT	6 months
Blankers *et al.* 2012; The Netherlands	Alcohol	RCT	(a) 7 chat-guided ICBT + modules (*n* = 68) (b) 4 unguided ICBT+ modules (*n* = 68) Delivery period: 4-6 weeks (unguided) and 10 weeks (chat)	Composite measure[b]	Intervention costs (software development costs, information and computer technology service costs, overhead costs, therapist costs), healthcare costs, participant costs, productivity costs, societal costs (societal)	**Cost-effectiveness analysis** ICER = €3683, that is, each case of clinical improvement in guided ICBT+ compared with unguided ICBT+ generated a cost of €3683 **Cost-utility analysis** ICER = €14 710; each QALY gained in guided ICBT+ compared to unguided ICBT+ generated a cost of €14 710 (converted ICER = £12 228) **WTP** With WTP €20 000 for 1 additional QALY, guided ICBT+ had a 60% likelihood of being more cost-effective than unguided ICBT+	6 months

Gerhards *et al.* 2010; The Netherlands	Depression	RCT	(a) Unguided ICBT ($n = 100$) (b) Unguided ICBT and TAU ($n = 100$) (c) TAU ($n = 103$) Delivery period: 9 weeks	BDI-II and EQ-5D	Intervention costs (excluding direct costs), healthcare costs, participant and family costs, productivity costs (societal)	**Cost-effectiveness analysis** ICER not reported. The mean difference in societal and health care costs were in favour of ICBT compared to TAU and compared with ICBT plus TAU. Patient and family costs were highest in ICBT **Cost-utility analysis** ICER not reported. There were no significant differences in effectiveness or QALY outcomes **WTP (net-benefit)** ICBT had a 65% probability of being cost effective compared with TAU or ICBT and TAU at WTP €0, but diminishing towards a 40% probability when increasing the threshold value up to €80 000. TAU had a 40% probability of being cost-effective at WTP €80 000	12 months
Graham *et al.* 2012; USA	Smoking cessation	RCT	(a) Unguided EI ($n = 651$) (b) Telephone guided EI ($n = 675$) (c) Basic Internet ($n = 679$) Delivery period: 6 months	Quitters (SPP and MPP)	Direct intervention costs (commercial charges for each intervention) (third-party payer)	**Cost-effectiveness analysis** ICER (EI *v.* EI and telephone) = US $1197. That is, compared with EI, the cost per additional quitter for EI plus telephone was $1197 at 3 months to $3781 (SPP) and $3123 at 18 months (MPP)	18 months
Hedman *et al.* 2012*a*; Sweden	Health anxiety	RCT	(a) E-mail guided ICBT ($n = 40$) (b) Attention control ($n = 41$) Delivery period: 12 weeks	HAI and EQ-5D	Direct intervention costs (costs of therapists), healthcare costs, participant costs, productivity costs (societal)	**Cost-effectiveness analysis** ICER = −£1244, indicating lower costs and larger clinical effects for each additional case of remission in ICBT compared to attention control at post-test **Cost-utility analysis** ICER = −£6533, that is, greater health gains in terms of QALY gained were generated for less costs by ICBT compared to attention control at post-test (converted ICER = −£6688) **WTP** ICBT had a 64% probability of being cost-effective compared to attention control at WTP £0. If society were willing to pay £5000 for one case of improvement, the probability of ICBT being cost-effective would increase to 96%. ICBT had a 67% probability of being cost-effective if society would pay $0 for one gained QALY. If the society were willing to pay £5000 for one additional	12 weeks

Table 1 (*cont.*)

Author (year); country	Target	Trial	Treatment arms (*n*); delivery period	Effect or utility outcome	Cost categories included (cost-perspective)	Health economic results	Time horizon
						QALY, the probability of ICBT being cost-effective would be 77%	
Hedman *et al.* 2011, 2014; Sweden	Social anxiety	RCT	(a) E-mail guided ICBT ($n = 64$) (b) CBGT ($n = 62$) Delivery period: 15 weeks	LSAS and EQ-5D	Direct intervention costs (costs of therapists), healthcare costs, participant costs, productivity costs (societal)	**Cost-effectiveness analysis** ICER = −US $7046, that is, greater health gains were generated for less cost by ICBT compared to CBGT, Cost Annual cost savings per treatment responder was $7046 at 6 month follow-up. However, at 4 year follow-up, ICER = US $10 100. That is, each incremental case of improvement produced by CBGT compared to ICBT generated a societal cost of $10 100 **Cost-utility analysis** ICER = −US $17 823, that is, greater health gains were generated for less cost by ICBT when comparing ICBT with CBGT at 6 month follow-up (converted ICER = −£11 307) At 4 year follow-up, ICER = −US $7345, in favour of ICBT. That is, each incremental QALY produced by ICBT compared to CBGT generated a societal net cost gain of $7345 (a larger clinical effect in terms of QALYs gained in ICBT compared to CBGT while costs were lower) (converted ICER = −£4660) **WTP** ICBT had a 81% probability of being cost-effective compared to CBGT at WTP £0. If society were willing to pay $3000 for one case of improvement, the probability of ICBT being cost-effective would increase to 89% at 6 months follow-up. At 4 year follow-up, ICBT had a 62% probability of being cost-effective compared to CBGT at WTP $0, and 22% at WTP $100 000 ICBT had an 81% probability of being cost-effective if the society would pay $0 for one gained QALY. If society were willing to pay $40 000 for one	6 months and 4 years

						additional QALY, the probability of ICBT being cost-effective would be 79% at 6 months follow-up. At 4 year follow-up, ICBT had a 62% probability of being cost-effective compared to CBGT at WTP $0, and 64% at WTP $100 000 for one additional QALY	
Hollinghurst *et al*. 2010; UK	Depression	RCT	(a) Chat-guided ICBT ($n = 149$) (b) TAU ($n = 148$) Delivery period: 10 sessions in 4 months	BDI and EQ-5D	Intervention costs (therapist costs, overhead charge) healthcare costs, NHS resources, participant costs, productivity costs (societal[c])	**Cost-effectiveness analysis (complete cases)** ICER = £3528. That is, each incremental improvement on BDI for participants in ICBT compared to TAU incurs a societal economic gain of £3528 **Cost-utility analysis (complete cases)** ICER = £17 173. That is, each additional QALY generated a societal earning of £17173, when compared ICBT with usual care (converted ICER = £19 322) **WTP (net-monetary benefit) (complete cases)** At WTP €20 000 for 1 additional QALY, guided ICBT had a 56% likelihood of being more cost-effective than TAU and a 71% chance at the £30 000 per QALY threshold	8 months
Javitz *et al*. 2011; USA	Smoking cessation	RCT	(a) Web-counselling ($n = 401$) (b) Web-counselling and PTC (PTC-web) ($n = 399$) (c) PTC ($n = 402$) All received varencicline, an orientation call and access to a support line. Delivery period: 12 weeks	6-mo non-smoking, healthy people 2000 measure	Intervention costs (software development costs, telephone-based contact, non-medication and supply costs, medication costs, overhead costs, staff and therapist time) (societal)	**Cost-effectiveness analysis** ICER not reported. CER: Web: $1278, PTC: $1472, PTC-Web: $1617 **Cost-utility analysis** ICER not reported. CER (QALY): Web: $1136, PTC: $1308, PTC-Web: $1437	6 months
Phillips *et al*., 2014; UK	Depression	RCT	(a) Unguided ICBT ($n = 318$) (b) Attention control ($n = 319$) Delivery period: 5 weeks	PHQ-9 and EQ-5D	Lost employment, service use (NR)	**Cost-effectiveness analysis** ICER = not reported. There were no differences in outcomes between ICBT and control. There were no major differences between the groups in service use at baseline and follow-up. The cost of lost employment and absence from work were higher for the control group at follow-up, but this was not significant (£111 *v*. £96, $p = 0.76$ and £143 *v*. £119,	6 weeks

Table 1 (*cont.*)

Author (year); country	Target	Trial	Treatment arms (*n*); delivery period	Effect or utility outcome	Cost categories included (cost-perspective)	Health economic results	Time horizon
						$p = 0.64$ respectively). There was no difference in QALYs gained between ICBT and the control group	
Smit *et al.* 2013; The Nether-lands	Smoking cessation	RCT	(a) Internet-based multiple tailoring and F2F counselling ($n = 163$) (b) Internet-based multiple tailoring only ($n = 132$) (c) TAU ($n = 119$) Delivery period: up to 6 months	Prolonged abstinence (12 mo), EQ-5D	Direct intervention costs (costs of therapists), healthcare costs, participant costs (societal)	**Cost-effectiveness analysis** ICER = €5100. That is, compared with usual care, €5100 had to be paid within the multiple tailoring group for each additional abstinent participant. Internet-based multiple tailoring only would be the most cost-effective treatment when smoking abstinence was the outcome measure **Cost-utility analysis** ICER = €40 300. That is, an incremental cost of €40 300 per QALY was gained when comparing multiple tailoring and counselling with usual care (converted ICER = £33 124), and an incremental cost of €18 367 (converted ICER = £15 096) per QALY when comparing multiple tailoring and counselling to multiple tailoring at follow-up **WTP (net-monetary benefit)** With WTP €18 000 per abstinent participant, the CUA showed that usual care would probably (64%) be the most efficient treatment	12 months
Titov *et al.* 2009; Australia	Social anxiety	Partial RCT	(a) E-mail guided ICBT ($n = 93$) (b) CBGT treatment ($n = 90$) Delivery period: 8-10 weeks	SIAS and SPS	Intervention costs (therapist time) (NR, but inferred health insurance perspective)	**Cost-effectiveness analysis** ICER=not reported. The cost for 1 year gained living with disability(YLD) averted was AUD $1496 in ICBT and AUD $5686 in CBGT treatment	6 months
van Spijker *et al.* 2012; The Nether-lands	Suicide	RCT	(a) Unguided ICBT+ ($n = 116$) + TAU (b) Attention control ($n = 120$) + TAU Delivery period: 6 weeks	BSS	Healthcare costs, participant costs, productivity costs (societal)	**Cost-effectiveness analysis** ICER = −€34 727. That is, greater health gains were generated for less cost by ICBT+ relative to attention control. Annual cost savings per treatment responder was €34 727 at post-test **WTP** With WTP €20 000 per additional treatment	6 weeks

						responder, ICBT+ had a 95.6% likelihood of being more cost-effective than attention control. With WTP €0, there was a 93% probability that ICBT+ would be regarded as more cost-effective than attention control at post-test	
Wallace *et al.* 2011; UK	Alcohol	RCT	(a) Unguided ICBT+ (n = 3972) (b) Attention control (n = 3963) Delivery period: 4 weeks	TOT-AL and EQ-5D	Intervention costs (development and delivery costs) (NR, but inferred health insurance perspective)	**Cost-effectiveness analysis** I(CE)R not reported. The total cost of ICBT+ was £107 317 and the control site cost £3390. The average cost per participant was £27.02 for ICBT+ and 85p for the control site at 3 months (a difference of £26,17). No significant differences in EQ-5D were found and therefore no cost-effectiveness ratio was calculated	3 months
Warmerdam *et al.* 2010; The Nether-lands	Depression	RCT	(a) E-mail guided ICBT (n = 88) (b) E-mail guided IPST (n = 88) (c) Wait-list (n = 87) Delivery period: 5 weeks	CES-D and EQ-5D	Intervention costs (therapist support, maintenance costs) Healthcare costs, participant costs, productivity costs (societal)	**Cost-effectiveness analysis** ICBT: ICER = €1817, that is, offering ICBT instead of wait-list, extra costs of €1817 were incurred for a health gain of reliable improvement for one additional participant IPST: ICER = €1248, that is, each case of clinical improvement in IPST compared with wait-list generated a cost of €1248 **Cost-utility analysis** ICBT: ICER = €22 609, that is, each QALY gained in ICBT compared with wait-list generated a cost of €22 609. (Converted ICER = £19 371). IPST: ICER = €11 523, that is, each QALY gained in IPST compared with wait-list generated a cost of €11 523. (Converted ICER = £9873) **WTP** When society is prepared to pay €10 000 for a clinically significant change from depression, the probabilities of ICBT and IPST being more acceptable than wait-list are 91% and 89%. With WTP €0, there is a probability of 30% and 38% respectively, that ICBT and IPST are more cost-effective than waiting for treatment. With	12 weeks

Table 1 (*cont.*)

Author (year); country	Target	Trial	Treatment arms (*n*); delivery period	Effect or utility outcome	Cost categories included (cost-perspective)	Health economic results	Time horizon
						WTP €30 000 for 1 additional QALY, ICBT had a 52% likelihood and IPST had a 61% likelihood of being more acceptable than wait-list	

[a] Unless stated otherwise.
[b] See Blankers *et al.* (2012).
[c] Authors mention NHS perspective but societal perspective is inferred.
AUD, Australian dollars; AUDIT, Alcohol Use Disorders Identification Test; BDI, Beck Depression Inventory; BDI-II, Beck Depression Inventory II; BSS, Beck Suicide Ideation Scale; CBGT, cognitive behavioural group therapy; CBT+, CBT enhanced with other therapeutic techniques, such as motivational interviewing, behavioural self-control, dialectical behavioural therapy or mindfulness based cognitive therapy; CER, cost-effectiveness ratio; CES-D, Centre for Epidemiological Studies Depression; CORE-OM, outcomes in routine evaluation; EI, enhanced internet; EQ-5D, EuroQol-5; F2F, face-to-face; HAI, Health Anxiety Inventory; ICBT, Internet-based cognitive behavioural therapy; ICER, incremental cost-effectiveness ratio; IPST, Internet-based problem solving therapy; LSAS, Liebowitz Social Anxiety Scale; mo, months; MPP, multiple point prevalence; NR, not reported; PDSS, Panic Disorder Severity Scale; PHQ-9, Patient Health Questionnaire; PTC, proactive telephone counselling; QALY, quality-adjusted life years; RCT, randomized controlled trial; RT, randomized trial; SIAS, Social Interaction Anxiety Scale; SPS, Social Phobia Scale; SPP, single point prevalence; TAU, treatment as usual; TOT-AL, total past week alcohol consumption; WTP, willingness to pay; YLD, years lived with disability.

Guided ICBT+ led to additional effects and a better QALY health gain at additional costs relative to unguided ICBT+. With ICER = £12 228 for one additional QALY, guided ICBT+ and unguided ICBT+ would be equally preferable. When society is willing to pay more than £12 228, guided ICBT+ would probably be more cost-effective than unguided ICBT+ (Blankers *et al.* 2012). For ICERs in local currency, please see Table 1. One study (Wallace *et al.* 2011) showed no significant differences in EQ-5D scores when unguided ICBT+ was compared to an attention control condition to reduce alcohol consumption, and therefore no CER was calculated. However, the ICBT intervention in this evaluation costs significantly more than the attention control.

Smoking

Internet-based multiple tailoring was more cost-effective compared to the same intervention provided as face-to-face counselling or usual care, when smoking abstinence was the outcome measure (Smit *et al.* 2013). However, when quality of life was used as an outcome measure, multiple tailoring was dominated by usual care because this treatment was both more expensive and less effective. Furthermore, multiple tailoring and counselling was more expensive but also more effective than usual care and multiple tailoring in increasing the QALYs gained. This resulted in an incremental cost of £33 124 per QALY gained when comparing multiple tailoring and counselling with usual care, and in an incremental cost of £15 097 per QALY when comparing multiple tailoring and counselling to multiple tailoring only (Smit *et al.* 2013). A telephone-guided smoking cessation Internet intervention was more cost-effective compared to the same Internet intervention without telephone support (Graham *et al.* 2012), whereas an Internet-based counselling intervention was more cost-effective than proactive telephone counselling only (Javitz *et al.* 2011).

Suicidal ideation

Unguided ICBT+ dominated the attention control at post-test, leading to better outcomes at lower costs for suicide prevention (van Spijker *et al.* 2012) With a WTP £0, there was a 93% probability that the Internet intervention would be regarded as more cost-effective than attention control.

Guidance

Guided Internet interventions seem to be cost-effective compared to both group treatment (Titov *et al.* 2009; Bergström *et al.* 2010; Hedman *et al.* 2011) and TAU/active control group (Hollinghurst *et al.* 2010; Nordgren *et al.* 2014), attention control (Hedman *et al.* 2012*a*),

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telephone counselling (Javitz *et al.* 2011), unguided Internet interventions (Blankers *et al.* 2012; Graham *et al.* 2012) and wait-list (Warmerdam *et al.* 2010). However, in the latter study, results from CUA for ICBT and IPST for depression were less robust (Warmerdam *et al.* 2010). The most expensive ICER from CUA was £33 124 (multiple tailoring and face-to-face counselling for smoking cessation), meaning that at a WTP of ⩾£33 124 per QALY, the Internet interventions are more attractive from the chosen cost-effectiveness perspective than the control conditions

From a cost-effectiveness analysis point of view, three unguided Internet interventions for suicide prevention, depression and smoking cessation demonstrated cost-effectiveness (Gerhards *et al.* 2010; van Spijker *et al.* 2012; Smit *et al.* 2013). However, data derived from CUA results were more modest for depression and smoking cessation compared to TAU; in these studies, usual care would probably be equally or more cost-effective compared to unguided Internet interventions effectiveness (Gerhards *et al.* 2010; Smit *et al.* 2013). In one study (Wallace *et al.* 2011), direct costs of unguided ICBT+ for alcohol consumption were higher compared to attention control, while there were no significant differences in effect on outcome or EQ-5D scores. Finally, in another unguided ICBT study, no significant differences in EQ-5D scores were found when unguided ICBT was compared to a psycho-educational attention control condition to reduce symptoms of depression (Phillips *et al.* 2014).

Economic perspective

Overall, guided Internet interventions appear to be cost-effective from the perspective of society, healthcare providers and third-party payers (Hollinghurst *et al.* 2010; Warmerdam *et al.* 2010; Hedman *et al.* 2011, 2012*a*, 2014; Javitz *et al.* 2011; Blankers *et al.* 2012; Graham *et al.* 2012). Unguided Internet interventions were cost-effective at WTP £0 from a societal perspective when depression, suicide ideation or smoking abstinence was the outcome measure, but not when QALYs were the outcome measure for depression and smoking abstinence, because there were no differential clinical effects (Gerhards *et al.* 2010; van Spijker *et al.* 2012; Smit *et al.* 2013). Of the studies which did not mention their economic perspective (but inferred societal or health insurance perspectives), guided Internet intervention appeared to be cost-effective (Nordgren *et al.* 2014), but only when direct intervention costs were included (Titov *et al.* 2009; Bergström *et al.* 2010). However, unguided Internet interventions were not cost-effective (Wallace *et al.* 2011; Phillips *et al.* 2014). Taken together, the economic perspective does not seem to be strongly related to cost-effectiveness outcomes.

Quality

Based on Drummond's checklist (Drummond & Jefferson, 1996), the quality of the included economic evaluations varied (see Table 2). On average, the studies scored 72% (338/471) of the items positive. Four studies (25%) did not mention the economic perspective. Eleven papers provided insufficient information about details of the design and results of the effectiveness study and therefore was rated unclear. The majority of them provided insufficient information on the method of allocation concealment of subjects. One paper was rated unfavourable because of the absence of ITT data. Furthermore, five studies (31%) did not include uncertainty analysis and/or sensitivity analysis. Most studies ($N = 12$; 75%) were evaluated over a short time frame (6 weeks–6 months). Three studies (19%) reported less than 60% of the necessary details recommended by economic guidelines (Drummond & Jefferson, 1996). Two studies targeting smoking cessation held a societal perspective, but did not include productivity costs and/or healthcare costs (Javitz *et al.* 2011; Smit *et al.* 2013). Because of the economic evaluation methodology (e.g. variation in economic perspectives, economic evaluations, comparison groups), comparison of results between studies was hampered. For example, alongside differences in included costs according to the chosen perspective, differences in methods for including or excluding costs were also apparent, such as that in some studies, development of intervention costs were included, whereas in other studies these costs were considered as sunk costs. However, ten of the included studies (62.5%) adhered to ⩾75% of the guidelines and therefore achieved a rating of good quality.

Discussion

Main findings

The aim of this review was to provide an overview of outcomes and quality of economic evaluations of Internet interventions compared to TAU, CBGT, attention control, telephone counselling or unguided Internet CBT for a range of mental health disorders. Concerning the intervention modality, the most robust evidence for cost-effectiveness was found for guided Internet interventions at a WTP range of £1801–£33 124 per QALY. With regards to the target disorder, the strongest evidence was found for anxiety disorders, followed by depression, smoking cessation and alcohol misuse. Overall, long-term follow-up data revealed higher costs per effect measure. Except for suicide ideation, cost-effectiveness of unguided Internet interventions for depression, alcohol and smoking cessation demonstrated weaker effects. Particularly with CUA, the Internet intervention was more expansive per

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Table 2. *Quality of studies investigating cost-effectiveness of Internet-based interventions*

	Economic evaluations							
Quality checklist (Drummond & Jefferson, 1996)	Nordgren *et al.* (2014)	Bergström *et al.* (2010)	Blankers *et al.* (2012)	Gerhards *et al.* (2010)	Graham *et al.* (2012)	Hedman *et al.* (2011)	Hedman *et al.* (2012*a*)	Hedman *et al.* (2014)
Study design								
1. Research question is stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Economic importance of research question is stated	Yes	Not clear	Yes	Yes	Not clear	Yes	Yes	Yes
3. Viewpoint/perspective is clearly stated	No	Not clear	Yes	Yes	Yes	Yes	Yes	Yes
Selection of alternatives								
4. Rationale of alternatives compared is stated	Yes	Yes	Yes	No	Yes	Yes	No	Yes
5. Alternatives compared are clearly described	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Form of evaluation								
6. Form of economic evaluation is stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Form is justified in relation to research question	Yes	Yes	Yes	Yes	Not clear	Yes	Yes	Yes
Effectiveness data								
8. Sources of effectiveness estimates used are stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9. Details of design and results of effectiveness are given	Not clear	Yes	Not clear	Not clear	Not clear	Yes	Yes	Yes
10. Details of method of synthesis/meta-analysis are given	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Benefit measurement and valuation								
11. Primary outcome is clearly stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12. Methods to value health states are stated	Yes	N.A.	Yes	Yes	N.A.	Yes	Yes	Yes
13. Details given of subjects whom valuations were obtained	Yes	N.A.	Yes	Yes	N.A.	Yes	Yes	Yes
14. Productivity changes are reported separately	Yes	N.A.	Yes	Yes	N.A.	Yes	Yes	Yes
15. Relevance of productivity changes is discussed	No	No	No	Yes	No	No	No	No
Costing								
16. Resource quantities + unit costs are reported separately	No	Yes	Yes	Yes	No	No	No	No
17. Methods for estimation of quantities and costs are described	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
18. Currency and price data are recorded	No	No	Yes	Yes	No	Yes	Yes	Not clear
19. Details of currency of price adjustment for inflation or currency conversions are given	No	No	Yes	No	No	No	Yes	No
Modelling								
20. Details of any model used are given	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
21. Choice of model and key parameters are justified	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Adjustments timing of costs & benefits								
22. Time horizon is stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

23. Discount rate is stated	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	No
24. Choice of rate is justified	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	No
25. Explanation is given when costs are not discounted	No	No	No	Yes	Yes	No	No	No
Allowance for uncertainty								
26. Details of statistical tests are given	Yes	Yes	Yes	Yes	Not clear	Yes	Yes	Yes
27. Approach to sensitivity analysis is given	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
28. Choice of variables for sensitivity analysis is justified	Yes	No	Yes	Yes	Yes	Yes	Yes	Not clear
29. Ranges over which the variables are varied are justified	Yes	No	No	Yes	Yes	Yes	Yes	Yes
30. Relevant alternatives are compared	Yes	No	Yes	Yes	Not clear	Yes	Yes	Not clear
Presentation of results								
31. Incremental analysis is reported	Yes	No	Yes	No	Yes	Yes	Yes	Yes
32. Major outcomes presented disaggregated and aggregated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
33. Answer to the study question is given	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
34. Conclusions follow from the data reported	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35. Conclusions are accompanied by the appropriate caveats	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	Hollinghurst *et al.* (2010)	Javitz *et al.* (2011)	Phillips *et al.* (2014)	Smit *et al.* (2013)	Titov *et al.* (2009)	van Spijker *et al.* (2012)	Wallace *et al.* (2011)	Warmerdam *et al.* (2010)
Study design								
1. Research question is stated	Yes	Yes	No	Yes	Yes	Not clear	Yes	Yes
2. Economic importance of research question is stated	Yes	Not clear	Yes	Yes	Not clear	Yes	Yes	Not clear
3. Viewpoint/perspective is clearly stated	Yes	Yes	No	Yes	No	Yes	No	Yes
Selection of alternatives								
4. Rationale of alternatives compared is stated	Yes	Yes	No	Yes	Yes	Yes	No	Yes
5. Alternatives compared are clearly described	Not clear	Yes	Yes	Yes	No	Yes	Yes	Yes
Form of evaluation								
6. Form of economic evaluation is stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Form is justified in relation to research question	Yes	Yes	Not clear	Yes	Yes	Not clear	Yes	Yes
Effectiveness data								
8. Sources of effectiveness estimates used are stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9. Details of design and results of effectiveness are given	Not clear	Not clear	Yes	Not clear	Not clear	Not clear	Not clear	Not clear
10. Details of method of synthesis/meta-analysis are given	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Benefit measurement and valuation								
11. Primary outcome is clearly stated	Not clear	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12. Methods to value health states are stated	Yes	No	N.A.	Yes	N.A.	N.A.	N.A.	Yes
13. Details given of subjects whom valuations were obtained	Yes	No	N.A.	Not clear	N.A.	N.A.	N.A.	Yes

Table 2 (*cont.*)

	Hollinghurst *et al.* (2010)	Javitz *et al.* (2011)	Phillips *et al.* (2014)	Smit *et al.* (2013)	Titov *et al.* (2009)	van Spijker *et al.* (2012)	Wallace *et al.* (2011)	Warmerdam *et al.* (2010)
14. Productivity changes are reported separately	Yes	No	N.A.	No	N.A.	N.A.	N.A.	Yes
15. Relevance of productivity changes is discussed	Yes	No	No	No	No	Yes	No	No
Costing								
16. Resource quantities + unit costs are reported separately	Yes	No	No	Yes	No	Yes	No	Yes
17. Methods for estimation of quantities and costs are described	Yes	Yes	Not clear	Yes	Not clear	Yes	Not clear	Yes
18. Currency and price data are recorded	Yes	Not clear	No	Yes	Yes	Yes	No	Yes
19. Details of currency of price adjustment for inflation or currency conversions are given	Not clear	No	No	Yes	No	Yes	No	No
Modelling								
20. Details of any model used are given	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
21. Choice of model and key parameters are justified	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Adjustments timing of costs and benefits								
22. Time horizon is stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
23. Discount rate is stated	N.A.	Yes	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
24. Choice of rate is justified	N.A.	Yes	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
25. Explanation is given when costs are not discounted	Yes	N.A.	No	Yes	No	No	No	No
Allowance for uncertainty								
26. Details of statistical tests are given	Yes	Yes	Not clear	Yes	Not clear	Yes	Yes	Yes
27. Approach to sensitivity analysis is given	Yes	Yes	No	Yes	No	Yes	No	Yes
28. Choice of variables for sensitivity analysis is justified		No	Not clear	Yes	No	Yes	No	Not clear
29. Ranges over which the variables are varied are justified	Yes	No	No	Yes	No	Yes	No	Not clear
30. Relevant alternatives are compared	Yes	Yes	No	Yes	No	Yes	No	Not clear
Presentation of results								
31. Incremental analysis is reported	Yes	No	No	Yes	No	Yes	No	Yes
32. Major outcomes presented disaggregated and aggregated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
33. Answer to the study question is given	Yes	Yes	Not clear	Yes	Yes	Yes	Yes	Yes
34. Conclusions follow from the data reported	Yes	Yes	Yes	Yes	Yes	Yes	Not clear	Yes
35. Conclusions are accompanied by the appropriate caveats	Yes	Yes	Yes	Yes	Yes	Yes	Not clear	Yes

N.A., Not applicable.

QALY compared to the control group. This may be due to limited effects in some trials.

Most studies took a societal perspective, which is the broadest possible perspective, including indirect as well as direct costs. Several of the included studies claimed to have employed a societal perspective. However, whether some of these studies really employed a societal perspective is questionable, and seem to rather have a partial societal perspective at best with a largely health sector perspective and the addition of productivity impacts. Interestingly, two studies targeting smoking cessation from a societal perspective did not include productivity costs, but one may argue that these costs are less relevant when smoking cessation is the primary outcome.

Quality of economic evaluations of Internet interventions

The Consolidated Health Economic Evaluation Reporting Standards (CHEERS) checklist (Husereau *et al.* 2013) is a newly developed checklist which aims better reporting of economic evaluations, and ultimately to better health decisions. Although CHEERS is intended to, and may be a very good checklist for reporting economic evaluations, we found the checklist to be difficult to use as a quality rating instrument. For example, some items were not specific enough for quality rating purposes. Therefore, we preferred to use the Drummond 35-item checklist (Drummond & Jefferson, 1996). The 35-item checklist is a widely supported checklist, and is incorporated in the latest version of the Cochrane Handbook for Systematic Reviews of Interventions as one of two instruments to rate the risk of bias in economic evaluations. Topics addressed in both instruments are comparable.

Economic evaluations of interventions rely on the assessment of their clinical effectiveness. Any limitation which weakens the assessment of effectiveness weakens any economic evaluations based on it. The quality of the effectiveness study could be captured in assessing the risk of bias. However, none of the common reporting checklists (CHEERS or Drummond lists) requires authors to report risk of bias (e.g. sequence generation, allocation concealment, blinding) explicitly. The majority of economic evaluations included provided insufficient details on allocation method. However, this information may likely have been provided in the source publication. All included studies used an RCT design, and analysed data by ITT (except one paper). Blinding participants for treatment allocation is rarely achievable in intervention trials for mental health disorders. However, as most studies used online self-report questionnaires, assessors were blind for participant outcomes. The quality of economic evaluations of the included studies varied. Most studies had short time horizons for evaluation, which may yield conservative cost estimates. While some studies lacked a considerable amount of detail, more than half of the included studies demonstrated almost full adherence to the economic guidelines. All of them featured sensitivity and/or uncertainty analyses, which increases the robustness of results. Similar to other economic evaluation reviews (Kraemer, 2008; Mihalopoulos & Chatterton, 2014), our review revealed considerable differences in methodology across studies (e.g. economic perspective, economic analysis, comparator intervention, outcome measures, included costs). Several papers included development costs of the intervention in the CEA. As to whether or not to take these costs into account is a matter of debate. Ronckers *et al.* (2014), for example, argue that it is important to only include those costs that will have to be incurred if the intervention is performed again. This means that development costs and costs incurred for research purposes should not be included and are considered as 'sunk costs'. However, particularly with increasing complexity of Internet interventions, development costs can be continuous. Therefore, although these sunk costs are not part of the CEA, it is informative to report the development costs. As such, any ongoing maintenance, content-update or refinement costs should be included in the intervention costs. Furthermore, differences existed for measures of effectiveness and cost per clinical outcome (e.g. measures of reduction in symptoms, abstinence, quitters). These CERs may be useful for direct comparison to other programmes, but cannot be easily compared to outcomes of programmes for other health conditions. Instead, comparable standardized outcome measures, like QALYs are preferred (Mihalopoulos & Chatterton, 2014). The majority of included studies used QALYs to calculate cost-utility outcomes, thereby increasing the comparability of outcomes of the different Internet interventions. For this purpose, future researchers are advised to include CUA using QALYs in their economic evaluations.

Comparison with prior work

Our finding that guided Internet interventions are cost-effective compared to e.g. group treatment, attention control group, or wait-list echoes earlier reviews of Internet interventions focussing on ICBT (Hedman *et al.* 2012*b*; Arnberg *et al.* 2014) and physical illnesses (Tate *et al.* 2009).

Strengths and limitations

One of the strengths of this systematic review included the comprehensive search strategy used, including a

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number of economic databases. Another important strength was the use of multiple study assessors achieving high inter-rater agreement. However, some limitations of the current review should be noted. First, due to the variability of methods used in the included studies, the comparison of results was hindered and we were unable to conduct a meta-analysis. Second, the time horizon of the included economic evaluations differed, with two studies using a time horizon of only 6 weeks but the majority spanning 6 months. However, comparing studies with shorter and longer time horizons did not influence the conclusions. Third, by expressing ICERs in comparable currency can also give a false sense of comparability since costs may be collected and valued differently hence reducing comparability. In addition, several studies lacked uncertainty analysis and/or sensitivity analysis. Finally, despite an extensive search, the number of studies was small, and most studies used a wait-list control or attention placebo as a comparison group, instead of the most cost-effective intervention currently available, which restricted our interpretations as to whether Internet interventions are cost-effective.

Implications

The economic evaluation studies included in this review demonstrated that Internet interventions, and guided Internet interventions in particular, compared favourably to, or surpassed the cost-effectiveness of wait-list, attention-placebo and traditional services, including CBGT, unguided CBT and TAU. These initial results are promising and suggest that if access to guided Internet interventions were increased, this could result in significant cost savings and reduced service demand on the health system, whilst improving mental health outcomes and quality of life for patients. However, more research is needed to test this.

Future research

More economic valuations are needed, especially comparing guided Internet interventions and face-to-face interventions or the most cost-effective intervention currently available directly instead of wait-list or attention controls, and economic evaluations for disorders not addressed (e.g. specific anxiety disorders, insomnia). Interpretation of results of economic evaluation of Internet interventions may be significantly improved by increasing comparability between the studies, e.g. by using standardized generic measures, and a greater degree of agreement as to the necessary costs to include in evaluations (especially regarding intervention development costs). Furthermore, longer follow-ups, and increased adherence to economic evaluation guidelines such as the Drummond checklists (including uncertainty and sensitivity analyses) will increase the robustness of results. With the emerging field of eMental health, earlier developed evidence-based self-help manuals (e.g. Bower *et al.* 2001) seem to be forgotten. However, given their potential for cost-effective treatments, it would be of value to investigate this further.

As mental illnesses are associated with profound economic consequences, both to the individual and to wider society (Gilbody *et al.* 2006), the societal perspective might be the most ideal perspective of most value to policy makers. Another advantage is that a wide perspective allows narrowing down in secondary analyses. Therefore we advise future researchers to employ the societal perspective.

Conclusions

Guided Internet interventions for depression, anxiety, smoking cessation and alcohol consumption demonstrated higher probabilities of being more cost-effective than controls at an ICER range of £1801–33 124 (the point of indifference). However, the evidence for unguided Internet interventions for depression and smoking cessation was less convincing. Most studies adhered reasonably to economic guidelines. With increasing pressure on healthcare budgets across the globe, strategies to improve access to mental healthcare at lower cost are needed. Results of this review are promising, pointing to the possible inclusion of guided Internet interventions in these strategies, but more economic evaluations for guided Internet interventions compared to the most cost-effective intervention currently available, is needed in order to determine cost-effectiveness of Internet interventions.

Supplementary material

For supplementary material accompanying this paper visit http://dx.doi.org/10.1017/S0033291715001427

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Declaration of Interest

Authors M.B., B.L. and E.H. are authors of some of the included studies.

References

Arnberg FK, Linton SJ, Hultcrantz M, Heintz E, Jonsson U (2014). Internet-delivered psychological treatments for mood and anxiety disorders: a systematic review of their efficacy, safety, and cost-effectiveness. *PLoS ONE* **9**, e98118.

Beck AT, Steer RA, Ball R, Ranieri WF (1996). Comparison of Beck Depression Inventories -IA and -II in psychiatric outpatients. *Journal of Personality Assessment* **67**, 588–597.

Bencic W, Bucsics A, Dressler H, Gerold W, Hartinger B, Hauser A, Huber JO, Krammer H, Kratzer H, Muller M, Penk A, Placheta P, Probst J, Spanninger G, Wieninger P, Wild C, Windischbauer A (2006). *Guidelines on Health Economic Evaluation*. Vienna: Institut fur Pharmaokonomische Forschung.

Bergström J, Andersson G, Ljótsson B, Rück C, Andréewitch S, Karlsson A, Carlbring P, Andersson E, Lindefors N (2010). Internet-versus group-administered cognitive behaviour therapy for panic disorder in a psychiatric setting: a randomised trial. *BMC Psychiatry* **10**, 54.

Blankers M, Koeter MWJ, Schippers GM (2011). Internet therapy versus internet self-help versus no treatment for problematic alcohol use: a randomized controlled trial. *Journal of Consulting and Clinical Psychology* **79**, 330–341.

Blankers M, Nabitz U, Smit F, Koeter MW, Schippers GM (2012). Economic evaluation of internet-based interventions for harmful alcohol use alongside a pragmatic randomized controlled trial. *Journal of Medical Internet Research* **14**, e134.

Bower P, Richards D, Lovell K (2001). The clinical and cost-effectiveness of self-help treatments for anxiety and depressive disorders in primary care: a systematic review. *British Journal of General Practice* **51**, 838–845.

Chen YF, Madan J, Welton N, Yahaya I, Aveyard P, Bauld L, Wang D, Fry-Smith , Munafò MR (2012). Effectiveness and cost-effectiveness of computer and other electronic aids for smoking cessation: a systematic review and network meta-analysis. *Health Technology Assessment* **16**, 1–205.

Civljak M, Stead LF, Hartmann-Boyce J, Sheikh A, Car J (2014). Internet-based interventions for smoking cessation. *The Cochrane Database of Systematic Reviews* **10**, CD007078.

Drummond MF, Jefferson TO (1996). Guidelines for authors and peer reviewers of economic submissions to BMJ. *British Medical Journal* **313**, 275–283.

Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL (2005). *Methods for the Economic Evaluation of Health Care Programmes*, 3rd edn. Oxford University Press: New York, USA.

EuroQol-Group (1990). Euroqol – a new facility for the measurement of health-related quality of life. *Health Policy* **16**, 199–208.

Exchange-Rates. Wereld valuta wisselkoersen en valuta wisselkoers historie. Historical Rates. http://nl.exchange-rates.org/HistoricalRates/E/GBP/31-12-2012; https://archive.today/NiXxI. Accessed 17 October 2014.

Gerhards SAH, de Graaf LE, Jacobs LE, Severens JL, Huibers MJH, Arntz A, Riper H, Widdershoven G, Metsemakers JFM, Evers SMAA (2010). Economic evaluation of online computerised cognitive-behavioural therapy without support for depression in primary care: randomised trial. *British Journal of Psychiatry* **196**, 310–318.

Gilbody S, Bower P, Whitty P (2006). Costs and consequences of enhanced primary care for depression: systematic review of randomised economic evaluations. *British Journal of Psychiatry* **189**, 297–308.

Graham AL, Chang Y, Fang Y, Cobb NK, Tinkelman DS, Niaura RS, Abrams DB, Mandelblatt JS (2012). Cost-effectiveness of internet and telephone treatment for smoking cessation: an economic evaluation of The iQUITT Study. *Tobacco Control* **22**, e11.

Hedman E, Andersson E, Ljótsson B, Andersson G, Rück C, Lindefors N (2011). Cost-effectiveness of Internet-based cognitive behavior therapy vs. cognitive behavioral group therapy for social anxiety disorder: results from a randomized controlled trial. *Behaviour Research and Therapy* **49**, 729–736.

Hedman E, Andersson E, Lindefors N, Andersson G, Rück C, Ljótsson B (2012*a*). Cost-effectiveness and long-term effectiveness of Internet-based cognitive behaviour therapy for severe health anxiety. *Psychological Medicine* **43**, 1–12.

Hedman E, El Alaoui S, Lindefors N, Andersson E, Rück C, Ghaderi A, Kaldo V, Lekander M, Andersson G, Ljótsson B (2014). Clinical effectiveness and cost-effectiveness of Internet- vs. group-based cognitive behavior therapy for social anxiety disorder: 4-year follow-up of a randomized trial. *Behaviour Research and Therapy* **59**, 20–29.

Hedman E, Ljótsson B, Lindefors N (2012*b*). Cognitive behavior therapy via the Internet: a systematic review of applications, clinical efficacy and cost-effectiveness. *Expert Review of Pharmacoeconomics & Outcomes Research* **12**, 745–764.

Hollinghurst S, Peters TJ, Kaur S, Wiles N, Lewis G, Kessler D (2010). Cost-effectiveness of therapist-delivered online cognitive-behavioural therapy for depression: randomised controlled trial. *British Journal of Psychiatry*, **197**, 297–304.

Husereau D, Drummond M, Petrou S, Carswell C, Moher D, Greenberg D, Augustovski F, Briggs AH, Mauskopf J, Loder E (2013). Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement. *Cost Effectiveness and Resource Allocation: C/E* **11**, 1, 6.

Javitz HS, Zbikowski SM, Deprey M, Mcafee TA, Mcclure JB, Richards J, Catz SL, Jack LM, Swan GE (2011). Cost-effectiveness of varenicline and three different behavioral treatments for smoking cessation. *Translational Behavioral Medicine* **1**, 182–190.

Karanikolos M, Mladovsky P, Cylus J, Thomson S, Basu S, Stuckler D, Mackenback JP, McKee M (2013). Financial crisis, austerity, and health in Europe. *Lancet* **381**, 1323–1331.

Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR & Walters EE (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV Disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry* **62**, 593–602.

Kraemer KL (2008). The cost-effectiveness and cost-benefit of screening and brief intervention for unhealthy alcohol use in medical settings. *Substance Abuse* **28**, 6–77.

Mihalopoulos C, Chatterton ML (2014). Economic evaluations of interventions designed to prevent mental disorders: a systematic review. *Early Intervention in Psychiatry* **9**, 85–92.

Muennig P (2007). *Cost-Effectiveness Analysis in Health: A Practical Approach*, 2nd edn. Jossey-Bass: San Francisco.

Nordgren LB, Hedman E, Etienne J, Bodin J, Kadowaki A, Eriksson S, Lindkvist E, Andersson G, Carlbring P (2014). Effectiveness and cost-effectiveness of individually tailored Internet-delivered cognitive behavior therapy for anxiety disorders in a primary care population: a randomized controlled trial. *Behaviour Research and Therapy* **59**, 1–11.

Phillips R, Schneider J, Molosankwe I, Leese M, Foroushani PS, Grime P, McCrone P, Morriss R, Thornicroft G (2014). Randomized controlled trial of computerized cognitive behavioural therapy for depressive symptoms: effectiveness and costs of a workplace intervention. *Psychological Medicine* **44**, 741–752.

Richards D, Richardson T (2012). Computer-based psychological treatments for depression: a systematic review and meta-analysis. *Clinical Psychology Review* **32**, 329–342.

Riper H, Blankers M, Hadiwijaya H, Cunningham J, Clarke S, Wiers R, Eber D, Cuijpers P (2014). Effectiveness of guided and unguided low-intensity internet interventions for adult alcohol misuse: a meta-analysis. *PLoS ONE* **9**, e99912.

Ritterband LM, Thorndike FP, Gonder-Frederick LA, Magee JC, Bailey ET, Saylor DK, Morin CM (2009). Efficacy of an Internet-based behavioral intervention for adults with insomnia. *Archives of General Psychiatry* **66**, 692–698.

Rodgers M, Asaria M, Walker S, McMillan D, Lucock M, Harden M, Palmer S, Eastwood A (2012). The clinical effectiveness and cost-effectiveness of low intensity psychological interventions for the secondary prevention of relapse after depression: a systematic review. *Health Technology Assessment* **16**, 1–130.

Ronckers ET, Groot W, Ament AJHA (2014). Systematic review of economic evaluations of smoking cessation: standardizing the cost-effectiveness. *Medical Decision Making* **25**, 437–448.

Saha S, Hoerger TJ, Pignone MP, Teutsch SM, Helfand M, Mandelblatt JS (2001). The art and science of incorporating cost effectiveness into evidence-based recommendations for clinical preventive services. *American Journal of Preventive Medicine* **20**, 36–43.

Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption – II. *Addiction*, **88**, 791–804.

Smit ES, Evers SMAA, De Vries H, Hoving C (2013). Cost-effectiveness and cost-utility of internet-based computer tailoring for smoking cessation. *Journal of Medical Internet Research* **15**, e57.

Tate DF, Finkelstein EA, Khavjou O, Gustafson A (2009). Cost effectiveness of internet interventions: review and recommendations. *Annals of Behavioral Medicine* **38**, 40–45.

Titov N, Andrews G, Johnston L, Schwencke G, Choi I (2009). Shyness programme: longer term benefits, cost-effectiveness, and acceptability. *Australian and New Zealand Journal of Psychiatry* **43**, 36–44.

Van Spijker BAJ, van Straten A, Kerkhof AJFM (2014). Effectiveness of online self-help for suicidal thoughts: results of a randomised controlled trial. *PLoS ONE* **9**, e90118.

Van Spijker BAJ, Majo MC, Smit F, van Straten A, Kerkhof AJFM (2012). Reducing suicidal ideation: cost-effectiveness analysis of a randomized controlled trial of unguided web-based self-help. *Journal of Medical Internet Research* **14**, e141.

Wade AG, Häring J (2010). A review of the costs associated with depression and treatment noncompliance: the potential benefits of online support. *International Clinical Psychopharmacology* **25**, 288–296.

Wallace P, Murray E, McCambridge J, Khadjesari Z, White IR, Thompson SG, Kalitzaki E, Godfrey C, Linke S (2011). On-line randomized controlled trial of an internet based psychologically enhanced intervention for people with hazardous alcohol consumption. *PLoS ONE* **6**, e14740.

Warmerdam L, Smit F, van Straten A, Twisk J, Riper H, Cuijpers P (2010). Cost-Utility and Cost-Effectiveness of Internet-based treatment for adults with depressive symptoms: randomized Trial. *Journal of Medical Internet Research* **12**, e53.

Warmerdam L, van Straten A, Twisk J, Riper H, Cuijpers P (2008). Internet-based treatment for adults with depressive symptoms: randomized controlled trial. *Journal of Medical Internet Research* **10**, e44.

Wittchen HU, Fuetsch M, Sonntag H, Müller N & Liebowitz M (2000). Disability and quality of life in pure and comorbid social phobia. Findings from a controlled study. *European Psychiatry* **15**, 46–58.

World Bank Data (2014). Inflation, GDP deflator (annual%). http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG/countries; https://archive.today/PN4vQ. Accessed 17 October 2014.