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# Cost-effectiveness of Internet-based cognitive behaviour therapy and behavioural stress management for severe health anxiety

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Abstract

**Objectives:** Internet-delivered exposure-based cognitive behaviour therapy (ICBT) has been shown to be effective in the treatment of severe health anxiety. The health economic effects of the treatment have however been insufficiently studied and no prior study has investigated the effect of ICBT compared to an active psychological treatment. The aim of the present study was to investigate the cost-effectiveness of ICBT compared to Internet-delivered behavioural stress management (IBSM) for adults with severe health anxiety defined as DSM-IV hypochondriasis. ICBT was hypothesized to the more cost-effective treatment.

**Setting:** This was a cost-effectiveness study within the context of a randomized controlled trial conducted in a primary care/university setting. Participants from all of Sweden could apply to participate.

**Participants:** Self-referred adults (N=158) with a principal diagnosis of DSM-IV hypochondriasis of whom 151 (96%) provided baseline and post-treatment data.

**Interventions:** ICBT or IBSM for 12 weeks.

**Primary and secondary measures:** The primary outcome was the Health Anxiety Inventory. Secondary outcome was the EQ-5D. Other secondary measures were used in the main outcome study but were not relevant for the present health economic analysis.

**Results:** Both treatments led to significant reductions in gross total costs, costs of health care visits, direct non-medical costs, and costs of domestic work cutback ($p$=.000-.035). The incremental cost-effectiveness ratio (ICER) indicated that the cost of one additional case of

clinically significant improvement in ICBT compared to IBSM was $144. The cost-utility ICER, i.e. the cost of one additional quality adjusted life year, was estimated to $10000.

**Conclusions:** ICBT is a cost-effective treatment compared to IBSM and treatment costs are offset by societal net cost reductions in a short time. A cost-benefit analysis speaks for ICBT to play an important role in increasing access to effective treatment for severe health anxiety.

**Trial registration:** Clinicaltrials.gov (Identifier NCT01673035).

*Key words:* Health economics, cost-effectiveness, severe health anxiety, Internet-delivered exposure-based therapy, Internet-delivered behavioural stress management

## Strengths and limitations of the study

*Strengths*

- A randomized controlled design was used
- Attrition rates were low
- A prospective societal perspective was used

*Limitations*

- Two Internet-based treatments were compared but we did not include a trial arm with conventional face-to-face treatment

## Introduction

Several features of severe health anxiety, here defined as DSM-IV hypochondriasis, lead to high societal costs of illness. These features include that severe health anxiety is associated with an increased health care consumption and functional impairment [1,2]. It is also a relatively common disorder and in absence of treatment it is chronic for most patients [3,4].

Although previously considered a disorder highly difficult to treat, in the last 15 years cognitive behaviour therapy (CBT) has emerged as an empirically supported treatment for severe health anxiety yielding large reductions of health anxiety [5]. Few studies have however investigated whether CBT is a cost-effective treatment. This type of analysis means relating the additional gains to the additional costs of an experimental treatment compared with an alternative, such as another treatment or wait-list [6]. Cost-effectiveness analysis is highly important as it provides information that can be used to guide treatment decisions so that more patients can be treated effectively and waiting times be reduced. Two studies have analysed cost-effectiveness of CBT for severe health anxiety delivered in a conventional face-to-face format compared to treatment as usual using data from randomized controlled trials [7,8]. In the first study it was found that CBT but not the control condition reduced consumption of primary and secondary health care contacts, but total costs were unchanged in both conditions [7]. In the second study, a large scale randomized trial, the health economic analyses showed that there were no significant differences between the two treatment conditions [8]. In both of the above studies CBT was superior in reducing health anxiety symptoms compared to treatment as usual which means, as costs were similar across groups, that CBT is likely to be the more cost-effective treatment option.

Our research group has developed an Internet-delivered exposure-based cognitive behaviour therapy (ICBT), which has been shown to be effective in reducing health

anxiety in two randomized controlled trials [9,10]. In terms of format, ICBT can be described as Internet-based bibliotherapy with online therapist support through a secure asynchronous online messaging system [11]. ICBT carries several advantages where one of the most essential being that it can increase access to psychological treatment for severe health anxiety as each therapist can have up to 80 patients in on-going treatment. Only one health economic evaluation ICBT for severe health anxiety has been conducted and in that study it was found that the treatment was highly cost-effective in comparison to a basic attention control condition that did not receive active treatment [12]. The incremental cost-effectiveness ratio was -£1244, meaning that each case of improvement in ICBT relative to the control condition generated a societal net economic gain of £1244. That is, the results suggested that when providing ICBT instead of no treatment, the most likely outcome is that patients are improved while society reduces its costs for health anxiety. No prior study has however investigated whether ICBT is cost-effective when compared to an active and comprehensive psychological treatment. In the most recently conducted trial of ICBT we compared it with Internet-delivered behavioural stress management (IBSM), which contrasts to ICBT in the sense that it is based on taking direct control over symptoms through stress management and applied relaxation. The results showed that both treatments caused large improvements in health anxiety but that participants who received ICBT made significantly larger reductions of health anxiety than those in IBSM [10]. This trial provides an excellent framework for investigating the cost-effectiveness of ICBT compared to an active treatment and to add on the limited body of knowledge on health economic aspects of CBT for severe health anxiety.

The aim of this study was to investigate the cost-effectiveness of ICBT vs. IBSM for severe health anxiety featuring a societal perspective and using randomized trial data. Our hypothesis was that ICBT would be cost-effective compared to IBSM using the

criteria of NICE [13], i.e. that an additional case of improvement or quality adjusted life year (QALY) would be achieved at a cost not exceeding £20000.

## Methods

*Design of the study*

This study used a prospective cost-effectiveness analysis design and a societal perspective was taken. This meant that direct costs, e.g. health care consumption, as well as indirect costs, e.g. work-cutback, were assessed and analysed. Data were collected within the context of a randomized controlled trial of ICBT (n=79) and IBSM (n=79) for adults with severe health anxiety. As outlined by Saha and co-workers, cost-effectiveness analysis is a combined measure of the incremental costs and gains of a new treatment compared to an alternative [14]. The outcome, incremental cost-effectiveness ratio (ICER), gives an estimate of the cost for one additional unit of improvement when administering ICBT compared to IBSM. Information about how the ICER is calculated is provided below under Data analysis. The trial was preregistered with clinicaltrials.gov (Identifier NCT01673035) and specifically approved by the Regional Ethics Review Board in Stockholm, Sweden. All participants provided written (through a web portal) informed consent. This procedure was approved by the ethics committee.

*Participants and recruitment*

The total sample comprised 158 adult participants with severe health anxiety, of whom 79 were randomized to ICBT and 79 to IBSM. The mean age in ICBT was 41.7 years (SD=13.6) and 41.4 (SD=13.2) in IBSM. There were 64 women (81%) in the ICBT group and the participants had suffered from health anxiety for 13 years on average (SD=13.1). In the IBSM group, there were 61 women (77%) and the participants had experienced symptoms of health

anxiety for 14 years (SD=13.1). The study was conducted at the Karolinska Institutet in Stockholm, Sweden but recruitment was done nationwide. To be included in the study participants who applied had to: (a) have a principal diagnosis of severe health anxiety (hypochondriasis) according to DSM-IV, (b) be at least 18 years old, (c) have no on-going or prior episode of bipolar disorder or psychosis, (d) have no on-going substance abuse or addiction, (e) have stable dosage since at least two months if on antidepressant or anxiolytic medication and agree to keep the dosage constant throughout the study, (f) not have severe depressive symptoms or serious suicide ideation as indicated by a total score or ≥ 31 or ≥4 on item 9 of the Montgomery Åsberg Depression Rating Scale-Self-rated [MADRS-S; 15], (g) receive no concurrent psychological treatment for severe health anxiety and have no history of completed CBT for severe health anxiety during the last 3 years, and (h) have no serious somatic disorder to which the health anxiety would be an adequate response. Diagnostic assessments were conducted using the MINI and the Anxiety Disorders Interview Schedule. A more detailed description of the recruitment procedure is presented in the Hedman et al. [10] paper.

Treatments

Both treatments comprised extensive self-help texts divided into 12 modules with associated homework exercises and participants were expected to complete at least one module per week during the 12-week treatments. Participants accessed the modules through a secure Internet-based treatment platform. Throughout the treatment, An online therapist guided participants and provided feedback on homework exercises through an asynchronous messaging system similar to email. As a main principle, the patient is exposed to the same treatment components as in face-to-face treatment.

*Internet-delivered exposure-based cognitive behaviour therapy (ICBT)*

The main intervention component was systematic exposure to health anxiety related situations or events in combination with response prevention. As described in the main outcome paper [10] an example of this could be to trigger feared bodily sensations through physical exercise (exposure) while refraining from checking that the pulse is normal (response prevention). Mindfulness training was used throughout the treatment as a way to enhance exposure, i.e. it was not a stand-alone intervention but used as a way to increase the possibility that patients would conduct exposure exercises. Treanor [16] has suggested that mindfulness training could facilitate extinction learning during exposure through increasing awareness of conditioned triggers of anxiety. The treatment was conducted within an exposure-extinction paradigm and patients were encouraged to use mindfulness and acceptance towards aversive internal events. This treatment has previously been shown to be effective both when given as face-to-face therapy [17] and via the Internet [9,10,18].

*Internet-delivered behavioural stress management (IBSM)*

The main components of IBSM were applied relaxation and various stress management strategies including activity scheduling, structured problem solving, and increasing recuperating activities. IBSM differed from ICBT in the important sense that it focused on direct symptom control rather than on exposure to health-anxiety related events. That is, when feeling anxious participants were encouraged to use applied relaxation and stress reduction techniques to take direct control over health anxiety symptoms. The treatment was similar to the behavioural stress management for severe health anxiety tested in a face-to-face format by Clark, Salkovskis and colleagues [19]. Applied relaxation did not strictly follow but was inspired by the treatment developed by Öst [20] and had previously been tested as an Internet-based intervention [21]. The program started with progressive relaxation,

followed by release-only relaxation, conditioning a relaxed state to a verbal cue, and applying rapid relaxation in distressing situations.

*Clinical outcome assessment*

The Health Anxiety Inventory [HAI; 22] was the primary outcome measure. This instrument has been shown to be a highly reliable health anxiety measure (test-retest $r$=.90 and Cronbach's $\alpha$=.95).

In order to assess health-related quality of life we used the EQ5D [23]. This is an instrument designed to be a generic measure of quality of life and suitable for a wide range of patient groups. It assesses mobility, self-care, usual activities, pain/discomfort and anxiety/depression [24].

*Cost assessment*

We used the Trimbos and Institute of Medical Technology Assessment Cost Questionnaire for Psychiatry [TIC-P; 25] to collect economic cost data. The TIC-P measures three economic domains: direct medical costs, indirect medical costs, and indirect non-medical costs. Direct medical costs are those associated with health care consumption, such as emergency care visits or visit to a psychiatrist. Indirect medical costs are costs that are related to the clinical problem, but not considered health care, such as participating in self-help groups. Finally, indirect non-medical costs are those related to loss of productivity, such as costs for sick leave or domestic productivity loss. When estimating costs of productivity loss we used the human capital approach, which means that monetary losses for the duration of the entire period of productivity loss were taken into account [26]. The costs were initially assessed in Swedish Krona (SEK) and converted into USD ($) using 2013 as reference year, yielding a one SEK equivalent of 0.1535 USD. Costs of health care services and medications were, when available, obtained from official health care tariff indexes for services offered

within the publicly funded health care system. The costs of the ICBT and IBSM were modelled as a function of therapist time using the same health care index to determine therapist tariffs, i.e., tariffs for licensed psychologists.

*Procedures*

Participants were randomized to ICBT or IBSM in a 1:1 ratio using no restriction or matching. Randomization took place after inclusion assessment meaning that no allocation bias could be present in terms of assessors knowing the status of forthcoming allocations. Clinical and health economic data of the present study were collected at baseline, i.e. before treatment start, and at post-treatment. Self-report assessments were conducted using a secure online assessment system. Internet-administration has been shown to be a reliable format for measures of psychiatric symptoms and quality of life [27].

Data analysis

STATA IC/11.0 (Stata Corp.) and SPSS 22.0 (IBM) were used to conduct the statistical analyses. Clinical data were analysed using a mixed effects model approach for repeated data using time and treatment group as independent variables [28]. Effect sizes were calculated using Cohen's *d* based on pooled standard deviations.

As for the health economic analyses, we estimated incremental cost-effectiveness ratios (ICERs) using the formula:

$$\frac{\Delta^{C1} - \Delta^{C2}}{\Delta^{E1} - \Delta^{E2}}$$

C1–C2 is the net difference in cost change between ICBT and IBSM at post-treatment and E1–E2 refers to the net difference of effectiveness of the two conditions [26]. The total net difference in costs was thus divided by the net difference in effectiveness. In this study effectiveness in the ICER formula was defined as the proportion of participants that showed

clinically significant improvement [29]. The criteria for clinically significant improvement was that participants had to be improved by at least 18 points on the HAI and have an end point score of 66 or lower. The ICER calculations were conducted using a bootstrap framework (5000 replications) generating an estimated figure of the incremental costs of ICBT compared to IBSM in relation to ICBT's incremental effectiveness. Using bootstrap sampling methods increases reliability of standard errors and cost distribution estimates [30].

Cost-utility analysis were also conducted, which is the same type of analysis as cost-effectiveness analysis, with the exception that the net cost of an incremental QALY is calculated instead of a disorder specific outcome measure [26] using the EQ5D and applying the quality of life weights as described by the EuroQol Group [31]. This meant that the cost-utility ICER was modelled as the ratio of the net between-group cost change difference and the net EQ5D change difference. For both cost-effectiveness and cost-utility ICERs we modelled graph planes comprising 5000 simulated ICERs in order to estimate the uncertainty around the ICER. Within-group cost changes were analysed using sign tests due to non-normality of the cost data. For the same reason, we used Mann-Whitney U tests to analyse between-group cost differences and Spearman's rho to assess association between improvement in health anxiety and gross total changes. As attrition rates were very low we imputed missing cost data carrying the last known observation forward.

## Results

*Attrition and health anxiety outcome*

Of the 158 participants, 158 (100%) completed assessments at baseline and 151 (96%) provided data at post-treatment. As previously reported, the pre-to-post-treatment effect size on the primary outcome of health anxiety HAI was $d$=1.8 in the ICBT group and

*d*=1.2 in the IBSM group, indicating that both treatments yielded large improvements in health anxiety [10]. Mixed-effects models analysis showed that ICBT led to significantly larger reductions of health anxiety compared to IBSM (*F*=3.9; df=2, 121; *p*=.022).

*Cost changes*

Table 1 presents estimates of costs across assessment points for ICBT and IBSM. In both ICBT and IBSM there were significant reductions in gross total costs, health care visit costs, direct non-medical costs, and costs of domestic work cutback (Z=-5.78--2.11; *p*=.000-.035). Participants in IBSM also reduced their medication costs (Z=-2.97; *p*=.006) whereas ICBT participants did not (Z=-0.38; *p*=.703). None of the groups had any cost changes regarding unemployment, sick leave or unemployment (Z=-0.16-0.00; *p*=.289-1.000). Mann-Whitney U showed no baseline or post-treatment between-group differences on any of the above type of costs (U=2614-3099; *p*=.073-.938).

*Association of cost and health anxiety changes*

As indicated by Spearman's rho analysis, there was a significant association between gross total cost changes and improvement in health anxiety as measured by the HAI in the among participants in the ICBT group (*r*=.31; *p*=.005) but not in the IBSM group (*r*=.17; *p*=.143). That is, participants in ICBT who made larger reductions of health anxiety lowered their costs more than those who were less improved.

*Cost-effectiveness analysis*

The cost-effectiveness ICER was estimated to 310/ 0.14 = 2214 indicating that each additional case of clinically significant improvement in ICBT compared to IBSM was associated with a societal cost of $2214. This was driven by slightly higher total net costs in

ICBT than in IBSM and that participants in ICBT were more likely to be clinically significant improved. The simulation of scattered ICERs is presented in Figure 1 where ICERs located in the southeastern quadrant suggests that ICBT is more effective to a lower net societal cost whereas ICERs in the northwestern quadrant indicates that ICBT is less effective and more costly. Of the ICERs in Figure 1, 4340 (87%) are located in the northeast quadrant indicating that the most likely outcome is that ICBT generates larger improvements at additional net societal costs. Of the remaining ICERs, 436 (9%) are located in the southeastern quadrant, 203 (4%) in the northwestern quadrant and 21 (<1%) in the soutwestern quadrant.

Figure 2 displays a cost-effectiveness acceptability curve where estimates vary as a function of societal willingness to pay (WTP) for an additional case of improvement. As shown in Figure 2, ICBT has a 9% probability of being cost-effective compared to IBSM if willingness to pay for an additional improvement is $0. If WTP is increased to $4000 the probability of ICBT being more cost-effective increases to 72% and if society were willing to pay $10000 for an additional case of clinically significant improvement the probability of ICBT being cost-effective compared to IBSM is 91%.

INSERT FIGURE 1 HERE; INSERT FIGURE 2 HERE

*Cost-utility analysis*

The cost-utility ICER was 310 / 0.031 = 10000 indicating that the incremental cost of one QALY in ICBT relative to IBSM was $10000. The cost-utility ICER plane in Figure 3 displays the scatter of the 5000 bootstrapped ICERs. The distribution of ICERs in the four quadrants is as follows: 3770 (75%) are located in the northeastern quadrant, 773 (15%) are in the northwestern quadrant, 401 (8%) ICERs are in the southeastern quadrant and 56 (1%) are located in the southwestern quadrant. The most likely outcome is thus that ICBT in

comparison to IBSM generates larger improvements in health-related quality of life to a larger net societal cost.

INSERT FIGURE 3 HERE

## Discussion

The aim of this study was to investigate the cost-effectiveness of ICBT and IBSM for severe health anxiety featuring a societal perspective. To our knowledge this is the second study assessing ICBT from a health economic view and the first to investigate the cost-effectiveness of two comprehensive psychological treatments for severe health anxiety. The results showed that both treatments significantly reduced the gross total costs, which was driven by lowered costs of health care visits, direct non-medical costs, and costs of domestic work cutback. The cost-effectiveness ICER indicated that the cost of one additional case of clinically significant improvement, when treating patients with ICBT instead of IBSM, was $2214 while the cost-utility ICER was $10000. Taken together the findings indicate that ICBT is a cost-effective treatment in comparison to IBSM.

In comparison to the previously conducted study investigating cost-effectiveness of ICBT for severe health anxiety, the findings of the present study showed a substantially higher ICER estimate. As ICBT displayed very similar outcomes both in terms of treatment pre-to-post effects and costs as in the previous randomized trial [9], the difference in ICERs across studies is explained by how the comparator performed. IBSM was much more effective in reducing health anxiety than the basic control condition in the first trial and also made significant cost reductions. As ICER is a relative measure this explains the higher ICER of the present study. With that being said, it is important to underscore that the ICERs of the present

study were rather small in a broader perspective and clearly below the suggested cost-effectiveness limit proposed by NICE, which is £20000 [13].

Put slightly differently, ICBT is extremely cost-effective in comparison to no treatment and cost-effective compared to IBSM. These results fit well with the cost-effectiveness studies of face-to-face CBT compared to active control conditions, which showed that gross total costs were similar in both treatment conditions but that patients who underwent CBT made larger improvements [7,32]. A secondary, but interesting finding of the present study was that there was a significant association between health anxiety improvement and lowered gross total costs in ICBT. Speculatively, this could be indicative of slightly different mechanisms in the two treatments where ICBT works through engaging in activities that are incompatible with behaviours related to the costs assessed in the present study, whereas IBSM does not. That is, lowering costs in ICBT could be indicative of treatment adherence as cost reductions are likely to be associated with treatment coherent behaviours, such as refraining from seeking health care instantly when experiencing symptoms or going to work despite having high levels of symptoms. This adherence with treatment could then in turn be related to improvement in health anxiety. This however remains to be empirically investigated.

This study has several important implications. First, the societal net costs of providing ICBT was estimated to be offset in a time frame as short as about 3 months. That is, the societal net cost savings exceed the cost of treatment in a short time period, which is important for policy makers, as ICBT thereby is a win-win treatment option in the sense that patients are improved at no longer-term net cost. Second, as the main part of cost reductions were in the realm of health care consumption it could mean that the agent that allocates resources to treat severe health anxiety will benefit through overall reduced resource use. For example, it may be that implementing ICBT for this patient group in primary care could lead

to reduced strain on general practitioners as the demand for their services decrease as severe health anxiety decreases. The significant association of health anxiety reduction and cost reduction found in the present study and in a previous clinical trial of the same treatment delivered in a face-to-face format [17] provide empirical support for this. In line with this are also the results from the trial by Seivewright and co-workers where it was found that CBT led to reduced health care consumption [7] Third, as each therapist can treat four times as many patients as in face-to-face CBT this Internet-delivered treatment can be an effective mean of making CBT accessible for patients with severe health anxiety.

Central strengths of the present study were the randomized design allowing for control over confounders, the high completion rates and the prospective societal perspective. As for limitations, the present study relied on self-report to obtain cost data, but this was regarded as acceptable against the background that studies have demonstrated high convergence between registry data and health economic estimates collected through self-report [33]. A second limitation was that we did not include a treatment arm of face-to-face CBT, which constitutes a highly important comparison treatment. This is an area for future research and although available effect size data suggest that face-to-face CBT and ICBT for severe health anxiety produce similar effects it cannot be ruled out that the additional direct costs of face-to-face CBT is balanced through larger health anxiety reductions.

Based on the findings of the present study we conclude that ICBT is a cost-effective treatment compared to IBSM and that the treatment leads to societal cost reductions offsetting the cost of intervention in a short time frame. ICBT has the potential to reduce suffering from a debilitating disorder while at the same time reducing strain on limited health care resources. Implementing ICBT could thus potentially be highly cost-effective not just from a societal perspective but also from a health care provider perspective. ICBT could play

an important role of making effective psychological treatment accessible for patients with severe health anxiety.

## Table

**Table 1.** *Costs by type of expenditure.*

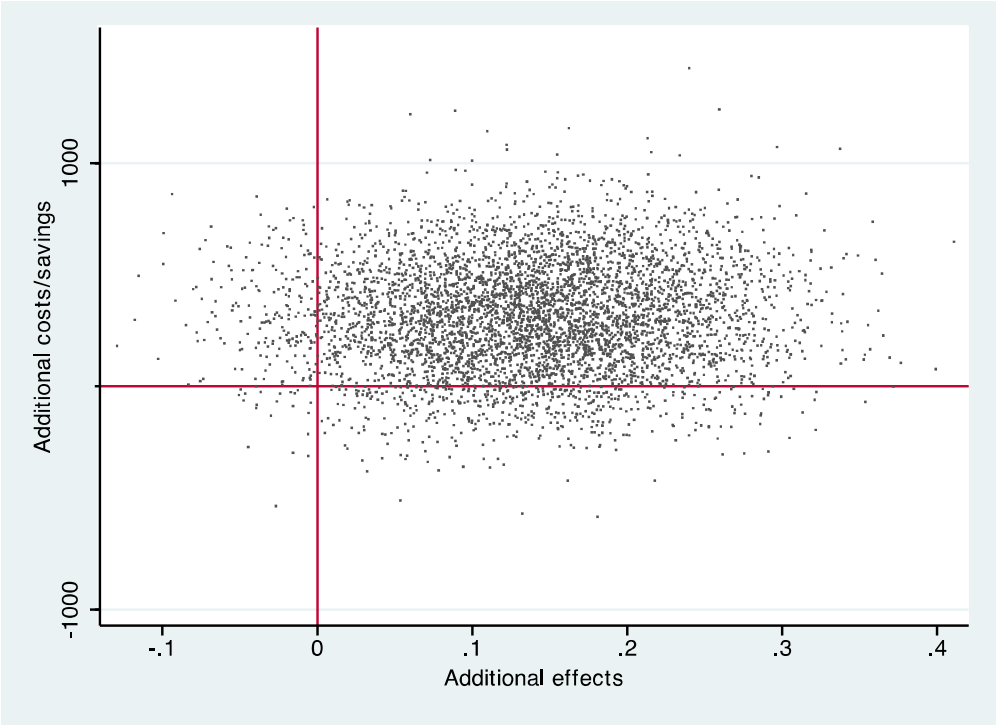
| Cost | Baseline | | | | Post-treatment | | | |
|---|---|---|---|---|---|---|---|---|
| | ICBT | | IBSM | | ICBT | | IBSM | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Direct medical | 569 | 773 | 547 | 552 | 337 | 407 | 354 | 403 |
| Health care visits | 562 | 770 | 540 | 550 | 331 | 405 | 350 | 404 |
| Medication | 7 | 13 | 6 | 9 | 6 | 10 | 4 | 8 |
| Direct non-medical costs | 173 | 370 | 129 | 224 | 139 | 374 | 106 | 269 |
| Indirect costs | 507 | 1059 | 621 | 1199 | 561 | 1392 | 439 | 910 |
| Unemployment | 238 | 926 | 354 | 1070 | 250 | 968 | 167 | 733 |
| Sick leave | 71 | 293 | 146 | 489 | 78 | 296 | 132 | 390 |
| Work cutback | 133 | 382 | 72 | 155 | 199 | 801 | 104 | 334 |
| Domestic | 65 | 140 | 49 | 173 | 34 | 68 | 37 | 125 |
| Gross total costs | 1249 | 1585 | 1297 | 1443 | 1036 | 1572 | 909 | 1077 |
| Intervention costs | – | | – | | 571 | | 431 | |
| Net total costs | | | | | 1607 | 1698 | 1340 | 1123 |

Note: ICBT, Internet-based cognitive behaviour therapy; IBSM, Internet-based behavioural stress management; All costs in $USD

CEA of ICBT and IBSM for health anxiety 20.

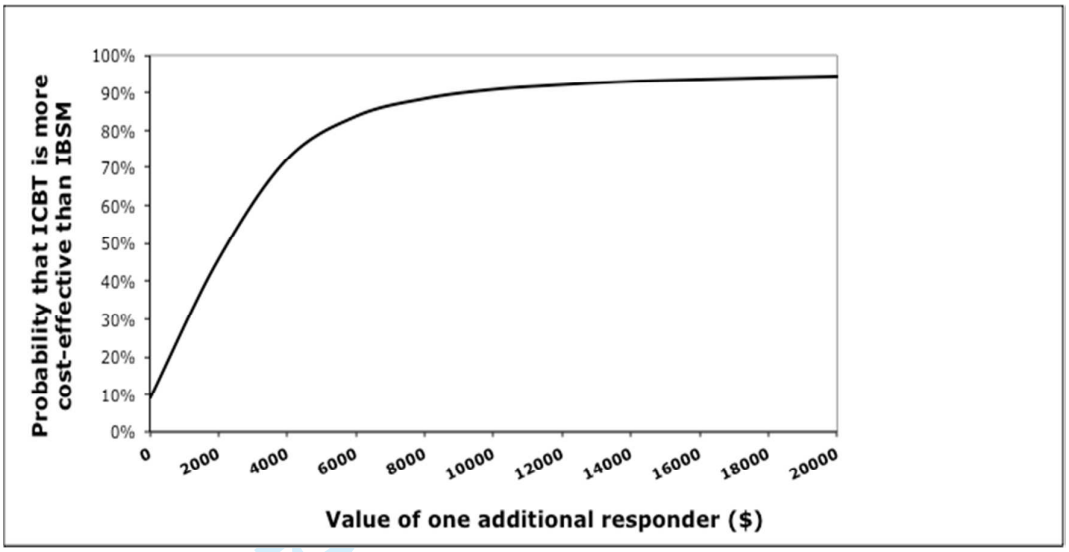
## Figures

**Figure 1.** *Cost-effectiveness plane comparing ICBT to IBSM.*



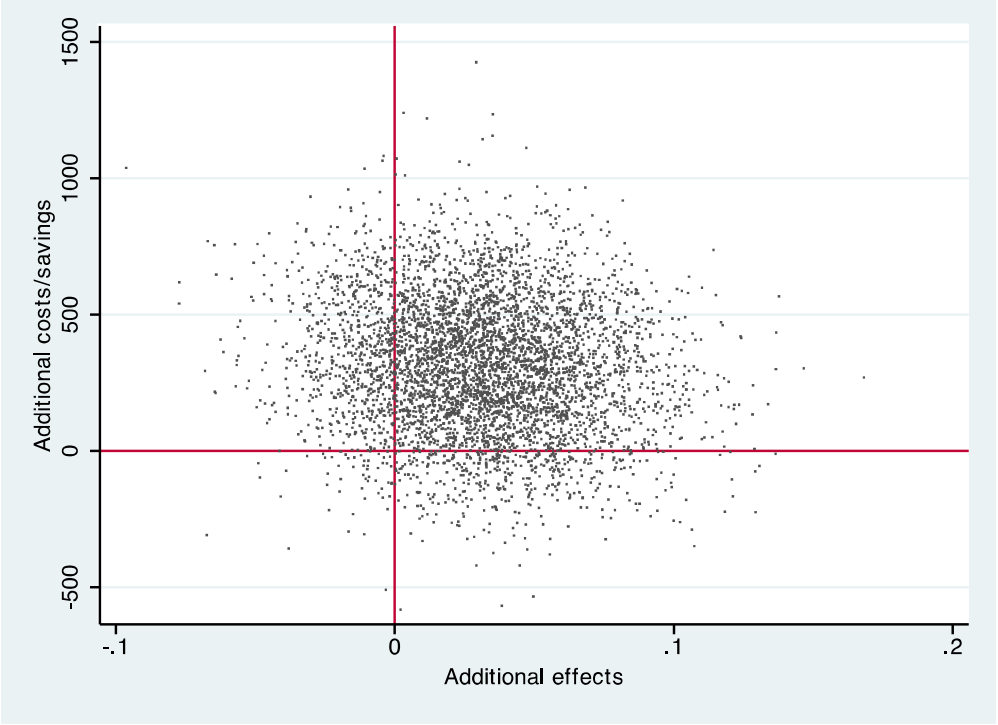

Note: ICBT, Internet-based cognitive behaviour therapy; IBSM, Internet-based behavioural stress management

**Figure 2**. *Cost-effectiveness acceptability curve comparing ICBT to IBSM.*




Note: ICBT, Internet-based cognitive behaviour therapy; IBSM, Internet-based behavioural stress management

**Figure 3.** *Cost-effectiveness utility plane comparing ICBT to IBSM.*




Note: ICBT, Internet-based cognitive behaviour therapy; IBSM, Internet-based behavioural stress management

## Contributorship statement

EH: conceived the study, collected data, interpreted the data, analyzed the data, drafted the paper.

EA: conceived the study, collected data, interpreted the data, drafted the paper.

BL: conceived the study, collected data, interpreted the data, drafted the paper.

ErlA: conceived the study, collected data, interpreted the data, drafted the paper.

ML: conceived the study, interpreted the data, drafted the paper.

## Competing interest

All authors report no competing interests.

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## Data sharing statement

No additional unpublished data are available.

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# CHEERS Checklist
## Items to include when reporting economic evaluations of health interventions

The **ISPOR CHEERS Task Force Report**, *Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—Explanation and Elaboration: A Report of the ISPOR Health Economic Evaluations Publication Guidelines Good Reporting Practices Task Force,* provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

| Section/item | Item No | Recommendation | Reported on page No/ line No |
|---|---|---|---|
| **Title and abstract** | | | |
| Title | 1 | Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared. | |
| Abstract | 2 | Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions. | |
| **Introduction** | | | |
| Background and objectives | 3 | Provide an explicit statement of the broader context for the study.<br>Present the study question and its relevance for health policy or practice decisions. | |
| **Methods** | | | |
| Target population and subgroups | 4 | Describe characteristics of the base case population and subgroups analysed, including why they were chosen. | |
| Setting and location | 5 | State relevant aspects of the system(s) in which the decision(s) need(s) to be made. | |
| Study perspective | 6 | Describe the perspective of the study and relate this to the costs being evaluated. | |
| Comparators | 7 | Describe the interventions or strategies being compared and state why they were chosen. | |
| Time horizon | 8 | State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate. | |
| Discount rate | 9 | Report the choice of discount rate(s) used for costs and outcomes and say why appropriate. | |
| Choice of health outcomes | 10 | Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed. | |
| Measurement of effectiveness | 11a | *Single study-based estimates:* Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data. | |

| | | | |
|---|---|---|---|
| | | 11b | *Synthesis-based estimates:* Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data. |
| | Measurement and valuation of preference based outcomes | 12 | If applicable, describe the population and methods used to elicit preferences for outcomes. |
| | Estimating resources and costs | 13a | *Single study-based economic evaluation:* Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs. |
| | | 13b | *Model-based economic evaluation:* Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs. |
| | Currency, price date, and conversion | 14 | Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate. |
| | Choice of model | 15 | Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended. |
| | Assumptions | 16 | Describe all structural or other assumptions underpinning the decision-analytical model. |
| | Analytical methods | 17 | Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty. |
| | **Results** | | |
| | Study parameters | 18 | Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended. |
| | Incremental costs and outcomes | 19 | For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios. |
| | Characterising uncertainty | 20a | *Single study-based economic evaluation:* Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact |

| | | | |
|---|---|---|---|
| | | of methodological assumptions (such as discount rate, study perspective). | |
| | 20b | *Model-based economic evaluation:* Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions. | |
| Characterising heterogeneity | 21 | If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information. | |
| **Discussion** | | | |
| Study findings, limitations, generalisability, and current knowledge | 22 | Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge. | |
| **Other** | | | |
| Source of funding | 23 | Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support. | |
| Conflicts of interest | 24 | Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations. | |

For consistency, the CHEERS Statement checklist format is based on the format of the CONSORT statement checklist

The **ISPOR CHEERS Task Force Report** provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* link or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

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# Cost-effectiveness of Internet-based cognitive behaviour therapy and behavioural stress management for severe health anxiety



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# Cost-effectiveness of Internet-based cognitive behaviour therapy and behavioural stress management for severe health anxiety

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Figures: 3

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Abstract

**Objectives:** Internet-delivered exposure-based cognitive behaviour therapy (ICBT) has been shown to be effective in the treatment of severe health anxiety. The health economic effects of the treatment have however been insufficiently studied and no prior study has investigated the effect of ICBT compared to an active psychological treatment. The aim of the present study was to investigate the cost-effectiveness of ICBT compared to Internet-delivered behavioural stress management (IBSM) for adults with severe health anxiety defined as DSM-IV hypochondriasis. ICBT was hypothesized to the more cost-effective treatment.

**Setting:** This was a cost-effectiveness study within the context of a randomized controlled trial conducted in a primary care/university setting. Participants from all of Sweden could apply to participate.

**Participants:** Self-referred adults (N=158) with a principal diagnosis of DSM-IV hypochondriasis of whom 151 (96%) provided baseline and post-treatment data.

**Interventions:** ICBT or IBSM for 12 weeks.

**Primary and secondary measures:** The primary outcome was the Health Anxiety Inventory. Secondary outcome was the EQ-5D. Other secondary measures were used in the main outcome study but were not relevant for the present health economic analysis.

**Results:** Both treatments led to significant reductions in gross total costs, costs of health care visits, direct non-medical costs, and costs of domestic work cutback ($p$=.000-.035). The incremental cost-effectiveness ratio (ICER) indicated that the cost of one additional case of

clinically significant improvement in ICBT compared to IBSM was $2214. The cost-utility ICER, i.e. the cost of one additional quality adjusted life year, was estimated to $10000.

**Conclusions:** ICBT is a cost-effective treatment compared to IBSM and treatment costs are offset by societal net cost reductions in a short time. A cost-benefit analysis speaks for ICBT to play an important role in increasing access to effective treatment for severe health anxiety.

**Trial registration:** Clinicaltrials.gov (Identifier NCT01673035).

*Key words:* Health economics, cost-effectiveness, severe health anxiety, Internet-delivered exposure-based therapy, Internet-delivered behavioural stress management

## Strengths and limitations of the study

*Strengths*

- A randomized controlled design was used
- Attrition rates were low
- A prospective societal perspective was used

*Limitations*

- Two Internet-based treatments were compared but we did not include a trial arm with conventional face-to-face treatment

## Introduction

Several features of severe health anxiety, here defined as DSM-IV hypochondriasis, lead to high societal costs of illness. These features include that severe health anxiety is associated with an increased health care consumption and functional impairment [1,2]. It is also a relatively common disorder and in absence of treatment it is chronic for most patients [3,4]. As health anxiety can be viewed as a dimensional phenomenon, ranging from adaptive concerns to severely debilitating anxiety [5], the term severe health anxiety is used in this paper to denote that we refer to clinically significant impaired individuals meeting diagnostic criteria of DSM-IV hypochondriasis.

Although previously considered a disorder highly difficult to treat, in the last 15 years cognitive behaviour therapy (CBT) has emerged as an empirically supported treatment for severe health anxiety yielding large reductions of health anxiety [6]. Few studies have however investigated whether CBT is a cost-effective treatment. This type of analysis means relating the additional gains to the additional costs of an experimental treatment compared with an alternative, such as another treatment or wait-list [7]. Cost-effectiveness analysis is highly important as it provides information that can be used to guide treatment decisions so that more patients can be treated effectively and waiting times be reduced. Two studies have analysed cost-effectiveness of CBT for severe health anxiety delivered in a conventional face-to-face format compared to treatment as usual using data from randomized controlled trials [8,9]. In the first study it was found that CBT but not the control condition reduced consumption of primary and secondary health care contacts, but total costs were unchanged in both conditions [8]. In the second study, a large scale randomized trial, the health economic analyses showed that there were no significant differences between the two treatment conditions [9]. In both of the above studies CBT was superior in reducing health anxiety

symptoms compared to treatment as usual which means, as costs were similar across groups, that CBT is likely to be the more cost-effective treatment option.

Our research group has developed an Internet-delivered exposure-based cognitive behaviour therapy (ICBT), which has been shown to be effective in reducing health anxiety in two randomized controlled trials [10]. In terms of format, ICBT can be described as Internet-based bibliotherapy with online therapist support through a secure asynchronous online messaging system [11,12]. ICBT carries several advantages where one of the most essential being that it can increase access to psychological treatment for severe health anxiety as each therapist can have up to 80 patients in on-going treatment. Only one health economic evaluation ICBT for severe health anxiety has been conducted and in that study it was found that the treatment was highly cost-effective in comparison to a basic attention control condition that did not receive active treatment [13]. The incremental cost-effectiveness ratio was -£1244, meaning that each case of improvement in ICBT relative to the control condition generated a societal net economic gain of £1244. That is, the results suggested that when providing ICBT instead of no treatment, the most likely outcome is that patients are improved while society reduces its costs for health anxiety. No prior study has however investigated whether ICBT is cost-effective when compared to an active and comprehensive psychological treatment. In the most recently conducted trial of ICBT we compared it with Internet-delivered behavioural stress management (IBSM), which contrasts to ICBT in the sense that it is based on taking direct control over symptoms through stress management and applied relaxation. The results showed that both treatments caused large improvements in health anxiety but that participants who received ICBT made significantly larger reductions of health anxiety than those in IBSM [12]. This trial provides an excellent framework for investigating the cost-effectiveness of ICBT compared to an active treatment and to add on the limited body of knowledge on health economic aspects of CBT for severe health anxiety.

The aim of this study was to investigate the cost-effectiveness of ICBT vs. IBSM for severe health anxiety featuring a societal perspective and using randomized trial data. Our hypothesis was that ICBT would be cost-effective compared to IBSM using the criteria of NICE [14], i.e. that an additional case of improvement or quality adjusted life year (QALY) would be achieved at a cost not exceeding £20000.

## Methods

*Design of the study*

This study used a prospective cost-effectiveness analysis design and a societal perspective was taken. This meant that direct costs, e.g. health care consumption, as well as indirect costs, e.g. work-cutback, were assessed and analysed. Data were collected within the context of a randomized controlled trial of ICBT (n=79) and IBSM (n=79) for adults with severe health anxiety. As outlined by Saha and co-workers, cost-effectiveness analysis is a combined measure of the incremental costs and gains of a new treatment compared to an alternative [15]. The outcome, incremental cost-effectiveness ratio (ICER), gives an estimate of the cost for one additional unit of improvement when administering ICBT compared to IBSM. Information about how the ICER is calculated is provided below under Data analysis. The trial was preregistered with clinicaltrials.gov (Identifier NCT01673035) and specifically approved by the Regional Ethics Review Board in Stockholm, Sweden. All participants provided written (through a web portal) informed consent. This procedure was approved by the ethics committee.

*Participants and recruitment*

The total sample comprised 158 adult participants with severe health anxiety, of whom 79 were randomized to ICBT and 79 to IBSM. The mean age in ICBT was 41.7 years (SD=13.6)

and 41.4 (SD=13.2) in IBSM. There were 64 women (81%) in the ICBT group and the participants had suffered from health anxiety for 13 years on average (SD=13.1). In the IBSM group, there were 61 women (77%) and the participants had experienced symptoms of health anxiety for 14 years (SD=13.1). The study was conducted at the Karolinska Institutet in Stockholm, Sweden but recruitment was done nationwide. To be included in the study participants who applied had to: (a) have a principal diagnosis of severe health anxiety (hypochondriasis) according to DSM-IV, (b) be at least 18 years old, (c) have no on-going or prior episode of bipolar disorder or psychosis, (d) have no on-going substance abuse or addiction, (e) have stable dosage since at least two months if on antidepressant or anxiolytic medication and agree to keep the dosage constant throughout the study, (f) not have severe depressive symptoms or serious suicide ideation as indicated by a total score or ≥ 31 or ≥4 on item 9 of the Montgomery Åsberg Depression Rating Scale-Self-rated [MADRS-S; 16], (g) receive no concurrent psychological treatment for severe health anxiety and have no history of completed CBT for severe health anxiety during the last 3 years, and (h) have no serious somatic disorder to which the health anxiety would be an adequate response. Diagnostic assessments were conducted using the MINI and the Anxiety Disorders Interview Schedule. A more detailed description of the recruitment procedure is presented in the Hedman et al. [12] paper.

Treatments

Both treatments comprised extensive self-help texts divided into 12 modules with associated homework exercises and participants were expected to complete at least one module per week during the 12-week treatments. Participants accessed the modules through a secure Internet-based treatment platform. Throughout the treatment, an online therapist guided participants and provided feedback on homework exercises through an asynchronous

messaging system similar to email. As a main principle, the patient is exposed to the same treatment components as in face-to-face treatment.

*Internet-delivered exposure-based cognitive behaviour therapy (ICBT)*

The main intervention component was systematic exposure to health anxiety related situations or events in combination with response prevention. As described in the main outcome paper [12] an example of this could be to trigger feared bodily sensations through physical exercise (exposure) while refraining from checking that the pulse is normal (response prevention). Mindfulness training was used throughout the treatment as a way to enhance exposure, i.e. it was not a stand-alone intervention but used as a way to increase the possibility that patients would conduct exposure exercises. This meant that participants were encouraged to use mindfulness techniques as a means to handle anxiety triggered by exposure. The treatment thus differed in this regard from the mindfulness-based cognitive treatment by McManus et al. [17] where mindfulness training is the main treatment component. Treanor [18] has suggested that mindfulness training could facilitate extinction learning during exposure through increasing awareness of conditioned triggers of anxiety. The treatment was conducted within an exposure-extinction paradigm and patients were encouraged to use mindfulness and acceptance towards aversive internal events. This treatment has previously been shown to be effective both when given as face-to-face therapy [19] and via the Internet [10,12,20].

*Internet-delivered behavioural stress management (IBSM)*

The main components of IBSM were applied relaxation and various stress management strategies including activity scheduling, structured problem solving, and increasing recuperating activities. IBSM differed from ICBT in the important sense that it

focused on direct symptom control rather than on exposure to health-anxiety related events. That is, when feeling anxious participants were encouraged to use applied relaxation and stress reduction techniques to take direct control over health anxiety symptoms. The treatment was similar to the behavioural stress management for severe health anxiety tested in a face-to-face format by Clark, Salkovskis and colleagues [21]. Applied relaxation did not strictly follow but was inspired by the treatment developed by Öst [22] and had previously been tested as an Internet-based intervention [23]. The program started with progressive relaxation, followed by release-only relaxation, conditioning a relaxed state to a verbal cue, and applying rapid relaxation in distressing situations.

*Clinical outcome assessment*

The Health Anxiety Inventory [HAI; 24] was the primary outcome measure. This instrument has been shown to be a highly reliable health anxiety measure (test-retest $r$=.90 and Cronbach's $\alpha$=.95).

In order to assess health-related quality of life we used the EQ5D [25]. This is an instrument designed to be a generic measure of quality of life and suitable for a wide range of patient groups. It assesses mobility, self-care, usual activities, pain/discomfort and anxiety/depression [26].

*Cost assessment*

We used the Trimbos and Institute of Medical Technology Assessment Cost Questionnaire for Psychiatry [TIC-P; 27] to collect economic cost data. The TIC-P is a self-report measure that covers three economic domains: direct medical costs, indirect medical costs, and indirect non-medical costs. Direct medical costs are those associated with health care consumption, such as emergency care visits or visit to a psychiatrist. Indirect medical costs are costs that are related to the clinical problem, but not considered health care, such as

participating in self-help groups. Finally, indirect non-medical costs are those related to loss of productivity, such as costs for sick leave or domestic productivity loss. When estimating costs of productivity loss we used the human capital approach, which means that monetary losses for the duration of the entire period of productivity loss were taken into account [28]. The costs were initially assessed in Swedish Krona (SEK) and converted into USD ($) using 2013 as reference year, yielding a one SEK equivalent of 0.1535 USD. Costs of health care services and medications were, when available, obtained from official health care tariff indexes for services offered within the publicly funded health care system. The costs of the ICBT and IBSM were modelled as a function of therapist time using the same health care index to determine therapist tariffs, i.e., tariffs for licensed psychologists.

*Procedures*

Participants were randomized to ICBT or IBSM in a 1:1 ratio using no restriction or matching. Randomization took place after inclusion assessment meaning that no allocation bias could be present in terms of assessors knowing the status of forthcoming allocations. Clinical and health economic data of the present study were collected at baseline, i.e. before treatment start, and at post-treatment. Self-report assessments were conducted using a secure online assessment system. Internet-administration has been shown to be a reliable format for measures of psychiatric symptoms and quality of life [29].

Data analysis

STATA IC/11.0 (Stata Corp.) and SPSS 22.0 (IBM) were used to conduct the statistical analyses. Clinical data were analysed using a mixed effects model approach for repeated data using time and treatment group as independent variables [30]. Effect sizes were calculated using Cohen's *d* based on pooled standard deviations.

As for the health economic analyses, we estimated incremental cost-

effectiveness ratios (ICERs) using the formula:

$$\frac{\Delta^{C1} - \Delta^{C2}}{\Delta^{E1} - \Delta^{E2}}$$

C1–C2 is the net difference in cost change between ICBT and IBSM at post-treatment and E1–E2 refers to the net difference of effectiveness of the two conditions [28]. The total net difference in costs was thus divided by the net difference in effectiveness. In this study effectiveness in the ICER formula was defined as the proportion of participants that showed clinically significant improvement [31]. The criteria for clinically significant improvement was that participants had to be improved by at least 18 points on the HAI and have an end point score of 66 or lower. Participants classified as clinically significant improved were thus reliably improved beyond what be could expected from measurement error using the Jacobson and Truax formula [31] (pre-to-post-treatment change divided by the standard error of the difference between scores) and were closer to the healthy population than to the clinical population. Healthy control scores were obtained from the study by Salkovskis et al. [24] and baseline scores of participants of the present study were used as reference for the clinical population. The ICER calculations were conducted using a bootstrap framework (5000 replications) generating an estimated figure of the incremental costs of ICBT compared to IBSM in relation to ICBT's incremental effectiveness. Using bootstrap sampling methods increases reliability of standard errors and cost distribution estimates [32].

Cost-utility analysis were also conducted, which is the same type of analysis as cost-effectiveness analysis, with the exception that the net cost of an incremental QALY is calculated instead of a disorder specific outcome measure [28] using the EQ5D and applying the quality of life weights as described by the EuroQol Group [33]. This meant that the cost-utility ICER was modelled as the ratio of the net between-group cost change difference and the net EQ5D change difference. For both cost-effectiveness and cost-utility ICERs we

modelled graph planes comprising 5000 simulated ICERs in order to estimate the uncertainty around the ICER. We also modelled cost-effectiveness acceptability curves, which is the proportion of scatter points falling south and east of a range of slopes through the origin of the ICER plane where a slope coefficient of 0 (equivalent to the x-axis) represents that willingness to pay is zero and 1 (equivalent to the y-axis) that willingness to pay is infinite [e.g. 34]. Within-group cost changes were analysed using sign tests due to non-normality of the cost data. For the same reason, we used Mann-Whitney U tests to analyse between-group cost differences and Spearman's rho to assess association between improvement in health anxiety and gross total changes. As attrition rates were very low we imputed missing cost data carrying the last known observation forward.

## Results

*Attrition and health anxiety outcome*

Of the 158 participants, 158 (100%) completed assessments at baseline and 151 (96%) provided data at post-treatment. As previously reported, the pre-to-post-treatment effect size on the primary outcome of health anxiety HAI was $d$=1.8 in the ICBT group and $d$=1.2 in the IBSM group, indicating that both treatments yielded large improvements in health anxiety [12]. Mixed-effects models analysis showed that ICBT led to significantly larger reductions of health anxiety compared to IBSM ($F$=3.9; df=2, 121; $p$=.022) (between-group $d$ at post-treatment=0.3).

*Cost changes*

Table 1 presents estimates of costs across assessment points for ICBT and IBSM. In both ICBT and IBSM there were significant reductions in gross total costs, health care visit costs, direct non-medical costs, and costs of domestic work cutback (Z=-5.78--2.11;

*p*=.000-.035). Participants in IBSM also reduced their medication costs (Z=-2.97; *p*=.006) whereas ICBT participants did not (Z=-0.38; *p*=.703). None of the groups had any cost changes regarding unemployment, sick leave or unemployment (Z=-0.16-0.00; *p*=.289-1.000). Mann-Whitney U showed no baseline or post-treatment between-group differences on any of the above type of costs (U=2614-3099; *p*=.073-.938). The slight difference in intervention costs (Table 1) was due to somewhat more therapist time used in ICBT (median minutes per week=11.0) compared to IBSM (median minutes per week=9.2).

*Association of cost and health anxiety changes*

As indicated by Spearman's rho analysis, there was a significant association between gross total cost changes and improvement in health anxiety as measured by the HAI in the among participants in the ICBT group (*r*=.31; *p*=.005) but not in the IBSM group (*r*=.17; *p*=.143). That is, participants in ICBT who made larger reductions of health anxiety lowered their costs more than those who were less improved.

*Cost-effectiveness analysis*

The cost-effectiveness ICER was estimated to 310/ 0.14 = 2214 indicating that each additional case of clinically significant improvement in ICBT (total n improved=38 (48%)) compared to IBSM (total n improved=27 (34%)) was associated with a societal cost of $2214. This was driven by slightly higher total net costs in ICBT than in IBSM and that participants in ICBT were more likely to be clinically significant improved. The simulation of scattered ICERs is presented in Figure 1 where ICERs located in the southeastern quadrant suggests that ICBT is more effective to a lower net societal cost whereas ICERs in the northwestern quadrant indicates that ICBT is less effective and more costly. Of the ICERs in Figure 1, 4340 (87%) are located in the northeast quadrant indicating that the most likely

outcome is that ICBT generates larger improvements at additional net societal costs. Of the remaining ICERs, 436 (9%) are located in the southeastern quadrant, 203 (4%) in the northwestern quadrant and 21 (<1%) in the soutwestern quadrant.

Figure 2 displays a cost-effectiveness acceptability curve where estimates vary as a function of societal willingness to pay (WTP) for an additional case of improvement. As shown in Figure 2, ICBT has a 9% probability of being cost-effective compared to IBSM if willingness to pay for an additional improvement is $0. If WTP is increased to $4000 the probability of ICBT being more cost-effective increases to 72% and if society were willing to pay $10000 for an additional case of clinically significant improvement the probability of ICBT being cost-effective compared to IBSM is 91%.

INSERT FIGURE 1 HERE; INSERT FIGURE 2 HERE

*Cost-utility analysis*

The cost-utility ICER was 310 / 0.031 = 10000 indicating that the incremental cost of one QALY in ICBT relative to IBSM was $10000. The cost-utility ICER plane in Figure 3 displays the scatter of the 5000 bootstrapped ICERs. The distribution of ICERs in the four quadrants is as follows: 3770 (75%) are located in the northeastern quadrant, 773 (15%) are in the northwestern quadrant, 401 (8%) ICERs are in the southeastern quadrant and 56 (1%) are located in the southwestern quadrant. The most likely outcome is thus that ICBT in comparison to IBSM generates larger improvements in health-related quality of life to a larger net societal cost.

INSERT FIGURE 3 HERE

## Discussion

The aim of this study was to investigate the cost-effectiveness of ICBT and IBSM for severe health anxiety featuring a societal perspective. To our knowledge this is the second study assessing ICBT from a health economic view and the first to investigate the cost-effectiveness of two comprehensive psychological treatments for severe health anxiety. The results showed that both treatments significantly reduced the gross total costs, which was driven by lowered costs of health care visits, direct non-medical costs, and costs of domestic work cutback. The cost-effectiveness ICER indicated that the cost of one additional case of clinically significant improvement, when treating patients with ICBT instead of IBSM, was $2214 while the cost-utility ICER was $10000. Taken together the findings indicate that ICBT is a cost-effective treatment in comparison to IBSM.

In comparison to the previously conducted study investigating cost-effectiveness of ICBT for severe health anxiety, the findings of the present study showed a substantially higher ICER estimate. As ICBT displayed very similar outcomes both in terms of treatment pre-to-post effects and costs as in the previous randomized trial [10], the difference in ICERs across studies is explained by how the comparator performed. IBSM was much more effective in reducing health anxiety than the basic control condition in the first trial and also made significant cost reductions. As ICER is a relative measure this explains the higher ICER of the present study. With that being said, it is important to underscore that the ICERs of the present study were rather small in a broader perspective and clearly below the suggested cost-effectiveness limit proposed by NICE, which is £20000 [14]. The threshold for what should be considered a cost-effective treatment is of course to some extent arbitrary and varies between countries. As described by Mihalopoulos and Chatterton [14] , the World Health Organization on Macroeconomics and Health has suggested that a general cost-effectiveness

criterion should be that if a the cost of a DALY does not exceed the average income per capita in a given country the treatment can be considered very cost-effective [35]. In 2013, the average annual income in Sweden was approximately (USD) $42500 [36] meaning that also when using the World Health Organization's criterion, the findings of the present study indicate that ICBT is cost-effective.

To summarize, ICBT is extremely cost-effective in comparison to no treatment and cost-effective compared to IBSM. These results fit well with the cost-effectiveness studies of face-to-face CBT compared to active control conditions, which showed that gross total costs were similar in both treatment conditions but that patients who underwent CBT made larger improvements [8,9].

This study has several important implications. First, the societal net costs of providing ICBT was estimated to be offset in a time frame as short as about 3 months. That is, the societal net cost savings exceed the cost of treatment in a short time period, which is important for policy makers, as ICBT thereby is a win-win treatment option in the sense that patients are improved at no longer-term net cost. Second, as the main part of cost reductions were in the realm of health care consumption it could mean that the agent that allocates resources to treat severe health anxiety will benefit through overall reduced resource use. For example, it may be that implementing ICBT for this patient group in primary care could lead to reduced strain on general practitioners as the demand for their services decrease as severe health anxiety decreases. The significant association of health anxiety reduction and cost reduction found in the present study and in a previous clinical trial of the same treatment delivered in a face-to-face format [19] provide empirical support for this. In line with this are also the results from the trial by Seivewright and co-workers where it was found that CBT led to reduced health care consumption [8] Third, as each therapist can treat four times as many

patients as in face-to-face CBT this Internet-delivered treatment can be an effective mean of making CBT accessible for patients with severe health anxiety.

Central strengths of the present study were the randomized design allowing for control over confounders, the high completion rates and the prospective societal perspective. As for limitations, the present study relied on self-report to obtain cost data, but this was regarded as acceptable against the background that studies have demonstrated high convergence between registry data and health economic estimates collected through self-report [37]. A second limitation was that we did not include a treatment arm of face-to-face CBT, which constitutes a highly important comparison treatment. This is an area for future research and although available effect size data suggest that face-to-face CBT and ICBT for severe health anxiety produce similar effects it cannot be ruled out that the additional direct costs of face-to-face CBT is balanced through larger health anxiety reductions.

Based on the findings of the present study we conclude that ICBT is a cost-effective treatment compared to IBSM and that the treatment leads to societal cost reductions offsetting the cost of intervention in a short time frame. ICBT has the potential to reduce suffering from a debilitating disorder while at the same time reducing strain on limited health care resources. Implementing ICBT could thus potentially be highly cost-effective not just from a societal perspective but also from a health care provider perspective. ICBT could play an important role of making effective psychological treatment accessible for patients with severe health anxiety.

## Table

**Table 1.** *Costs by type of expenditure.*

| Cost | Baseline | | | | Post-treatment | | | |
|---|---|---|---|---|---|---|---|---|
| | ICBT | | IBSM | | ICBT | | IBSM | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Direct medical | 569 | 773 | 547 | 552 | 337 | 407 | 354 | 403 |
| Health care visits | 562 | 770 | 540 | 550 | 331 | 405 | 350 | 404 |
| Medication | 7 | 13 | 6 | 9 | 6 | 10 | 4 | 8 |
| Direct non-medical costs | 173 | 370 | 129 | 224 | 139 | 374 | 106 | 269 |
| Indirect costs | 507 | 1059 | 621 | 1199 | 561 | 1392 | 439 | 910 |
| Unemployment | 238 | 926 | 354 | 1070 | 250 | 968 | 167 | 733 |
| Sick leave | 71 | 293 | 146 | 489 | 78 | 296 | 132 | 390 |
| Work cutback | 133 | 382 | 72 | 155 | 199 | 801 | 104 | 334 |
| Domestic | 65 | 140 | 49 | 173 | 34 | 68 | 37 | 125 |
| Gross total costs | 1249 | 1585 | 1297 | 1443 | 1036 | 1572 | 909 | 1077 |
| Intervention costs | – | | – | | 571 | | 431 | |
| Net total costs | | | | | 1607 | 1698 | 1340 | 1123 |

Note: ICBT, Internet-based cognitive behaviour therapy; IBSM, Internet-based behavioural stress management; All costs in $USD

## Contributorship statement

EH: conceived the study, collected data, interpreted the data, analyzed the data, drafted the paper.

EA: conceived the study, collected data, interpreted the data, drafted the paper.

BL: conceived the study, collected data, interpreted the data, drafted the paper.

ErlA: conceived the study, collected data, interpreted the data, drafted the paper.

ML: conceived the study, interpreted the data, drafted the paper.

## Competing interest

All authors report no competing interests.

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## Data sharing statement

No additional unpublished data are available.

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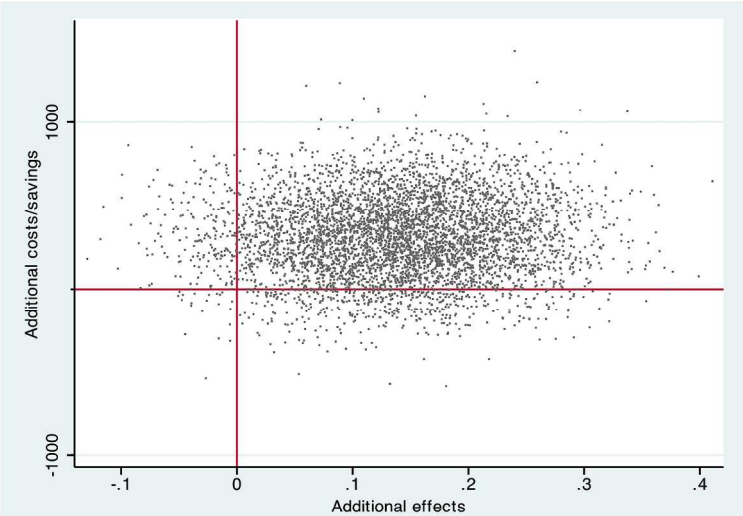
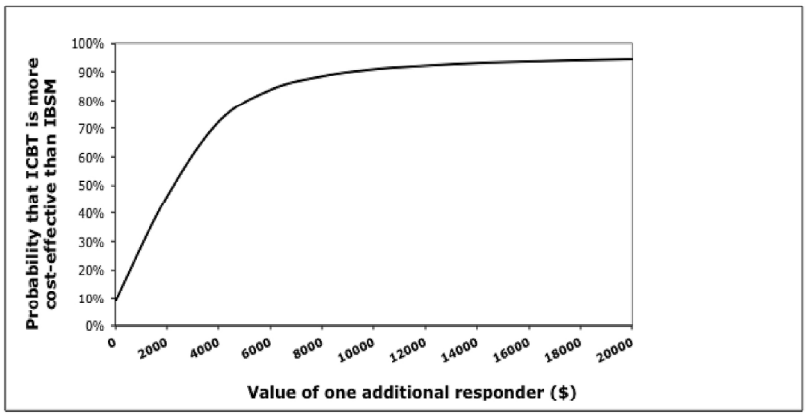
**Figure 1.** Cost-effectiveness plane comparing ICBT to IBSM.




Note: ICBT, Internet-based cognitive behaviour therapy; IBSM, Internet-based behavioural stress management

Figure 1. Cost-effectiveness plane comparing ICBT to IBSM.
188x150mm (300 x 300 DPI)

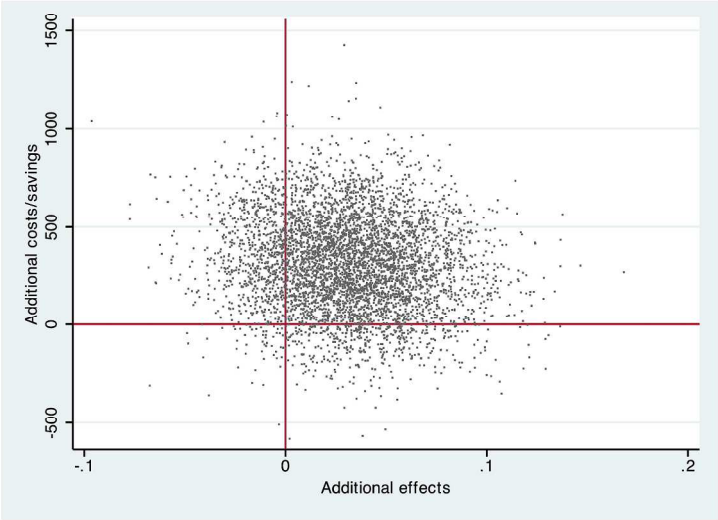
**Figure 2**. Cost-effectiveness acceptability curve comparing ICBT to IBSM.




Note: ICBT, Internet-based cognitive behaviour therapy; IBSM, Internet-based behavioural stress management

Figure 2. Cost-effectiveness acceptability curve comparing ICBT to IBSM.
187x128mm (300 x 300 DPI)

**Figure 3.** Cost-effectiveness utility plane comparing ICBT to IBSM.




Note: ICBT, Internet-based cognitive behaviour therapy; IBSM, Internet-based behavioural stress management

Figure 3. Cost-effectiveness utility plane comparing ICBT to IBSM
195x157mm (300 x 300 DPI)

# CHEERS Checklist
## Items to include when reporting economic evaluations of health interventions

The **ISPOR CHEERS Task Force Report**, *Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—Explanation and Elaboration: A Report of the ISPOR Health Economic Evaluations Publication Guidelines Good Reporting Practices Task Force,* provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

| Section/item | Item No | Recommendation | Reported on page No/ line No |
|---|---|---|---|
| **Title and abstract** | | | |
| Title | 1 | Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared. | |
| Abstract | 2 | Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions. | |
| **Introduction** | | | |
| Background and objectives | 3 | Provide an explicit statement of the broader context for the study.<br>Present the study question and its relevance for health policy or practice decisions. | |
| **Methods** | | | |
| Target population and subgroups | 4 | Describe characteristics of the base case population and subgroups analysed, including why they were chosen. | |
| Setting and location | 5 | State relevant aspects of the system(s) in which the decision(s) need(s) to be made. | |
| Study perspective | 6 | Describe the perspective of the study and relate this to the costs being evaluated. | |
| Comparators | 7 | Describe the interventions or strategies being compared and state why they were chosen. | |
| Time horizon | 8 | State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate. | |
| Discount rate | 9 | Report the choice of discount rate(s) used for costs and outcomes and say why appropriate. | |
| Choice of health outcomes | 10 | Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed. | |
| Measurement of effectiveness | 11a | *Single study-based estimates:* Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data. | |

| | | |
|---|---|---|
| | 11b | *Synthesis-based estimates:* Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data. |
| Measurement and valuation of preference based outcomes | 12 | If applicable, describe the population and methods used to elicit preferences for outcomes. |
| Estimating resources and costs | 13a | *Single study-based economic evaluation:* Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs. |
| | 13b | *Model-based economic evaluation:* Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs. |
| Currency, price date, and conversion | 14 | Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate. |
| Choice of model | 15 | Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended. |
| Assumptions | 16 | Describe all structural or other assumptions underpinning the decision-analytical model. |
| Analytical methods | 17 | Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty. |
| **Results** | | |
| Study parameters | 18 | Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended. |
| Incremental costs and outcomes | 19 | For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios. |
| Characterising uncertainty | 20a | *Single study-based economic evaluation:* Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact |

| | | | |
|---|---|---|---|
| | | of methodological assumptions (such as discount rate, study perspective). | |
| | 20b | *Model-based economic evaluation:* Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions. | |
| Characterising heterogeneity | 21 | If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information. | |
| **Discussion** | | | |
| Study findings, limitations, generalisability, and current knowledge | 22 | Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge. | |
| **Other** | | | |
| Source of funding | 23 | Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support. | |
| Conflicts of interest | 24 | Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations. | |

For consistency, the CHEERS Statement checklist format is based on the format of the CONSORT statement checklist

The **ISPOR CHEERS Task Force Report** provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* link or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

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