
Title: Cost-utility of screening for depression among asylum seekers: a modelling study in Germany

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# Cost-utility of screening for depression among asylum seekers: a modelling study in Germany

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Highlights

- There is a high probability that depression screening for asylum-seekers is cost-effective.
- The modelling approach produces consistent results despite data uncertainty.
- Process parameters are particularly important in determining cost-effectiveness.
- There is considerable monetary value in conducting further research in this area

## Abstract

Background: Asylum seekers have a high burden of mental illness owing to traumatic experiences before, during and after flight. Screening has been suggested to identify asylum seekers with psychosocial needs. However, little is known about the costs of screening relative to expected gains. We assessed the cost-effectiveness of population-based screening for depression in German asylum reception centres compared to case-finding by self-referral.

Methods: Explorative modelling study using a decision tree over 15 months to estimate the incremental cost per Quality-Adjusted Life-Year gained. Data points were taken from the published literature. Deterministic and probabilistic sensitivity analyses were used to address uncertainty around parameter estimates. Value of information analyses were performed to indicate the value of future research.

Results: The model demonstrates a high probability (p=83%) of the screening intervention being cost-effective at a €50,000/QALY threshold. Cost-utility depends on the process of care following screening: when acceptability and adherence parameters were decreased by 40%, the resulting ICER increased by 27-131%. Eliminating uncertainty was most valuable for the screening process and cost parameters, at €3·0 and €4·4 million respectively.

Conclusions: Screening asylum seekers for depression may be a cost-effective strategy to identify those in need of care. However, there is considerable value in conducting further research in this area, especially regarding resource requirements and the process of care following screening.

## 1. Introduction

The recent period of migration to Europe from conflict areas in the Middle East and East Africa poses several political, social and organisational challenges to national governments, one of which is how best to organise essential health care services for those whose residence status is not yet assured.

One crucial aspect is responding to the high psychosocial needs of this population. The burden of mental illness in asylum seekers and refugees is higher than in the general population [1,2], owing to pre-, peri- and post-flight factors [3]. National governments have a legal obligation under the EU directive on the reception of refugees to protect vulnerable individuals, including people with severe psychological illness or those who have experienced violence, torture or abuse [4]. However, both the identification and treatment of asylum seekers who require psychosocial support remains a challenge, owing to cultural, structural, linguistic, financial and organisational barriers [5].

A reception strategy that includes mental health screening and subsequent needs-based treatment could help identify refugees in need of psychosocial support. The use of screening tools could ensure identification of need if implemented in a standardised manner, improving equity and efficiency of the system as well as reducing the burden of disease. It is estimated that approximately 11/19 of EU governments have made some provisions for mental health screening of refugees [6]. However, there is currently very little evidence on the effectiveness and efficiency of such an intervention. Several systematic reviews [7–9] have shown that there is no evidence to support mental health screening in the general population, but that it may be an effective strategy in high-risk groups with a high disease prevalence.

A rapid review undertaken by the authors identified only six studies reporting a screening programme for depression in asylum seekers or refugees [10–15], none of which examined effectiveness or efficacy of the intervention. In the absence of conclusive empirical evidence on the entirety of the screening intervention, this study uses a modelling approach to consider the cost-effectiveness of this strategy using published data on the different elements of the screening pathway. Using a modelling approach with value of information analyses allows us to assess the strength of evidence attached to each element and aid priority setting for future research in this area.

## 2. Material and Methods

This study uses the German context to model the cost-effectiveness of a depression screening intervention for asylum seekers. Germany has seen a large increase in the numbers of individuals seeking asylum in recent years, peaking at 745 545 asylum applications in 2016 and declining to 185 853 applications in 2018 [16]. Main countries of origin in 2018 were Syria, Iraq, Iran, Nigeria and Turkey [16]. In Germany, regional authorities are responsible for the health care provision of asylum seekers. Entitlements to health care are restricted to acute and painful conditions during the first 15 months after arrival and mental health care is only covered on a case-by-case basis [17]. Mental health screening is not a routine part of the initial medical examinations in Germany [18]. Instead, identification of mental illness is widely based on self-referrals and follow-up care varies across the country [19].

We developed a hypothetical population-based screening intervention, analogous to the process followed in “stepped care” models of depression treatment [20], provided as an optional offer during the initial medical examination in reception centres. Screening for depression is carried out on a voluntary basis using a self-complete version of the nine-item version of the Patient Health Questionnaire (PHQ9) [20] in the base-case scenario.

Assessment of results is carried out by a nurse, who refers anyone with a score above 10, suggesting moderate to severe depression, on for a diagnostic appointment. The diagnostic appointment is carried out by a psychologist using the Structured Clinical Interview for DSM-IV (SCID) [21]. Patients who are subsequently diagnosed with moderate to severe depression are referred on for 12 sessions of cognitive behavioural therapy (CBT).

*[insert figure 1]*

### 2.1. Model Structure and comparators

We used a decision tree (figure 1) to compare the population-based screening intervention for depression to case-finding via self-referrals and follow-up care by non-profit psychosocial centres. The decision tree takes a 15-month time horizon. Screening is followed by three months of treatment (12 sessions of cognitive behavioural therapy (CBT)) and 12 months of follow-up. This is the length of time for which most accurate estimates of effect size are available [22]. Benefits and costs are calculated from a healthcare perspective as the responsibility for healthcare provision for asylum seekers in Germany, including the initial medical examination, lies entirely with regional healthcare authorities.

Benefits are calculated by adjusting the time spent in each of the three health outcomes ("not depressed", "moderate depression", "full remission") over the 12 months of follow-up by their respective utility values to calculate quality-adjusted life-years (QALYs). We assume that rates of remission are equally distributed over the follow-up period. Costs and benefits of the two arms are compared using an incremental cost-effectiveness ratio (ICER). Given that there is no recommended cost-effectiveness threshold in Germany, this study uses the frequently cited arbitrary threshold of €50,000/QALY to assess cost-effectiveness [23]. Costs and benefits are not discounted given the short timeframe. Both the screening and the case finding option were also compared with a "do nothing" option, in which no treatment was offered to individuals with depression.

Microsoft Excel© version 15 was used to build the model and carry out deterministic, probabilistic and value of information analyses.

### 2.2. Study population

We considered the hypothetical population entering the model as a cohort of 1000 newly registered asylum seekers 18 years of age or above. Using data from the most recent systematic review, it was estimated that on arrival to Germany, 30·8% of asylum seekers suffer from moderate or severe depression [2] as defined in the International Classification of Disease (ICD10).

### 2.3. Sources of Data Points

All parameter estimates can be found in table 1.

*Current practice pathway*

Estimates for regular case-finding are taken from data published by non-profit psychosocial centres across Germany, which provide the majority of care for this population [17]. We use the number of individuals in treatment and on waiting lists to approximate the current demand for services.

Individuals with depression who do not receive treatment may still show improved symptoms after 12 months of follow up. We used a 53% spontaneous remission rate elicited from a meta-analysis on major depression [24].

*Screening pathway*

Data from existing mental health screening studies in asylum seekers and refugees are used to estimate the follow-up after a screening test and the proportion accepting treatment

following a diagnosis [11–14]. Mean values are used in instances with diverging values across studies.

*[insert table 1]*

The rate of screening coverage could not be elicited from existing data. As the hypothetical intervention runs alongside the initial health examinations, coverage is expected to be high. Nevertheless, implementation gaps may arise and thus a 90% coverage rate is estimated.

*Treatment effectiveness & completion*

For the purposes of this paper, treatment of depression with CBT is assumed, as good estimates for effectiveness are available for this therapeutic approach. However, results are likely to be similar for the other licensed treatments [22]. We use data on treatment effectiveness from studies of the general population, as synthesized in a large, international meta-analysis [22].

*Health-related quality of life*

To estimate utility values for “depression in full remission” and “moderate depression” health outcomes, a Euroqol Five Dimensions Questionnaire (EQ5D) valuation from the Dutch population [25] is used to approximate German values. The utility value for healthy patients was taken from the UK catalogue of utility values for 20–29 year olds [26], corresponding to the mean age of asylum seekers in Germany.

*Cost data*

Resource requirements of the screening process are based on estimates made by Valenstein and colleagues [27]. The nurses’ time required per individual is expanded to ten minutes to allow for additional coordinating capacity. Figures in table 1 correspond to the German public services salary levels for an upper-band junior nurse and an upper-band junior doctor.

Costs of the diagnostic interview and treatment are calculated using the tariffs of the National Association of Statutory Health Insurance Physicians [28]. Costs of the diagnostic interview are calculated using time requirements of the SCID. Costs of treatment are calculated for 12 sessions of CBT, with each session is estimated to last 50 minutes.

The annual cost of depression is estimated using a costing study in the general population in Germany [29]. Due to the barriers of asylum seekers to accessing regular primary care, only inpatient costs, assumed to relate to acute cases of depression and emergency care, are considered. The reported average costs per depressed patient are adjusted to reflect 2017 prices.

**2.4. Sensitivity Analysis**

One-way deterministic sensitivity analyses (DSA) are carried out to test the robustness of the model by increasing or decreasing each parameter by 40% in turn (table 1). Since utility values of health outcomes cannot be assumed to be independent, all three parameters were jointly increased or decreased by 40% in a multi-way DSA.

Structural uncertainty is addressed using three multi-way deterministic sensitivity analyses. This included varying the screening instrument, mode of diagnostic interview and changing the type of therapeutic intervention, changing both effectiveness and resource requirements for these elements of the screening pathway (table 2).

*[insert table 2]*

A probabilistic sensitivity analysis (PSA) was carried out for all parameters, save therapeutic costs which are fixed tariffs set by the National Association of Statutory Health Insurance Physicians. PSA was conducted using the Monte Carlo method with 1000 simulations, with

data points assumed to be independent. For parameters taken from the literature, standard errors were taken from publications. Probability and utility parameters were assigned beta distributions, treatment effectiveness was assigned a lognormal distribution and the cost of depression was assigned a gamma distribution. For parameters which have been estimated (pathway parameters, time requirements, staff costs), no assumptions could be made about the distribution of uncertainty around these values. Instead, values were increased or decreased by 40% to represent maximum and minimum values and a uniform distribution was assigned as suggested by Bilcke and colleagues [30]. A large variation of 40% was chosen due to the substantial uncertainty that exists around these estimates.

**2.5. Value of Information**

The Expected Value of Perfect Information (EVPI) per patient was calculated from PSA simulations, by comparing the marginal monetary value obtained under conditions of data uncertainty to that obtained under conditions of absolute data certainty [31]. Population EVPI was calculated by assuming an annual asylum seeking population of 200,000 per year over the course of 5 years, discounted at 3% per year. The short timeframe was chosen due to the unpredictability of the size and the instability of the characteristics of this population.

The Expected Value of Perfect Parameter Information (EVPPI) was calculated with an outer loop of 1000 iterations and an inner loop of 1000 iterations. Parameters were grouped by type (table 3).

Further details on data points, assumptions and methods are provided in the supplementary web appendix (see Additional file 1).

*[insert table 3]*

# 3. Results

### 3.1. Base Case Scenario

In the base case scenario, the option to "do nothing", leaving all cases of depression untreated, generated a total of 801·11 QALYs at a total cost of €47,334 for every 1000 asylum seekers entering the German healthcare system (table 4). Case-finding for depression in asylum seekers generated 803·63 QALYs at a cost of €78,982. The screening intervention itself came at a cost of €2·75 per individual screened. Carrying out this intervention resulted in 806·58 QALYs generated at a total cost of €137,398 once the costs of diagnosis, treatment and the cost of depression to the health system had been taken into account (table 4).

Despite being the cheapest option, doing nothing was less cost-effective than case-finding, with an incremental cost-effectiveness ratio of €12,588. Compared to case-finding, screening resulted in an additional 16 depressed patients in remission after 15 months. This translated into 2·95 QALYs at a cost of €58,416 and an ICER of €19,779/QALY (table 4).

*[insert table 4]*

### 3.2. Deterministic Sensitivity Analysis

The DSA revealed that the largest changes in the ICER are seen for screening pathway parameters (proportion of patients accepting the therapy offer, proportion completing treatment, proportion attending the diagnostic interview and screening coverage), health outcome utility values as well as the sensitivity and specificity of the screening instrument (figure 2).

None of the structural sensitivity analyses push the ICER above the €50,000/QALY threshold (table 4). Changing the screening instrument to Hospital Anxiety and Depression

Scale (HADS-D) or the two-item version of the Patient Health Questionnaire (PHQ2) and changing the intervention type to Brief CBT do not have a large impact. However, using the Mini Neuropathic Psychiatric Interview (MINI) as a diagnostic tool has considerable negative impacts on the resulting ICER (€27,263/QALY), as the comparatively worse psychometric properties of this tool are not balanced by the resource savings.

*[insert figure 2]*

### 3.3. Probabilistic Sensitivity Analysis

The distribution of matched pairs of the probabilistic analysis illustrated in the cost-effectiveness plane shows that the screening intervention generally generates more QALYs at a higher cost when compared to regular case-finding ( figure 3). The cost-effectiveness acceptability curve (CEAC) in figure 4 shows that regular case-finding has a higher probability of being cost-effective until a threshold of €25,000/QALY. At a threshold of €50,000, the probability of screening being cost-effective is p=83%.

*[insert figures 3&4]*

### 3.4. Expected Value of Perfect Information & Expected Value of Perfect Parameter Information

The EVPI per asylum seeker screened for depression is €4·2 for a €50,000/QALY threshold. The total population expected to benefit from perfect information in this intervention is estimated at 913,520 over five years. At a threshold of €50,000/QALY, the population EVPI is €3·8 million (figure 5).

*[insert figure 5]*

In population EVPPI analyses, eliminating uncertainty around cost and screening intervention parameters emerged as being most valuable, at €4·4 million and €3·0 million respectively over five years (table 3). Eliminating uncertainty around quality of life gained through screening and treatment, screening instrument and treatment effectiveness also demonstrated value, at €2·1 million, €1·3 million, and €0·2 million respectively. Parameter groups of routine data on regular case-finding and healthcare costs did not emerge as being valuable, as the screening intervention remains the dominant option in each iteration of the model despite the uncertainty of the parameters in question (table 3).

## 4. Discussion

This modelling study finds that screening for depression can be cost-effective at a €50,000/QALY threshold. The probability of the intervention being cost-effective remains high (p=83%) once uncertainty of parameters has been considered. Neither the deterministic sensitivity analyses nor the structural sensitivity analyses result in an ICER above the €50,000/QALY threshold.

Despite the high data scarcity in this area of research, this study has shown that not all parameter uncertainty has an equal bearing on results. The cost-effectiveness of the intervention is particularly dependent on specific elements of the model. Process parameters relating to the screening process, such as the proportion covered by screening, attendance rates at diagnostic interviews and therapy, as well as the health outcome utilities and psychometric properties of screening tests have a particularly large impact on results.

The overall population EVPI is high at €3·8 million. This reflects both the high probability for the cost-effectiveness of screening, the current uncertainty of model parameters and the large population of asylum seekers which could benefit from it. The EVPPI demonstrates a

high value of €3·0 million to eliminate the uncertainty relating to screening process parameters and €4·4 million for more accurate resource requirements and cost estimations, as well as considerable value for eliminating uncertainty around health outcome utilities, psychometric properties of screening tools and treatment effectiveness. Conducting further research on regular case-finding and healthcare costs did not emerge as valuable, as there is enough certainty in these parameters to make a decision between the two alternatives. The limited value for further research on these parameters may, however, have been affected by uncertainties in the structure of the model, which was not tested in this analysis and requires further research.

Analogous to the treatment cascade, the screening cascade which was elicited through this study (figure 6) demonstrated a large potential drop-off in individuals who could benefit from the intervention at all stages following screening. The advantages of screening individuals will be foregone if individuals are lost to follow-up further down the screening cascade. What happens following screening, namely the linkage to care, the continued re-engagement with patients and the organisation of care, is crucial in ensuring the cost-effectiveness of the intervention as a whole. The population of asylum seekers, in Germany and elsewhere, is characterised by its heterogeneity [32], meaning that perceptions of how depression should be identified and treated may differ substantially between individuals. Thus, experiences and expectations of the described process of care are likely to vary markedly, with sensitivities around, for example, the gender of the healthcare provider of the setting of the patient-provider interaction having a large potential impact on adherence to care. Responding to these expectations, for example through dedicated case management, is likely to be particularly important in keeping individuals engaged with the care process.

*[insert figure 6]*

However, it is precisely these process parameters and the resources required for this process which remain largely unexplored in the current literature and which bring the greatest degree of uncertainty into the model presented in this paper. The current research landscape in this area is heavily focused on the adaptation of screening tools and treatment plans for the asylum seeking and refugee population. The present study shows that this important work needs to be complemented by studies which embed these tools into models of care, with process parameters that allow for an assessment of effectiveness in the entirety of the causal chain: screening, referral, treatment and follow-up, as wells a detailed costing studies to more accurately depict the resources required for this process.

### 4.1. Strengths and Limitations

Given the current scarcity of data, this study can be considered as an explorative, rather than definitive, cost-effectiveness analysis, corresponding to Stage II in the iterative economic evaluation framework proposed by Sculpher and colleagues [33].

The strength of this analysis lies in the modelling approach, which allows for a synthesis of current evidence on the topic of depression screening for asylum seekers and an assessment of the sensitivity of results to the uncertainty of parameters. Using economic methods, we quantified the value of additional research to further investigate the cost-effectiveness of the intervention.

The limitations of this analysis lie in the lack of comprehensive data underlying the model. It was not possible to build a model representing the natural history of depression, the patient journey through a stepped care model, or sub-group differences. In some instances, e.g. for the rate of spontaneous remission from depression, reliable and generalisable data for the refugee population was not available, and a methodological decision had to be made to favour reliable estimates from the general population, at the risk of reduced internal validity. It was also not possible to consider a longer timeframe, which may have led to a substantial

underestimation of the cost-effectiveness of screening for depression as further benefits are likely to accrue beyond the 12 months of follow-up. Further economic analyses could also consider the impact on cost-effectiveness of screening for other mental health issues with a high relevance for the asylum seeking population (e.g. trauma), either concurrently or sequentially to the depression screening. Finally, this model only considers one alternative to regular case-finding, although other alternatives, such as dedicated case-finding through training & mobilisation of social workers, have been proposed [17].

Furthermore, the lack of reliable data on current demand of asylum seekers for psychosocial services in Germany meant that these had to be estimated from the grey literature; the resulting comparison arm is simplistic. The treatment parameters used in this model also need further consideration, as there is some contention over whether treatments developed and tested in a Western context can be assumed to be equally effective for migrants and refugees. For the purposes of this project, we draw on the growing body of literature which show that the approaches which have been developed to address symptoms of depression are suitable for a range of cultural contexts [34].

In addition, the resource estimations made in this model have been informed by studies carried out in very different contexts. Additional resource costs, such as start-up costs for a screening intervention, costs of social workers who refer to psychosocial centres in the case-finding scenario and cost incurred from a societal perspective have not been considered here. Future studies should apply more rigorous micro-costing approaches, and estimates compared with this study.

This study assumes that sufficient resources are available to treat all asylum seekers which have screened positive, and that necessary access to care is not restricted. The provision of effective and timely treatment is one of the key preconditions of any screening programme [35]. However, there is a notorious lack of therapeutic resources currently available for

asylum seekers in Germany, and even when capacity is sufficient, most asylum seekers are denied treatment on the basis of their residence status [17]. Identifying people in need of treatment and subsequently not providing required services is not only inefficient, but also unethical. As such, improving the capacity for and granting access to responsive therapeutic services is a necessary precondition for a screening intervention.

Not all limitations have an equal bearing on the results of this study. Conservative estimates were used in cases where data points were uncertain, so the result of the model is more likely to be an underestimation of true cost-effectiveness. Uncertainty around data parameters was thoroughly explored in sensitivity analyses; these do not affect the main results of the study. More detailed economic models with multiple comparators are required to confirm the result of the present study and evaluate the economic rationale for screening as more evidence emerges.

## 5. Conclusions

This study presents an explorative model to assess the cost-effectiveness of screening asylum seekers for depression when they arrive in Germany. It shows that such an intervention has a potential to be cost-effective and that additional research in this field is valuable. The resource requirements and acceptability of the screening process, including the test and treatment, emerged as particularly important factors in determining the cost-effectiveness of the intervention. Future research should focus on generating accurate data on the process of care following screening, applying more rigorous micro-costing approaches to estimate resource requirements along the screening pathway. More accurate models with more nuanced representations of the disease progression of depression, multiple comparators and a longer time horizon are needed to confirm this result.

Authors contributions

LB: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – Original Draft, Visualization, Project Administration
AM: Methodology, Formal Analysis, Writing – Review & Editing, Supervision
KB: Methodology, Investigation, Writing – Review & Editing, Supervision, Funding Acquisition

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Conflicts of interest
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*Figure 1*

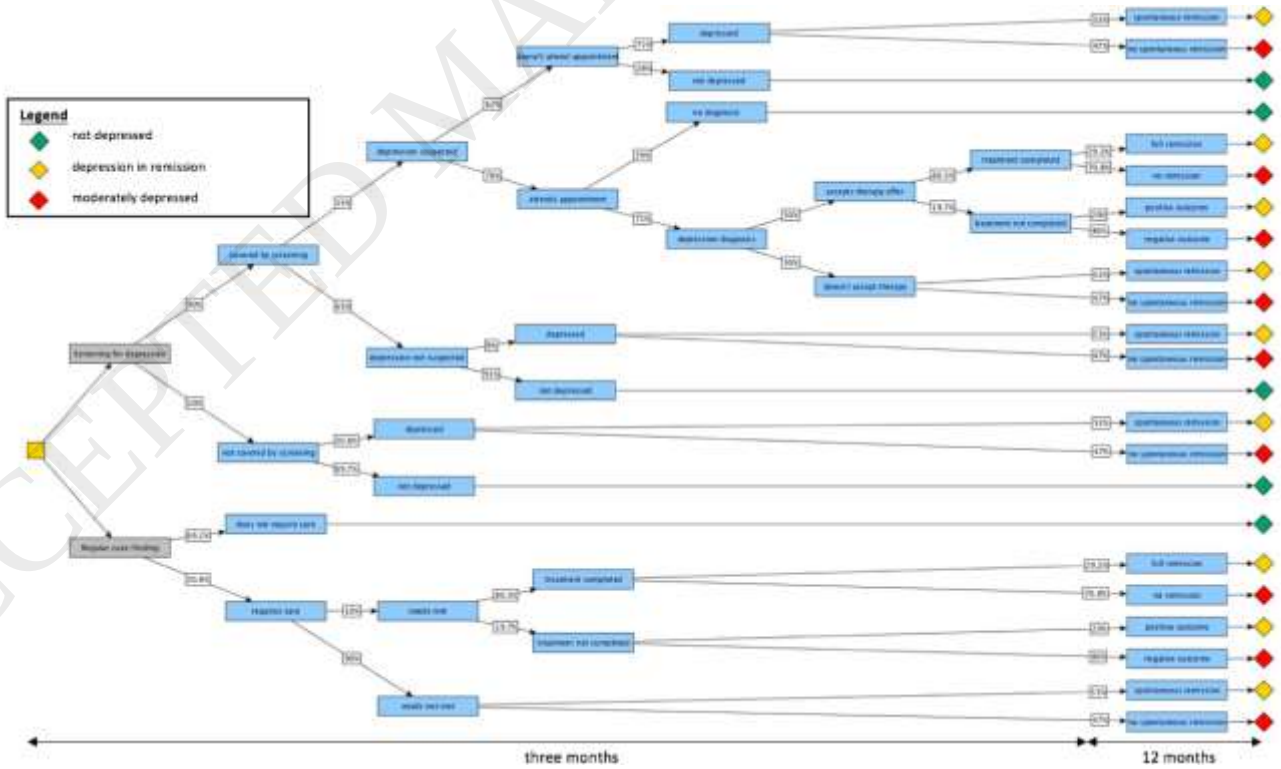


*Figure 2*

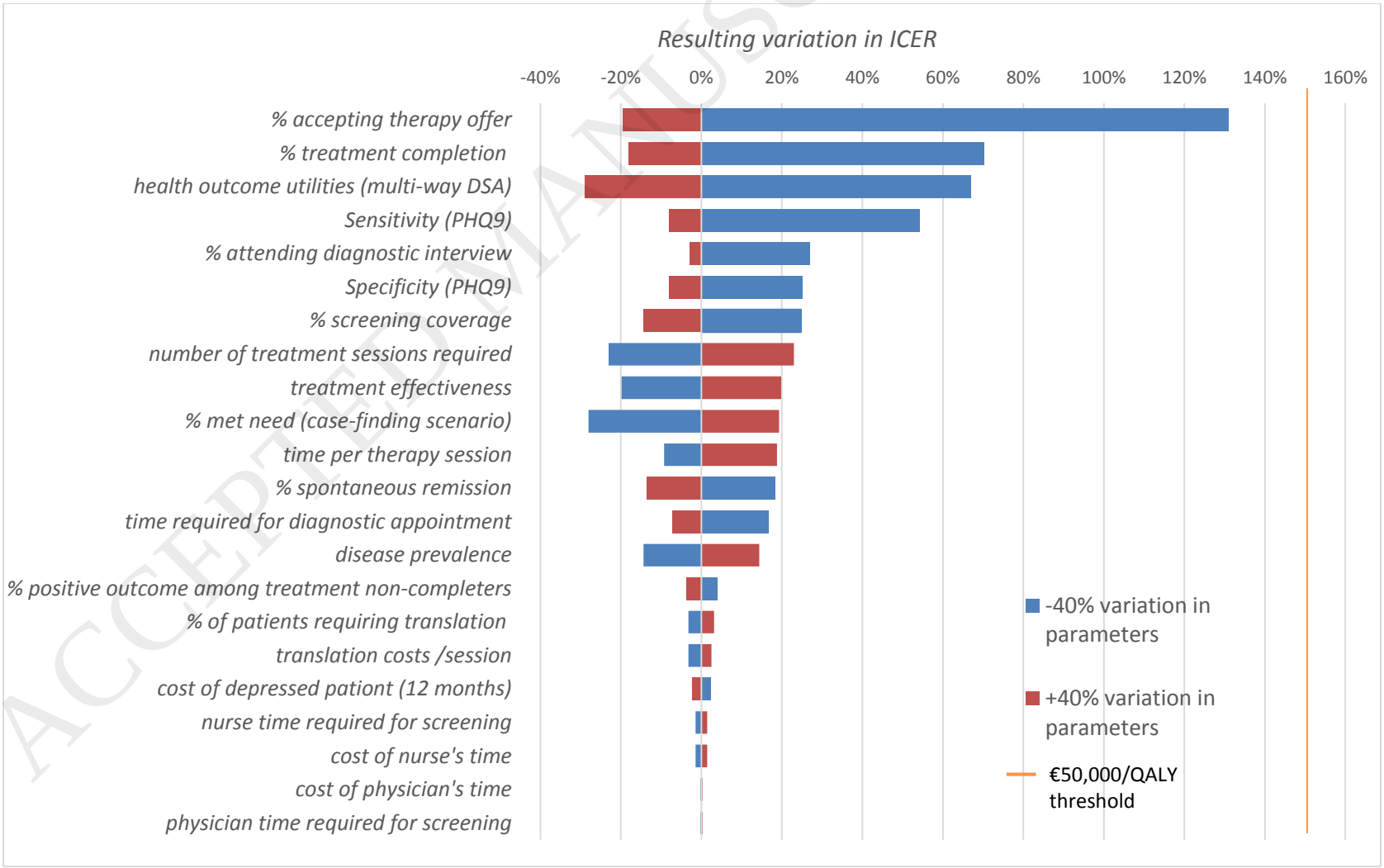

*Figure 3*

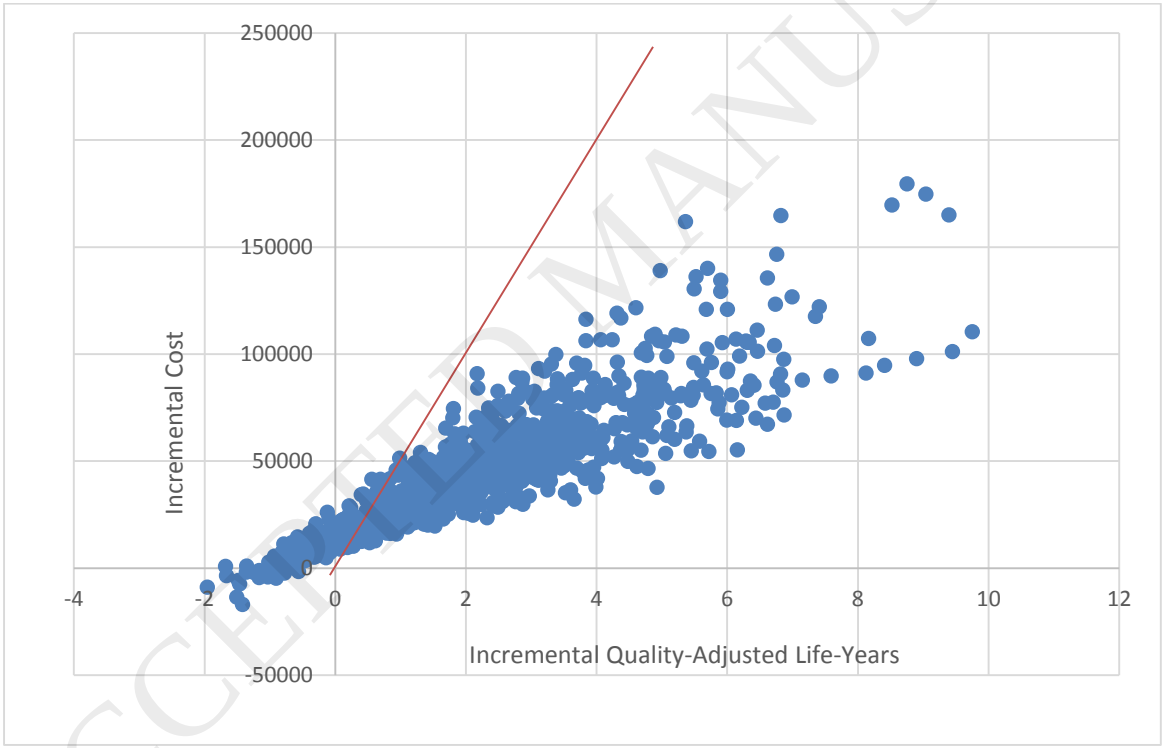


*Figure 4*

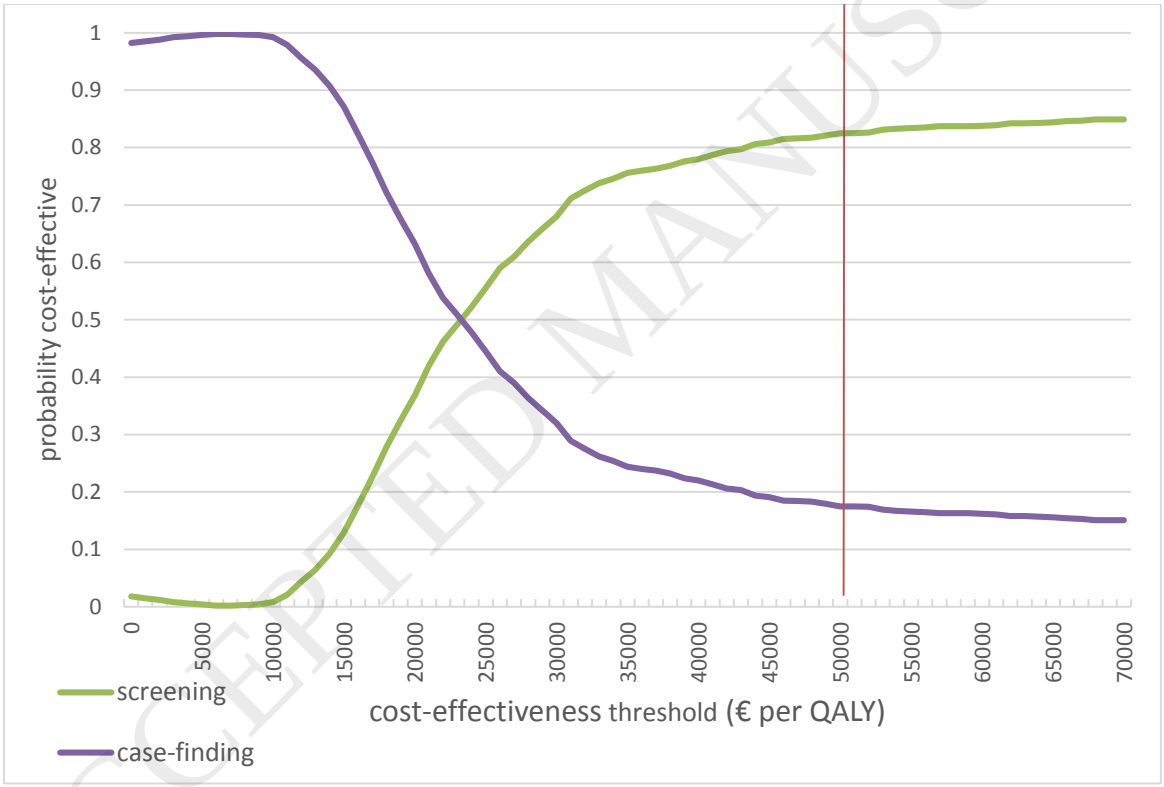


*Figure 5*

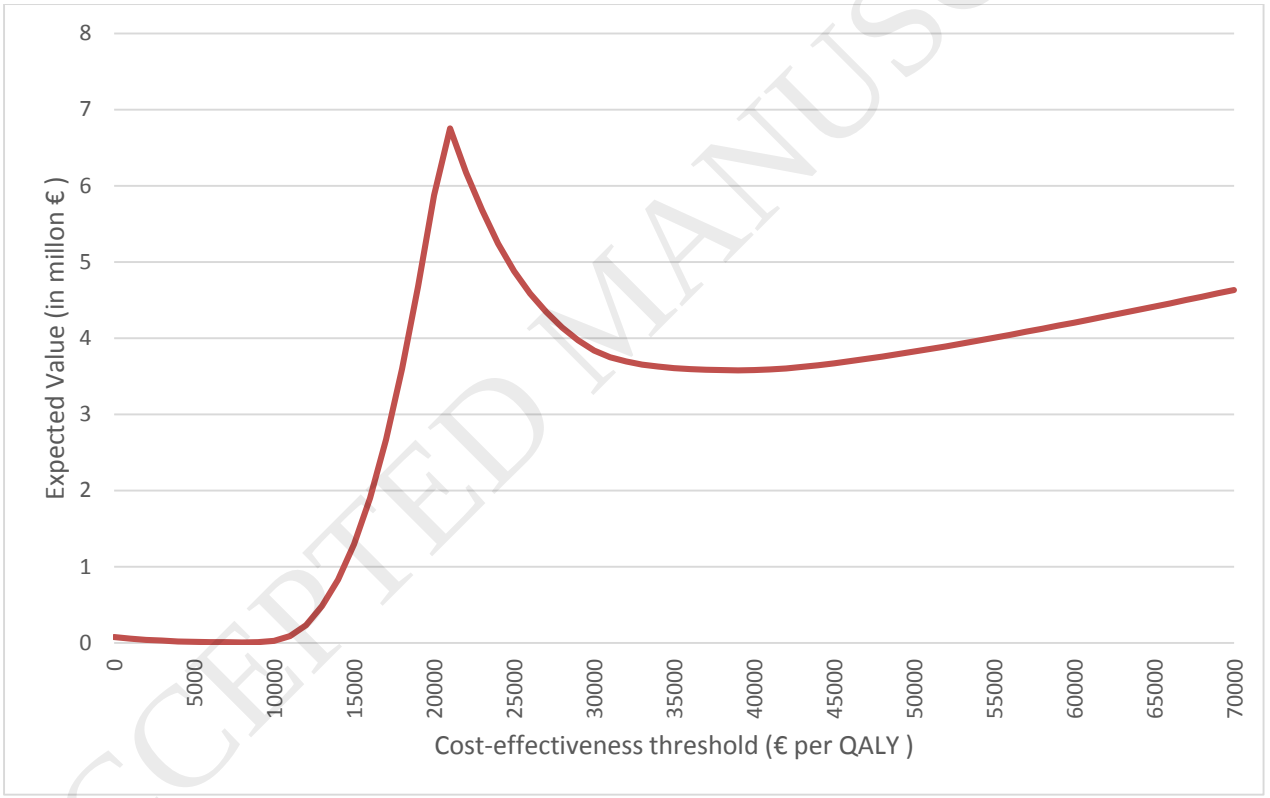


*Figure 6: Screening Pathway Cascade of Hypothetical Population-based Screening Intervention*

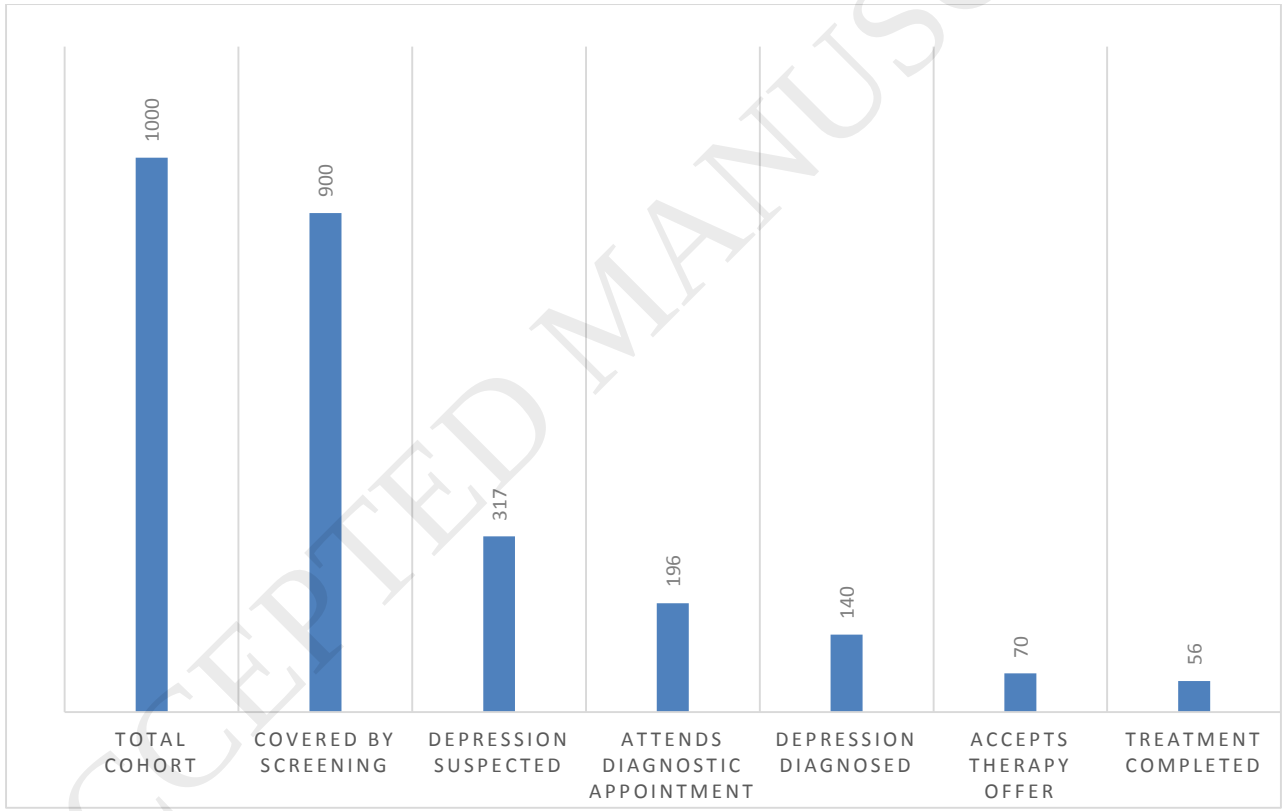

*Table 1: Data Points Used in the Base Case, One-Way Deterministic and Probabilistic Analyses*

| **Model parameter** | **Mean** | **DSA[a] upper** | **DSA[a] lower** | **Distribu-tion** | **Standard error** | **EVPPI[a] group** | **Source[b]** |
|---|---|---|---|---|---|---|---|
| *Case-finding pathway* | | | | | | | |
| % identified through case-finding | 10·43% | 15% | 6% | uniform | - | 1 | Baron & Flory (2016) |
| *Screening pathway* | | | | | | | |
| % attending diagnostic interview | 62% | 87% | 37% | uniform | - | 3 | Llosa et al.(2017), Bertelsen et al.(2016), Polcher & Calloway(2016), Savin et al. (2005) |
| % covered by screening | 90% | 100% | 54% | uniform | - | 3 | Assumption |
| % accepting therapy offer | 50% | 70% | 30% | uniform | - | 3 | Polcher & Calloway (2016) |
| *Depression parameters* | | | | | | | |
| Depression prevalence | 30·8% | 43% | 18% | beta | 0·023% | 1 | Steel et al. (2009) |
| Spontaneous remission | 53% | 74% | 32% | beta | 0·033% | 5 | Whiteford et al. (2013) |
| *Psychometric properties screening instruments* | | | | | | | |
| Sensitivity PHQ9[a] | 0·813 | 1 | 0·49 | beta | 0·05 | 2 | Mitchell et al. (2016) |
| Specificity PHQ9[a] | 0·853 | 1 | 0·51 | beta | 0·02 | 2 | Mitchell et al. (2016) |
| *Treatment parameters* | | | | | | | |
| Number needed to treat (CBT)[a] | 3·42 | 4·79 | 2·05 | lognormal | 0·31 | 5 | Cuijpers et al. (2013) |
| Treatment completion rate | 80·3% | 100% | 48% | beta | 0·005% | 3 | Swift & Greenberg (2012) |
| % positive outcome among treatment non-completers | 20% | 28% | 12% | beta | 0·01% | 3 | Koeser et al. (2015) |
| *Health-related quality of life* | | | | | | | |
| Healthy (20-29 years old) | 0·905 | 1 | 0·54 | beta | 0·002 | 4 | Sullivan et al. (2011) |
| Depression in full remission | 0·7 | 0·91 | 0·42 | beta | 0·015 | 4 | Kolovos et al. (2017) |
| Moderately depressed | 0·52 | 0·73 | 0·31 | beta | 0·018 | 4 | Kolovos et al. (2017) |
| *Resource needs* | | | | | | | |
| Screening: nurse's time (minutes) | 10 | 14 | 6 | uniform | - | 6 | Valenstein et al. (2001) |
| Screening (physician's time (minutes) | 1 | 1·4 | 0·6 | uniform | - | 6 | Valenstein et al. (2001) |
| Length of clinical appointment (minutes) | 90 | 126 | 54 | uniform | - | 6 | Spitzer at al. (1992) |
| Treatment: sessions required | 12 | 16·8 | 7·2 | uniform | - | 6 | Cuijpers et al. (2013) |
| Treatment: time per session (minutes) | 50 | 70 | 30 | uniform | - | 6 | Royal College of Psychiatrists (2016) |
| *Resource costs* | | | | | | | |
| Cost of nurse's time (per minute) | €0·23 | €0·33 | €0·14 | uniform | - | 6 | Öffentlicher Dienst (2017) |
| Cost of physician's time (per minute) | €0·42 | €0·59 | €0·25 | uniform | - | 6 | Öffentlicher Dienst (2017) |
| Cost of physician contact per quarter | €20·45 | - | - | - | - | - | Kassenärztliche Bundesvereinigung (2016) |
| Therapeutic costs per 10 minutes | €14·19 | - | - | - | - | - | Kassenärztliche Bundesvereinigung (2016) |
| Medical coordination costs | €20·66 | - | - | - | - | - | Kassenärztliche Bundesvereinigung (2016) |
| Translation costs per session | €15 | €21 | €9 | uniform | - | 6 | Kassenärztliche Vereinigung Rheinland-Pfalz (2016) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| % of patients requiring translation | 76% | 100% | 46% | uniform | - | 6 | Baron & Flory (2016) |
| Cost of depressed individual (12 months) | €209·09 | €292·73 | €125·45 | gamma | €83·64 | 7 | Klein-Budde et al. (2013) |

[a]Legend of abbreviations: DSA = Deterministic Sensitivity Analysis; EVPPI = Expected Value of Perfect Parameter Information; PHQ9 = 9-item version of Patient Health Questionnaire; CBT = Cognitive Behavioural Therapy

[b]All references for data sources can be found in the supplementary web material (see Additional file 1)

*Table 2: Parameters Used for Structural Deterministic Sensitivity Analyses*

| Parameter | Value | Source |
|---|---|---|
| *HADS-D[a] screening instrument* | | |
| Sensitivity | 0·72 | Brennan et al. (2010) |
| Specificity | 0·86 | Brennan et al. (2010) |
| *PHQ2[a] screening instrument* | | |
| Sensitivity | 0·89 | Mitchell et al. (2016) |
| Specificity | 0·76 | Mitchell et al. (2016) |
| Screening: nurse's time (minutes) | 8 | Assumption |
| *MINI[a] diagnostic tool* | | |
| Time taken for clinical appointment (minutes) | 50 | Kassenärztliche Bundesvereinigung (2016) |
| Sensitivity (MINI) | 0·94 | Lecrubier et al. (1997) |
| Specificity (MINI) | 0·79 | Lecrubier et al. (1997) |
| *Brief CBT[a]* | | |
| Treatment effectiveness (number needed to treat) | 8 | Nieuwsma et al. (2012) |
| Treatment: sessions required | 6 | Nieuwsma et al. (2012) |
| Treatment: time per session (minutes) | 30 | Nieuwsma et al. (2012) |

[a]Legend of abbreviations: HADS-D = Hospital Anxiety and Depressions Scale; PHQ2 = 2-item version of the Patient Health Questionnaire; MINI = Mini International Neuropsychiatric Interview; CBT = Cognitive Behavioural Therapy

*Table 3: Parameter Groups Used for and Outcome of Expected Value of Perfect Parameter Information Analysis*

| | Group | Parameters included | EVPPI |
|---|---|---|---|
| 1 | Routine data | % identified through case-finding<br>Depression prevalence | € 0 |
| 2 | Screening instrument properties | Sensitivity PHQ9<br>Specificity PHQ9 | €1,261,431 |
| 3 | Screening intervention parameters | % attending diagnostic interview<br>% accepting therapy offer<br>% completing treatment<br>% covered by screening<br>% positive outcome among treatment non-completers | €3,042,937 |
| 4 | Utility values | Healthy (20-29 years old) health utility<br>Depression in full remission health utility<br>Moderately depressed health utility | €2,113,743 |
| 5 | Treatment effectiveness | Spontaneous remission<br>Number needed to treat (CBT) | €194,018 |
| 6 | Service costs | Screening: nurse's time (minutes)<br>Screening: physician's time (minutes)<br>Time required for clinical appointment (minutes)<br>Treatment: sessions required<br>Treatment: time per session (minutes)<br>Cost of nurse's time (per minute)<br>Cost of physician's time (per minute)<br>Translation costs per session<br>% of patients requiring translation | €4,360,283 |
| 7 | Healthcare costs | Cost of depressed health outcome | €0 |

*Table 4: Results of Base Case, Scenario and Structural Uncertainty Analyses*

| Analysis | QALYs | Cost | ICER |
|---|---|---|---|
| *Base case results* | | | |
| Do Nothing | 801·11 | €47,334 | - |
| Case-finding | 803·63 | €78,982 | - |
| Screening | 806·58 | €137,398 | - |
| *Case-finding vs. Do Nothing* | *2·51* | *€31,648* | *€12,588* |
| ***Screening vs. Case-finding*** | ***2·95*** | ***€58,416*** | ***€19,779*** |
| *Scenario and structural uncertainty analyses (incremental results)* | | | |
| HADS-D[a] screening tool vs. Case-finding | 2·33 | €48,959 | €21,030 |
| PHQ2[a] screening tool vs. Case-finding | 3·47 | €70,817 | €20,401 |
| Brief CBT[a] therapy vs. Case-finding | 2·04 | €36,874 | €18,073 |
| MINI[a] diagnostic tool vs. Case-finding | 1·89 | €51,483 | €27,263 |

[a]Legend of abbreviations: HADS-D = Hospital Anxiety and Depressions Scale; PHQ2 = 2-item version of the Patient Health Questionnaire; CBT = Cognitive Behavioural Therapy; MINI = Mini International Neuropsychiatric Interview

## Additional files

File name: Additional_file_1.docx
Title of data: Web Appendix - Additional Details on Methodology and Data Sources
Caption: Additional methodological details required to replicate the economic model presented as well as a full list of references for data sources.