MODEL DEVELOPMENT AND SCENARIO ANALYSIS FOR A COST EFFECTIVENESS STUDY ON THE SCREENING FOR POSTPARTUM DEPRESSION IN YOUTH HEALTH CARE

Master thesis Health Sciences

Track: Health Services and Management

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Date
February 2014

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Abstract

Background Postpartum depression (PPD) is a depression which may occur in women who have recently given birth to a child. It can have severe consequences on the wellbeing of both mother and child. When PPD is detected at an early stage, appropriate treatment and care can be offered to mother and child sooner than when the depression is detected at a later stage. This earlier treatment and care is associated with improved wellbeing of mother and child. To detect PPD in an early stage, the Edinburgh Postnatal Depression Scale (EPDS) can be used. This is a screening questionnaire showing whether or not a mother is likely to have PPD. In the Netherlands, Youth Health Care (YHC) in the Twente region is currently working with the EPDS to detect PPD. Other regions in the Netherlands are not working with the EPDS: YHC doctors do pay attention to the wellbeing of the mother, but there is no structured approach to detect PPD. Even though screening for PPD can have positive health effects, it can also lead to a rise in health care costs because extra costs may be linked with performing the screening. Constantly increasing health care costs mean that it is important that current health care resources are allocated optimally.

Objective This study will assess the incremental cost effectiveness of screening for PPD in YHC compared to care as usual in YHC. It will be evaluated whether or not screening for PPD should be recommended in YHC in the Netherlands based on results from the model that is created, the burden of the disease and the affordability of the screening.

Methods A hypothetical population was used, where an intervention group was compared to a control group. A screening for PPD in YHC was already implemented in the region Twente, so new mothers from the region Twente were defined as the intervention group and new mothers from the region Apeldoorn and Deventer were defined as the control group. To compare the two groups, a decision tree was created that presents the possible decisions and chances that were relevant for the investigated process in YHC. Information about costs and effects was obtained from collective labour agreements, from literature and from questionnaires. These questionnaires were distributed amongst YHC doctors, YHC nurses and General Practitioners in order to gain insights into the way of working in YHC with and without screening, and the current referral and treatment procedures for mothers with PPD. At the end the incremental cost effectiveness ratio (ICER) was calculated to determine whether or not the screening for PPD in YHC was cost effective. The ICER is defined as the extra costs that are needed to detect one additional true positive case of PPD.

Results The results of the model show that the incremental costs of screening are - € 933.87, whilst the incremental effectiveness was 15 extra detected true positives. This resulted in an ICER value of - € 60.53 per extra detected mother with PPD. In this case this means that costs can be saved in YHC and extra mothers with PPD can be detected. Scenarios were created for the sensitivity analysis, leading to ICERs ranging from € 2.12 to - € 361.49 per extra detected mother with PPD.

Conclusion Based on this study, the burden of the disease and the affordability of the screening, it is recommended that screening for PPD in YHC is implemented, provided that a proper follow up process is available for mothers with PPD. It should be taken into account that in the current model effect data from existing literature was used. It is recommended to use effect data from the ongoing Post-Up research once this is available. Screening should then be reassessed for cost-effectiveness.

Content

1. Introduction

1.1 Postpartum Depression

1.1.1 Background

Pregnancy and the time just after pregnancy are often associated with happiness and great delight. However, not every new parent experiences these times as joyous days. Especially just after delivery, it is not unusual for mothers to get a so called 'baby blues'. This is a short period of time when a mother feels slightly down, which is amongst others caused by hormonal changes. Within two weeks this baby blues usually passes on its own. However, there are mothers who do not get out of this baby blues and continue to have depressive feelings. When this happens, the baby blues has turned into a 'Postpartum Depression' (PPD). Globally around 13% of the new mothers develop a PPD (Hewitt & Gilbody, 2009) (O'Hara & Swain, 1996). In the Netherlands the prevalence is estimated at around 10% of the new mothers, which is approximately 22 000 women per year (Engels & Haspels, 2003). The consequences of PPD go beyond the wellbeing of the mother, because there is someone else involved who has to be taken into account: the new-born baby. For both mother and child PPD can have severe consequences.

1.1.2 Consequences

Mothers with PPD often experience a lot of stress, are very tired and are constantly in a negative mood (La Leche League, n.d.). They have an increased risk of developing other disorders; they are for example more likely to develop anxiety disorders, eating disorders, bipolar disorders and substance abuse (Kendall-Tackett, 2010). Due to these consequences, the mother can influence her child in a negative way. The negative mood of the mother causes her to misinterpret cues of a child, which has a bad impact on the relationship between mother and child and on the development of the child (Paulden, Palmer, Hewitt, & Gilbody, 2009) (Hewitt & Gilbody, 2009). In both cognitive and emotional development the child can experience problems and it can become more sensitive to stress (Murray & Cooper, 1997) (Berg M. v., 2009). Not every child of a mother with PPD experiences these consequences, but the risk of getting one of these problems is higher. For example, a study of Murray, Fiori-Cowley & Hooper (2009) showed that 57% of the children from depressed mothers suffered from insecurity at the age of 18 months, whilst 30% of the children of non-depressed mothers was insecure at that age. Another research showed that children of mothers with PPD have a lower ego-resiliency and feel less competent within groups (Kersten-Alvarez, Hosman, Riksen-Walraven, Doesum, Smeekens, & Hoefnagels, 2012). Because of the negative consequences for both mother and child it is important that care givers are aware of the impact of PPD and that they respond appropriately when they suspect a mother has PPD (Berg M. v., 2009).

1.1.3 Detection

To be able to respond appropriately when a mother has PPD, it is important at first that a care giver notices when a mother presumably has a PPD. The earlier PPD is detected, the better this is for the treatment of the depression and the wellbeing of the people involved. An earlier treatment is hereby associated with an earlier recovery of the mother. The early detection and treatment of PPD can ensure improvements in the quality of the mother-child relationship and the development of the child. Research shows that there are still a lot of PPD cases missed, up to more than half of the cases seem to remain undetected (Hearn, et al., 1998) (Perfetti, Clark, & Fillmore, 2004) (Zauderer, 2009). A reason for this is that mothers can be embarrassed about how they feel and they are afraid that

their family and friends will not understand them. Therefore they will not seek help (Zauderer, 2009). It is important for care givers to be aware of this and that they give attention to the fact that mothers can have PPD. Several tools are developed that can help in the detection of PPD, but the tool that is important for this research is the Edinburgh Postnatal Depression Scale (Cox, Holden, & Sagovsky, 1987).

Edinburgh Postnatal Depression Scale

The Edinburgh Postnatal Depression Scale (EPDS) is a screening questionnaire that is developed to detect the risk of someone having a PPD (Cox, Holden, & Sagovsky, 1987). It consists of 10 questions with each four answering categories. A total of 30 points can be scored; a score higher than 10 means the parent has an increased chance on having a minor PPD, a score above 13 indicates it is likely that the parent has a major PPD (Gibson, McKenzie-McHarg, Shakespeare, Price, & Gray, 2009). An example of the questionnaire can be found in Appendix A.

There is mixed evidence about the validity of the EPDS. Two systematic reviews about the validity of the questionnaire show that there is a lot of variation in its effectiveness (Gibson, McKenzie-McHarg, Shakespeare, Price, & Gray, 2009) (Eberhard-Gran, Eskild, Tambs, Opjordsmoen, & Samuelsen, 2001). There is therefore also still a lot of variety in views whether or not the EPDS is a useful tool in health care.

1.2 Situation in the Netherlands: Youth Health Care

Youth Health Care (YHC) in the Netherlands is a body created by the government that is responsible for the preventive health care of children between the age of 0 – 19 years. YHC keeps track of the development of children (especially in the first years) and helps guiding parents with parental support and advice (Nederlands Centrum Jeugdgezondheidszorg, 2012). The task of arranging YHC lies with Municipal Health authorities, they have to organise the so called YHC Centres.

All parents of new born children get an invitation to visit a YHC centre. They can choose whether or not to accept this invitation; when they accept the invitation, a first appointment will be made within two weeks. This appointment takes place at home with a YHC nurse. After this, during the first year after delivery the parents are invited to visit the YHC Centre when their child is 1, 2, 3, 4, 6, 7 ½, 9 and 11 months. At these visits the development of the child is monitored and vaccinations of the national vaccination programme are provided. The visits also give the opportunity to parents to ask questions and get parental advice (Dunnink & Lijs-Spek, 2008) (Wegwijzerloket, n.d.) (Zwangerschapsforum, n.d.).

When it is presumed a mother has a PPD, there is a general referral policy that should be followed. When PPD is presumed, a mother should be referred to a General Practitioner (GP) or a primary care psychologist for further diagnosis. Based on this diagnosis treatment can be offered. The treatment options are similar to the treatment options of someone with a general depression. Besides the referral to a GP or a psychologist, mothers with a presumption of PPD should get a recommendation to participate in a mother-child intervention. This is a programme which focuses on the quality of the interaction between mother and child and is meant to prevent emotional and social development issues of the child later in life.

Even though literature gives an indication of the effectiveness of screening for PPD (further information about this can be found in paragraph 2.2.6), there is currently no structured approach in

YHC for detecting PPD. However, in 2008 the region of Twente did start using the EPDS questionnaire. It was initiated by YHC professionals. By detecting PPD in an early stage, problems in the development of children could be prevented and mothers could get earlier support in dealing with their depression.

1.3 Post-Up

At the Academic Collaborative Centre for Youth in Twente (AWJTwente) a research project started on the screening for PPD with the EPDS, called Post-Up. It is investigated whether or not the screening for PPD is effective, if physicians and parents are satisfied about the screening and if the incremental effectiveness of the EPDS justifies the costs associated with the screening procedures (Academische Werkplaats Jeugd in Twente, n.d.).

1.3.1 Cost effectiveness analysis

This research will focus on this last part of the Post-Up research; the cost effectiveness of screening for PPD in YHC compared to the care as usual in YHC. In the theoretical framework (Chapter 2) and in the method section (Chapter 3) more will be explained about cost effectiveness analyses and the design of the analysis that will be performed in this research. The next paragraph, 1.4, will show the research question of this cost effectiveness analysis.

1.4 Research Question

What is the expected incremental cost effectiveness of screening for PPD in Youth Health Care compared to the care as usual in YHC in a general population, when screening mothers in the first six months after delivery?

1.4.1 Sub questions

1. What are the incremental costs of screening for PPD in YHC compared to the care as usual in YHC?
2. What are the incremental effects of screening for PPD in YHC compared to the care as usual in YHC?

1.5 Scientific and social relevance

Depression is a major contributor to health and social costs (Chisholm, Diehr, Knap, Patrick, Treglia, & Simon, 2003). It accounts for 4.3% of the global burden of disease and it causes 11% of all years lived with disability globally (World Health Organisation, 2013). Postpartum depression is just one type of depression, but it is also a large contributor to health and social costs and has a high burden of disease. Research showed that women from the UK who have PPD spend £392.10 more on health and social care than women without PPD (Petrou, Cooper, Murray, & Davidson, 2002). Besides this, it should be taken into account that not only the mother suffers from the depression. The child of the depressed mother can also experience problems and may need more health and social care later in life. This causes a rise in health care costs. Because of this contribution to health care costs, it is important that well thought decisions are made about the organisation of health care for mothers with PPD.

The structure of finances of health care in the Netherlands for mothers with a PPD is currently organised as follows. Depression is a psychological illness and is therefore covered by Mental Health Care (GGZ). Expenses in Mental Health Care are more than doubled in the time between 2000 and 2010, from €2.91 billion to €6.14 billion (Bijenhof, Folkerstma, Kommer, Slobbe, & Polder, 2012). A

lot of care offered in Mental Health Care is reimbursed by health insurance companies. In the basic insurance, non-specialist primary care is covered for everyone (for example GP or social care). Treatment by a primary care psychologist is partially covered when someone has a referral from a GP and treatment in secondary mental health care is completely covered in the basic insurance. Secondary mental health care will be covered by a General Law for Specific Costs in Health Care (AWBZ) if the treatment continues after one year (Rijksoverheid, n.d.). This means the government takes on most of the costs patients make in Mental Health Care. The remaining costs are out-of-pocket costs for the patient.

The Dutch Health Insurance Board (CVZ) is currently planning to reduce the number of disorders that are covered in the basic insurance package. The CVZ determines what care will and will not be covered in the basic insurance package for a large part on scientific evidence that a treatment or service is effective. The reduction of disorders that are covered can lead to a reduction in mental health care costs for the government (GGZnieuws.nl, 2013). It would however also mean that out-of-pocket expenses for patients will rise. In the case of detecting PPD this could lead to a decrease in the number of mothers with PPD that seek help, because mothers will then have to pay for treatment.

Early detection of depression is associated with a lot of benefits for the wellbeing of the mother, the wellbeing of the child and for health care costs. Screening for PPD could help improve this early detection. There is however still a lot of uncertainty about the cost effectiveness of this screening. A systematic review of Hewitt & Gilbody (2009) concludes that it is difficult to say something about the cost effectiveness of screening for PPD. Results show that screening appears to lead to better outcomes, but these results can be influenced by the availability of a proper follow up process after the screening (Hewitt & Gilbody, 2009). In 2013 another research was published which shows similar results; the effectiveness of a screening seems to depend on the follow up process for women who have a positive screening result (Myers, et al., 2013).

No research has been performed so far to see how screening for PPD affects the detection rate of PPD in the Netherlands and what the associated costs are with the screening. It is therefore useful to perform a cost effectiveness research about screening in the Dutch system, so more insights can be gained on whether or not it is worth implementing a national screening programme for PPD in YHC in the Netherlands.

2. Theoretical Framework

This chapter will cover two major concepts that are important to understand before being able to perform this cost effectiveness research. In two paragraphs, the concept of screening and the rationale for health economic evaluations will be described.

2.1 Screening

2.1.1 Definition

Screening is a way to detect a disease when it is still in an early stage (Morabia & Zhang, 2004). There are several definitions available for screening, but one that is often used in research comes from the Commission on Chronic Illness (CCI). This definition can be found below.

Definition of the CCI:

> *"The presumptive identification of unrecognised disease or defect by the application of tests, examinations, or other procedures which can be applied rapidly. Screening tests sort out apparently well persons who probably have a disease from those who probably do not. A screening test is not intended to be diagnostic. Persons with positive or suspicious findings must be referred to their physicians for diagnosis and necessary treatment"*
>
> (Commission on Chronic Illness, 1957)

In the context of the rest of this research, another definition that is suitable comes from the Dutch government. This definition is also displayed below.

Definition of the Dutch government:

> *"A screening is a medical exam for people who do not have health issues. The test is meant for finding a disease, a genetic predisposition or risk factors that increases the chance on becoming ill"*
>
> (Rijksinstituut voor Volksgezondheid en Milieu, n.d.)

As both definitions point out, it is important to realise that screening is a way to detect people who are likely to have or get a certain disease; the result is not a diagnosis. After a person has had a positive screening for a disease, another diagnostic test is necessary to confirm (or deny) the presence of the disease.

2.1.2 Criteria

Not every screening instrument is a valid way to detect diseases. There are several criteria that are important when determining the usefulness of a screening instrument. Important points in these criteria are that earlier detection through screening should lead to a better prognosis for the patient, the screening should be valid and repeatable and a sufficient portion of true cases should be identified among the people who got the screening (Morabia & Zhang, 2004). A globally accepted list of criteria for the acceptance of a screening programme is set up by Wilson & Jungner (1968). Seeing this list was established a long time ago, the World Health Organisation (WHO) revised the criteria slightly in 2008. In Table 1 these revised criteria of the WHO can be found.

Table 1 – Revised screening criteria WHO (Andermann, Blancquaert, Beauchamp, & Dér, 2008)

1.	The screening programme should respond to a recognized need.
2.	The objectives of screening should be defined at the outset.
3.	There should be a defined target population.
4.	There should be scientific evidence of screening programme effectiveness.
5.	The programme should integrate education, testing, clinical services and programme management.
6.	There should be quality assurance, with mechanisms to minimize potential risks of screening.
7.	The programme should ensure informed choice, confidentiality and respect for autonomy.
8.	The programme should promote equity and access to screening for the entire target population
9.	Programme evaluation should be planned from the outset.
10.	The overall benefits of screening should outweigh the harm

The criteria are guidelines to determine whether or not a screening instrument is acceptable. For determining the (cost-)effectiveness of a screening programme for PPD in YHC, these criteria should be taken into account.

2.1.3 Relevant concepts

To determine if a screening instrument meets the criteria of the WHO, information is required about the disease and the screening instrument. This information often comes with certain concepts that need to be understood to be able to comprehend the information. In this paragraph some of these concepts will be explained.

Prevalence

The prevalence of a disease indicates how many people suffer from a certain disease at a specific moment in time. It shows the number of people who have the disease, divided by the total number of people that are at risk for the disease (Bouter, Dongen, & Zielhuis, 2005) (Kleinbaum, Kupper, & Morgenstern, 1982).

Sensitivity and Specificity

The sensitivity and the specificity are indicators of the accuracy of a test. The definition of these two concepts are according to Rothman, Greenland and Lash (2008):

*"**Sensitivity:** The proportion of those with the condition who have a positive test"*

*"**Specificity:** The proportion of those without the condition who have a negative test"*

This means that the sensitivity shows the percentage of people who have a certain disease, who also get a positive result from the test. The specificity on the other hand indicates the percentage of people without a disease, who also have a negative test result (Rothman, Greenland, & Lash, 2008) (Bouter, Dongen, & Zielhuis, 2005) (Kleinbaum, Kupper, & Morgenstern, 1982).

A test is completely accurate when both sensitivity and specificity are 100%. This is however almost never the case, there is often a chance some cases will have a false test result.

Positive Predictive Value and Negative Predictive Value

The positive predictive value (PPV) and the negative predictive value (NPV) are two other concepts that describe the accuracy of a test. The PPV is the percentage of people with a positive test result, who actually have the disease. The NPV on the other hand, is the percentage of people who have a negative test result, that also do not have the disease (Fletcher & Fletcher, 2005).

In Figure 1 an overview can be found of the possible tests results, with the sensitivity, specificity, PPV and NPV explained in formulas.

Figure 1 – Sensitivity, specificity, PPV and NPV. Adapted from Bouter, Dongen, & Zielhuis, 2005

		Disease		
		Present	**Absent**	
Test	**Positive**	True positive (a)	False positive (b)	a+b
	Negative	False negative (c)	True negative (d)	c+d
		a+c	b+d	

Sensitivity = a / (a+c) Specificity = d / (b+d)

PPV = a / (a+b) NPV = d / (c+d)

There are four concepts in Figure 1 that still need further explanation: true positive, false positive, true negative and false negative. These concepts can be explained by applying them to the screening process for PPD. When a screening shows a mother has an increased risk of having PPD and an additional diagnostic procedure shows that the mother indeed has PPD, the case of the mother is called a 'true positive'. However, when the screening shows a mother has an increased risk of having PPD, but diagnosis shows that the mother does not have PPD, it is a 'false positive'.

The same goes for 'true negative' and 'false negative': a screening which shows that a mother is not likely to have PPD, but diagnosis shows that the mother does have PPD, is called a 'false negative'. When the screening shows that a mother is not likely to have PPD and she also does not have PPD, it is called a true negative.

2.1.4 Effectiveness screening for postpartum depression

Screening for PPD is a type of secondary prevention. Secondary prevention is prevention that is focused on the early detection of a disease to prevent the disease from aggravating. Early detection is associated with earlier recovery from the disease (Bouter, Dongen, & Zielhuis, 2005). Most studies that examined the effects of screening for (postpartum) depression indicate that early detection of depression is important and is something that should be strived for (Leung, et al., 2011). However, why this early detection is important and what its consequences are for the treatment of depression or for the wellbeing of mother and child is unclear. One study is performed that investigated the effects of secondary prevention of depression amongst children and adolescents. The results showed that secondary prevention had a positive influence on the reduction of adjustment, relational and educational problems, and on improving competencies of children and adolescents (Durlak & Wells, 1998). This is a different target population and setting than it would be with secondary prevention of PPD, but this result combined with the indications in other studies on the importance of early detection of PPD, makes the assumption likely that early detection is beneficial for the wellbeing of mother and child. A reason for this can be that early detection could lead to earlier treatment and therefore the mother will be cured from depression earlier. This could then lead to less exposure of mother and child to the negative influences of PPD, which has a beneficial effect on the wellbeing of mother and child.

2.2 Economic Evaluations in Health Care

To understand the value of and the reasons for doing cost effectiveness analyses, it is important to know its rationale. Therefore in the next paragraphs the background of costs in health care will be discussed at first, and after this the background of economic evaluations and relevant issues of these evaluations will be explained.

2.2.1 Costs in health care

Health care costs are constantly rising and are putting a heavy burden on public resources. In 1972 health care expenses were 8% of the gross domestic product (BBP), in 2011 this has increased to 13% of the BBP and it is expected to rise to 22% of the BBP in 2040 if no changes are made in the current way of working. An current important factor in the Dutch health care system is its solidarity. If the percentage of BBP that goes to health care continues to grow however, this will have a negative impact on the solidarity of the system (Horst, Erp, & Jong, 2011). Between 2007 and 2010 health care expenses have risen with an average of 5.3% per year, total costs for health care and wellbeing has risen in this time period from € 74.4 billion to € 87.6 billion (Slobbe, Smit, Groen, Poos, & Kommer, 2011). It is not possible to point out what the exact reasons for the rise in costs are, as it is likely a combination of factors. The ageing population and the rapid development of new technologies are however two factors that are likely to be a big contributor to the rising costs (Giesbers, Verweij, & Beer, 2013) (Rijksoverheid, 2011).

Although health care costs are constantly rising, health care resources remain scarce. It is therefore important to make informed decisions about how to allocate scarce health care resources. In 2006 the Council for Public Health and Health Care (RVZ) in the Netherlands published a report about sensible and sustainable care. The report stresses three important criteria of health care:

1. Health care should be given to those people who need it the most; if care needs are high, it is more likely financing will come from collective resources.
2. Health care should be effective and efficient; value for money is an important aspect when there is a restriction on health care expenses. When an intervention offers high value for money, it will be more appropriate to offer this health care from collective resources.
3. Health care has to be equitable and based on solidarity; this is a very subjective criterion and it will therefore also be difficult to find an equitable and solidary way that is suitable for everyone. It is however something that should be taken into account when decisions in health care are made.

(Raad voor Volkgezondheid en Zorg, 2006)

To determine whether or not care is sensible and sustainable, accurate information is necessary. A way to obtain this information is by performing health economic evaluations. What these type of evaluations are and how an economic evaluation can be performed will be explained in the next paragraph.

2.2.2 Economic Evaluations in Health Care

Economic evaluations are an important and useful tool to gain relevant information for the second criterion the RVZ established; the effectiveness and efficiency of a health care intervention. Economic evaluations give a systematic approach to determine what relevant costs and benefits are of alternative interventions. In economic evaluations two or more alternative interventions are evaluated and compared on their costs and their effects. The result of an economic evaluation is an overview of the relative benefits and the costs of each investigated alternative (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005). When decisions would be made based on economic evaluations only, health care would be maximised within the available resources.

There are three types of economic evaluations. The effects that are chosen for the evaluation and the method for measuring these effects influence the type of evaluation that is appropriate for a research. An overview of these methods and differences between them can be found in Table 2.

Table 2 - Overview types of economic evaluations (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005)

Types of study	Measurement/valuation of costs in both alternatives	Measurement/valuation of consequences	Outcome
Cost benefit analysis	Monetary units	Monetary units	Net benefit (total cost–total benefit)
Cost effectiveness analysis	Monetary units	Natural units (e.g. life years gained, disability days saved, points of blood pressure reduction etc.)	Costs per one unit of effect (difference in costs / difference in units of effectiveness)
Cost utility analysis	Monetary units	Health years (typically measured as quality adjusted life years)	Costs per QALY (difference in costs / difference in QALYs)

In cost benefit analyses (CBA) both costs and consequences are valued in monetary units. This can be difficult, seeing benefits (for example life-years gained) have to be translated to a monetary value. An advantage of this method is however that it gives a concrete way of comparing costs and benefits. This makes it easy to determine whether or not the benefits of an intervention are worth the costs (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005).

A cost effectiveness analysis (CEA) is a method that can show whether or not more benefits can be produced with the same costs, or whether or not the same benefits can be produced for lower costs (Morris, Devlin, & Parkin, 2007). Drummond et al. (2005) add to this that a CEA is particularly useful when a decision maker has to deal with a given budget. To be able to perform a CEA it is necessary that the alternatives that are being compared strive for the same health effect (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005).

Finally, a cost utility analysis (CUA) is quite similar to a CEA, but instead of measuring effects in natural units like in CEAs, the effects are measured in Quality Adjusted Life Years (QALYs). A QALY expresses the amount of time someone is in a specific health state, multiplied by the quality of life the person has in that state. The QALY is often expressed as a number between 0 and 1, with 1 being in perfect health and 0 being dead. The advantage of using QALYs is that programmes that strive for different health effects can be compared (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005) (Morris, Devlin, & Parkin, 2007).

One method for performing a CBA, CEA or CUA is to create a model. Two types of models prevail in economic analyses; decision tree models and Markov models (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005). Both models help in identifying the health care intervention that maximises the health that can be gained per euro that is spent. When choosing between a decision tree or a Markov model, it should be kept in mind that the model has to represent reality as much as possible. When an event can repeat itself over time (when there are time cycles) and when a long time-span is adopted, a Markov model can be recommended. If time is not an important factor in the analysis, a decision tree can be chosen.

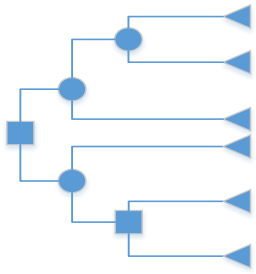
For this research it is chosen to use a decision tree, because the time frame of the study is a one year period, which is a relatively short period, and because there are no time cycles in the analysed

process. Both type of models will be explained in the next two subparagraphs, but because the Markov model is not used in this research, this model will be described in less detail than the decision tree.

Decision tree model

A decision tree is a decision support tool that uses a tree-like graph or model that displays certain decisions and their possible consequences, including chance event outcomes, resource costs and effectiveness or utility. It consists of decision nodes, chance nodes and probabilities and it helps to identify the strategy most likely to reach a pre-specified goal, in this case maximizing health gains per euro spent. In Figure 2 a basic, empty decision tree model is shown.

Figure 2 – Decision Tree Model



The square points in the model are *decision nodes*. At these points a decision has to be made, for example the decision whether or not to perform surgery. A decision node can lead to more than two alternatives to choose from, the alternatives should, however, be mutually exclusive.
Chance nodes are the round dots in the tree. A chance node is a point which shows the chance a certain outcome occurs after a decision is made. There can be more than two alternative chance nodes, the sum of the alternative chances should however always be 1.
The triangular nodes are *terminal nodes*. These show the end of a pathway and the outcomes of a pathway are placed here. Possible outcomes are the value of the effect that is measured (QALYs for example) and the costs of a pathway.
When there is enough information about chances and outcome values to implement in the model, the *expected value* can be calculated. An expected value is calculated by multiplying the possibility of an outcome with the value of this outcome. The formula for the expected value is:

$$E(X) = \sum_{i=1}^{n} P(X_i) \times U(X_i)$$

E = Expected Value — P = Probability of the outcome
X = Number of outcomes — U = Value of the outcome

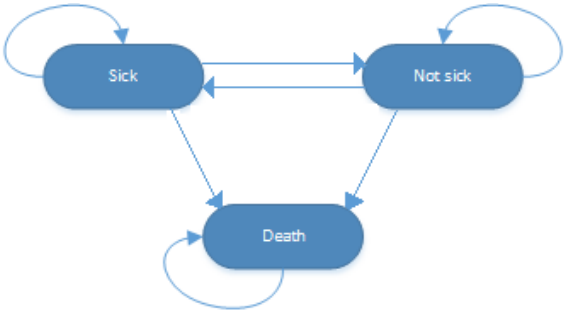
(Adapted from (Parkin, 2009))

The decision tree is a tool to get an overview of the possible decisions that need to be made during a process and the consequences this will have on (health) effects. These consequences are presented as the costs that are made to achieve a certain effect. The decision tree has however some limitations. First, the time dependency of values cannot be included in a decision tree. Second, when the pathway of a chronic or long-term illness has to be represented in a decision tree, a lot of branches are needed. This would make a tree complicated and too extended to get a good model. This is where a Markov model can be a solution (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005) (Morris, Devlin, & Parkin, 2007).

Markov model

Markov models assume there are a certain number of health states a person can be in. These health states change over a certain period of time and are amongst others influenced by the received treatment. A simplified example of a Markov model can be found in Figure 3.

Figure 3 - Markov Model



The time period in which this health state can change is called a *time cycle*. A transition of health state can be to another health state, but it can also be to the same health state again. The chance of changing to a different health state is called the *transition probability*. To be able to compare the intervention group with the control group in a CEA, a Markov model has to be filled in twice. The basis of both models is the same, the values of parameters vary however. These are dependent on the treatment that is chosen. The expected values in a Markov model are calculated by weighing values according to the time he or she spends in a certain health state (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005) (Morris, Devlin, & Parkin, 2007).

2.2.3 Costs of an intervention

Model-based health economic analyses require adequate information to populate the model with. When a CEA is performed, this means amongst others that information about costs is necessary. This paragraph will explain what type of costs there are and how these should be handled.

There are four different categories of costs. Table 3 shows these four categories and what costs are relevant in each category.

Table 3 - Overview type of costs in health care (Hakkaart-van Roijen, Tan, & Bouwmans, 2010)

	Within the health care sector	Outside the health care sector
Direct costs	Medical costs for treatment and care	Costs for patients (time and travel)
Indirect costs	Medical costs in life years gained	Production loss, juridical costs, special education

It depends on the perspective in an economic evaluation which costs should be included in an analysis. Possible perspectives are those of the insurance company, the community, the patient and the society (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005). For example, when taking a patient's perspective in the case of screening for PPD (the patient is in this case the mother), costs that are relevant are possible extra traveling costs to get to the YHC centre and production losses. Production losses could occur because a mother may have to take time off her work to go to the screening. When looking from the community perspective, travel costs would not be relevant, because the community does not have to pay these costs. Costs of the screening however are, seeing the community reimburses these costs. The societal perspective takes the costs of all perspectives into account. This is the perspective that is usually recommended for health economic evaluations, because economics is based on getting the most benefits from scarce resources within a society. If an

evaluation was focused only on costs within health care, health outcomes would be optimised, but the welfare of society in general would not (Byford & Raftery, 1998).

Discounting costs

A CEA compares alternatives at a certain point in time, this time being usually the present. It is important to realise that costs (and benefits) that are made in the past (or will be made in the future), might have another value at the current point in time. Inflation, bank interests and time preferences all affect the value of costs. A time preference means that people rather enjoy benefits now than after a certain period of time and they would rather postpone costs than pay them now (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005) (Morris, Devlin, & Parkin, 2007) (Hakkaart-van Roijen, Tan, & Bouwmans, 2010). The *present value (PV)* can be used to calculate costs at a current time. This PV multiplies the costs in other years with the relevant discount rates of each year (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005).

As with costs, benefits can also be discounted. As the value of costs changes over time, the value of benefits changes as well. There are different perspectives and arguments about to what extent this discounting should be done and therefore there is no globally accepted standard for discounting costs and benefits. The CVZ has set a guideline for economic evaluations of health care interventions in the Netherlands, which also includes recommendations about discounting costs and benefits. For the discount rate of costs a rate of 4% is recommended and for benefits a rate of 1,5% (College voor Zorgverzekeringen, 2006).

Friction cost method

When someone is unable to work due to a certain disease, production losses occur. The friction cost method is a recommended method in pharmacoeconomic research to measure costs associated with production losses. The method assumes that in a long time span every employee is replaceable, so production losses only occur until an employee is replaced. Until this has happened, there is a friction period where extra costs are made to compensate the absence of an employee. It is calculated that on average the friction period is 160 days, which means that after 160 days no extra costs are made to compensate production losses. The production losses are calculated by multiplying the costs of being absent at work per time period with the time that someone is absent (Brouwer & Koopmanschap, 2005) (Hakkaart-van Roijen, Tan, & Bouwmans, 2010).

2.2.4 Incremental Cost Effectiveness Ratio

When costs and benefits of an intervention are calculated and valued, it has to be determined whether or not the costs are worth the benefits. A ratio that can help to determine this, is the Incremental Cost Effectiveness Ratio (ICER). The ICER is the ratio that shows the extra amount of money that is necessary to create one extra unit of effect. It is a common outcome for CEAs. The ICER is calculated by dividing the difference in costs between two health care interventions by the difference in effects of these health care interventions. The formula is as follows:

$ICER = (C_1 – C_2) / (E_1 – E_2)$

C_1 = Costs of the intervention

C_2 = Costs in the control situation

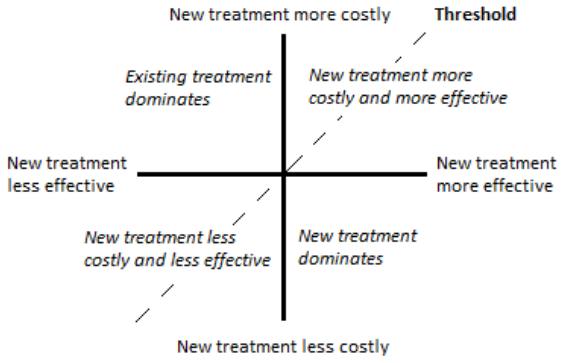
E_1 = Effects of the intervention

E_2 = Effects in the control situation

(Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005) (Morris, Devlin, & Parkin, 2007)

This value can be used to determine whether or not a new intervention is more cost effective than the current standard. To be able to determine which ICER is cost effective and which is not, a diagram can be used to help visualise the decision. This diagram is called the cost effectiveness plane and is displayed in Figure 4.

Figure 4 - Cost Effectiveness Plane (adapted from Drummond, Sculpher, Torrence, O'Brien, & Stoddart, 2005)



When a new treatment is more costly, but less effective, the intervention is placed in the upper left quadrant. Seeing the extra costs for the new intervention do not deliver extra benefits, it is better to stick with the already existing standard. In the bottom right quadrant it is the other way around. The new treatment does not only cost less, but also generates better outcomes, so it is recommended to use the new treatment. When an intervention is placed in the upper right or the bottom left quadrant, a trade-off has to be made. In the upper right quadrant the new treatment costs more, but it has also a higher effectiveness. In the bottom left quadrant the new treatment is less expensive, but is also less effective. So in this case it depends on what the threshold is for indicating something as cost effective, whether or not it can be recommended to adopt or to reject a new treatment. In Figure 4 this threshold is indicated with the dotted line. When an intervention is placed below the line, the new treatment is recommended; when an intervention is placed above the dotted line, the new treatment is not recommended.

To determine the value of this threshold several perspectives can be adapted (Raad voor Volkgezondheid en Zorg, 2006). These perspectives all give a different view on how to calculate and determine the threshold of the ICER. Research shows that on average an amount of €70 000 and €80 000 per QALY is an acceptable limit. In the Netherlands there is no specific threshold for cost effectiveness. The RVZ does indicate however that the maximum of the threshold should be €80 000 per QALY when the burden of the disease is very high. For preventive interventions a threshold of €20 000 per QALY is recommended (Raad voor Volkgezondheid en Zorg, 2006) (Berg, Baal, Wit, & Schuit, 2008). The difference in these two thresholds already indicates that it depends on the setting and the burden of the disease what threshold can be defined as an acceptable cost effectiveness limit.

Even though CBAs, CEAs, CUAs and the ICER are good tools for decision makers to use, there is no consensus on whether or not these analyses could (or should) be the only source of information in decision making processes. They deliver good quantitative information which is useful for decision making, but it has to be taken into account that models are used to create this information. Data is summarised to make it fit in the models, which can lead to information losses. Furthermore, the

affordability of an intervention and the burden of the targeted disease are also important factors in the decision making process (Raad voor Volkgezondheid en Zorg, 2006) (Feenstra, Baal, Wit, Polder, & Hollander, 2006).

2.2.5 Sensitivity analysis

Every model is prone to various types of uncertainty. This uncertainty can come from the structure of the model, the values of parameters and/or from decisions that are made. To deal with parameter uncertainty a sensitivity analysis is usually included in an economic analysis. This is a tool that helps showing how sensitive the results of an analysis are when parameter values change (Morris, Devlin, & Parkin, 2007) (Drummond, Sculpher, Torrance, O'Brien, & Stoddart, 2005). It helps to see how much expected outcomes change when other values of input parameters are used in the model and it can help to estimate the reliability of the results.

There are various ways in which sensitivity analyses can be performed. Examples are a one way sensitivity analysis, a two or multi-way sensitivity analysis and statistically-based sensitivity analysis. A one way sensitivity analysis looks at the changes in results when only one parameter changes; a two or multi-way sensitivity analysis looks at changes in results when two or more parameters change. The statistically-based sensitivity analysis uses statistical methods which are helpful for quantifying uncertainty in a consistent and easy to understand way (Morris, Devlin, & Parkin, 2007).

2.2.6 Cost effectiveness research conducted on the screening for PPD

Multiple studies show that it is effective to use formal methods for screening for PPD (Durlak & Wells, 1998) (Myers, et al., 2013) (Leung, et al., 2011). There are however a lot less studies that also include the relevant costs and analyse the cost effectiveness of screening.

Paulden et al. (2009) found that the use of formal screening methods was not cost effective in the UK. They performed a CUA and calculated the ICER when care with the use of EPDS was compared to care as usual. The ICER was £41 103 per QALY, which is above the threshold range that is set in the UK of £20 000 to £30 000 per QALY. This research thus says that screening is not cost effective (Paulden, Palmer, Hewitt, & Gilbody, 2009). A systematic review of Hewitt & Gilbody (2009) concludes that it is difficult to say something about the cost effectiveness of screening for PPD. Results show that the screening appears to lead to better outcomes, but these results can be influenced by the availability of a proper follow up process after screening. Seeing the different studies include different care or treatment components in their analysis, it is difficult to compare their results (Hewitt & Gilbody, 2009).

The importance of a follow up process was mentioned above; two studies were found that included the process in the research for screening. The Agency for Health Care Research and Quality in the United States reported that screening for PPD should be performed when enough resources are available for further diagnosis and treatment. It does not have results on what type of screening and what policy for the follow up process is the best way to organise the screening, but it does say that when screening, diagnosis and treatment are all provided within the same organisation, the best outcomes will come forth (Myers, et al., 2013). A research in the UK also showed that a good referral and treatment programme for mothers with PPD is effective compared to a usual care programme. The economic evaluation concluded with that having this appropriate referral and treatment programme was likely to be cost effective compared to a control group where no proper referral and treatment programme was available (Morrell, et al., 2009).

3. Research Methods

This chapter describes the methodology of the research. There are several sections, which will all describe a part of the design of the study and which will explain how the economic evaluation is performed.

3.1 Research population

In this research a hypothetical research population was used. The population consisted of 500 mothers: 250 mothers in the intervention region and 250 mothers in the control region. The hypothetical population was similar to the research population in the Post-Up research. The mothers in the intervention group represented new mothers from the region Twente who visit a YHC centre and the mothers in the control group represented new mothers from the regions Apeldoorn and Deventer who visit a YHC centre. This is because the screening for PPD in YHC is already implemented in the region Twente and in the regions Apeldoorn and Deventer mothers receive care as usual in YHC, so without the screening programme. It was assumed that all mothers accept the screening.

3.2 Study background

The study was a cost effectiveness analysis of the screening for PPD in Youth Health Care. It was performed on behalf of the research project Post-Up, which is performed at the Health Technology and Services Research department of the University of Twente and the Academic Collaborative Centre for Youth in Twente. The aim of the research was to assess the incremental cost effectiveness of screening for PPD in YHC.

3.2.1 Perspective, time frame and discount rate

The societal perspective was used in this research, which meant direct and indirect costs from within and outside health care were taken into account. This perspective is generally recommended for economic evaluations, the results of the evaluation will then show what the most benefits are that can be achieved with the scarce resources available. The time frame of the model was a one year period, which was adopted from the Post-Up research. The participating cohort had a one year follow up period, within this year it was determined whether or not a mother has or has had a PPD, and whether or not she has been diagnosed with PPD. Because the time frame was a relative short time period, it was not necessary to discount costs and benefits.

3.3 Study design

3.3.1 Comparators

The incremental cost effectiveness of screening versus no screening for PPD in YHC was studied by comparing an intervention group, where a screening for PPD is performed in YHC, and a control group, where care as usual in YHC is given. The different processes in the intervention and the control group are described in the next two subparagraphs.

Intervention group

In the intervention group, mothers and their children visited the YHC centre in the first year after delivery when their child was 1, 2, 3, 4, 6, 7½ (optional), 9 and 11 months old. At these moments, the YHC doctor or nurse went through standard conversations about the development of the child, provided needed vaccinations and he or she could ask about the psychological wellbeing of the mother. This was all based on basic task guidelines the RIVM has drawn for Youth Health Care 0 -19 (Dunnink & Lijs-Spek, 2008).

Beside these basic tasks, mothers in the intervention group were asked to complete the EPDS questionnaire a week before the visit when the child is 1, 3 and 6 months old. When the mother and her child visited the YHC centre a week later, the YHC doctor or nurse discussed the results of the EPDS with them. It then depended on the height of the score on the EPDS whether or not a mother was recommended to visit a GP or psychologist. If a mother scored higher than 12 on the EPDS, there was a presumption of a major depression and a direct referral to a GP or a psychologist was recommended. When the mothers scored between the 9 and 12, a minor depression was presumed and an additional inventory home visit of a YHC nurse was recommended before determining whether or not a referral to a GP or a psychologist is necessary. Additional to the referral to a GP or psychologist, when a mother had a raised score on the EPDS (>9), a mother could be recommended to participate in a mother-child intervention.

Control group

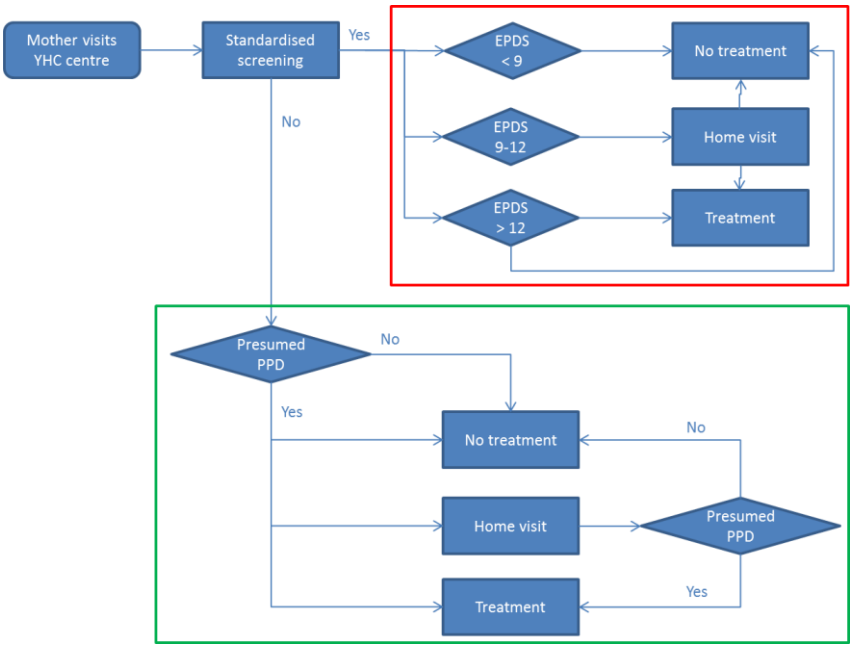
The control group received care as usual from YHC doctors. Care as usual was care as described in the guidelines for YHC. The mothers visited the YHC centre in the first year after delivery when their child was 1, 2, 3, 4, 6, 7½ (optional), 9 and 11 months old. The YHC doctor or nurse went through standard conversations about the development of the child, provided needed vaccinations and he or she could ask for the psychological wellbeing of the mother. The basic task guidelines did not specify that the YHC doctor had to check for PPD, just for the wellbeing of the mother in general. If a PPD was suspected, a referral to a GP or psychologist could be offered. A home visit from a YHC nurse could be recommended first. When there was a presumption of PPD, a mother could also be recommended to participate in a mother-child intervention.

The referral process and treatment for PPD were the same in both the intervention group and the control group.

3.3.2 Flowchart with the studied processes

A flowchart describing the alternative pathways is presented in Figure 5. The green bordered square indicates the process in the control region, the red bordered square represents the process in the intervention group. Seeing the screening takes place at the YHC centre when the child is one month, three months and six months old, it means that the screening takes place at three moments. The red bordered process only shows one screening moment, in the intervention region this process is therefore repeated three times.

Figure 5 - Flowchart of the compared processes



3.3.3 Cost Effectiveness Analysis

A CEA was chosen over a CUA or a CBA because the consequences of the intervention are going to be measured in natural units, namely the extra number of true positives of mothers with PPD that will be detected. By doing this, the actual consequences of a screening for PPD became clearer, compared to no screening for PPD. The CEA compared an intervention group that receives YHC including the screening for PPD with a control group that receives care as usual in YHC.

3.4 Outcome measures

3.4.1 Choice of health outcomes

The primary outcome measure was the incremental costs for detecting one additional mother with PPD. This primary outcome measure was adapted from the Post-Up research. The health outcome was therefore the number of true positive screens. This health outcome is an outcome in natural units, which is appropriate for a cost effectiveness analysis. By choosing the number of true positive screens as health outcome, it was assumed that the extra detection of mothers with PPD led to a better wellbeing of mother and child and that early detection through screening on PPD had a causal relation with a better recovery of the mother and a better development of the child.

3.4.2 Measurement of effectiveness

The effectiveness of the intervention was based on the chosen health outcome in the analysis: the number of true positive cases of PPD that was detected. Because the results of the Post-Up research were not available yet, information from literature was used to determine the number of true positives in the intervention region and the control region. The numbers in the intervention region were based on a review on validation studies of the EPDS (Eberhard-Gran, Eskild, Tambs, Opjordsmoen, & Samuelsen, 2001). This review showed different PPVs and NPVs at different sensitivities and specificities of the EPDS and with different prevalence rates. For the model the PPV and NPV were chosen at a sensitivity of 70%, a specificity of 95% and a prevalence of 10%. This prevalence rate was based on the article of Engels & Haspels (2003). The PPV and NPV were 61% and 96.6% respectively.

3.4.3 Measurement of costs

A flowchart was created of the screening and treatment process for new mothers in the intervention and the control group. It showed all steps that are relevant for detecting PPD in this study and was based on expert opinions and on information from the websites of the Netherlands Youth Institute (NJI) and the Netherlands Centre for Youth Health Care (NCJ). The flowchart can be found in Appendix B. Based on this flowchart all relevant cost categories could be established. Five cost groups could be distinguished: (1) screening costs, (2) home visit costs, (3) treatment costs, (4) costs of the mother-child intervention and (5) production losses as a result of the depression.

Information about the costs were collected in three different ways, namely with information from experts, with reference prices and with questionnaires. Each method is described below:

1. *Information from experts*

Experts from the municipal health service (GGD Twente) were asked for information about costs of inventory home visits by YHC nurses and information about the number of new mothers YHC doctors see on average per year. Furthermore experts from the Trimbos Institute were consulted about the costs of the mother-child intervention.

2. *Reference prices*

The reference prices can be divided in two categories: reference prices from the guide for costs research of Hakkaart-van Roijen et al. (2010) and reference prices from collective labour agreements (CAOs). The guide for costs research of Hakkaart-van Roijen et al. (2010) gave information about current reference prices and important guidelines for economic evaluations. CAOs were mainly used when costs per hour for professionals in health care needed to be determined. CAOs give recommendations on the wages of employees working in certain sectors. The function appreciation in health care (FWG) is a concept that is used in CAOs to classify different jobs in health care with different wage levels. Within every FWG there are also different wage scales, based amongst others on educational level and years of employment. When a general wage scale has to be chosen from a FWG, Hakkaart-van Roijen et al. (2010) recommend to use the middle wage scale + 1 scale.

3. *Questionnaires*

Questionnaires were distributed amongst YHC doctors from the intervention region, YHC doctors and nurses from the control region and amongst GPs. The distributed questionnaires can be found in Appendix C. The questions addressed experiences respondents had in the last year with the screening for and treatment of PPD. YHC doctors from the intervention region were approached during a team leaders meeting of YHC doctors. The YHC doctors and YHC nurses from the control region were approached by e-mail by a contact from the GGD IJsselland. The GPs were at first contacted by phone, the names and phone numbers of these GPs were obtained from the GGD Twente. When a GP wanted to complete a questionnaire, he or she was sent an e-mail with a link to complete the questionnaire online.

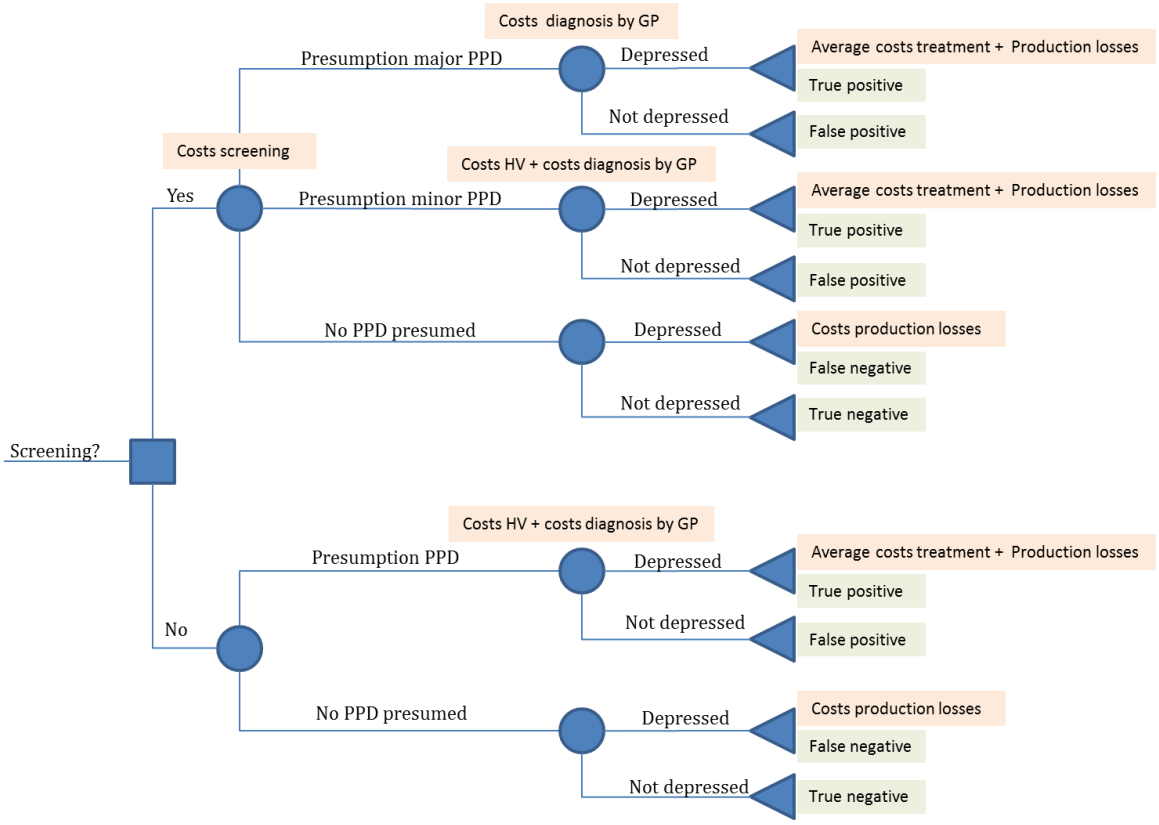
The questionnaires were used to gain insights in the time YHC doctors spent on the detection of PPD and in the number of mothers with PPD that are now detected and referred for treatment. For example, the questionnaires of YHC doctors from the intervention region gave information about the percentage of mothers with a score on the EPDS > 12 who get a referral to a GP, to Mental Health Care (MHC) or to a primary care psychologist, and the percentage of mothers who accept the different types of referrals. The results of the completed questionnaires from GPs were

complemented with information from a research about the treatment of general depressions (Verhaak, Dijk, & Verheij, 2011).

3.5 Decision model

The type of model that was chosen for this CEA was a decision tree. The created and used tree can be found in Figure 6. After the decision tree was established, it was determined at every node what the relevant costs were at that point in the tree. At each terminal node it was determined what the health outcome was. These costs and the health outcomes are also indicated Figure 6.

Figure 6 – Decision tree



3.5.1 Assumptions

To be able to create the model and fully populate this, some assumptions about parameters needed to be made.

1. *The average number of new mothers a YHC doctors sees per working hour is the same for every YHC doctor.*

Of the YHC doctors from the intervention region who completed the questionnaires it was known how many new mothers they saw on average per year. This number was provided by an epidemiologist from the GGD Twente. Because it was known how many mothers with an EPDS score higher than 12, an EPDS score between 9 and 12, or an EPDS score lower than 9 the YHC doctors saw, this number was necessary to calculate the probability of a mother getting a certain EPDS score.
In the control region it was not known how many new mothers the YHC doctors that completed the questionnaire saw on average per year. Therefore, in both the questionnaires for YHC doctors in the intervention region and in the control region, the doctors were asked for the number of hours they worked in YHC per week. This way, the total number of working hours of the YHC doctors in the

intervention region and in the control region could be calculated. With this information and the information about the number of new mothers in the intervention region, the number of new mothers in the control region could be calculated in the control region. The average number of new mothers per working hour could be calculated, and with the number of working hours of the YHC doctors in the control region the expected number of new mothers in the control region could be calculated. How this is done can be found in Table 4.

Table 4 – Calculation of # new mothers in control region

	# working hours YHC doctors per week	# new mothers
Intervention region	168	1 387
Control region	187	**X →** (1 387 / 168) * 187 = **1544**

This assumption had to be made, because questionnaires from the control region were completed anonymously, so we could not retrieve the actual number of new mothers from the YHC doctors in this region.

2. *Screening rate*

It is assumed that after a mother from the intervention region has had a positive screening at a consult, she still has a chance to get a screening at one of the next screening consults. YHC doctors from the intervention region were asked what percentage of the mothers they screened at the three different screening moments. Results of these questions can be found in Table 5.

Table 5 – Screening rate at the three screening moments

Parameter	Average result	Minimum	Maximum
% of mothers screened at consult 1 months	91%	80%	100%
% of mothers screened at consult 3 months	89%	80%	100%
% of mothers screened at consult 6 months	81%	50%	100%

Since the screening can take place at three consults, the costs for a screening in theory should be multiplied by three. But as not every screening moment has a screening rate of 100%, the costs for the screening are multiplied with the sum of the three screening rates: 0.91+0.89+0.81 = 2.61.

3. *Costs of false positives and costs of treatment postpartum depression*

For the model it is assumed that the costs of a false positive only consist of the diagnosis at a GP's office. It is thereby also assumed that false positives do not start treatment, because they are correctly diagnosed at the GP's office.

Furthermore, an assumption on the costs of treatment for PPD is made. It is assumed in this analysis that the costs for treating PPD are equal to the costs for treating a general depression. This is assumed for both treatments in primary care, as treatments in secondary care. This assumption is made because there is little information available about the costs of treating PPD.

3.6 Analysis

The decision tree was analysed in the software programme Excel 2010. By adding the expected costs of all paths in the intervention and of all paths in the control group, the expenses in both groups could be compared. The effectiveness of the screening for PPD in YHC could also be evaluated because in both the intervention and the control group it was known how many true positive screens there are in each group.

3.6.1 Incremental Cost Effectiveness Ratio

The end measurement that was used to determine whether or not the screening for PPD in YHC is cost effective or not compared to the care as usual in YHC, was the ICER. The primary effect measurement that was used for this is the extra number of true positive cases with PPD that is detected in the screening region compared to the control region. The ICER was therefore expressed as the extra costs that are needed to detect one additional true positive case of PPD. The formula of the ICER then looked as follows:

$$\text{ICER} = \frac{\text{(Costs screening for PPD in YHC – Costs care as usual in YHC)}}{\text{(Number of true positive cases with PPD with screening for PPD in YHC – Number of true positive cases with PPD with care as usual in YHC)}}$$

In short: with the help of a decision tree model the ICER is calculated, which represented the extra costs that are needed to detect one additional true positive cases of PPD in the screening group.

3.6.2 Decision criteria

To be able to determine whether or not the screening for PPD was cost effective, it had to be determined what the threshold was for the incremental cost effectiveness. This meant it had to be decided what costs were acceptable to be able to detect one extra true positive mother with PPD.

Guidelines to determine the cost effectiveness threshold are often aimed at studies where the effects of an intervention are measured in QALYs. In this study the effects were measured as the number of true positives, which made it difficult to determine a specific threshold of cost effectiveness. However, it could be said that if costs could be saved whilst detecting more true positives, the screening would be cost effective. When additional costs needed to be made to detect more true positives, the theoretical framework showed that the affordability of the intervention and the burden of the disease needed to be taken into account to determine whether or not the screening for PPD was cost effective. The first criteria, the affordability of the screening for PPD, depended on the costs of the screening. These costs were determined during this research. The second criteria, the burden of disease, could be considered as high. Depression in general is one of the largest contributors to the global burden of disease (World Health Organization, 2012). Besides this, in the case of PPD not only the mother her wellbeing is affected by the disease, her child its wellbeing is affected as well. In general, when the burden of a disease is high, it is reasonable to accept a higher ICER threshold. So in this case it also meant that the threshold for cost effectiveness could be relatively high.

3.6.3 Sensitivity analysis

A sensitivity analysis was performed to see how robust the expected ICER is. Every parameter value was changed at first with plus and minus its standard deviation (SD). This SD was calculated based on the data from the sample that completed questionnaires. When no SD could be calculated, a change of minus or plus 20% in parameter value was used. It was evaluated what effect the change in each parameter value had on the value of the ICER. Based on the change in ICER it was determined what parameters influence the ICER the most. These parameters were used to create several scenarios to see how changes in parameters can affect the outcomes.

4. Results

4.1 Response questionnaires

YHC doctors from the intervention region were asked during a team leaders meeting to complete a questionnaire. Eight doctors were present at the meeting and they all completed a questionnaire. The YHC doctors and YHC nurses from the control region were approached by a contact from GGD IJsselland, it is unknown how many were contacted. Eventually eight YHC doctors and twenty YHC nurses completed an online questionnaire.

18 GPs were contacted by phone. Nine of them indicated they wanted to complete a questionnaire and were sent an e-mail to complete an online questionnaire. Five of them eventually completed a questionnaire.

4.2 Study parameters

4.2.1 Screening and treatment process

In Table 6 information about parameters can be found which are focused on the duration and content of the screening and treatment process. It summarizes information that was retrieved from the completed questionnaires.

Table 6 – Parameters screening and treatment process

	Average	Min.	Max.
Intervention region – YHC doctors (N = 8)			
Preparation time EPDS	3	0	5
Additional time duration consult due to EPDS	3	0	5
Control region – YHC doctors (N = 8)			
Preparation time consult for detecting PPD	0	0	0
Additional time duration consult for discussing presumed PPD	10	5	15
YHC nurses (N = 20)*			
Preparation time consult for detecting PPD	2	0	30
Preparation inventory home visit	9	0	20
Duration home visit (without travel time)	55	0	80
Travel time for home visit	10	0	15
General Practitioners (N = 5)			
# mothers with presumed PPD per year	1	1	3
# consults when treating PPD	5	2	7

** Questionnaires were only distributed amongst YHC nurses from the control region. The results on the home visit are however used for both intervention and control region, seeing the home visit is performed in the same way in both regions.*

4.2.2 Probabilities and percentages

The probabilities and percentages of parameters that are used in the model could be calculated with information from completed questionnaires from YHC doctors from the intervention and control region. In Table 7 the information about these parameters can be found.

Table 7 – Parameters with probabilities and percentages

Parameter	Average	Min.	Max.	Total
Intervention region				
% mothers screened 1 month	91%	80%	100%	
% mothers screened 3 months	89%	80%	100%	
% mothers screened 6 months	81%	50%	100%	

# mothers with EPDS > 12*	9	2	25	70
# mothers with EPDS 9-12*	18	1	50	145
Probability mothers EPDS > 12	5%			
Probability mothers EPDS 9 - 12	10%			
Probability mothers EPDS < 9	84%			
% referral treatment	43%	10%	90%	
% acceptance treatment	63%	10%	90%	
% offering home visit	73%	10%	90%	
% acceptance home visit	63%	10%	90%	
% offering mother child intervention	44%	0%	70%	
% acceptance mother child intervention	40%	0%	70%	
Control region				
# mothers with presumption PPD	8	3	30	65
Probability mothers with presumption PPD	4%			
% referral treatment	55%	10%	90%	
% acceptance treatment	58%	10%	90%	
% offering home visit	50%	10%	90%	
% acceptance home visit	63%	10%	90%	
% offering mother child intervention	23%	10%	50%	
% acceptance mother child intervention	10%	10%	10%	

** In the questionnaires the YHC doctors were asked how many mothers they saw on average per year with an EPDS score between 9 and 12 and with an EPDS score higher than 12. The numbers displayed have to be seen in perspective of the total number of new mothers a YHC doctor sees per year. On average this number is 173 new mothers per year.*

4.2.3 Cost categories

The costs are divided in five different categories, namely 'Screening costs', 'Home visit costs', 'Mother Child intervention costs', 'Treatment costs' and 'Production losses'. In Table 8 an overview of the total costs of the cost parameters can be found. These total costs represent the average costs for the screening and/or treatment of one mother. An extended overview of all costs, with explanations of how total values are calculated, can be found in Appendix D.

Table 8 – Cost parameters

Costs	Total costs	Source
Screening		
Labour costs YHC doctor	€ 1.77	Labour costs: (SOVVT, 2012) Labour volume: questionnaires YHC doctors intervention region
Preparation costs YHC doctor	€ 0.69	Labour costs: (SOVVT, 2012) Labour volume: questionnaires YHC doctors intervention region
Training EPDS for YHC doctor	€ 0.02	Labour costs: (SOVVT, 2012) Labour volume: staff YHC doctor GGD Twente
Home visit YHC nurse		
Labour costs	€ 36.03	Labour costs: (SOVVT, 2012) Labour volume: Finance advisor region Twente
Travel costs	€ 1.00	Travel costs and travel distance: (Hakkaart-van Roijen, Tan, & Bouwmans, 2010)
Mother-Child intervention		
Labour costs social-psychiatric nurse	€ 321.44	Labour costs: (GGZ Nederland, 2011) Labour volume: (Trimbos instituut, 2013)
Travel costs social-psychiatric nurse	€ 1.48	Travel costs and average distance: (Hakkaart-van Roijen, Tan, & Bouwmans, 2010)

Training social-psychiatric nurse MCI	€ 1.44	Training costs: (Trimbos instituut, 2013)
Material costs		
Video camera for video-observations	€ 0.60	
Treatment		
GP visit	€ 296.40	Costs GP consult: (Hakkaart-van Roijen, Tan, & Bouwmans, 2010) Volume: (Verhaak, Dijk, & Verheij, 2011)
Treatment in Mental Health Care		
Primary care psychologist	€ 640.00	Costs psychologist consult: (Hakkaart-van Roijen, Tan, & Bouwmans, 2010) Volume: (Landelijke Vereniging voor Eerstelijnspsychologen, 2011)
Secondary care treatment	€ 5 129.29	Costs and volume: Vektis, GGZ detailinformatiesysteem, 2009, 2010
Medication	€ 98.00	Costs medication and volume: (College voor Zorgverzekeringen, n.d.)
Production loss mother	€ 2 215.05	(Rijksinstituut voor Volksgezondheid en Milieu, 2014)

Costs for the intervention group include all five cost categories. The costs for the control group exclude the 'Screening costs', the other four cost groups are included.

4.3 Incremental Cost Effectiveness Ratio

For the input on effects the model assumes the research population consists of 500 mothers: 250 mothers from the intervention region and 250 mothers from the control region. The number of true positives in the intervention region is 24, compared to 8 true positives in the control region.
Following from the model, the expected costs of a mother in the intervention region are € 316.51. The expected costs of a mother in the control region were € 1 250.38. This means the difference in costs is - € 933.87.

When these results from the performed analysis are used to calculate the ICER, the ICER is (€ 316.51 - € 1 250.38) / (24 -8) = **- € 60.53** per extra detected true positive mother with PPD, which in this case means the intervention is cost saving whilst still detecting more mothers with PPD.

4.4 Sensitivity analysis

4.4.1 Most influential parameters

To calculate the robustness of the ICER, at first it was checked what parameters influence the ICER the most by changing the values of every parameter with plus or minus its SD and seeing what this has as an effect on the ICER. Because the value of the parameter 'Probability EPDS < 9' is dependent on the value of the parameters 'Probability EPDS > 12' and 'Probability EPDS 9 – 12', only the 'Probability EPDS > 12' and the 'Probability EPDS 9 - 12' are lowered and raised with its SD. The parameter 'Probability EPDS < 9' is hereby adapted to make the total chance of scoring on the EPDS 100%. The PPV and the NPV of the EPDS are both changed with minus and plus 20%, because there was no dataset available of these parameters from which a SD could be calculated. Of the costs parameters there was also no data set available, therefore these are changed with plus and minus 20% as well.

Table 9 shows the six parameters that influence the ICER the most and their values from the sensitivity analysis, ranked on the height of the influence.

Table 9 – Sensitivity analysis

Parameters	Value	SD	Value – SD	Value + SD	ICER – 20%	ICER + 20%	Δ ICER
PPV EPDS	61%	12%	49%	73%	- € 91.00	- € 44.17	€ 40.82
NPV EPDS	96.6%	19%	77.3%	100%	- € 37.11	- € 64.65	€ 23.42
Production loss mother with PPD	€ 2 215.05	20%	€ 1 772.04	€ 2 658.05	- € 48.00	- € 73.06	€ 12.53
Probability mothers EPDS 9-12	10.5%	1.25%	9,2%	11,7%	- € 70.49	- € 52.81	€ 9.96
Probability mothers with presumption PPD	4.2%	1%	3.37%	5.05%	- € 54.34	- € 68.81	€ 6.19
Probability mothers EPDS>12	5%	0.59%	4.46%	5.64%	- € 64.85	- € 56.64	€ 4.32

4.4.2 Scenarios

Based on amongst others the parameters that influence the parameters the most, five scenarios are created to see how the ICER changes when there are different settings. What these scenarios are and what the value of the ICER was in each scenario can be found in the following paragraphs. At the end a summary of all results will be presented, an extended overview of the results of the scenarios can be found in Appendix E.

i. Change in positive and negative predictive value of the EPDS

In the base case model the percentages of the PPV and NPV of the EPDS are based on the review of Eberhard-Gran et al. (2008), with a sensitivity of the EPDS of 70% and the specificity of the EPDS of 95% and a prevalence of PPD of 10%. However, the review shows also that the PPV and the NPV change when the sensitivity and specificity of the EPDS change. In this scenario the effect of a change in sensitivity and specificity are tested: a sensitivity of 90% and specificity of 75% are adopted at a prevalence of 10%. The current values of the parameters and the changed values for this scenario are shown in Table 10.

Table 10 - Overview of changing parameters scenario *i*

Parameter	Base case	Scenario *i*
Positive Predictive Value EPDS	61%	29%
Negative Predictive Value EPDS	96.6%	98.5%

When these parameter values are changed in the model, the value of the ICER changes to - € 361.49 per extra detected true positive mother with PPD.

ii. YHC doctors in intervention region refer all mothers based on prescribed guidelines from GGD

This scenario looks at the consequences in the ICER when all the referrals and offers for a treatment are based on prescribed guidelines from the GGD. This means that in the intervention group every mother with an EPDS score higher than 12 is referred for further diagnosis and/or treatment. The mothers from the intervention group with an EPDS score between 9 and 12 are offered an inventory home visit. This means that both the referral rate from YHC doctors in the intervention region, as the acceptance of treatment of mothers in the intervention region is hereby 100%. Table 11 shows an overview of the current value of parameters that will be changed, and the value they will adopt in this scenario.

Table 11 – Overview of changing parameters scenario *ii*

Parameter	Base case	Scenario *ii*
% referral treatment - intervention region	42.5%	100%
% acceptance treatment - intervention region	62.5%	100%
% offering home visit - intervention region	72.9%	100%
% acceptance home visit - intervention region	62.5%	100%

When all parameters are changed to 100%, the new value of the ICER is - € 56.13 per extra detected true positive mother with PPD.

iii. Probabilities of presumption PPD in mothers

a. Increase in awareness YHC doctors in control region for PPD

A rise in the probability of a mother with a presumption for PPD could be caused by an increase in awareness of YHC doctors from the control region on the possibility of a mother having a PPD and the severity of the disease. If YHC doctors are aware of this, they might detect more cases of PPD. Therefore, in this scenario it is tested what an increase of 50% in the probability of a mother with a presumption for PPD could do with the ICER. Table 12 shows the values of the relevant parameter in this scenario.

Table 12 - Overview of changing parameters scenario *iii a*

Parameter	Base case	Scenario *iii a*
Probability mothers with presumption PPD – control region	4.2%	6.3%

This scenario leads to an ICER of - € 83.65 per extra detected true positive mother with PPD.

b. Different detection ratio from EPDS

In the literature another distribution of the probabilities for the EPDS questionnaire is found. In this scenario it is tested how the ICER would change if the numbers from literature are used in the model instead of the numbers from questionnaires from YHC doctors. In Table 13 the changing parameters and their values can be found.

Table 13 - Overview of changing parameters scenario *iii b*

Parameter	Base case	Scenario *iii b*
Probability mothers EPDS > 12	5%	7%
Probability mothers EPDS 9 – 12	10.5%	8%
Probability mothers EPDS < 9	84.5%	85%

This scenario showed an ICER of - € 64.23 per extra detected true positive mother with PPD.

iv. Production losses mother with PPD

a. Lower production losses

In the base case model the production losses are calculated with the average labour costs of a woman between the age of 20 and 40 years old and the average number of hours a mother works when she has 1.5 child. In the calculation maternity leave and vacation days are not taken into account, which makes it is possible that the costs of production losses are lower than the costs that are used in the base case model. Therefore, in this scenario the production losses used in the base case model have been reduced with 40%. Table 14 shows this change in production losses.

Table 14 - Overview of changing parameters scenario *iv a*

Parameter	Base case	Scenario *iv a*
Production loss mother with PPD	€ 2 215.05	€ 1 329.03

This scenario resulted in an ICER of - € 35.47 per extra detected true positive mother with PPD.

b. Production losses are not included

The production costs are relatively high compared to other cost parameters. In the intervention and control group the mothers with PPD are not asked whether or not they experience production losses due to the depression. It is therefore an assumption that these production losses occur. Because it was not studied in the research population of this study whether or not the production losses actually occur and what the value of these losses are on average, this scenario looks at the cost effectiveness of the screening for PPD in YHC when the production losses would not be taken into account. Table 15 shows the change in parameter value for this scenario.

Table 15 - Overview of changing parameters scenario *iv b*

Parameter	Base case	Scenario *iv b*
Production loss mother with PPD	€ 2 215.05	€ 0.00

This scenario showed an ICER of € 2.12 per extra detected true positive mother with PPD.

v. Change in % treatment with mother child intervention

Most YHC doctors from the intervention and the control region indicated to be aware of the mother child intervention. However, the percentage of mothers who get a referral and who accept a mother child intervention is relatively low. Seeing the mother-child intervention is a method to improve the mother's and child's wellbeing, it could be useful if YHC doctors referred more mothers for the intervention. Table 16 shows the parameters that will be changed in this scenario, with the base values and with the values that will be adopted in this scenario.

Table 16 – Overview of changing parameters scenario *v*

Parameter	Base case	Scenario *v*
% offering mother child intervention - control region	22.5%	80%
% acceptance mother child intervention - control region	10%	80%
% offering mother child intervention - intervention region	43.8%	80%
% acceptance mother child intervention - intervention region	40%	80%

This scenario leads to an ICER of - € 59.82 per extra detected true positive mother with PPD.

4.4.3 Summary of scenario analyses

To see what the effects of the different scenarios on the change in costs, the change in number of true positives and the ICER were, a table and two figures are created to summarize the results. Table 17 shows an overview of the effect and cost changes and the changes in the ICER per scenario. Furthermore, the changes in effect and changes in costs are also presented in a cost effectiveness plane, which can be found in Figure 7. Figure 8 then shows a graph with the different ICERs per scenario.

Table 17 - Summary of scenario analyses

Summary	Δ # true positives	Δ Costs	ICER
Base Case	15	-€ 933,87	-€ 60,53
Scenario i - Change in PPV and NPV of the EPDS	3	-€ 1.094,71	-€ 361,49
Scenario ii - YHC doctors in intervention region refer all mothers based on guidelines GGD	15	-€ 866,05	-€ 56,13
Scenario iii a - Increasing awareness YHC doctors in control region for PPD	11	-€ 949,81	-€ 83,65
Scenario iii b - Different detection ratio EPDS	15	-€ 941,87	-€ 64,23
Scenario iv a - Lower production losses	15	-€ 547,21	-€ 35,47
Scenario iv b - Production losses are not included	15	€ 32,77	€ 2,12
Scenario v - Change in % treatment with MCI	15	-€ 547,21	-€ 59,82

Figure 7 - Cost Effectiveness Plane

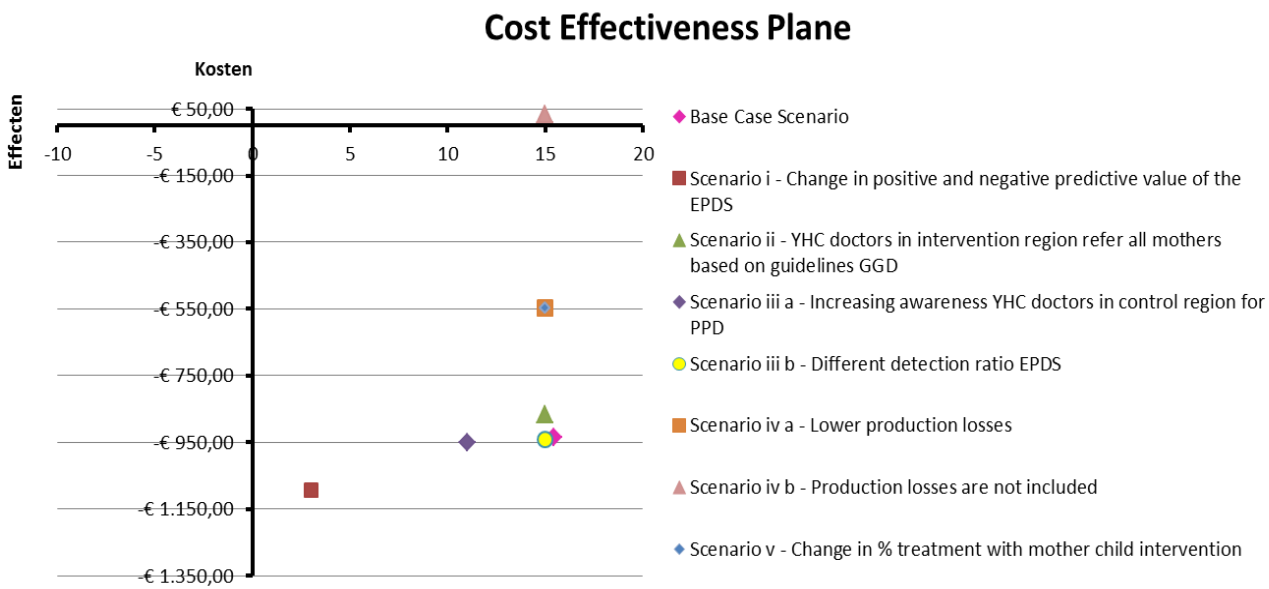
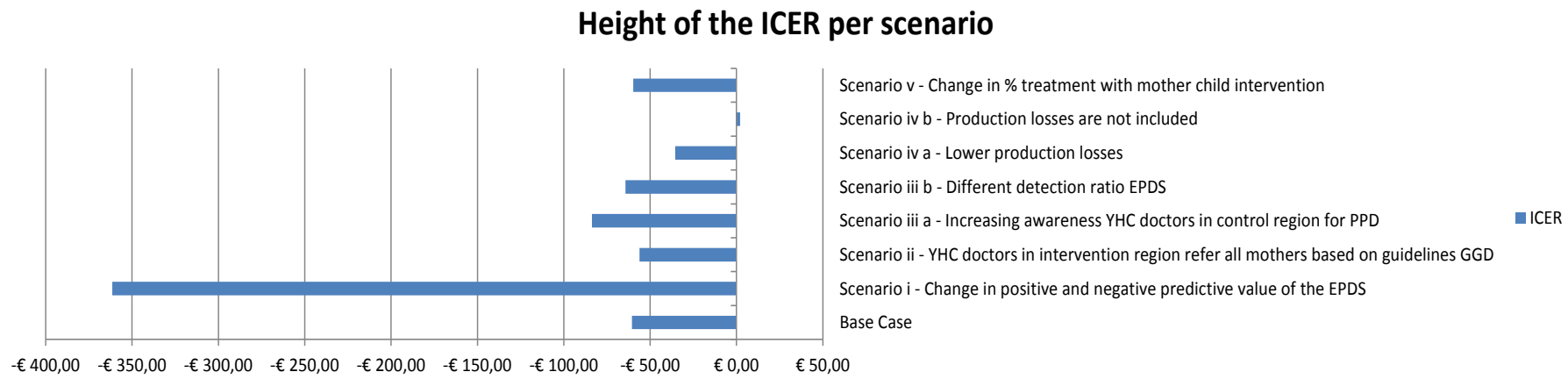


Figure 8 - ICER in the different scenarios



4. Discussion and conclusion

This research studied the incremental cost effectiveness of the screening for PPD in Youth Health Care. In order to investigate this, an intervention and control group were compared. The intervention group represented new mothers who visit a YHC centre in the region Twente and the control group represented new mothers who visit a YHC centre in the regions Apeldoorn and Deventer. Information was gathered about the costs and the performance of screening for PPD, and the costs and the treatment of PPD by spreading questionnaires amongst YHC doctors, YHC nurses and GPs. Additional information about (labour) costs was gathered by consulting experts and CAOs. The cost effectiveness analysis showed an ICER of - € 60.53 per extra true positive mother with PPD detected. In this case this means that according to the results of the model, costs can be saved with a screening for PPD in YHC and extra mothers with PPD can be detected. Therefore it can be concluded that screening for PPD in YHC can be recommended based on the result of the cost effectiveness model only.

To determine the robustness of the ICER, scenario analyses were performed. These analyses showed that six parameters influence the value of the ICER the most. These parameters are the PPV and the NPV of the EPDS, the probability of scoring 9 - 12 or >12 on the EPDS, the costs of production losses of a mother with PPD and the probability a YHC doctors presumes a mother has PPD in the control region. Based on amongst others these parameters, five scenarios were created. The results of the scenario analysis showed that the ICER varied in the different scenarios from - € 361.49 per extra detected true positive to € 2.12 per extra detected true positive. The scenario where production losses of the mother with PPD are not taken into account resulted in the ICER of € 2.12, which in this case means that extra true positives can be detected at higher costs. Every other sketched scenario showed a negative ICER for the screening for PPD, in this case implying that the screening leads to cost savings, whilst detecting more true positives. The biggest change in both incremental costs and incremental number of true positives was caused in the scenario where the PPV and the NPV were changed. In this scenario the NPV was only slightly increased, which did not significantly change the expected costs or the number of detected true positives. The PPV of the EPDS was however decreased from 61% to 29%, which made the expected costs of true positives a lot lower. Besides this, it caused less mothers with PPD to be detected. As a result the expected costs in the intervention region decreased significantly and the scenario showed an ICER of - € 361.49 per extra detected true positive.
Because all scenarios but one resulted in a negative ICER, which in this case meant that costs can be saved whilst detecting more true positives, the conclusion can be maintained that screening for PPD can be recommended based on results of the model only.

The low expected costs in both the control and the intervention region are caused by the small chance of a mother having PPD and receiving treatment for it. The average costs for treatment of PPD by a GP or in MHC per mother are relatively high (€ 865.47), but because the chance of a new mother having a PPD, this PPD getting noticed and the mother accepting treatment is small, the expected costs of treatment are relatively low.
The main reason why the screening seems to be cost saving compared to care as usual, is that the costs for false negatives (these are undetected mothers with PPD) in the control group are much higher than they are in the intervention group. The costs for this group consist mainly of production losses. In the screening group, less mothers with PPD remain undetected so less production losses

occur. So even though extra costs are made in the intervention region to treat more women with PPD, the costs in the control region of the production losses are high enough to make the screening cost effective.

4.1 Comparing results with findings in literature

The article of Paulden, Palmer, Hewitt & Gilbody (2009) concluded that screening for PPD would not be cost effective. The first thing that should be kept in mind when comparing the research of Paulden et al. (2009) with this research is that the research of Paulden et al. (2009) was a cost utility analysis and this research was a cost effectiveness analysis. Paulden et al. (2009) used QALYs as the health outcome, whilst in this research the number of true positives was used as the effect measure. Therefore the results cannot be compared one on one, but when this difference is taken into account some of the results of the two researches can be compared. The main cost driver in the study of Paulden et al. (2009) was the number of false positives, whilst in this research the false positives did not induce high costs. This research only included the average costs for diagnosis as costs for false positives, whilst Paulden et al. (2009) included besides the costs for diagnosis, also supportive care for false positives. Looking at the effect measures, the difference in QALYs between the intervention and control group was relatively small (± 0.006) in the study of Paulden et al. (2009). This caused the ICER to have a high value, because the difference in costs of the compared interventions are divided by a small value. In this research, the difference in number of true positives (the effect measure of this research) was 15. Seeing this value of true positives is always a non-decimal number, the difference in costs would have to be very high to create a high value of the ICER.

The small difference in QALYs that the research of Paulden et al. (2009) shows, can also be used on the results of this research. In this research it is assumed that detection of extra true positives will lead to an earlier recovery of PPD and that the wellbeing of mothers also improves due to this early detection. But looking at the results of the research of Paulden et al. (2009) it would seem that this detection would not lead to a large increase in wellbeing. However, if taken into account that the detection and treatment of PPD also influences the wellbeing of the child, the increase in health outcomes (for example QALYs) in this other relevant target group could be significant. Several researches support the argument that earlier recovery from PPD has a positive influence on the wellbeing of a child (Berg M. v., 2009) (Hewitt & Gilbody, 2009)(Kersten-Alvarez, et al., 2012) (Murray & Cooper, 1997) (Murray, Fiori-Cowley, & Hooper, 1996) (Nilsen, Gustavson, Kjledsen, Røysamb, & Karevold, 2013) (Paulden, Palmer, Hewitt, & Gilbody, 2009). The Post-Up research is gathering information about the wellbeing of mother and child in the first year after delivery. When this information is available, it can be used to evaluate whether or not detecting extra true positives has a positive influence on the wellbeing of mother and child.

4.2 Strengths

The systematic review performed in 2009 by Hewitt & Gilbody concluded that at that moment there was not sufficient data about the cost effectiveness of the screening for PPD to give a proper conclusion about this cost effectiveness. This study is a useful addition to the current data. Besides this, the study is unique because no comparable study has been performed before on the screening for PPD in YHC in the Netherlands. With the current rise in health care costs it is important studies like these are performed to see if there are ways to reduce costs in the health care sector.

Another strength of this study is that two situations have been compared, where both regions were familiar with the way they were supposed to work. There was no artificial setting which could make participating YHC doctors change their way of working. This ensures it to be less likely that YHC

doctors presented the situation differently when observations were made for this research. The described situation in YHC for this study is therefore quite generalizable for the situation in the region Twente, Deventer and Apeldoorn.

4.3 Limitations

The first limitation of the analysis is that a model was used for the analysis. Models always come with uncertainty, which causes results to be less accurate. Numbers about the effectiveness of the EPDS were also based on literature findings, whilst initially these numbers were supposed to be based on data of the Post-Up research. However, due to the shorter time period of this research the data from the Post-Up research was not available yet and data from literature had to be used.

Another limitation of the study is that the number of completed questionnaires by YHC doctors in the intervention and control region is quite low. In order to be able to generalize information from these questionnaires, it would have been better if there would have been more respondents. The reason why no more YHC doctors were contacted, was that at first the questionnaires would only be used for determining the time YHC doctors spend on screening with the EPDS in the intervention region, and how much time YHC doctors spend in the control region during a consult trying to detect a PPD. The completed questionnaires showed that results on these times were quite similar, so with eight responses per region this information was quite generalizable. However, eight responses to determine probabilities does not give representative results. Seeing YHC doctors also indicated that they found it difficult to give a good indication of some numbers, it is less likely that the results on probabilities are very generalizable.

Several assumptions had to be made in this research. The assumptions were made when no other information was available of relevant parameters. Some assumptions were more likely than others. The first assumption, which was that the average number of new mothers a YHC doctor sees per working hour is the same for every YHC doctor, was a big assumption to make. There was however limited information available about the background of YHC doctors that completed the questionnaires, which made it necessary to make this assumption. The second assumption, about the screening rate, is likely to be representative. These percentages are based on information from questionnaires from YHC doctors and the doctors all gave very similar answers. Another assumption was made about the costs of false positives: these would only consists of the diagnosis at a GP's office. This assumption is likely, because a mother will probably not receive a complete treatment for PPD if she has a positive screening outcome. If a treatment would be started, it would probably soon be recognised that the treatment is not necessary and the treatment will end. Besides this, it is also likely that the mother herself would not choose to receive treatment if treatment was offered, seeing the mother would not see the necessity of it. These reasons would ensure it is likely that treatment costs of false positives are not likely to be much higher than only the diagnosis costs. A final assumption was made that the treatment costs for PPD are the same as the treatment for a general depression. It is quite likely to assume these costs are comparable; information from an expert from secondary care indicated that there was no different protocol for treating PPDs than there was for treating general depressions. However likely the assumptions that are made are, by making assumptions it does ensure the results of the model to be less certain on representing reality.

A final limitation of the study is that one important cost category is not taken into account; namely the costs a child might make in health care later in life due to the influence of the PPD of the mother in early childhood. Because of the limited time available for this research and the adopted time horizon in this study of a one year period, this factor could not be taken into account.

5. Recommendations

5.1 Recommendations for practice

Based on the results of this study, it can be recommended to introduce screening for PPD in YHC. The ICER is in the base case scenario and in most other scenarios a negative number, which in this case means that costs can be saved and more true positives can be detected by implementing the screening. When the high burden of the disease PPD and the affordability of screening are also taken into account, this recommendation can be further supported. Depression have a high burden of disease and the screening for PPD is a relatively cheap intervention. In this recommendation the acceptability of mothers and YHC doctors with the screening for PPD are not taken into account. These are however important aspects of the screening so should be considered. The Post-Up research is investigating these aspects, so once information about this acceptability is available, it should be taken into account for the recommendation.

Looking at the criteria of the WHO that determine whether or not a screening program should be recommended, there are five criteria that need attention before this screening for PPD can be properly implemented (Andermann, Blancquaert, Beauchamp, & Dér, 2008). There needs to be an (1) objective and (2) an evaluation plan for the screening program. Furthermore there should be (3) integrated education, testing, clinical services and programme management, (4) quality assurance and (5) awareness of the importance of informed choice, confidentiality and respect for autonomy. When these criteria are given thought and properly satisfied, the screening can be recommended. At the moment there is not enough information available for this study about these five criteria. It is up to implementing authorities to make clear statements about these criteria.

Another thing that should be kept in mind before implementing the screening is the follow up process after screening. This was already addressed in researches of Myers, et al. (2013) and Morrell, et al. (2009), and it also applies to this research. The content of the follow up process influences the expected costs of the screening a lot. For example, at the moment the mother child intervention is used very little. This intervention is however an effective way to improve the wellbeing of mother and child and it is therefore likely that an increase in the use of this intervention would be recommendable. However, if more mothers will receive the intervention, expected costs will rise, but the effect on the wellbeing of mothers is also likely to improve. What the effect is of these kind of changes in the follow up process needs therefore to be taken into account when decisions are being made about the screening. Changes in these parameters can influence the cost effectiveness of the screening.

5.2 Recommendations for further research

It is recommended to implement data from the Post-Up research about the effectiveness of the screening in the model when this data becomes available. The main things that will change in the model by using this data are the probabilities of events and the effect outcomes. By using data from the Post-Up research the results will give a more accurate representation of the real situation.

And as stated before, it would be useful if research would be performed about the follow up process for mothers who have PPD. In this study only five GPs completed a questionnaire and all of them indicated to see very few women with PPD per year. This did not give a representative image of the follow up process and this data was therefore complemented with information about the treatment

of a general depression (Verhaak, Dijk, & Verheij, 2011). It would be useful if research would be performed to obtain more accurate data about the follow up process for women with a PPD, about for example the treatment possibilities and other supportive activities. Before this follow up process is properly available, it is likely that the screening program itself will not be as effective as possible.

Another recommendation is that it is important to keep the chosen health outcome in mind, when determining and interpreting the cost effectiveness of the screening for PPD. In this research the number of true positives was chosen as primary outcome, which is also useful considering the short time horizon for this study. However, at the end the goal of screening is to improve the wellbeing of the mother, and more importantly the wellbeing of the child. If these effects would be investigated, a long follow-up period would be necessary because the effects of PPD on the mother or more importantly on a child can persist over or show after a long period of time. The Post-Up research adapted a time horizon of one year for studying the wellbeing of the children of participating mothers. Even though this is a relatively short period, it can already give indications on the usefulness of screening for PPD regarding the wellbeing of children. The wellbeing of participating mothers is measured when their child is nine months old, this could also be taking into account.

Finally, the Post Up research is currently also investigating whether or not production losses are relevant for the here evaluated process and if so, what these production losses are. In this research it was assumed that production losses do occur and based on information from Hakkaart-van Roijen et al. (2010) the value of these losses is calculated. To ensure the results resemble practice as well as possible, it is however recommended to use the Post Up data on production losses once this becomes available.

6. Literature

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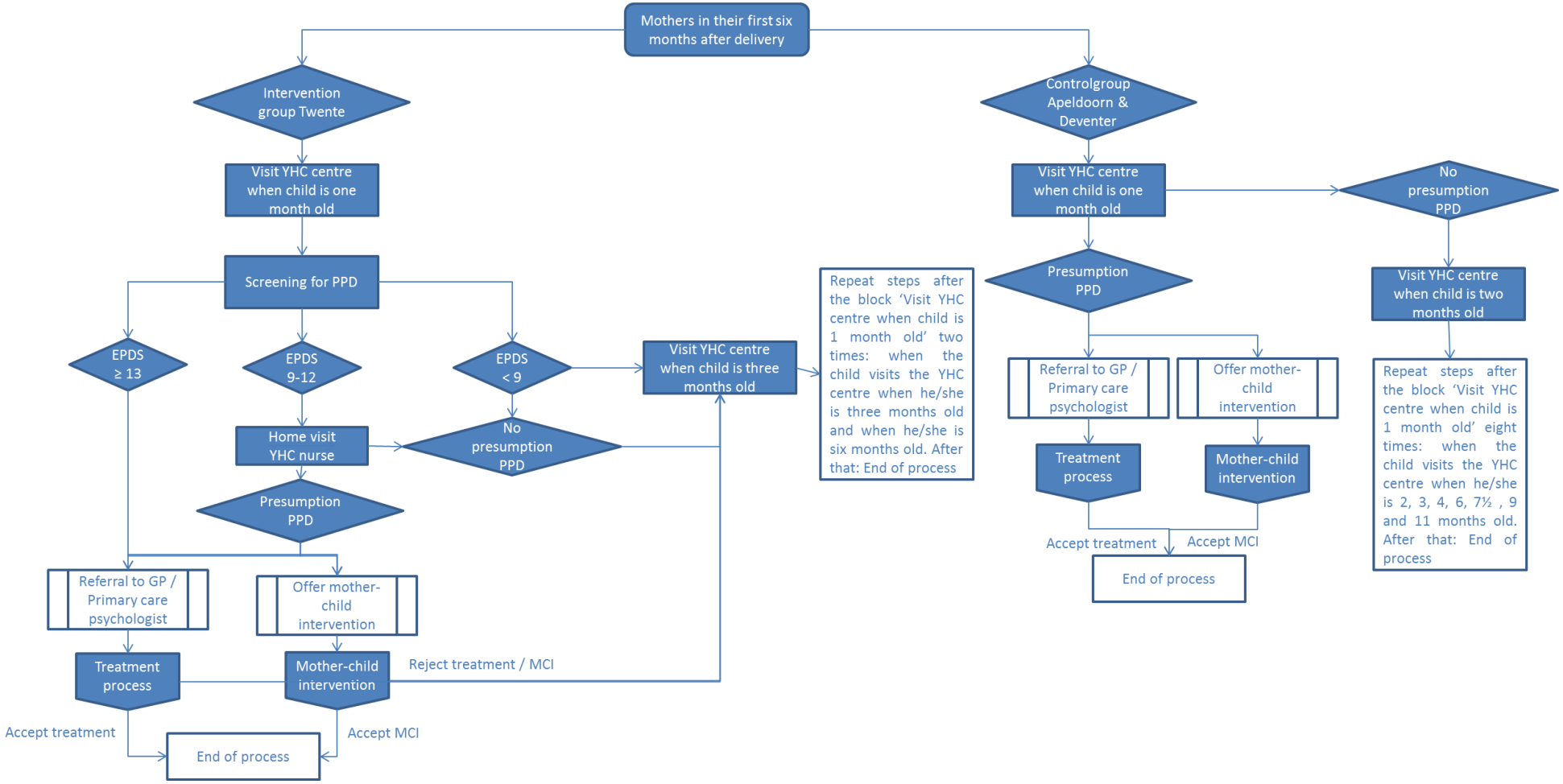
7. Appendices

Appendix A: Edinburgh Postnatal Depression Scale (EPDS)

Edinburgh Postnatal Depression Scale (EPDS)		
Circle the number for each statement, which best describes how often you felt or behaved this way *in the past 7 days…*		
I have been able to laugh and see the funny side of things		
	0	As much as I always could
	1	Not quite so much now
	2	Definitely not so much now
	3	Not at all
Things have been getting on top of me		
	3	Yes, most of the time I have not been able to cope at all
	2	Yes, sometimes I have not been coping as well as usual
	1	No, most of the time I have coped quite well
	0	No, I have been coping as well as ever
I have looked forward with enjoyment to things		
	0	As much as I ever did
	1	Rather less than I used to
	2	Definitely less than I used to
	3	Hardly at all
I have felt so unhappy that I have had difficulty sleeping		
	3	Yes, most of the time
	2	Yes, sometimes
	1	Not very often
	0	No, not at all
I have blamed myself unnecessarily when things went wrong		
	0	No not at all
	1	Hardly ever
	2	Yes, sometimes
	3	Yes, very often
I have felt sad and miserable		
	3	Yes, most of the time
	2	Yes, quite often
	1	Not very often
	0	No, not at all
I have been anxious or worried for no good reason		
	3	Yes, quite a lot
	2	Yes, sometimes
	1	No, not much
	0	No, not at all
I have been so unhappy that I have been crying		
	3	Yes, quite a lot
	2	Yes, sometimes
	1	No, not much
	0	No, not at all
I felt scared or panicky for no very good reason		
	3	Yes, quite a lot
	2	Yes, sometimes
	1	No, not much
	0	No, not at all
The thought of harming myself has occured to me		
	3	Yes, quite often
	2	Sometimes
	1	Hardly
	0	Never
Total =	…	

Appendix B: Flowchart of the detection of PPD in Youth Health Care, with and without screening



Appendix C: Questionnaires

Questionnaires YHC doctors intervention region

Deze vragenlijst is bedoeld om inzicht te krijgen in de tijdsbesteding op het consultatiebureau aan de screening naar postpartum depressie (PPD) en het verwijzingstraject voor de behandeling van PPD. Wanneer er naar percentages/aantallen gevraagd wordt, gaat dit om **schattingen**. Als u het precieze percentage/aantal bij een vraag dus niet weet, is het voldoende een indicatie te geven. De vragenlijst bestaat uit 18 vragen.

Achtergrond jeugdarts	
1. Hoe lang bent u al werkzaam in de jeugdzorg?	…… jaar
2. Hoeveel uur per week werkt u gemiddeld in de JGZ 0-4?	…… uur
Screening programma	
Voorbereiding	
3. Besteedt u vooraf en achteraf van het consult nog tijd aan het voorbereiden van de screening?	Ja / Nee
a. Zo ja, hoeveel tijd besteedt u gemiddeld nog aan deze voorbereiding en afronding?	……
Uitvoering	
4. Besteedt u, vanwege het uitvoeren van de screening naar PPD, meer tijd aan een consult?	Ja / Nee
a. Zo ja, hoeveel extra tijd besteedt u hier gemiddeld aan?	……
Er zijn drie momenten waarop de screening naar PPD plaats vindt; bij het consult wanneer het kindje één maand oud is, wanneer het kindje drie maanden oud is, en wanneer het kindje zes maanden oud is.	
5. Bij welk percentage van de consulten wanneer het kindje **één maand** oud is, voert u de meting uit?	…… %
6. Bij welk percentage van de consulten wanneer het kindje **drie maanden** oud is, voert u de meting uit?	…… %
7. Bij welk percentage van de consulten wanneer het kindje **zes maanden** oud is, voert u de meting uit?	…… %
Verwijzingen	
Bij het beoordelen van de EPDS worden de volgende criteria aangehouden: - *score <9: PPD onwaarschijnlijk, advies is geen verder actie ondernemen* - *score 9-12: advies is een huisbezoek JGZ verpleegkundige aanraden ter inventarisatie* - *score >12: grote kans op PPD, advies is een directe verwijzing naar huisarts of GGZ voor verdere diagnose*	
8. Bent u op de hoogte van deze verdeling?	Ja / Nee
9. Gebruikt u deze verdeling ook bij het bepalen of een moeder voor verdere behandeling doorgestuurd moet worden?	Ja / Nee
a. Zijn er nog andere factoren die u bij de verwijzing meeneemt? ……	
……	
10. Hoeveel moeders heeft u de afgelopen 12 maanden op consult gehad met een score op de EPDS > 12?	…… moeders
11. Kruis aan welk percentage van de moeders met een score > 12 u direct heeft verwezen naar huisarts of GGZ:	
☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	
12. Kruis aan welk percentage van de moeders die u hebt verwezen volgens u gebruik heeft gemaakt van uw verwijzing?	
☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	
13. Hoeveel moeders heeft u de afgelopen 12 maanden op consult gehad met een score op de EPDS tussen de 9 en 12?	…… moeders
14. Kruis aan welk percentage van de moeders met een score tussen 9-12 u vervolgens een huisbezoek heeft aangeboden:	
☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	

15. Kruis aan welk percentage van de moeders die u een huisbezoek heeft aangeboden volgens u gebruik heeft gemaakt van dit aanbod:

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

Naast de verwijzing voor een behandeling van de depressie bij de moeder zelf, wordt er ook aangeraden een moeder met PPD te wijzen op de moeder-kind interventie. Deze interventie richt zich op het opbouwen van het contact tussen moeder en kind, om een negatieve invloed van een depressie op het hechtingsproces zoveel mogelijk te beperken.

16. Bent u op de hoogte van deze aanbeveling? Ja / Nee

17. Kruis aan welk percentage van de moeders met PPD u de moeder-kind interventie heeft aangeraden:

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

18. Kruis aan welk percentage van deze moeders volgens u gebruik heeft gemaakt van dit aanbod:

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

Heeft u nog opmerking naar aanleiding van deze vragen, dan kunt u deze hier vermelden:

Bedankt voor het invullen van de vragenlijst!

Questionnaires YHC doctors control region

Deze vragenlijst is bedoeld om inzicht te krijgen in het huidige opsporings-, behandelings- en verwijzingsbeleid met betrekking tot moeders met PPD. Bij verschillende vragen wordt er naar percentages of aantallen gevraagd, het gaat hierbij om **schattingen**. Als u het precieze percentage of aantal bij een vraag dus niet weet, is het voldoende om een indicatie te geven. De vragenlijst bestaat uit 13 vragen en het invullen duurt ongeveer 5 minuten.

Achtergrond jeugdarts	
1. Hoe lang bent u al werkzaam in de jeugdzorg?	…… jaar
2. Hoeveel uur per week werkt u gemiddeld in de JGZ 0-4?	…… uur
Detecteren van PPD	
3. Hoeveel moeders heeft u de afgelopen 12 maanden op consult gehad waarbij u een vermoeden van een postpartum depressie had?	…… moeders
4. Bereidt u zich vooraf aan een consult voor op het kunnen detecteren van een PPD bij een moeder?	Ja / Nee
a. Zo ja, hoe bereidt u zich extra voor op het detecteren van PPD?	……
b. Hoeveel tijd besteedt u gemiddeld aan deze voorbereiding?	…… minuten
5. Duurt een consult langer wanneer u een vermoeden heeft dat een moeder een PPD heeft, en u dit vermoeden en de behandelingsmogelijkheden van PPD met de moeder bespreekt?	Ja / Nee
a. Hoeveel tijd besteedt u dan extra aan een consult?	…… minuten

Verwijzingen

Wanneer er een vermoeden is dat een moeder PPD heeft, bestaan er verschillende mogelijkheden voor het vervolgtraject. Er kan een verwijzing worden gegeven naar de huisarts of naar de GGZ, maar ook kan er eerst een inventariserend huisbezoek van een jeugdverpleegkundige aangeboden worden.

6. Bij welk percentage van de moeders waarbij u een vermoeden van PPD had, heeft u direct heeft verwezen naar de huisarts of GGZ?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

7. Welk percentage van de moeders die u hebt verwezen maakt volgens u ook gebruik van deze verwijzing?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

8. Bij welk percentage van de moeders waarbij u een vermoeden van PPD had, heeft u een huisbezoek heeft aangeboden?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

9. Welk percentage van de moeders die u een huisbezoek heeft aangeboden, heeft volgens u gebruik gemaakt van dit aanbod?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

10. Welk percentage van de moeders die een huisbezoek hebben gehad, maakte uiteindelijk gebruik van een verwijzing voor behandeling?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

Wanneer er een vermoeden is dat een moeder PPD heeft, kan er naast de behandeling van depressie ook een moeder-kind interventie aangeboden worden. Deze interventie richt zich op het opbouwen van het contact tussen moeder en kind, om een negatieve invloed van een depressie op het hechtingsproces zoveel mogelijk te beperken.

11. Bent u op de hoogte van deze aanbeveling?	Ja / Nee

12. Welk percentage van de moeders met PPD heeft u de moeder-kind interventie aangeraden?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

13. Welk percentage van deze moeders heeft volgens u gebruik gemaakt van dit aanbod?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

Heeft u nog opmerking naar aanleiding van deze vragen, dan kunt u deze hier vermelden:

Bedankt voor het invullen van de vragenlijst!

Questionnaires YHC nurses control region

Deze vragenlijst is bedoeld om inzicht te krijgen in de tijdsbesteding op het consultatiebureau aan het detecteren van PPD. Daarnaast zullen ook enkele vragen gericht zijn op het verwijzingstraject voor de behandeling van PPD. Wanneer er naar percentages of aantallen gevraagd wordt, gaat dit om **schattingen**. Als u het precieze percentage of aantal bij een vraag dus niet weet, is het voldoende een indicatie te geven. De vragenlijst bestaat uit 14 vragen en neemt 5-10 minuten in beslag.

Achtergrond jeugdverpleegkundige	
1. Hoe lang bent u al werkzaam in de jeugdgezondheidszorg?	…… jaar
2. Hoeveel uur per week werkt u gemiddeld in de JGZ 0-4?	…… uur
Detecteren van PPD	
3. Hoeveel moeders heeft u de afgelopen 12 maanden op consult gehad waarbij u een vermoeden van een postpartum depressie had?	…… moeders
4. Bereidt u zich vooraf aan een consult voor op het kunnen detecteren van een PPD bij een moeder?	Ja / Nee
a. Hoe bereidt u zich extra voor op het consult om een PPD te kunnen detecteren?	……
b. Zo ja, hoeveel minuten besteedt u gemiddeld aan deze voorbereiding?	... minuten
Verwijzingen	
Wanneer er een vermoeden is dat een moeder PPD heeft, bestaan er verschillende mogelijkheden voor het vervolgtraject. Er kan een verwijzing worden gegeven naar de huisarts of naar de GGZ, maar ook kan er eerst een inventariserend huisbezoek van een jeugdverpleegkundige aangeboden worden.	
5. Bij welk percentage van de moeders waarbij u een vermoeden van PPD had, heeft u overlegd met de arts over eventuele vervolgstappen? ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	
6. Bij welk percentage van deze moeders is er besloten een vervolgstap te zetten door een verwijzing naar de huisarts of de GGZ te geven? ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	
7. Bij welk percentage van deze moeders is er besloten een vervolgstap te zetten door een verwijzing voor een inventariserend huisbezoek van een jeugdverpleegkundige te geven: ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	
8. Hoeveel minuten besteedt u aan de voorbereiding van een inventariserend huisbezoek bij een vermoeden aan een postpartum depressie?	... minuten
9. Hoeveel minuten besteedt u aan het inventariserende huisbezoek zelf, de reistijd niet meegenomen?	... minuten
10. Hoeveel reistijd bent u gemiddeld kwijt aan een huisbezoek?	... minuten
11. Welk percentage van de moeders die een huisbezoek hebben aangenomen, hebben uiteindelijk gebruik maakt van een verwijzing voor de behandeling van PPD? ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	
Wanneer er een vermoeden is dat een moeder PPD heeft, kan er naast de behandeling van depressie ook een moeder-kind interventie aangeboden worden. Deze interventie richt zich op het opbouwen van het contact tussen moeder en kind, om een negatieve invloed van een depressie op het hechtingsproces zoveel mogelijk te beperken.	
12. Bent u op de hoogte van deze interventie?	Ja / Nee
13. Bij welk percentage van de moeders met PPD heeft u de moeder-kind interventie aangeraden? ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	
14. Welk percentage van deze moeders heeft volgens u daadwerkelijk gebruik gemaakt van dit aanbod? ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%	
Heeft u nog opmerking naar aanleiding van deze vragen, dan kunt u deze hier vermelden:	

Bedankt voor het invullen van de vragenlijst!

Questionnaires General Practitioners

Deze korte vragenlijst is bedoeld om inzicht te krijgen in het behandel- en verwijzingstraject bij moeders met PPD. Wanneer er naar aantallen gevraagd wordt, gaat dit om **schattingen**. Als u het precieze aantal bij een vraag dus niet weet, is het voldoende een indicatie te geven. De vragenlijst bestaat uit negen vragen en duurt ongeveer 5 minuten.

Achtergrond huisarts

1. In welke plaats bent u werkzaam? ……

Verwijzingen van moeders met PPD

2. Hoeveel vrouwen, waarbij vermoed wordt dat ze een PPD hebben, worden er ongeveer per jaar naar u doorverwezen? …… vrouwen
3. Hoeveel procent van deze vrouwen had daadwerkelijk een PPD?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

4. Hoeveel procent van deze vrouwen hield u voor behandeling bij u in de praktijk?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

   a. Hoeveel procent van de vrouwen die u diagnosticeerde met een PPD, wilde geen gebruik maken van een vervolgbehandeling?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

   b. Hoeveel procent van de vrouwen die u in uw praktijk hield voor behandeling, heeft u antidepressiva voorgeschreven?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

   c. Wanneer een moeder met een PPD bij de huisarts behandeld wordt, hoeveel consulten zijn er dan gemiddeld nodig? …… consulten

Er wordt uitgegaan van een consultduur van 20 minuten wanneer psychische klachten bij een huisarts behandeld worden.

5. Hoeveel procent van de vrouwen die bij u langskwam voor een postpartum depressie, heeft u doorverwezen naar een psycholoog?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

6. Hoeveel procent van de vrouwen die u heeft doorverwezen naar een psycholoog, heeft ook gebruik gemaakt van deze verwijzing?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

7. Hoeveel procent van de vrouwen die bij u langskwam voor een PPD, heeft u doorverwezen naar de GGZ?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

8. Hoeveel procent van de vrouwen die u met een PPD heeft doorgestuurd naar de GGZ, heeft ook gebruik gemaakt van deze verwijzing?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

9. Heeft u nog een andere manier van behandelen of verwijzen gebruikt voor vrouwen met een PPD? Ja / Nee
   a. Kunt u deze andere behandel- of verwijsmethode toelichten? ……

   b. Hoeveel procent van de vrouwen die met een PPD depressie bij u langskwam, heeft u deze andere behandeling of verwijzing gegeven?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

Heeft u nog opmerking naar aanleiding van deze vragen, dan kunt u deze hier vermelden:

Bedankt voor het invullen van de vragenlijst!

Appendix D: Cost categories of the analysed processes

Table 18 – Screening costs

Screening	Costs	Volume	Total	Source	Comments
Labour costs YHC doctor	€ 26.57	0.05	€ 1.45	Labour costs: (SOVVT, 2012) Labour volume: questionnaires YHC doctors intervention region	*YHC doctors are classified in the FWG 60 or FWG 65 (Nationaleberoepengids.nl, n.d.). Therefore, to determine the costs per hour for a YHC doctor, the average is taken from the middle wage scale + 1 scale in the FWG 60 and the middle wage scale + 1 scale in the FWG 65.* *The volume (number of extra minutes) necessary during a consult to perform the screening was 3 minutes. The volume is therefore 3/60 = 0.05*
Preparation costs YHC doctor	€ 26.57	0.02	€ 0.50	Labour costs: (SOVVT, 2012) Labour volume: questionnaires YHC doctors intervention region	*Costs for preparation appeared to be 3 minutes on average per consult, so volume is 3/60.*
Training EPDS for YHC doctor	€ 26.57	0.0005	€ 0.01	Labour costs: (SOVVT, 2012) Labour volume: staff YHC doctor GGD Twente	*A training for a YHC doctor to use the EPDS takes 3 hours. Once this training is followed, there is no follow-up necessary and the screening can be performed on many mothers. Volumes are calculated per mother, so the costs of training for one patient are very low.*
Total			€ 1.97		
Total incl. overhead (42%)			€ 2.79		

Table 19 – Inventory home visit costs

Home visit YHC nurse	Costs	Volume	Total	Source	Comments
Labour costs YHC nurse	€ 17.28	1.5	€ 25.92	Labour costs: (SOVVT, 2012) Labour volume: Finance advisor region Twente	*YHC nurses are classified in the FWG 45 (Nursing.nl, 2011). The middle salary scale + 1 scale results in an hourly wage of € 17.28.*
Travel costs	€ 0.20	5	€ 1.00	Travel costs and travel distance: (Hakkaart-van Roijen, Tan, & Bouwmans, 2010)	*The volume of 5 is calculated by multiplying 2.5 (the average distance in km from a consultation office to a household) by two, because it is a two-way travel*
Total			€ 26.92		
Total including overhead (42%)			€ 38.23		

Table 20 - Mother child intervention costs

Mother-Child intervention	Costs	Volume	Total	Source	Comments

Labour costs social-psychiatric nurse	€ 28.57	11.3	€ 321.44	Labour costs: (GGZ Nederland, 2011) Labour volume: (Trimbos instituut, 2013)	*A social-psychiatric nurse is classified in FWG 55. Wages in the CAO of the GGZ were wages per month, in the CAO it is hereby assumed that there is a 36-hour work week. This means an employee works 36*4.5 = 162 hours per week. With an monthly wage of €3330,-, this means the wage per hour is €20,56. These costs per hour are again multiplied with 1,39, because of the 39% addition on holiday allowances and social contributions (Hakkaart-van Roijen, Tan, & Bouwmans, 2010).* *The volume is calculated by assuming an average of 9 visits, each visit during on average 1,25 hours*
Travel costs social-psychiatric nurse	€ 0.20	7.4	€ 1.48	Travel costs and average distance: (Hakkaart-van Roijen, Tan, & Bouwmans, 2010)	*The volume of 7,4 is calculated by multiplying 3,7 (the average distance in km from a nursing home to a household) by two, because it is a two-way travel*
Training social-psychiatric nurse M-C intervention	€ 720.00	0.002	€ 1.44	Training costs: (Trimbos instituut, 2013)	*Seeing the training of a social-psychiatric nurse for the Mother Child intervention is a one time training, a lot of mothers can be treated by training one nurse. The volume of this parameter is therefore estimated as a low number.*
Material costs					
Video camera for video-observations	€ 300.00	0.002	€ 0.60		*The video camera used for the mother child intervention can be used multiple times for different mother child intervention sessions. The volume of this parameter is therefore also estimated as a low number*
Total			€ 324.96		
Total including overhead (42%)			**€ 461.44**		

Table 21 - Treatment GP and MHC costs

Treatment GP / MHC	Costs	Volume	Total	Probability	Source
General Practitioner	€ 57.00	5	€ 296.40	85%	Costs GP consult: (Hakkaart-van Roijen, Tan, & Bouwmans, 2010) Volume and probability: (Verhaak, Dijk, & Verheij, 2011)
Average costs treatment in Mental Health Care			€ 3 632.86	15%	Probability: (Verhaak, Dijk, & Verheij, 2011) (Hakkaart-van Roijen, Tan, & Bouwmans, 2010)
- Primary care psychologist	€ 80.00	8	€ 640.00	5%	Probability: (Verhaak, Dijk, & Verheij, 2011) Costs psychologist consult: (Hakkaart-van Roijen, Tan, & Bouwmans, 2010) Volume: (Landelijke Vereniging voor Eerstelijnspsychologen, 2011)
- Secondary care treatment	€ 5 129.29	1	€ 5 129.29	10%	Costs and volume: Vektis, GGZ detailinformatiesysteem, 2009, 2010 Probability: (Verhaak, Dijk, & Verheij, 2011)
Medication	€ 98.00	1	€ 98.00	70%	Costs medication and volume: (College voor Zorgverzekeringen, n.d.) Probability: (Verhaak, Dijk, & Verheij, 2011)
Total			**€ 865.47**		

Table 22 - Production losses calculated with the friction costs method

Production losses	Costs	Volume	Total	Source	Comments
Production losses mother with PPD	€ 24.40	90.79	€ 2 215.05	(Rijksinstituut voor Volksgezondheid en Milieu, 2014)	*The production losses are calculated with the friction costs method. The production costs per hour are calculated for women between the age of 20 and 40 years. The number of days absence of work through depression is adapted from numbers from the RIVM*

Appendix E: Sensitivity analyses

Table 23 - Scenario I – Change in positive and negative predictive value of the EPDS

	Base Case	*Scenario*
Positive Predictive Value EPDS	61%	29%
Negative Predictive Value EPDS	96.6%	98.5%
Δ Costs	-€ 933.87	-€ 1 094.71
Δ # true positives	15	3
ICER	-€ 60.53	-€ 361.49

Table 24 - Scenario ii – YHC doctors in intervention region refer all mothers based on guidelines GGD

	Base Case	*Scenario*
Intervention region		
% referral treatment	42.5%	100%
% acceptance treatment	62.5%	100%
% offering home visit	72.86%	100%
% acceptance home visit	62.50%	100%
Δ Costs	-€ 933.87	-€ 866.05
Δ # true positives	15	15
ICER	-€ 60.53	-€ 56.13

Table 25 - Scenario iii a – Increasing awareness YHC doctors in control region for PPD

	Base Case	*Scenario*
Probability mothers with presumption PPD	4.21%	6.3%
Δ Costs	-€ 933.87	-€ 949.81
Δ # true positives	15	11
ICER	-€ 60.53	-€ 83.65

Table 26 - Scenario iii b – Increasing awareness YHC doctors in control region for PPD

	Base Case	*Scenario*
Probability mothers EPDS > 12	5.05%	7%
Probability mothers EPDS 9 - 12	10.45%	8%
Probability mothers EPDS < 9	84.50%	85%
Δ Costs	-€ 933.87	-€ 941.87
Δ # true positives	15	15
ICER	-€ 60.53	-€ 64.23

Table 27 - Scenario iv a – Lower production losses

	Base Case	*Scenario*
Production loss mother with PPD	€ 2 215.05	€ 1 329.03
Δ Costs	-€ 933.87	-€ 547.21
Δ # true positives	15	15
ICER	-€ 60.53	-€ 35.47

Table 28 – Scenario iv b – Production losses are not included

Scenario iv b - Production losses are not included		
Parameters	***Base Case***	***Scenario***
Production loss mother with PPD	€ 2.215,05	€ 0,00
Δ Costs	-€ 933,87	€ 32,77
Δ # true positives	15	15
ICER	-€ 60,53	€ 2,12

Table 29 - Scenario v – Change in % treatment with mother child intervention

	Base Case	***Scenario***
Control region		
% offering m-c intervention	22.5%	80%
% acceptance m-c intervention	10%	80%
Intervention region		
% offering m-c intervention	43.8%	80%
% acceptance m-c intervention	40%	80%
Δ Costs	-€ 933.87	-€ 547.21
Δ # true positives	15	15
ICER	-€ 60.53	-€ 59.82