Modelling the cost-effectiveness of interventions to encourage young people, especially socially disadvantaged young people, to use contraceptives and contraceptive services

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EXECUTIVE SUMMARY

This report aims to assess the cost-effectiveness of a range of interventions to encourage young people to use contraceptives or contraceptive services. It accompanies the report of the evidence review of the effectiveness and cost-effectiveness of these interventions. An economic model was required to synthesise data from a number of different sources and to estimate key economic outcomes. A scope for the economic modelling was developed based on the results of the evidence review of the effectiveness of interventions. A spreadsheet model was developed in Excel to follow a cohort of 100,000 young people over a lifetime from the age at which the intervention is provided. There is a probability of becoming pregnant at each age and, following conception, dependent on age, there is a probability of the female having a birth, an abortion, a miscarriage, an ectopic pregnancy or a stillbirth. The model calculates the costs and consequences of each of these outcomes of a pregnancy and the cost of the intervention and associated contraceptive services. The model also calculates the impact of any changes in condom use upon Sexually Transmitted Infection rates.

Interventions assessed within the model include the dispensing of condoms within schools, the dispensing of hormonal contraception within schools, intensive case management to prevent repeat teenage pregnancies, advanced provision of emergency hormonal contraception provided to those young people who attend a clinic for contraceptive services and usual current practice. Model outcomes are presented in terms of the cost per age specific pregnancy averted and the cost per abortion averted. It was not feasible or appropriate to calculate results in terms of a cost per QALY gained. Costs are calculated from a public sector perspective. Probabilistic sensitivity analysis and one way sensitivity analyses are undertaken within the model to assess the impact of uncertainties associated with the model assumptions and parameters upon the model results.

The economic analysis indicates that, from a public sector perspective, the dispensing of contraceptives within schools is effective and results in net cost savings compared with no dispensing of contraceptives within schools. This result is robust to changes in the key model assumptions if the costs of

government-funded Benefits are included within the analysis; however if government-funded Benefits are excluded from the analysis, dispensing contraceptives within schools has around a 50% probability of resulting in net cost savings. The analysis also suggests that dispensing hormonal contraceptives within schools is likely to be more effective for preventing pregnancies and may lead to greater cost savings than dispensing condoms within schools, although this comparison is subject to considerable uncertainty.

The economic analysis also suggests that, from a public sector perspective, intensive case management results in a cost per repeat teenage pregnancy averted of £4,000 compared with no follow up following a teenage birth. Excluding government-funded Benefits from the analysis leads to an estimated cost per repeat teenage pregnancy averted of £15,000.

Advanced provision of emergency hormonal contraception is estimated by the model to be more effective and less costly than no advanced provision of emergency hormonal contraception from a public sector perspective; however when government-funded Benefits are excluded from the analysis (i.e. an NHS & PSS perspective), the intervention is estimated to have a cost per age 15 - 19 pregnancy averted of £310 compared with no advanced provision. Finally, the analysis suggests that the advanced provision of EHC is likely to remain cost saving from a public sector perspective when provided alongside the dispensing of contraceptives within schools.

These results are limited by the availability of data, particularly around long term outcomes consequent on teenage pregnancy and around both the short and long term effectiveness of the interventions. The evidence around the costs and effectiveness of the interventions is based upon studies carried out in non-UK countries. Differences in the health care systems and cultural differences around contraceptive behaviour and attitudes lead to questions around the generalisability of these studies within the UK setting. Thus, these results should be treated with caution. Further research is recommended in the following areas:

- UK research around the effectiveness and cost of interventions which may reduce teenage pregnancy rates, including subgroup analyses to determine whether particular groups should be targeted;
- UK research around the effectiveness and cost of interventions targeted at young people aged 20 – 24 years aiming to reduce abortion rates;
- Research to quantify the long term implications of a teenage birth for the mother, father and child within the UK and circumstances that lead to negative outcomes;
- Analyses of the implications of current strategies which are being rolled out or piloted such as the Family Nurse Partnership scheme which are likely to impact upon the long term outcomes of teenage/ young mothers;
- Analyses of the quality of life over time of the mother, father and child dependent upon mother's age at first birth;
- Potential valuations of abortion.

1 BACKGROUND

1.1 Purpose of this report

This report aims to assess the cost-effectiveness of a range of interventions to encourage young people, especially socially disadvantaged young people, to use contraceptives and contraceptive services (including access to, and information about, contraceptive services). It accompanies the report of the evidence review of the effectiveness and cost-effectiveness of these interventions (Blank *et al.*, 2009).

This report only considers the cost-effectiveness of interventions to encourage teenagers (<20 years) to use contraceptives and contraceptive services. Whilst the rate of abortion is high for young people aged 20 – 24 years, insufficient evidence was identified within the effectiveness reviews to consider the cost-effectiveness of interventions aimed to prevent unintended pregnancies within this age group.

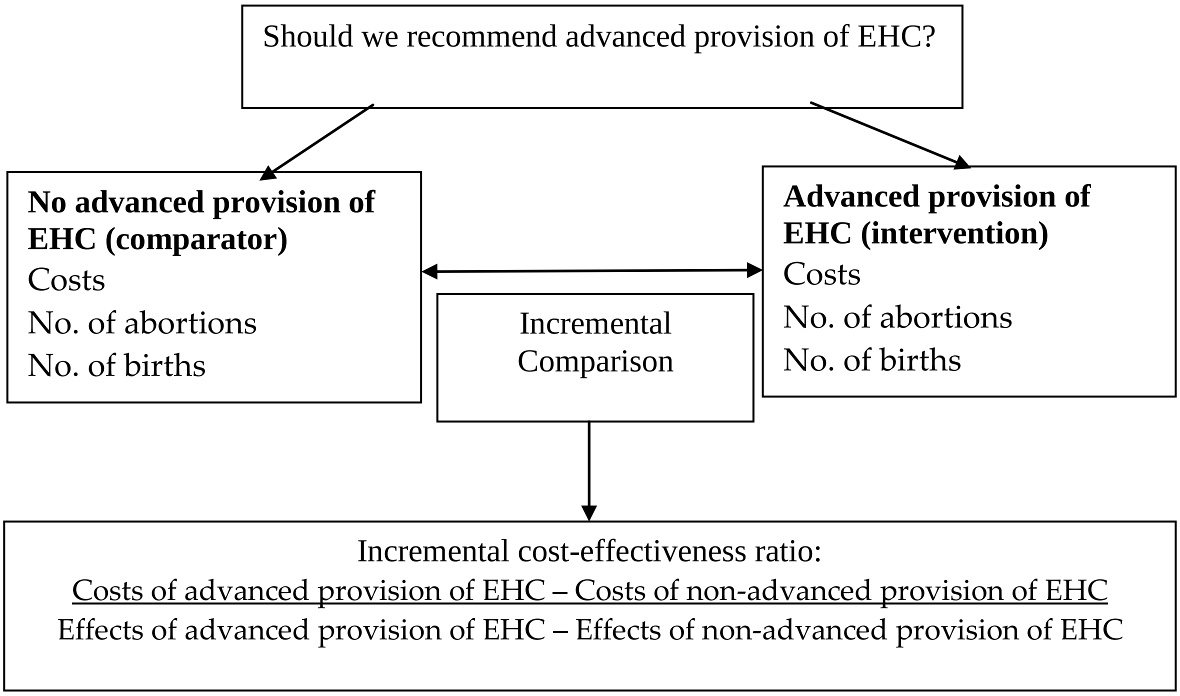
1.2 The role of economic evaluation within the NICE process

The original purpose of NICE was to advise the National Health Service (NHS) on the effectiveness and cost-effectiveness of clinical-management strategies and health technologies. Since 2005, this remit has expanded to the wider public sector with respect to public health. The NHS, and more generally the public sector, has limited resources yet demands are essentially unlimited. Where money is spent on a new intervention, existing interventions will be displaced. Therefore, a rational and coherent framework is required to help to inform decisions about which interventions are considered to be economically attractive to society.

Within a cost-effectiveness analysis, the additional costs and benefits of a new intervention are compared with those of the current standard intervention over a sufficient period to capture these differences. It is important to capture all consequences of an intervention, and hence it is appropriate for many health economic models to compare costs and outcomes over a lifetime. A new intervention can be considered cost-effective if it generates more benefits to patients than it displaces as a result of any additional costs imposed on the system. An economic model is required to objectively combine data from a number of different sources and to make projections into the future. Inevitably within models, assumptions are required which simplify reality. For example, assumptions are required to be able to estimate future costs and benefits using current data. There will always be some uncertainty associated with the model structure and the model parameters and, therefore, around the model results as a consequence of the assumptions required to develop the model. The strength of the available evidence and the uncertainties around the relationship between costs and outcomes in the present and costs and outcomes in the future will impact upon the model results.

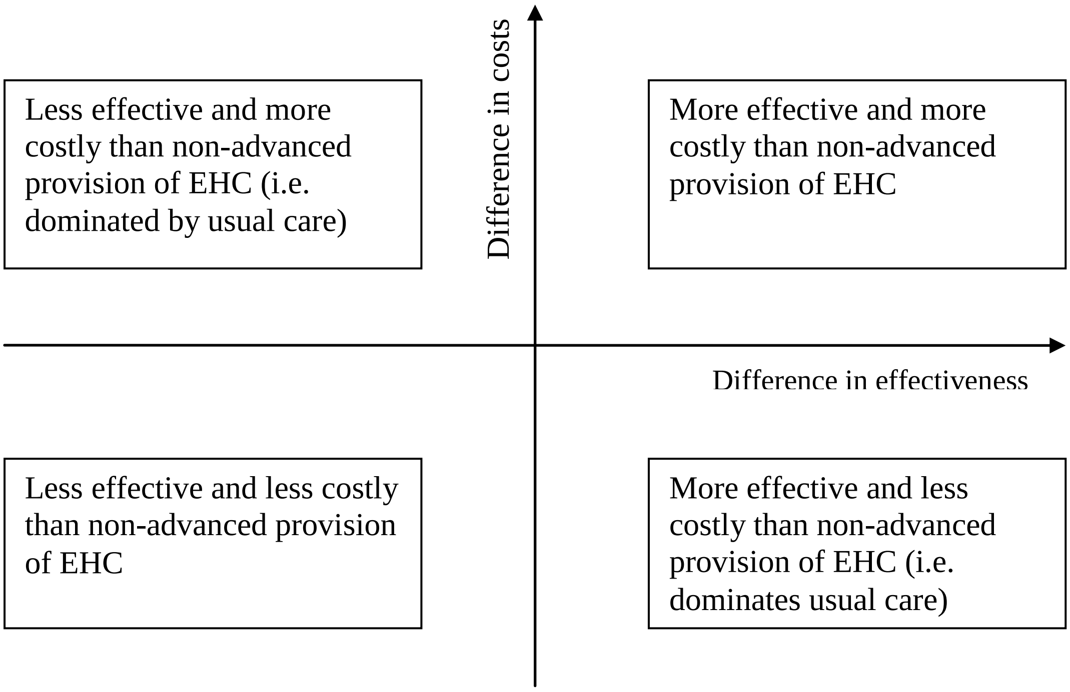
In order to assess the impact of the key assumptions within the model upon the model results, a sensitivity analysis is required. A sensitivity analysis involves varying model assumptions to assess the impact of a different assumption to that made within the base case (the main results presented) upon the model results. If varying an assumption in some sensible way has a large impact upon the model results, then more information may be required around that parameter or structural assumption in order for the model to be able to inform the decision. However, if varying a parameter or assumption has a limited impact upon the model results, then the model results can be considered to be reasonably robust to that assumption. If all of the key assumptions are tested within a sensitivity analysis and they all have a limited impact upon the model results, then there is more certainty that the model results are illustrative of the truth. The benefits of a new intervention can be measured in terms of disease-specific/ topic specific outcomes. A diagram of the calculation of cost-effectiveness of an example intervention such as the advanced provision of Emergency Hormonal Contraception (EHC) compared with no advanced provision is shown in Figure 1 below.

Figure 1: Example of economic evaluation of EHC



The resulting Cost Effectiveness Ratio (ICER) may be presented in terms of a Cost-Effectiveness Plane as shown in Figure 2 below. Within this figure the cost and effectiveness of current standard practice is denoted by the origin. The additional benefits and costs generated as a result of each of the interventions assessed are then plotted on the x- and y-axis respectively.

Figure 2: Cost-effectiveness plane for EHC


Difference in costs
Less effective and more costly than non-advanced provision of EHC (i.e. dominated by usual care)
More effective and more costly than non-advanced provision of EHC
Difference in effectiveness
Less effective and less costly than non-advanced provision of EHC
More effective and less costly than non-advanced provision of EHC (i.e. dominates usual care)

Interventions which fall into the north-west quadrant of the plane would not be considered as cost-effective in comparison to current standard practice. Conversely, interventions which fall into the south-east quadrant of the plane would be considered to be economically attractive in comparison to current standard practice as they are estimated to be more effective and cost saving in comparison to current standard practice. The cost-effectiveness of interventions which fall into the north-east or south-west quadrant of the plane are less clear as they are more effective and more costly or less effective and less costly than current standard practice respectively. In these cases, the decision maker must decide how much they are willing to pay for a measure of effect. In order to be able to compare the cost-effectiveness of interventions over different disease areas and populations, NICE usually uses the cost per quality-adjusted life year (QALY) gained of the new intervention compared with current standard practice. In order to calculate the cost per QALY, a health utility score (where 0 is a notional health state equivalent to being dead and 1 is a notional health state equivalent to full health) is estimated for each of the states within the economic model. The total utility scores of each person are weighted over the time frame of the model according to time in each state to produce the total QALYs gained for the new intervention compared with the current standard practice. NICE suggest that the opportunity cost of other interventions displaced by the new intervention is around £20,000 - £30,000 per QALY gained per person. Interventions which are more effective than the comparator and are estimated to have a cost per QALY gained of less than £20,000 - £30,000 are therefore considered to be economically attractive, and hence appropriate for introduction and adoption in England and Wales (NICE, 2009).

Within the current analysis, only outcomes specific to the topic (pregnancies averted and abortions averted) are calculated and the QALY outcome is not used. The reasons for this will be discussed in detail in Section 2.2.1. This means that if the results fall into the north-east quadrant, the decision makers would need to decide how much they should be willing to pay for a delayed pregnancy or for avoiding an abortion. This is a judgement which would not be required if the results fall in the south-east quadrant (intervention is more effective and less expensive than current practice).

The cost-effectiveness ratio may differ according to the perspective from which costs and effects are incurred. The reference perspective for NICE public health is the public sector perspective. This involves considering all costs incurred by the public sector.

1.3 Cost-effectiveness evidence around interventions to encourage the use of contraceptives and contraceptive services

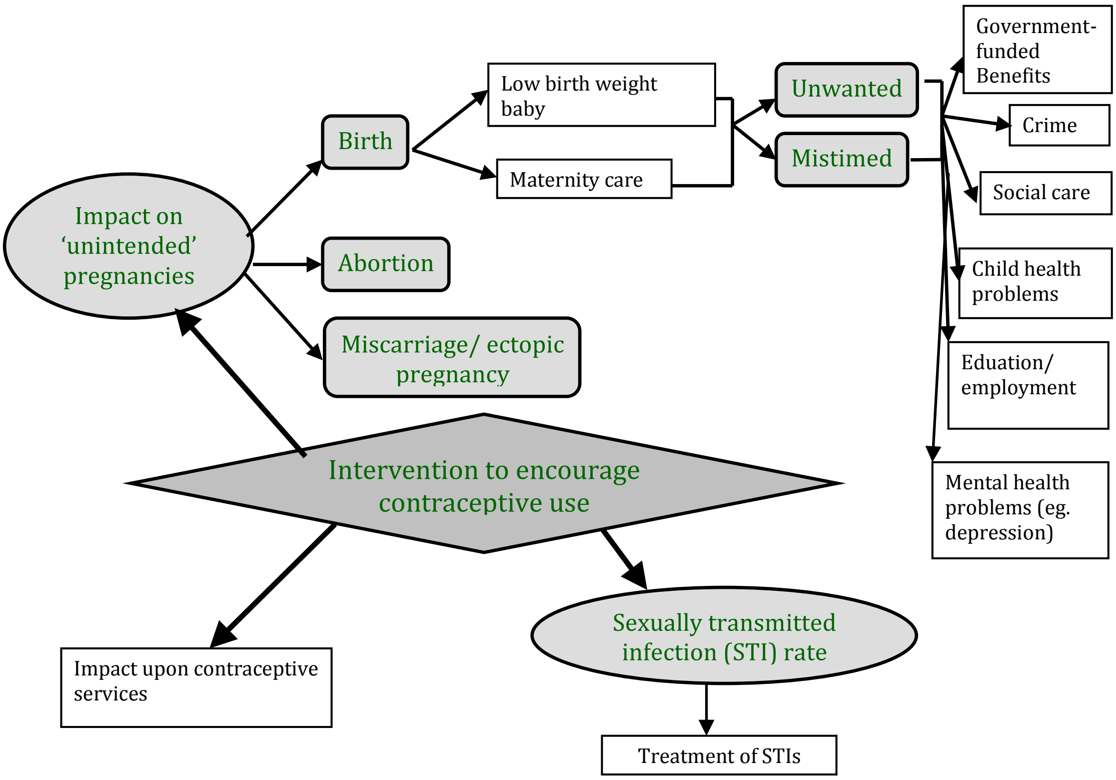
A series of three effectiveness and cost effectiveness evidence reviews were undertaken by ScHARR, according to the context in which the contraceptive service was delivered; these were education, health care and community settings (Blank *et al.*, 2009). One economic evaluation was identified within the three reviews which considered the cost-effectiveness of an intensive, school-based intervention for teen mothers to prevent repeat pregnancies (Key *et al.*, 2008). This economic evaluation was poorly reported and appeared to contain some errors within the calculations. No other economic evaluations which met the inclusion criteria were identified by the reviews. Whilst not formally searched for within the reviews, a number of economic evaluations were identified which assessed the cost-effectiveness of individual contraceptives. However, it is important to recognise that the scope of this work is not to consider individual contraceptives, but to assess the cost-effectiveness of interventions which encourage young people to use contraceptives and contraceptive services. Clearly, the two are not entirely unrelated; it is important to increase use of *effective* services and hence the effectiveness of comparable contraceptives will be considered within the model where appropriate.

In the absence of cost-effectiveness evidence for the interventions covered by the evidence reviews it is necessary to produce an economic model to derive estimates of the cost-effectiveness of interventions to encourage young people, especially socially disadvantaged young people, to use contraceptives and contraceptive services.

2 METHODS

A conceptual model was developed based upon the initial mapping review to form the foundations of what might be included within the health economic model. Based upon the conceptual model, further literature searches were undertaken to facilitate decisions about the extent of which all of these factors should be included within the health economic model and to identify appropriate parameters and assumptions within the model. The conceptual model is shown in Figure 3 below.

Figure 3: Conceptual model of interventions to encourage contraceptive use



Based upon the three effectiveness reviews (Blank *et al.*, 2009), three health economic models have been developed, each based upon the above conceptual model; (1) a model of interventions for young people who have not previously been a parent (but who may or may not have been pregnant without carrying to term) within secondary school, (2) a model of interventions to prevent repeat pregnancies for young mothers within a secondary school and (3) a model of young people within the general population who are sexually active and who may have unprotected sex. Each of the three models will be based upon the same general model, but with some variations in terms of the scope of the models. The General Model will be described within Section 2.2. Each of the variations of this General Model will then be described in Section 2.3, including the interventions and comparators within each of the models.

2.1 General Model

2.1.1 Economic model scope

Population:

The population within each of the models varies and will be described in Section 2.3. National statistics suggest that those people who become pregnant as teenagers are more likely to be from a lower socioeconomic status and have limited education (ONS, 2009). There is an argument that those people who have less career potential are more likely to become pregnant as a teenager because they perceive that they have less to lose from becoming pregnant than those who have a greater career potential (see accompanying views review). The model population includes young people within the general population ('young' age is defined differently for each of the models dependent on the age group which might receive the intervention – see Section 2.3). Since the proportion of socially disadvantaged people having teenage pregnancies is greater than the proportion of teenage pregnancies within the general population, those teenagers becoming pregnant within the model will predominantly consist of socially disadvantaged young people.

No evidence was identified around specific subgroups of people that might be considered to be socially disadvantaged as defined within the scope of this work (including homeless people, children in care, young people with learning difficulties and young people in the armed forces). The population included within all models is any young person who might become pregnant as a teenager, which may, for example, include children in care and young people with learning difficulties within this population. The population included within the models does not include homeless people or people in the armed forces because these are very different subgroups of people for which the effectiveness of the interventions cannot reasonably be generalised and for which there is insufficient evidence around the different assumptions required of the possible outcomes of a pregnancy. The majority of mothers under 19 are White British, although there are substantial regional variations

(Department of Health, 2008). Ethnic minorities will not be considered specifically within the model since there is insufficient evidence to suggest what impact the interventions would have upon different ethnicities, but again these will be a subgroup of the population within the models.

Some of the interventions are provided to both males and females. The costs and outcomes of a male using contraceptive services are measured in terms of the pregnancy status of his partner since the key consequences of the male using the contraceptive service are in terms of his partner's pregnancy status. Any impact of the intervention on Sexually Transmitted Infection (STI) rates is also included.

The starting population considered within the model is limited to those people under 20 years. This is in part due to the paucity of evidence around interventions to encourage the use of contraceptives and contraceptive services for people aged 20 – 24 years. Moreover, current evidence assessing the impact of a birth upon the mother's long term outcomes tends to compare outcomes of teenager mothers with older mothers, which suggests that the negative impacts associated with a teenage birth are not generally associated with mothers in their early twenties. Elicitation with the programme development group (PDG) (described within Section 2.2.3) also suggested that if the baby is wanted, there are unlikely to be negative impacts associated with having a baby in the early twenties compared with having a baby in the late twenties or early thirties. There is, however, a greater probability of abortion during the early twenties compared with the late twenties or early thirties.

Interventions and comparator:

The interventions and comparator within each of the models varies and will be described in Section 2.3. The interventions included within the model were chosen following Programme Development Group (PDG) discussions around which interventions the group would consider for inclusion within the final recommendations based upon the current evidence base (see the accompanying effectiveness reviews) and the PDG's expertise. In some cases, more than one study assessed a particular intervention. However due to the extensive heterogeneity between the published studies; each intervention assessed within the models is based upon a specific paper which is chosen to be of the highest quality and the most representative for a UK analysis. It should be noted that although the evidence suggests that the use of outreach services to bring young people into mainstream clinics is effective, there is insufficient evidence available around the costs and effectiveness of this intervention in order to undertake an economic analysis. This example highlights the fact that there may be other interventions which are potentially effective which have not been formally reported.

The scope of this work is to assess the cost-effectiveness of interventions which encourage young people to use contraceptives and contraceptive services. The aim of the use of contraceptives is to prevent pregnancies (and STIs in the case of condoms). However, some young people (<25) may want to have a child. An intervention to encourage the use of contraceptives and contraceptive services is unlikely to prevent young people who hope to become pregnant from endeavouring to become pregnant. For interventions provided within a setting where young people are already choosing to access a contraceptive service, it seems reasonable to assume that the young person wants to prevent pregnancy (at least when the intervention is first provided). Conversely, for interventions which aim to increase access to service for people who are not currently using contraceptives, it is not known whether the young person would like to become pregnant or not. It is therefore difficult to assess the effectiveness of such interventions. For this reason, the majority of the effectiveness evidence identified by the literature review focuses upon the former. The model therefore focuses upon interventions which are aimed at people already accessing contraceptive services in some way.

Outcomes:

Outcomes are presented in terms of the number of pregnancies averted for a particular age group which the intervention targets. For example, an intervention aimed at school children aged 14 – 16 years would be assessed in terms of a Cost per age 14 – 16 pregnancy averted. A detailed discussion around the way in which this outcome is calculated is presented within Section 2.2.8. The initial intention was to consider only outcomes associated with unintended pregnancies; however the trials used to inform the effectiveness data did not collect this information. Moreover, long term outcomes of teenage motherhood are not provided in terms of initial intention. It is therefore not possible to estimate costs and benefits separately for intended and unintended pregnancies.

The number of abortions averted is also calculated. This outcome is subject to less uncertainty since it provides a clear indication that the pregnancy is unintended; however it does not capture any negative outcomes of a teenage birth.

The NICE reference case for comparing the cost-effectiveness of interventions within the NHS suggests the use of the cost per QALY gained as discussed in Section 1.1. However, in this case there are several problems with the use of the QALY. Firstly, QALYs are applied under the assumption that life is a positive thing. In this case, we are assessing the cost-effectiveness of interventions which aim to prevent or delay the existence of life; hence the interventions which are being assessed would not be considered effective using QALYs in the standard sense. Secondly, there is no evidence around how the age of first birth affects the quality of life of the mother, the father or the child. Similarly, there is limited evidence around how miscarriage and abortion affects the quality of life of the parents. Finally, the valuation of abortion may depend upon ethical and religious views and hence it would not be possible to reach a consensus around the valuation of an abortion. In addition, the valuation may lie outside of the QALY measurement (i.e. not just based upon health). Due to these reasons, the PDG and NICE agreed that it would not be appropriate to use the QALY outcome.

The following outcomes will therefore be presented for each model:

- **Cost per abortion averted** (includes only the costs of the intervention, abortion and the treatment of STIs; does not consider other outcomes of pregnancy including birth, miscarriage, ectopic pregnancy and stillbirth);

- **Cost per age specific pregnancy averted** (where the age is dependent upon the specific intervention provided).

Perspective:

All analyses will take a public sector perspective which includes costs incurred by the public sector. Costs included within this perspective will include:

- Cost of the intervention and additional contraception required as a result of the intervention
- Cost of maternity care
- Cost of abortion
- Cost of miscarriage/ ectopic pregnancy/ stillbirth
- Cost of treatment for low birth weight babies
- Cost of treatment of sexually transmitted infections (STIs)
- Cost of government-funded Benefits (this will be referred to with a capital 'B' throughout to differentiate between government-funded Benefits and other effects of the interventions within the model)

Other costs included within the conceptual model (Figure 3 above) were considered for inclusion within the analysis; however subsequent research suggested that they were not required within the health economic model. Reasons for inclusion and exclusion of costs will be described within the following sections of the report.

The analysis will be presented with and without the inclusion of government-funded Benefits. There is a debate from the public sector perspective around whether government-funded Benefits should be seen as transfer payments, that is, payments which are paid from one person in society to another without the overall wealth of society changing. However, this debate is not pertinent in this case. This is because interventions to encourage young people to use contraceptives and contraceptive services aim to prevent some babies being born. Therefore by preventing such babies being born, the cost of the Benefit payments would not be incurred to the government. Hence there is a true cost reduction from both a public sector and a societal perspective (i.e. it does change the overall wealth of society). This is not offset by the benefits of having a baby for the potential mother if the baby was unwanted at the time of conception. In conjunction, the non-monetary benefits to society are assumed to be neutral i.e. the number of children a person has, as long as they do not yet exist, is neutral in terms of benefits to society (Broome, 2004). Therefore, Benefit payments in this case should be included within the public sector perspective. Those results presented excluding Benefit payments will provide a National Health Service (NHS) and Personal Social Service (PSS) perspective, since all other costs within the model are incurred from this budget.

2.1.2 General modelling methodology

The model was developed within Excel. The model follows a cohort of 100,000 young people over a lifetime from the age at which the intervention is provided. There is a probability of becoming pregnant at each age and, following conception, there is a probability (dependent upon age) of the female having a birth, an abortion, a miscarriage, an ectopic pregnancy or a stillbirth.

The probability of abortion and birth is based upon national government statistics for England and Wales (ONS, 2009). The birth rate is adjusted to account for the fact that 1.5% of all births will be multiple births. The probability of miscarriage and ectopic pregnancy is reported by Hospital Episode Statistics (HES) data collected by the Information Centre for Health and Social Care (HES online, accessed 2009). This suggests that 8.5% of all pregnancies result in miscarriage or ectopic pregnancy; however this is not separated by age. A study by Andersen *et al.* (2000) reports outcomes of pregnancy by age and suggests that 6% of all pregnancies of women less than 20 years end in miscarriage, ectopic pregnancy or stillbirth, and that 8% of all pregnancies of women 20 – 24 years end in miscarriage, ectopic pregnancy or stillbirth. This analysis was based within Denmark; however it seems consistent with the UK HES data. This study was therefore used to parameterise the miscarriage rate. It should be noted that these miscarriage statistics are based upon the number of hospital stays and not all miscarriages require a hospital stay, meaning the proportion of pregnancies ending in miscarriage, ectopic pregnancy or abortion may be underestimated. The impact of this upon the model results is tested within a one way sensitivity analysis. These probabilities of each outcome following conception are shown in Table 1 below. Costs and consequences associated with each of these outcomes are calculated as described in the remainder of Section 2.

Table 1: Probability of each outcome following pregnancy

Age at conception	Probability of abortion	Probability of birth	Probability of miscarriage/ ectopic pregnancy/ stillbirth
Age 14 years	79.1%	14.5%	6.4%
Age 15 years	72.8%	20.8%	6.4%
Age 16 years	62.1%	31.5%	6.4%
Age 17 years	50.2%	43.4%	6.4%
Age 18 years	43.4%	50.2%	6.4%
Age 19 years	37.4%	56.2%	6.4%
Age 20 years	33.2%	58.3%	8.5%
Age 21 years	30.4%	61.1%	8.5%
Age 22 years	28.1%	63.4%	8.5%
Age 23 years	26.2%	65.3%	8.5%
Age 24 years	23.2%	68.3%	8.5%

Source: ONS, 2009

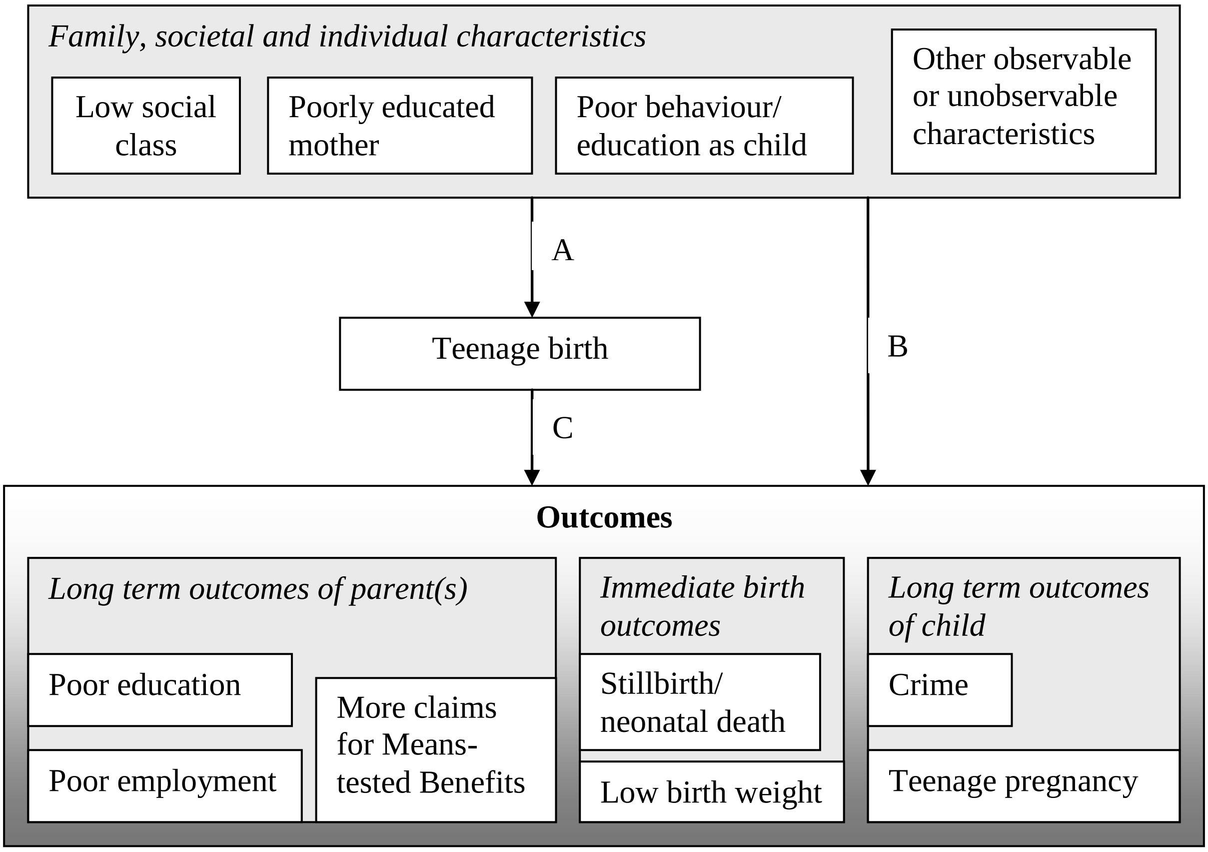
2.1.3 Modelling the outcomes of a pregnancy

It is important within any health economic analysis to compare the additional costs and the additional benefits associated with an intervention. An intervention may increase contraceptive use or change contraceptive use behaviour with the aim to reduce the number of teenage pregnancies. A pregnancy may result in a birth, an abortion, a miscarriage, an ectopic pregnancy or a stillbirth. The consequences of each of these outcomes need to be estimated in terms of costs and benefits. The use of the outcomes 'age specific pregnancies averted' and 'abortions averted' means that whilst it is possible to calculate the long term costs associated with a birth, the value of the outcomes of a birth are not explicitly captured within the model. An attempt to address this issue was made by eliciting the PDG's valuations of the outcomes of a teenage birth (described in detail later).

There are numerous negative outcomes typically associated with a teenage pregnancy. Firstly, young age of pregnancy is associated with a greater likelihood of abortion (See Table 1). Secondly, if the pregnancy is continued, there might be an increased risk of foetal death and a greater risk of having a low birth weight baby. Finally, there are longer term negative outcomes for the mother, the father and the child typically associated with a teenage birth (Ermisch and Pevalin, 2003a). These include lower education, poorer employment status, an increased risk of a female child becoming a teenage mother herself and an increased risk of male children committing crime as they become older. For the state, young age of motherhood is typically associated with an increase in claims of means-tested Benefits. Long term outcomes of a birth must be taken into account within the model since it is important to consider all of the lifetime consequences that have resulted from the provision of the intervention.

However, evidence of the negative consequences associated with teenage births is often based upon studies comparing the outcomes of an older mother with the outcomes of a teenage mother. This produces biased results because of the baseline outcomes of these two groups. Older mothers are more often highly educated and are more likely to have pursued their career before starting a family (Ermisch and Pevalin, 2003a). Teenage mothers are relatively more frequently from a lower socioeconomic background and arguably have less to lose from becoming pregnant at a young age and hence would be more likely to have a baby as a teenager (see accompanying views review). Comparing the outcomes of these two very different populations will not provide an estimate of the consequences of a teenage birth, since many of the poorer outcomes associated with those people who have had a teenage birth would have occurred to some extent anyway. Figure 4 shows some of the possible causes and consequences associated with a teenage birth. This figure shows that there are some family, societal and individual characteristics which predispose a person to a teenage birth (arrow A). Some of the negative outcomes which occur in people who have a teenage birth are independent of the age at birth and can be explained by their initial family, societal and individual characteristics (arrow B). However, there may also be some negative consequences associated with the age at first birth itself (arrow C).

Figure 4: Possible causes and consequences of a teenage birth



It is very difficult to estimate how much of these outcomes age at first birth accounts for (i.e. to estimate arrow C). The outcomes must be adjusted to account for the poorer initial family, societal and individual characteristics to provide an unbiased estimate of any negative consequences of teenage pregnancy. This issue will be investigated firstly in terms of a literature review of this evidence and secondly via elicitation with the PDG.

Literature review to assess long term outcomes of a teenage birth

A literature review was undertaken to identify studies which aim to do this. A description of the search strategy and a detailed analysis of this literature can be found in the accompanying review (Pilgrim *et al*., 2010). The search strategy was not limited to UK papers; however the accompanying review includes only UK papers due to the differences in the UK education, work and Benefits system compared with other countries such as the US. Six UK studies were identified by the review. Five of the studies compare the mother's socioeconomic outcomes at around age 30 years. Only one UK study provides evidence around the long term outcomes of the child. No relevant UK studies were identified around the outcomes of the father of a child born to a teenage mother. Three broad statistical methodologies are used within these analyses; family fixed effects, instrumental variable techniques and propensity score matching. Each of these and the advantages and disadvantages of each is described briefly in Table 2 below.

Table 2: Methods for estimating long term outcomes of teenage birth

Method	Brief description	Advantages	Disadvantages	Direction of bias*
Family fixed effects	Comparing the outcomes of siblings or twins, where one has given birth as a teen and one has not.	- Controls for mother's characteristics.	- Does not control for father's characteristics, societal characteristics or unobservable characteristics influencing selection into motherhood (eg. personality); - Usually small sample.	Over-estimate
Instrumental variable	An instrumental variable is a variable that can explain teenage fertility, without describing unobserved characteristics that influence later socioeconomic outcomes. This variable is used within a statistical regression to estimate outcomes.	- Able to control for unobservable characteristics influencing selection into motherhood in addition to observable characteristics.	- Depends upon instrument used. If a weak instrument is used, it may not adequately control for unobservable characteristics.	Depends upon instrument used
Using miscarriage as an instrumental variable	Comparing the outcomes of a teen mother and a young person who was pregnant as a teen but experienced a miscarriage. This variable is used within a statistical regression to estimate outcomes.	- Able to control for unobservable characteristics influencing selection into motherhood in addition to observable characteristics.	- Usually small sample; - May not be completely random events (some studies try to adjust for this); - Some of the negative impacts of teenage pregnancy may already have occurred eg. may have already dropped out of school before the miscarriage.	Under-estimate
Propensity score matching	Matches pairs based upon a specified criteria	- Able to control for unobservable characteristics influencing selection into motherhood in addition to observable characteristics.	- Does not control for unobservable characteristics influencing the decision whether to terminate the pregnancy.	Over-estimate

* Overestimate = Overestimates negative impacts of teenage motherhood; Underestimate = Underestimates negative impacts of teenage motherhood

Whilst all of these studies suggest reduced negative outcomes of teenage birth compared with the older literature which compares teen mothers with older mothers, the results of the studies are varied and uncertain. This is due to the fact that none of the methods are ideal since they are limited by the evidence available from longitudinal observational datasets. Some of the methods are unable to control fully for unobservable characteristics which may influence selection into motherhood such as personality and hence these methods will overestimate the negative impacts of teenage motherhood.

Of the five studies assessing the outcomes of the mother, the three highest quality studies all use instrumental variables to control for the unobservable factors which may influence selection into teenage motherhood. All of these studies suggest that there is very little (if any) difference between the outcomes of teenage mothers and the outcomes of older mothers when controlling for other factors which might influence these outcomes. One of these studies suggests that age at first birth has no impact upon worklessness of the mother (Walker *et al.*, 2009). Goodman *et al.* (2004) suggest that age at first birth has no substantial impact on socioeconomic status of the mother at age 30 years. Finally, Ermisch and Pevalin (2003b) suggest that a teenage birth is not likely to lead to substantially poorer outcomes at age 30 years in terms of education and employment for the mother. The study by Ermisch and Pevalin (2003b) does, however, suggest that a teenage birth is likely to lead to the mother faring less well in the 'marriage market' in that she is more likely to partner a person who is unemployed or on a lower wage. This outcome in itself cannot be easily incorporated into the health economic model since the employment rate of the partner is independent of the mother's outcomes; if the mother had not partnered that person they would still be in society, probably with the same socioeconomic status. However, the analysis also suggests that a teenage birth is likely to decrease the probability of owning a house. The results of the study suggest that this is more likely to be due to the choice of partner, rather than as a result of the education and employment of the mother. It is unclear from the study whether or not those people who do not own a house would be in receipt of Housing Benefit. For a person to be entitled to Housing Benefit within England and Wales, they must be entitled to

Income Support. The study by Ermisch and Pevalin (2003b) suggests that at age 30, a mother who had her first child as a teenager is around 4% more likely to require Income Support than a 30 year old mother whose first birth was at a later age but with otherwise equivalent characteristics. These impacts can therefore be included within the model using the difference in Income Support reported by the study.

Elicitation to assess outcomes of a teenage birth

An elicitation technique was used with members of the PDG at NICE using a person trade-off type of approach to try and establish a valuation of delaying pregnancy. The PDG members were asked to consider how many pregnancies would need to be delayed at age x years to provide equivalent benefits as delaying a pregnancy at age 14 years, where x = 15, 16, 17, 18, 20 and 24. This elicitation aimed to serve three purposes; (1) for results which fall into the north east quadrant of the cost-effectiveness plane (more effective and more expensive), the elicitation could be used as a means for comparing alternative interventions (2) to provide an indication around the relative size of the benefits of delaying a teenage pregnancy and (3) for validating (or otherwise) the parameterisation around the mother's socioeconomic outcomes following a teenage birth.

The PDG members were initially asked to undertake the elicitation for the general population as a reference case. They then repeated the exercise for socially disadvantaged individuals using several scenarios for social disadvantage including a young person with severe learning difficulties, a homeless heroin addict, a young person excluded from school, a looked after child and a young person who is more likely to become a teenage parent due to the following factors (Ermisch and Pevalin, 2003a):

- Low household social class as a child
- Own mother has no qualifications
- Own mother was a teen mother
- Poor vocabulary at age 5
- Poor child behaviour at age 10
-Low self-esteem at age 10.

The results of these elicitation exercises generally suggested that for several classifications of social disadvantage, preventing an unintended birth at age 14 would be expected to be equivalent in terms of outcomes as preventing two births at age 18. This suggests that the PDG generally believed that there are twice as many negative outcomes associated with a teenage birth at age 14 than at age 18. The median results from these elicitations are shown in Appendix 1. The latter definition of social disadvantage provides the most representative interpretation of those teenagers becoming pregnant within the health economic model. The median results from this elicitation are shown in Table 3 below.

Table 3: PDG elicitation summary for socially disadvantaged young people (median valuations)

<table>
<tr><td colspan="2">Age</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>20</td><td>24</td></tr>
<tr><td rowspan="2">No. of births averted to provide equivalent benefits</td><td>Wants a baby</td><td>1</td><td>1</td><td>1.25</td><td>1.75</td><td>2</td><td>NA</td><td>NA</td></tr>
<tr><td>Does not want a baby</td><td>1</td><td>1</td><td>1.2</td><td>1.5</td><td>2</td><td>4</td><td>10</td></tr>
</table>

The elicitation was experimental and was intended to provide a basis for future work in this area. The results from the elicitation are uncertain due to the relatively small sample size of the PDG (15 people) and the limited time period within which the elicitation was undertaken which meant that each PDG member could not be interviewed individually. In addition, insufficient detail was provided around each elicitation scenario such that some of the PDG members found it difficult to value the impact of age at first birth since they did not know what other factors might be affecting the young person's outcomes. For example, some of the PDG members suggested that if the young person had a full support network then age at first birth would not be a major concern. However, if, for example, the young person did not have a support network and was thrown out of their family home, then an 18-year old is likely to cope better than a 14-year old. This detail therefore needed to be described more fully within the elicitation exercises. In addition, some of the PDG members were valuing different aspects of the benefits of delay. For example, some members focussed upon the educational impacts whilst some focussed upon health impacts of delaying a pregnancy. In order to take the elicitation forward it would be essential to capture the reasons for the valuations more formally. There are also several limitations associated with the person-trade off approach including the choice of start points and the introduction of biases from the framing of the question. A further discussion of this approach and its advantages and disadvantages can be found in Nord (1995).

In discussions following the elicitation, the PDG were clear that decisions in practice are based on much wider considerations than age. The PDG agreed that there are short term negative outcomes for the baby of a teenage mother aged below 17 years, including low birth weight and neonatal death. Some of the PDG suggested that if the teen was from a chaotic or dysfunctional family they may have a greater chance of moving away from the family if older. Conversely, some of the PDG said that older teens might be more vulnerable than younger teens due to the support network available at a younger age not being available for older mothers. The results around the PDG elicitation are an important starting point in this area of work, and helped to validate the results of the studies discussed above.

Incorporating the outcomes of a teenage birth into the model

The long term negative benefits of teenage birth were incorporated into the model by assuming that those girls and women who have a teenage birth are 4% more likely to receive Income Support and Housing Benefit (Ermisch and Pevalin, 2003a) than those women whose first birth is between 20 and 35 years. The model also assumes that teenage mothers are 4% more likely to receive Child Tax Credits and NHS Dentist and Prescription costs over this time period since those people receiving Income Support are also eligible for these other Benefits. This estimate of 4% is varied within the sensitivity analysis due to the uncertainty surrounding this parameter. The model assumes that 90% of teenage mothers will receive Income Support and associated Benefits (Department for Children, Schools & Families, 1999) and, hence, that 87% (= 96% of 90%) of mothers aged 20 – 24 years will receive Income Support and associated Benefits.

No evidence was identified within the literature review assessing the father's outcomes of a child born to a teenage mother, which controls for both observable and unobservable characteristics. However, one study was identified (Berrington *et al*., 2005) which does not control for unobservable factors which may predispose young fatherhood. Even without controlling for unobservable characteristics, this study suggests that becoming a young father (<23 years) is not associated with substantial long term negative outcomes. Hence no negative impact upon the father has been incorporated into the model.

The review identified one study (Francesconi *et al*., 2008) comparing the long term outcomes of the children born to teenage mothers with those children born to older mothers, adjusting for factors which might influence the child's long term outcomes. This study suggests that children of teenage mothers have a slightly lower chance of high educational attainment, greater risk of inactivity and teenage childbearing and a higher probability of lower earnings. However, this study does not adequately control for unobservable characteristics which may influence the child's outcomes and hence it may overestimate the negative outcomes associated with a teenage birth. The model therefore takes a conservative approach and does not incorporate any long term negative implications of a teenage birth upon the child.

In addition to the long term outcomes of a teenage birth, two studies, undertaken in the US, have been identified which consider the impact of teenage birth upon immediate birth outcomes including low birth weight and foetal death, which control for factors which might predispose a person to teenage motherhood (Chen et al., 2007; Markovitz, 2004). US studies are used to estimate these outcomes due to lack of UK data; however these short term outcomes are thought to be more generalisable to the UK population than the long term socioeconomic outcomes. Both studies suggest that there is an increased risk of neonatal death if the expectant mother is aged 17 years or younger. It is not possible to incorporate this within the model since model outcomes are not presented in terms of life years gained. However, the baseline probability of neonatal death is small and hence this would not be expected to have a substantial impact upon the model results. The study by Chen *et al.* (2007) suggests that women who are below 16 years are more likely to have a low birth weight baby than women who are 16 – 17 years, and that the probability of a low birth weight baby decreases by mother's age at birth until age 20 years. This study also reports the baby's Apgar score (a score which evaluates the newborn baby on five simple criteria; Appearance, Pulse, Grimace, Activity, Respiration) which was shown to be positively correlated with young age; however this was not included within the model to avoid double counting the treatment required. The parameters associated with the outcomes of a teenage birth are shown in Table 4 below.

Table 4: Outcome parameters

Parameter	**Parameter value**	**Source**
Percentage increase in probability of Income Support receipt and associated Benefits	4%	Ermisch and Pevalin, 2003b
Additional probability of very low birth weight baby compared with a woman aged 20 - 24 years		
Aged <16 years	0.48%	Chen *et al.*, 2007
Aged 16 -17 years	0.15%	
Aged 18 -19 years	0.03%	

2.1.4 Sexually transmitted infection (STI) outcomes

The model assumes that the rate of STIs is not affected by any form of contraception other than condoms. The outcomes associated with STIs are modelled under simplifying assumptions. The impact of contraception upon the rate of STIs would ideally be modelled using an infectious disease model, which allows for the STIs to be passed on to numerous people who may in turn pass STIs on to other individuals. However, due to time and resource constraints, an infectious disease model was not feasible. Many of the assumptions and parameters applied within this analysis are based upon the health economic model developed for the NICE Sex and Relationship Education (SRE) public health guidance (Nherera *et al.*, 2009). The following assumptions are applied within this analysis to simplify the calculation of infection rates:

- All acts of sexual intercourse are heterosexual vaginal intercourse;
- Sexually active young people have only one sexual partner;
- The proportion of people who wear condoms do so for every act of sexual intercourse and the remainder never wear condoms.

The relationship between condom use and STI infection was estimated in the same way as for the SRE model, using a Bernoulli model of HIV transmission developed by Pinkerton and Abramson (1993) and adapted by Wang *et al.* (2000). The analysis is limited to primary transmission (transmission from already infected partners). The proportion acquiring an STI is calculated by estimating the STI infection rate using a condom according to frequency of sexual intercourse, multiplied by the proportion using a condom. This is added to the STI infection rate when not using a condom according to frequency of sexual intercourse, multiplied by the proportion not using a condom. This is then all multiplied by the prevalence of the STI within the population. In mathematical notation, this can be expressed using the following formula:

$$W = v*((g * (1-((1-tk)^{s}))) + ((1-g) * (1-((1-t)^{s}))))$$

Where

W = Proportion acquiring STI
v = Prevalence of STI (or probability partner has STI)
g = Proportion using condoms
t = Transmission rate
k = Condom failure rate
s = Acts of sexual intercourse per annum

The parameters used within the above formula are shown in Table 5 below. It is also assumed that if Chlamydia and gonorrhoea are left untreated, there is a 25% and 15% probability of contracting pelvic inflammatory disease (PID) respectively. PID is an inflammation of the female, uterus, fallopian tubes and/

or ovaries and should be treated as soon as possible to avoid damage to the reproductive system.

Table 5: STI parameters

Parameter	**Parameter value**
Prevalence of Chlamydia	8.1%
Prevalence of gonorrhoea	4.1%
Prevalence of genital warts	6.5%
Prevalence of HIV	0.1%
Transmission rate of Chlamydia	45%
Transmission rate of gonorrhoea	53%
Transmission rate of genital warts	60%
Transmission rate of HIV	0.07%
Condom failure rate for Chlamydia, gonorrhoea, genital warts & HIV	5%
Acts of sexual intercourse per annum if sexually active	15
Probability of treatment for Chlamydia, gonorrhoea & genital warts	90%
Probability of contracting PID if Chlamydia left untreated	25%
Probability of contracting PID if gonorrhoea left untreated	15%
Probability of treatment for HIV	100%

Source: Nherera *et al.*, 2009

Since QALYs are not incorporated into the analysis, only the costs of STIs are included within the model; however it is expected that the large costs of treating STIs will account for the majority of the negative impacts associated with STIs since most of the negative health impacts are temporary. The exception to this is the shortening of life associated with HIV which has not been incorporated into the model. Hence the negative effects of contracting HIV may be underestimated within the model.

2.1.5 Modelling the costs of a pregnancy

The costs incorporated within the health economic model include:

- Additional contraceptives and provision of contraceptives required by the intervention
- Maternity care/ ectopic pregnancy/ stillbirth
- Abortion

- Miscarriage/ ectopic pregnancy
- Treatment of low birth weight baby
- Treatment of STIs
- Government-funded Benefits
    - Income Support
    - Housing Benefit
    - Dentist & Prescription Costs
    - Child Tax Credits
    - Child Benefits

The cost of each method of contraception considered within the models is based upon the costs reported within the British National Formulary (BNF 58, 2009) and is shown in Table 5 below. The costs of additional contraception required as a result of the intervention compared with current practice are calculated for each intervention. Any additional cost of the intervention besides the contraceptives required is also calculated. The assumptions around these calculations will be described in Section 2.3 for each intervention separately.

The estimated costs of maternity care, miscarriage, ectopic pregnancy and stillbirth are £2,692, £359, £1,577 and £1,923 respectively, based upon the NICE assessment of Long-Acting Reversible Contraception (Mavranezouli *et al*., 2008). The costs within this assessment have been expressed in 2007-08 prices. The cost of abortion is made up of the cost of medical abortion and the cost of surgical abortion, weighted by the proportion of each undertaken within England and Wales based upon national government statistical data (ONS, 2009). Medical abortion is assumed to be undertaken within an outpatient setting 50% of the time, and within an elective inpatient setting 50% of the time. The impact of this assumption upon the model results is tested within a one-way sensitivity analysis. Surgical abortion is assumed to be undertaken within an elective inpatient setting 100% of the time. The model also assumes that abortion is not funded by the NHS 4% of the time for pregnant women less than 20 years and 12% of the time for pregnant women aged 20 years and older (ONS, 2009).

Treatment for a low birth weight baby is assumed to consist of 3 days within a neonatal intensive care unit. Only babies weighing below 1500g are assumed to incur this cost.

The cost of treatment of STIs is based upon the health economic model developed for the NICE Sex and Relationship Education (SRE) public health guidance (Nherera *et al.*, 2009). Treatment for chlamydia and gonorrhoea is assumed to require one dose of Azithromycin and a GP consultation, whilst treatment for genital warts is assumed to require one dose of imiquimod and a GP consultation. An average cost of HIV treatment per year is estimated based upon the sum of the average cost of care for HIV patients and the average cost of drug treatment (Nherera *et al.*, 2009).

The cost of Benefit payments are also included within the model, since these are costs incurred by the public sector, and represent real resource savings if the baby that might otherwise eventuate has not been conceived. The model assumes that 90% of all teenager mothers within the model will receive Income Support, based upon evidence within the Teenage Pregnancy Strategy (Department for Children, Schools & Families, 1999), and hence that 90% of all teenage mothers will also receive associated Benefits (Housing Benefit, NHS dentist and prescription costs and Child Tax Credits). Claims of Benefits are assumed to begin at the birth of the first child since evidence suggests that 90% of teenage mothers have moved out of their family home within a year of child birth (Department for Children, Schools & Families, 1999). This means that a person first giving birth at age 14 years will claim Benefits for 6 years longer than a person first giving birth at age 20 years. For the 10% (or 14%) of people who do not receive Income Support, the model assumes that those people (or their parent(s) if under 16) will claim Child Benefits.

The model also assumes that mothers who had their first baby at age 20 – 24 years will be 4% less likely to receive Income Support than teenage mothers based upon Ermisch and Pevalin (2003b). It is assumed that this difference will be maintained at a constant level from age 20 – 24 (whenever the baby is born during these years) through to the mother reaching age 35 years. In order to calculate this, a baseline cost of Benefit payments needs to be incorporated into the model up to age 35. There is no clear evidence around the Benefits received by age at first birth over time. However, figures from the Office for National Statistics (ONS, 2009) indicate that of those people in the lowest two income deciles, it would not be unreasonable to assume that around 45% of the people who have given birth before age 25 years (half of those that had received Benefits in their teenage years) continue to receive some form of government-funded Benefits beyond age 25 (although some may move from Income Support to other Benefits). The model therefore assumes that half of those people who have given birth before age 25 years receive the same amount of government-funded Benefits after they turn 25 years old as before they were aged 25 years old, and that this amount of government-funded Benefits continues until age 35 years. Beyond age 35 years, the model assumes that there is no longer a difference between the Benefits claimed by the intervention group and the comparator group (i.e. that all negative effects of teenage birth plateau out by age 35 years) since there is no evidence of a difference beyond this age. The model assumes that the cost of Benefits will remain the same between the intervention and comparator group for those people who have an abortion or a miscarriage within the model.

All costs and associated parameters are shown in Table 6 below.

Table 6: Cost and associated parameters

Parameter	Parameter value	Source
Medical termination of pregnancy (elective inpatient)	£618	NHS Reference Costs 2007-08
Medical termination of pregnancy (outpatient)	£160	
Surgical termination of pregnancy (elective inpatient)	£827	
Probability of abortion not undertaken by NHS (<20yrs)	4%	ONS, 2009 (Table 6 of abortion statistics)
Probability of abortion not undertaken by NHS (≥20yrs)	12%	
Probability of surgical termination\ abortion	65%	ONS, 2009 (Table 2 of abortion statistics)
Probability of medical termination \abortion	35%	
Probability of outpatient procedure \medical	50%	Assumption
Probability of elective inpatient procedure \medical	50%	Assumption
Weighted cost of miscarriage/ ectopic pregnancy/ stillbirth	£626	Mavranezouli et al., 2008 (uplifted to 2007-08)
Maternity care	£2,692	
Treatment of low birth weight child	£2,922	NHS Reference Costs 2007-08†
Annual cost of condom use	£7.50	Boots online, 2009
Annual cost of Hormone implants	£153.73	BNF 58, 2009; Curtis, 2008
Annual cost of Oral contraceptive pill	£11.48	BNF 58, 2009
Annual cost of Injection of hormones	£26.04	
One-off emergency hormonal contraceptive pill	£13.83	
Azithromycin	£8.95	
Imiquimod	£51.32	
Doctors consultation	£36.00	Curtis, 2009
Annual treatment cost of HIV	£14,000	Nherera *et al.,* 2009
Cost of PID	£2,846	
Probability of treatment for Chlamydia, gonorrhoea & genital warts	90%	
Probability of treatment for HIV	100%	
Probability of contracting PID if Chlamydia left untreated	25%	
Probability of contracting PID if gonorrhoea left untreated	15%	
Annual cost of Income Support per person aged <16	£0	Directgov, 2009
Annual cost of Income Support per person aged 16-17	£2,649	
Annual cost of Income Support per person aged 18-19	£3,344	
Annual cost of housing benefit	£4,214	
National average annual cost of council tax for Band A	£943	Find a property.com
Annual cost of dentist & NHS prescriptions	£47	www.nhs.uk‡
Annual Child Tax Benefit	£2,780	Directgov, 2009
% of teen mothers receiving income support	90%	Department for Children, Schools & Families, 1999
Reduced % of mothers aged 20+ years receiving IS	4%	Ermisch and Pevalin (2003b)
% of mothers of those receiving Benefits before age 24 continuing to receive Benefits beyond age 25 years	50%	Assumption based upon ONS, 2009
Annual Child Benefit	£1,040	Directgov, 2009
Annual Child Tax Benefit (2nd child)	£2,235	
Annual Child Benefit (2nd child)	£653	

† Assumes 100% of babies weighing less than 1500g require neonatal intensive care for 3 days

‡ Assumes 2 dentist appointments & 2 prescriptions per year

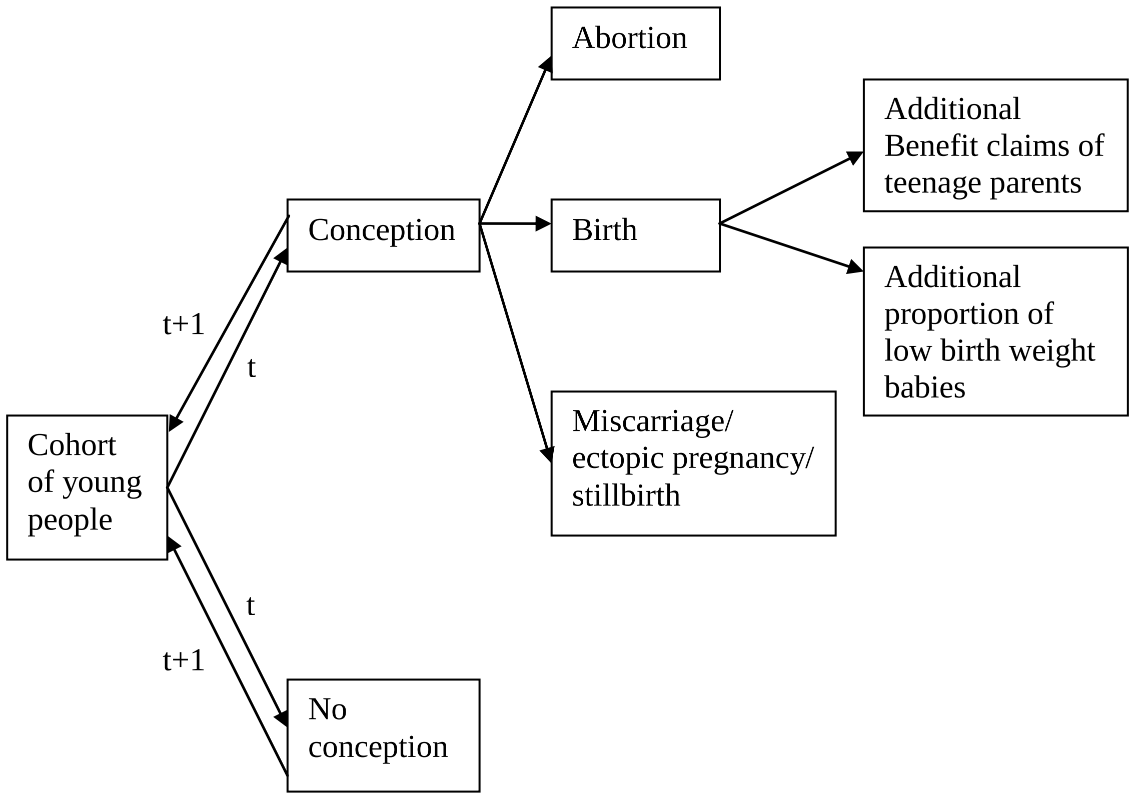
2.1.6 Adverse events and discontinuation of contraceptive methods

Adverse events of contraceptive methods have not been included within the analysis due to the relatively small costs and outcomes associated with the adverse events per se. Most people who experience adverse events will discontinue use of the contraceptive, and if the method of contraception is not replaced, the rate of unintended pregnancies may again increase. However, since the trial data reported pregnancies or use of contraception after the follow up period, the discontinuation rates should be captured with these effectiveness estimates.

2.1.7 Model schematic

A model schematic is shown in Figure 5 which shows which costs and outcomes are included within the model. The initial conceptual model shown in Figure 3 has been modified according to relevance for the model and according to available evidence.

Figure 5: Model Schematic

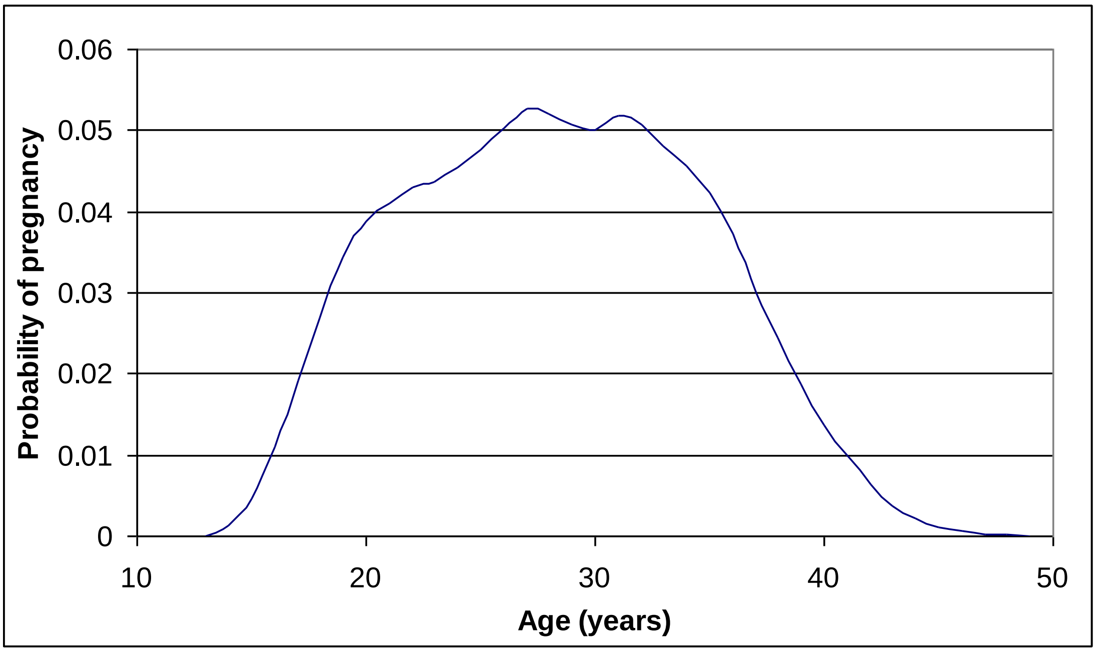


2.1.8 Effectiveness of the interventions

The interventions are modelled based upon the effectiveness estimates from specific studies identified by the literature review. Each intervention is assumed to be effective at preventing pregnancies during the time that it is provided. For example, if there are 8 pregnancies out of 1000 young women within the intervention group and 10 pregnancies out of 1000 young women within the comparator group within a study, then the intervention is said to have a relative risk of 0.8 $\left(\text{i.e. } \frac{8/1000}{10/1000}\right)$. This means that, if the probability of a pregnancy within the model was 1% at age 16 years without the intervention, then the probability of a pregnancy within the model at age 16 years if the intervention were provided would be 1% x 0.8 = 0.8%. If the intervention is provided to school children aged 14 – 16 years, then the model assumes that the relative risk of 0.8 can be applied equally over each of the 3 years during which the intervention is provided.

The follow up period for each of the studies identified by the effectiveness reviews is variable and generally short. Many studies report 6 month or 12 month follow up, whilst some report 3 month follow up or less. Very few studies report greater than 12 month follow up, making it difficult to estimate the long term impacts of the interventions. In the example above, the relative risk of the intervention is likely to change beyond age 16 years. If the intervention reduces the number of pregnancies at school age, some of those pregnancies that would have occurred then are likely to be delayed until the person is older. Therefore, whilst the probability of pregnancy will be lower during the time that the intervention is provided, those young people that would have become pregnant in the absence of the intervention may want to become pregnant at an older age. This means that at some older age, the probability of pregnancy will become greater than it would have been without the intervention. The current probability of becoming pregnant by age is shown in Figure 6 below, based upon national statistics (ONS, 2009).

Figure 6: Probability of becoming pregnant by age

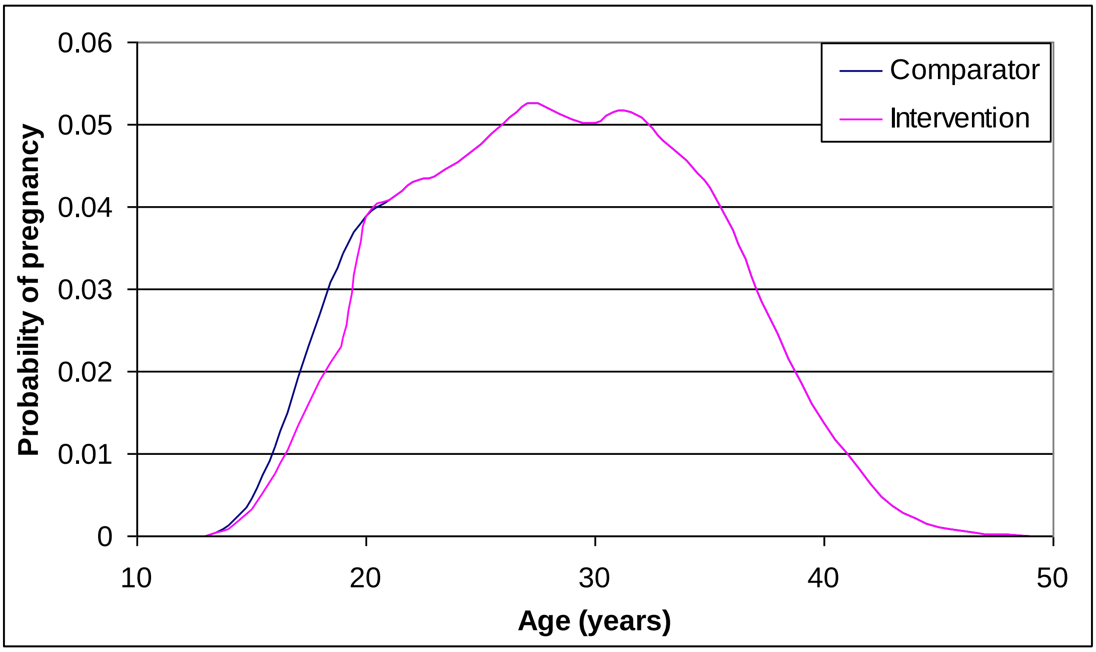


Effective interventions to reduce pregnancies occurring at a young age will alter the far left hand side of this distribution, estimated based upon the effectiveness studies identified within the literature review. However, it is not known what impact the intervention will have upon this distribution beyond the age at which the intervention is provided since the follow up from the effectiveness evidence is insufficient. It is important to model this so that all of the lifetime costs and benefits associated with both the interventions and the comparator are captured in order that an appropriate comparison can be made. Two extreme assumptions have been identified:

Option 1: Unwanted pregnancy

This option assumes that teen pregnancies prevented result in a reduction in the ultimate family size. This would mean that the probability of becoming pregnant and giving birth at later ages would not be altered. This type of distribution is shown in Figure 7 below.

Figure 7: All pregnancies prevented by the intervention are unwanted

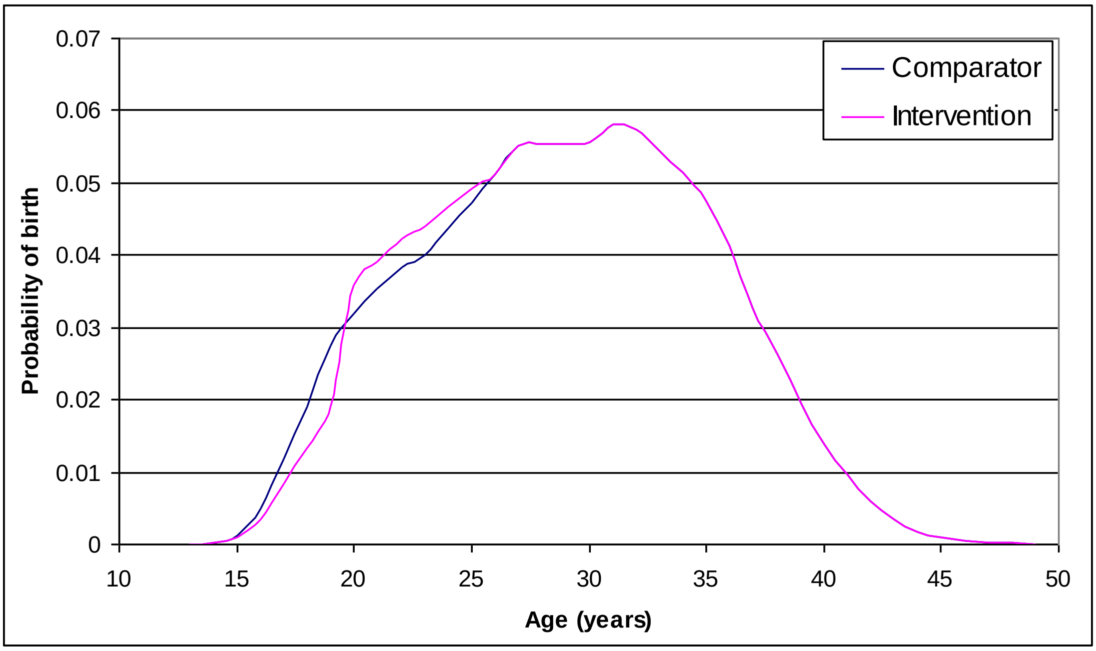


Option 2: Birth mistimed

This option assumes teenage births which are prevented are simply delayed by the intervention to a later stage in the woman's life, meaning that the expected family size remains the same. This means that whilst the probability of having a baby will be reduced if the intervention is provided during the teenage years, the probability of having a baby in later years will be greater, such that the area under the curve will remain the same for the intervention as for the comparator. This option refers to the number of births rather than the number of pregnancies since, whilst the number of births may remain the same, the number of pregnancies is likely to be reduced by preventing teenage pregnancy due to the fact that fewer abortions occur as the potential mother becomes older.

Given the family and individual characteristics associated with teenage pregnancy, it is unlikely that those women who would have had a teenage pregnancy would delay their pregnancy until age 30 years for example. Evidence suggests that women who have their first child beyond their early twenties are more likely to be highly educated and to have developed a professional career before having children (Ermisch and Pevalin, 2003a). It is therefore expected that the majority of women who delay a teenage birth because of an intervention, will generally delay the birth only by a few years. An example illustration of this option is shown in Figure 8 below, although there are clearly a range of variations around this broad option.

Figure 8: All births prevented by the intervention are mistimed



In reality, the true impact of the interventions will lie somewhere between these two broad options. Unfortunately, there is no evidence to suggest the proportion of mistimed births and the proportion of unwanted pregnancies within this age group. Some evidence comparing outcomes at age 30 of teenage mothers and older mothers suggests that mothers who have their first child as a teenager may result in a larger family; however this may be driven by the fact that the women who delayed childbearing may not have completed their expected family size at age 30 years. Within the base case analysis, it is assumed that there is a 50% probability that teenage births result in an additional child, and a 50% probability that the expected family size remains the same. Within the probabilistic sensitivity analysis, this proportion is varied from 0% to 100%. It is assumed that those teenage births which are delayed are delayed until the person is aged 20 – 24 years. Since we are assuming that the person will not delay birth until their thirties and forties, fertility problems do not need to be incorporated into the model. The delayed births are equally divided by years 20 – 24.

Other issues associated with estimating the effectiveness of the interventions

There are several other issues associated with the use of the studies identified within the effectiveness reviews for modelling the costs and benefits associated with the interventions. The studies do not always provide the data required for the modelling, so additional assumptions are required in order to be able to apply the evidence from the effectiveness reviews within a health economic model. Firstly, some of the effectiveness studies provide outcomes in terms of contraceptive use rather than in terms of number of pregnancies. Based upon the proportion of young people using each form of contraceptive within the studies and the total rate of contraceptive failure (contraceptive failure with perfect use + user failure), the number of pregnancies in both the intervention group and the comparator group is estimated.

Secondly, the evidence provides one estimate of effectiveness of the intervention for a range of age groups, and in some cases for both males and females. This means that we do not know if an intervention is more effective for one age group than another, or for females compared with males. The model assumes that the intervention is equally effective over all ages included within the study, and for both males and females if the intervention is provided to both and the results are not reported separately. In addition, some of the studies only provide a mean age of those provided with the intervention, without providing details of a range or standard deviation. This means that it is not possible to know what range of ages the intervention is targeted at. In these cases, the model assumes that the intervention is given only to those people of the mean age within the study.

Finally, there are issues with the generalisability of the studies, mainly in terms of the populations considered within the studies, which leads to uncertainty around the effectiveness of the interventions in the UK populations.

The following assumptions are made around the effectiveness of the interventions:

- The intervention is equally effective for the time that it is available
    - The intervention may be effective beyond this time point, but unless evidence suggests this for a particular intervention, the model makes a conservative assumption.
- The relative risk of becoming pregnant is constant over all ages assessed within the study (unless results are provided by age)
    - This means that if a trial assesses the effectiveness of an intervention for 13-17 year olds, the intervention would be assumed to have the same relative risk of preventing pregnancy/ increasing contraceptive use for a 13-year old as for a 17-year old.
- Same effectiveness for both males and females (where the intervention targets both but does not provide results by gender)
- Where the intervention is aimed at both males and females, it is as effective as predicted by the study.
    - In practice, it may be that the intervention would be slightly more effective than in the trials if the intervention targeted both males and females and if the proportion of people partnering within the trials was greater than the proportion in general practice. Conversely, the opposite would be true if the proportion of people partnering within the trials was less than the proportion in general practice.

2.1.9 Sensitivity analysis

A probabilistic sensitivity analysis (PSA) was undertaken to assess the impact of uncertainties around the model assumptions upon the model results. This involves assigning an appropriate statistical distribution to all uncertain parameters within the model in order to characterise the uncertainty around each parameter. Each parameter is then varied simultaneously using these distributions over a large number of iterations of the model. This provides an indication of the uncertainty around the model results. All General Model parameters and their distributions for the probabilistic sensitivity analysis are shown in Table 7 below.

Table 7: General Model parameters

Parameter	Value	Distribution (95% confidence intervals)	Source
Probability of additional pregnancy versus delayed pregnancy	50%	Uniform (0.025,0.975)	Assumption
Probability of abortion			ONS, 2009
Age 14 years	79%	Fixed, but dependent on probability of miscarriage/ ectopic pregnancy/ stillbirth	
Age 15 years	73%		
Age 16 years	62%		
Age 17 years	50%		
Age 18 years	43%		
Age 19 years	37%		
Age 20 years	33%		
Age 21 years	30%		
Age 22 years	28%		
Age 23 years	26%		
Age 24 years	23%		
Probability of birth			ONS, 2009
Age 14 years	14%	Fixed, but dependent on probability of miscarriage/ ectopic pregnancy/ stillbirth	
Age 15 years	21%		
Age 16 years	31%		
Age 17 years	43%		
Age 18 years	50%		
Age 19 years	56%		
Age 20 years	58%		
Age 21 years	61%		
Age 22 years	63%		
Age 23 years	65%		
Age 24 years	68%		
Probability of miscarriage/ ectopic pregnancy/ stillbirth			
Age <20 years	6%	Beta (4%,9%)	Andersen, 2000
Age ≥20 years	8%	Beta (4%,14%)	
Abortion parameters			
Probability of non-NHS abortion (<20yrs)	4%	Fixed	ONS, 2009
Probability of non-NHS abortion (≥20yrs)	12%	Fixed	
Probability of surgical termination\ abortion	65%	Fixed	
Probability of medical termination \abortion	35%	Fixed	
Probability of outpatient procedure \medical	50%	Uniform (2.5%,97.5%)	Assumption
Probability of elective inpatient procedure \medical	50%	Uniform (2.5%,97.5%)	Assumption
STI parameters			
Prevalence of Chlamydia	8.1%	Fixed	Nherera *et al.*, 2009
Prevalence of gonorrhoea	4.1%		
Prevalence of genital warts	6.5%		
Prevalence of HIV	0.1%		
Transmission rate of Chlamydia	45%		
Transmission rate of gonorrhoea	53%		
Transmission rate of genital warts	60%		
Transmission rate of HIV	0.07%		
Condom failure rate for all modelled STIs	5.00%		
Annual acts of sexual intercourse if sexually active	15	Normal (9,21)	

Parameter	Value	Distribution (95% confidence intervals)	Source
Additional probability of low birth weight baby compared with a woman aged 20 - 24 years			
Aged <16 years	0.48%	Fixed	Chen *et al.*, 2007
Aged 16 -17 years	0.15%		
Aged 18 -19 years	0.03%		
Costs & associated parameters			
Medical termination of pregnancy (elective inpatient)	£618	Fixed	NHS Reference Costs 2007-08
Medical termination of pregnancy (outpatient)	£160	Fixed	
Surgical termination of pregnancy (elective inpatient)	£827	Fixed	
Miscarriage/ ectopic pregnancy/ stillbirth	£626	Fixed	Mavranezouli et al., 2008
Maternity care	£2,692	Fixed	
Treatment of low birth weight child	£2,922	Fixed	NHS Reference Costs 2007-08
Annual cost of condom use	£7.50	Fixed	Boots online, 2009
Annual cost of Hormone implants	£154	Fixed	BNF 58, 2009; Curtis, 2009
Annual cost of Oral contraceptive pill	£12	Fixed	BNF 58, 2009
Annual cost of Injection of hormones	£26	Fixed	
One-off emergency hormonal contraceptive pill	£14	Fixed	
Azithromycin	£9	Fixed	
Imiquimod	£51	Fixed	
Doctors consultation	£36.00	Fixed	Curtis, 2009
Annual treatment cost of HIV	£14,000	Normal (£10k,£18k)	Nherera *et al.,* 2009
Cost of PID	£2,846	Fixed	
Probability of treatment for Chlamydia, gonorrhoea & genital warts	90%	Beta (75%,98%)	
Probability of treatment for HIV	100%	Fixed	
Probability of contracting PID if Chlamydia untreated	25%	Fixed	
Probability of contracting PID if gonorrhoea untreated	15%	Fixed	
Annual cost of Income Support (IS) per person aged <16 years	£0	Fixed	Directgov, 2009
Annual cost of IS per person aged 16-17 years	£2,649	Fixed	
Annual cost of IS per person aged 18-19 years	£3,344	Fixed	
Annual cost of housing benefit	£4,214	Fixed	
Child Tax Benefit (first child)	£2,780	Fixed	
Child Benefit (first child)	£1,040	Fixed	
Child Tax Benefit (second child)	£2,235	Fixed	
Child Benefit (second child)	£653	Fixed	
National average annual council tax cost for Band A	£943	Fixed	Find a property.com
Annual cost of dentist & NHS prescriptions	£47	Normal (£27, £67)	www.nhs.uk
% of teen mothers receiving IS	90%	Beta (60%,99%)	Department for Children, Schools & Families, 1999
Reduced % of mothers aged 20+ years receiving IS	4%	Beta (1%,10%)	Assumption
% of mothers of those receiving Benefits before age 24 continuing to receive Benefits beyond age 25	50%	Fixed	Assumption

A number of one way sensitivity analyses were also undertaken to assess the impact of key individual uncertain parameters and assumptions upon the model results. One way sensitivity analysis provides an indication around which parameters have the largest impact upon the model results and which parameters do not affect the model results substantially. If a parameter is uncertain but has only a small impact upon the model results, then it would not be worth trying to improve the parameter estimate as it would not impact upon the cost-effectiveness estimates and hence the decision being made. However, if a parameter is uncertain and has a large impact upon the model results, then it may be worth undertaking further research to improve the parameter estimate so that the uncertainty in the model results might be reduced.

The following one way sensitivity analyses were undertaken within all models:

1) **The proportion of pregnancies ending in miscarriage is doubled**

   The rate of miscarriage is based upon the proportion of miscarriages which result in a hospital stay (6% for people aged <20 years; 8% for people aged ≥20 years); however not all miscarriages result in a hospital stay and hence this percentage may be underestimated.

2) **The proportion of medical abortions which are treated as elective inpatients is increased from 50% to 100%**

   It is unclear from current evidence how many of the medical abortions are elective patients and how many are treated within an outpatient appointment. This analysis tests what impact there would be upon the model results if 100% of medical abortions were treated as elective inpatient stays at the hospital.

3) **The annual difference in Income Support receipt of people who have a teenage pregnancy and people who have a pregnancy in their early twenties is decreased from 4% to 0%.**

   Current evidence around the difference in Income Support receipt between teenage mothers and older mothers is uncertain. An analysis assuming that there is no difference is therefore assessed within the model. This sensitivity analysis continues to assume that a percentage of young people will receive Income Support and hence a younger mother will require more Income Support in total as a result of requiring these Benefits for longer (even though the annual difference is assumed to be zero).

2.2 Individual Models

This Section describes each of the three variations upon the General Model for modelling the different interventions identified by the effectiveness review. Variations upon the General Model are required since the interventions are applied to three different populations. The scope of each model is outlined and a model overview is provided. Any additional assumptions or parameters required for each model are outlined.

2.2.1 Model 1: School-based interventions for nulliparous young people

2.2.1.1 Model scope

Population: Young people aged between 14 and 16 years who have not previously been a parent (but who may or may not have been pregnant without carrying to term) within secondary school.

Interventions:

- School-based dispensing of hormonal contraceptives to 14-16 year olds
- School-based dispensing of condoms to 14-16 year olds

Comparator: School nurse only

Outcomes:

- Cost per age 14 – 16 Pregnancy Averted
- Cost per Abortion Averted

Perspective: Public sector perspective

2.2.1.2 Model overview

The model follows a cohort of 100,000 14 year old males and/or females within the general population, some of whom are sexually active, over a lifetime. Over time, an increasing number of those entering the model will become sexually active and the intervention is provided to all of the sexually active members of the cohort from ages 14 – 16 years. For the male members of the cohort, the pregnancy outcomes of their partner are modelled. The model assumes, as in the general model, that 50% of the teenage pregnancies averted by the intervention would have been additional pregnancies. Of the remaining 50% which are assumed to be delayed as a result of the intervention, 50% are delayed until the person is 17 – 19 years old and 50% are delayed until the person is 20 – 24 years old. This is divided equally between each of the ages which these age groups. These probabilities are varied from 0% to 100% within the sensitivity analysis.

Only four studies were identified within the accompanying literature reviews which assess the effectiveness of direct provision of contraceptives dispensed on site from school based health centres. Two of these were rated as good quality ('+') papers; one of which reported upon the effectiveness of dispensing condoms within schools (Blake *et al.*, 2003), the other reported upon the effectiveness of dispensing hormonal contraceptives within schools to pupils who had accessed the family planning service (Zimmer-Gembeck *et al.*, 2001). The results of these studies were used to model the cost-effectiveness of school-based dispensing of condoms and school-based dispensing of hormonal contraceptives.

Both studies provide information around the proportion of the young people within the study population using different types of contraception. Blake *et al.* (2003) report the proportions of people using no contraceptive method, condoms and other. The model assumes that the 'other' category is the oral pill. Zimmer-Gembeck *et al.* (2001) report the proportion of people using each of no method, oral pill, hormone injection and hormone implants. The proportion of pregnancies that might have occurred is estimated based upon the difference in the usage of each contraceptive method and the failure rate of each of these methods, which is adjusted for user failure. Failure rates of each method of contraceptive are presented in Table 8 below. It should be noted that Zimmer-Gembeck *et al.* (2001) do not provide an estimate of the proportion of young people using condoms (of which there are likely to be some). The relative risk of pregnancy associated with each of the interventions is estimated by calculating the expected number of pregnancies within the intervention group and dividing this by the expected number of pregnancies within the comparator group. This is calculated to be 0.81 for the dispensing of condoms within schools and 0.77 for the dispensing of hormonal contraceptives within schools.

Due to the uncertainty around the failure rates of the contraceptive methods as a result of user failure, and due to the uncertainty associated with generalising estimates of effectiveness from specific subgroups of the US population to the UK population, these relative risks have been varied within the PSA. There was no reason to expect that the relative risk would be more likely to be greater or lower than those predicted from the US studies. However, it was not possible to know the range of possible values which the relative risks might take within the UK population; hence a wide ranging distribution was applied with a standard deviation of 5%, to allow the relative risk to vary substantially without it becoming greater than 1.

The additional benefit of a reduction in STI rates is modelled for the dispensing of condoms within schools, as described in Section 2.1.4. The study by Blake *et al.* (2003) suggests that of those who are sexually active, the proportion using condoms is 44% for the comparator group and 28% for the intervention group. These parameters are input into the equation described in Section 2.1.4 to estimate the percentage reduction in the STIs Chlamydia, gonorrhoea, genital warts and HIV as a result of the use of condoms. Using this equation, the reduction of each of these STIs as a result of dispensing condoms within schools is 0.92, 0.44, 0.66 and 0.0001 percentage points respectively.

The costs of the additional contraceptives required are calculated based upon the difference in the usage of each contraceptive method and the cost of each method of contraception (shown in Table 7). This calculation assumes that all school pupils who are sexually active receive all required contraception from the intervention. The proportion of school pupils that are sexually active, dependent upon age, is based upon a National Survey of Sexual Attitudes and Lifestyles (NATSAL, 1990-91). Estimates of sexual activity were unavailable for those people aged 20 – 24 years; however since 84% are sexually active by age 19 years, and since it is unlikely that 100% of people will be sexually active by age 24 years, appropriate estimates can be assumed for this age group.

It is unclear whether additional staff time would be required to dispense the contraceptive services or whether there would already be staff in place that could dispense the contraceptives. Moreover, this is likely to vary across the country and from pupil to pupil according to the amount of information and advice required alongside the provision of the contraceptives. The model assumes that for 50% of individuals, only the contraceptives would be required and that the remaining 50% of individuals would each require an hour of staff time per year at a cost of £12 per hour. The same amount of staff time is assumed to be required for both interventions.

Additional model parameters used within Model 1 are shown in Table 8 below. All other model parameters are shown in Table 7 in Section 2.2.9.

Table 8: Additional model parameters for Model 1

Parameter	Value	Distribution (95% confidence intervals)	Source
Of the 50% of births which are delayed, the proportion delayed from age 14-16 to age 17-19 as against to age 20-24 years	50%	Uniform (2.5%, 97.5%)	Assumption
Cost of additional staff time for dispensing contraceptives & providing advice	£12	Normal (£10, £14)	NHS Salaries online (2009)
Probability of young person in the general population becoming pregnant			
Age 14 years	0.19%	Fixed, but dependent on probability of miscarriage/ ectopic pregnancy/ stillbirth	ONS, 2009
Age 15 years	0.63%		
Age 16 years	1.48%		
Age 17 years	2.63%		
Age 18 years	3.65%		
Age 19 years	4.53%		
Age 20 years	5.15%		
Age 21 years	5.37%		
Age 22 years	5.50%		
Age 23 years	5.68%		
Age 24 years	6.02%		
Probability of being sexually active			
Age 14 years	8%	Fixed	NATSAL (1990-91)
Age 15 years	19%		
Age 16 years	42%		
Age 17 years	62%		
Age 18 years	76%		
Age 19 years	84%		
Age 20 years	90%	Fixed	Assumption
Age 21 years	92%		
Age 22 years	93%		
Age 23 years	94%		
Age 24 years	95%		
Annual pregnancy failure rate			
Condoms	16%	Beta (9%,25%)	Ranjit *et al.*, 2001
Oral contraceptive pills	8%	Beta (5%,12%)	
Hormone injection	0.2%	Fixed	Nherera *et al.*, 2009
Hormone implants	0.005%	Fixed	
No contraceptives (ages 14-24 years)	90%	Beta (75%,98%)	Department for Children, Schools & Families, 1999
Relative risk of pregnancy as a result of intervention			
Dispensing of hormonal contraceptives at school to 14 – 16 year olds	0.77	Normal (0.67,0.87)	Derived from Blake *et al.* (2003)
Dispensing of condoms at school to 14 – 16 year olds	0.81	Normal (0.71,0.91)	Zimmer-Gembeck *et al.* (2001)
Of those who are sexually active, the proportion not using condoms			
Comparator	44%	Beta (34%,54%)	Blake *et al.* (2003)
Relative risk for dispensing of condoms within schools	28/44 = 63.6%	Dependent upon above	

The following additional one way sensitivity analyses were undertaken within Model 1 only:

1) **All births averted at ages 14 – 16 years are delayed only until ages 17 – 19 years**

   There is no evidence to suggest what proportion of births which are prevented at ages 14 – 16 years would have been additional births and what proportion are delayed until the person is older. If the baby is delayed, it is not possible to know by how many years. Therefore, a one way sensitivity analysis has been undertaken to test the impact upon the model results if all births that are averted at ages 14 – 16 years are delayed until ages 17 – 19 years (i.e. the interventions will have minimum benefit).

2) **Pregnancies averted at ages 14 – 16 years are additional pregnancies**

   As a converse to the above, this sensitivity analysis tests the impact of the interventions having maximum benefit, by assuming that the pregnancies averted at ages 14 – 16 do not occur in the future.

3) **The probability of condom failure is doubled**

   Whilst the probability of condom failure with perfect use is reasonably certain, the probability of condom failure as a result of user failure for this population is highly uncertain. The probability of condom failure in terms of both prevention of pregnancies and STIs was therefore doubled to test the impact of much greater user failure upon the model results.

4) **The relative risk of both interventions for preventing pregnancy is increased by 10 percentage points**

   The effectiveness of the interventions for preventing pregnancy is uncertain due to the US population within the study. Therefore, this sensitivity analysis considers the impact of a decreased effectiveness for both interventions.

2.2.2 Model 2: School-based interventions to prevent repeat pregnancy

2.2.2.1 Model scope

Population: Young mothers within a secondary school
Intervention: Intensive case management to prevent repeat pregnancy (this involves a culturally matched school-based social worker [including home visits], weekly school-based peer education support and comprehensive medical care including contraception).
Comparator: No follow up following first pregnancy
Outcome: Cost per age under 19 Repeat Pregnancy Averted
Perspective: Public sector perspective

2.2.2.2 Model overview

The model follows a cohort of 100,000 16 year old female mothers who remain at school, over a lifetime. The model assumes that if a repeat pregnancy occurs, those that have already had one birth will choose to have another birth rather than an abortion. For this reason, the cost per abortion is not calculated for this model.

Four studies were identified within the accompanying literature review which assessed the effectiveness of intensive case management to prevent repeat pregnancy. Three of these studies were reported by the same author (Key *et al.*, 2001; Key *et al.*, 2005; Key *et al.*, 2008) and based upon the same intervention, with slightly different populations in each due to ongoing enrolment. The fourth study by Ziegler *et al.* (2004) was of poor quality. Therefore, the latest paper reporting the study by Key *et al.* was used within the modelling analysis.

The probability of repeat teenage birth for years 2 and 3 following the first teenage birth is based upon Key *et al.* (2008). The model assumes that after the third year following the first birth, the probability of pregnancy will return to that of the general population, but that there will remain a higher probability of birth due to the assumption that those that have already had one birth will have a second birth if they become pregnant rather than an abortion. A relative risk of repeat pregnancy due to the intensive case management of 0.55 is applied for years 2 and 3 following the first birth based upon Key *et al.* (2008). This relative risk is varied within the PSA since the effectiveness of the intervention is uncertain within the UK population compared with that of the US population within the study. As for the general model, this model assumes that 50% of all repeat pregnancies prevented between ages 17 – 19 years are delayed until the person is 20 – 24 years old and 50% would have been additional births. These proportions are varied within the sensitivity analysis.

Model 2 assumes that the repeat pregnancy does not cause additional people to claim Income Support (and hence Housing Benefit, Council Tax costs and NHS dental and prescription costs) compared with those already claiming following their first birth. The model does however, assume that the same proportion of mothers who were claiming Child Tax Credits for their first child (90% for teenage mothers, 87% for mothers aged 20 – 24 years), will do so for their second child in addition, and that the remaining proportion (10% for teenage mothers, 13% for mothers aged 20 – 24 years) will claim Child Benefit for their second child in addition to their first child.

The cost of the intervention is estimated to be £764 per year over the first three years following the first birth, based upon Key *et al.* (2008). Unfortunately, the cost is not presented separately for each year and hence it is assumed that this cost is divided equally by 3 years. Discounting may therefore lead to a slight overestimate of this cost as the cost of the intervention may depreciate over the three year period. Within the paper, the number of participants included within the cost calculations is greater than the number included within the effectiveness estimates. This has been corrected so that the cost per person corresponds with the effectiveness evidence. This cost is highly uncertain since it is based upon the provision of intensive case management in the US and converted into UK currency, and hence this is varied within the PSA. Insufficient evidence is provided around the use of specific contraceptive methods; hence any cost differences or STI impacts associated with alternative contraceptive methods are excluded from the model.

Additional model parameters used within Model 2 are shown in Table 9 below. All other model parameters are shown in Table 7 in Section 2.2.9.

Table 9: Additional model parameters for Model 2

Parameter	Value	Distribution (95% confidence intervals)	Source
Probability of repeat pregnancy given teen birth			Key *et al.*, 2008
Year 2	20%	Beta (8%,35%)	
Year 3	9%	Beta (5%,14%)	
Relative risk of pregnancy as a result of intervention			
Intensive case management for repeat pregnancy	0.55	Normal (0.45,0.65)	
Cost of intervention			
Cost of intensive case management per year	£764	Normal (£611, £917)	

The following additional one way sensitivity analyses were undertaken within Model 2 only:

1) **The cost of the intervention is halved from £764 to £382 per person per year over the first 3 years**
   The cost of the intervention is based upon a US study, and hence may be very different within the UK.

2) **The relative risk for intensive case management of preventing pregnancy is increased from 0.55 to 0.65**
   The evidence around the effectiveness of intensive case management is based upon a subgroup of the US population which may be very different to those within the UK. This sensitivity analysis tests the impact of reducing the effectiveness of the intervention.

2.2.3 Model 3: Interventions to encourage the use of emergency hormonal contraception following unprotected sex

2.2.3.1 Model scope

Population: Young people aged between 15 – 19 years who are sexually active

Intervention: Advance provision of Emergency Hormonal Contraception (EHC)

Comparator: No advance provision of EHC (a proportion will obtain EHC from clinic/ pharmacist)

Outcomes:

- Cost per age 15 – 19 Pregnancy Averted
- Cost per Abortion Averted

Perspective: Public sector perspective

2.2.3.2 Model overview

The model follows a cohort of 100,000 15 year old females over a lifetime since 15 is the age at which Advanced Provision of EHC begins in all of the effectiveness studies. The proportion having unprotected sex at each age is estimated based upon the probability of being sexually active at each age and the probability of using emergency contraception within current practice. The model assumes that the emergency contraceptive pill is provided rather than the emergency IUD since it is the pill which is used most frequently. The model incorporates the failure rate of the emergency contraceptive pill, based upon the average length of time elapsed from sexual intercourse to taking the pill. The model assumes that all births prevented at age 15 – 19 years are delayed until the person is 20 – 24 years old.

Four studies around the advanced provision of EHC were identified by the literature review (Ekstrand *et al.*, 2008; Harper *et al.*, 2005; Belzer *et al.*, 2005; Gold *et al.*, 2004). Three of these studies provided very similar estimates of effectiveness. Within the model, the estimates of effectiveness are based upon Harper *et al.* since this paper reported the most information, both about the study methodology and the results. The study suggests that advanced provision of EHC will increase the use of EHC following unprotected sex from 29% to 44%, without altering contraceptive use substantially. The study also suggests that there is a greater probability of taking EHC sooner after unprotected sex if it is provided in advance. Evidence suggests that EHC is more effective the sooner it is taken after unprotected sex. The model therefore assumes that the failure rate of advanced provision of EHC is 5%, whilst the failure of non-advanced provision of EHC is 9%. This parameter is varied within the sensitivity analysis over a wide range of values. The probability of pregnancy given that a young person has had unprotected sex, with and without the advanced provision of EHC, is calculated based upon the following formula, where Pr = probability:

Pr of pregnancy =
(Pr of not taking EHC if have unprotected sex * Pr of pregnancy if have unprotected sex once)
+ (Pr of taking EHC if have unprotected sex * Failure rate of EHC * Pr of pregnancy if have unprotected sex once)

The probability of pregnancy if a young person has unprotected sex once is variable throughout the monthly cycle. However, a study by Wilson *et al.* (2001) undertaken with a large sample size predicts that the average probability of pregnancy from one act of unprotected sex is 3.1%. The relative risk of becoming pregnant given advanced provision of EHC can therefore be calculated by dividing the probability of pregnancy given advanced provision of EHC by the probability of pregnancy without advanced provision of EC. This results in a relative risk of pregnancy of 0.79.

The cost of the interventions are assumed to consist only of the EHC (see Table 7) and do not include any additional resources such as staff time, since it is assumed that there are already staff in place who would provide the Advanced Provision of EHC alongside other services. The model assumes that all sexually active young people within the intervention group will receive one dose of advanced provision of EHC per year from age 15 to age 19.

Within the comparator group, the cost of EHC is calculated based upon the number of young people having unprotected sex multiplied by the proportion of those people who go and obtain EHC given that they have had unprotected sex. The proportion of people having unprotected sex, dependent upon age, is based upon the study by Harper *et al.* (2005) since Ekstrand *et al.* (2005) did not provide sufficient information around these parameters.

Additional model parameters used within Model 3 are shown in Table 10 below. All other model parameters are shown in Table 7 in Section 2.2.9.

Table 10: Additional model parameters for Model 3

Parameter	Value	Distribution (95% confidence intervals)	Source
Relative risk of pregnancy given advanced provision of EHC	0.79	Normal (0.69,0.89)	Calculated based upon parameters below
Probability of pregnancy if have unprotected sex once & do not use EHC	3.1%	Fixed	Wilson *et al.* (2001)
Probability of taking EHC if have unprotected sex			
Without advance provision	29%	Beta (15%,45%)	Harper *et al.* (2005)
With advanced provision	44%	Fixed, but based on relative risk of 44/29	
Failure rate of EHC for preventing pregnancy[§]			
Without advance provision	9%	Beta (5%,13%)	Ekstrand *et al.* (2005) & Von Hertzen *et al.* (1998)
With advanced provision	5%	Beta (4%,7%)	
Probability of unprotected sex given that the person is sexually active			
Age <16 years	38.6%	Fixed	Harper *et al.* (2005)
Age 16 – 17 years	37.6%		
Age 18 – 19 years	39.4%		
Age 20 – 24 years	30.7%		

[§] Based upon the average length of time elapsed from sexual intercourse to taking the pill

The following additional one way sensitivity analyses were undertaken within Model 3 only:

1) **The probability of using EHC given no advanced provision is increased from 29% to 50%**

   The probability of using EHC without advanced provision is based upon a study undertaken within the US. The proportion of young people using EHC may therefore be different within the UK.

2) **The failure rate of advanced provision of EHC is assumed to be the same as using EHC without advanced provision**

   The time period for using EHC is shown by the US studies to be shorter for those young people with advanced provision of EHC than for those without advanced provision, and EHC is assumed to be more effective if taken earlier. This sensitivity analysis tests the effect upon the model results if advanced provision of EHC only increased usage and did not reduce the amount of time taken to use EHC.

2.3 Comparison of the cost-effectiveness of all interventions assessed within the models

The interventions considered within each of the three models may, if implemented, alter the expected effectiveness, and hence cost-effectiveness, of the other interventions assessed within the models. It is therefore useful to compare the interventions across each of the three models.

If both dispensing of contraceptives (hormonal contraceptives or condoms) within schools and intensive case management for repeat pregnancy were considered to be economically attractive, then it would be beneficial to adopt both. By dispensing contraceptives within schools, the rate of teenage pregnancies is expected to decrease, and hence intensive case management would need to be provided to fewer young people to prevent repeat teenage pregnancies. However, the cost-effectiveness ratio of both interventions would remain unchanged if both were adopted. This would also be the case if both the advanced provision of EHC and intensive case management to prevent repeat pregnancies were adopted.

If the dispensing of contraceptives was adopted within schools, and the advanced provision of EHC was also provided, then fewer people would use the advanced provision of EHC since it is expected that less people would have unprotected sex due to the dispensing of contraceptives within schools. This means that the advanced provision of emergency hormonal contraception would be less cost-effective in combination with the dispensing of contraceptives within schools than alone. Hence an additional analysis has been undertaken to assess the cost-effectiveness of combining the dispensing of contraceptives within schools and the advanced provision of EHC compared with dispensing of contraceptives within schools only. This analysis calculates a new relative risk of pregnancy as a result of the advanced provision of EHC, based upon the probability of having unprotected sex and the probability of using EHC given advanced provision and non-advanced provision. The studies by Blake et al. (2003) and Zimmer-Gembeck et al. (2001) have been used to estimate the effectiveness of the dispensing of condoms within schools and the dispensing of hormonal contraceptives within schools respectively. These studies report the proportion of young people using no method of contraception (15% and 24% respectively). This analysis assumes that the proportion of having unprotected sex on one occasion is equivalent to the proportion of people using no method within these studies. This is a poor indicator of the proportion of people who will have unprotected sex once and hence the results of this analysis should be treated as indicative only.

3 RESULTS

The base case results and the results of the sensitivity analyses for Model 1, 2 and 3 are presented within Sections 3.1, 3.2 and 3.3 respectively. For each model the results are presented using mean values of each parameter, termed as ‘deterministic’ results. They are also presented in terms of expected values from the PSA, which are the average of 10,000 iterations of the model. The discussion of the model results will focus upon the expected values, unless the deterministic results differ substantially from the expected values. Within the NICE reference case, both costs and benefits should be discounted by 3.5% to adjust for the fact that people place more weight on what happens now than what happens in the future (NICE public health methods guide, 2009). All model results are presented as discounted results, and the expected values are also presented as undiscounted results.

The tables below which contain the model results can be explained as follows:
Column 1 provides the abbreviated names of the intervention;
Column 2 provides the estimated number of abortions of the cohort of 100,000 young people from the age at which the intervention is provided to age 24 years;
Column 3 provides the estimated number of pregnancies of the cohort during the time the intervention is provided for;
Column 4 provides the costs of abortions, the intervention and the cost of treatment of STIs associated with the cohort;
Column 5 provides the costs of abortion, pregnancy (i.e. cost of maternity care, miscarriage, ectopic pregnancy, still birth and treatment of extremely low birth weight babies), the cost of the intervention and the cost of treatment of STIs associated with the cohort;
Column 6 provides the costs of Benefit payments associated with the cohort in addition to the costs within Column 5. The cost of Benefit payments includes Income Support and associated payments to 90% of teenagers who become pregnant as teenagers and similarly to 86% of people aged 20 – 24 years who become pregnant. It is assumed that this difference will be maintained at a constant level from age 20 – 24 (whenever the baby is born

during these years) through to the mother reaching age 35 years. In order to calculate this, a baseline cost of Benefit payments has been incorporated into the model up to age 35. These costs are provided solely to provide a calculation of the difference in Benefit payments; they do not provide absolute estimates of lifetime Benefit payments due to the large numbers which would be required;

Columns 7, 8 and 9 provide the key outputs from the model; the incremental cost per abortion averted, the incremental cost per age specific pregnancy averted (excluding Benefit payments) and the incremental cost per age specific pregnancy averted (including Benefit payments) respectively. These are calculated by estimating the differences in the relevant costs divided by the differences in the relevant effectiveness measure for the most effective intervention compared with the next most effective intervention, which is compared with the next most effective intervention, and so on.

For all models, PSA scatter plots are also presented, which show the range of uncertainty around the model results. The PSA scatter plots and the results of the one way sensitivity analysis are presented in terms of discounted results only. Please note that the scale of the axes of these scatter plots varies and hence some incremental costs are presented on a scale of thousands or millions. Results of the one way sensitivity analyses which do not vary substantially from the base case results will be described within this Section but the accompanying tables are presented within Appendix 2 rather than within the main report. Within these results, an intervention which is more effective and less costly than current standard practice is said to ‘dominate’ current standard practice.

3.1 Results of Model 1

3.1.1 Base case results

Base case results for Model 1 are presented in Tables 10, 11 and 12 below. The deterministic results (using mean parameter values only) shown in Table 10 are similar to the expected values from the PSA (where each parameter is varied within a plausible range) shown in Table 11. Table 11 suggests that for the cost per abortion averted (which does not include costs and effects associated with other pregnancy outcomes including miscarriages, ectopic pregnancies, stillbirths and births), the total cost associated with the dispensing of condoms within schools is greater than not dispensing contraceptives within schools, resulting in an estimated cost per abortion averted of £822 for the dispensing of condoms within schools compared with no dispensing of contraceptives within schools. This table also shows that the total cost associated with the dispensing of hormonal contraceptives within schools is greater than the dispensing of condoms within schools, with an estimated cost per abortion averted of £1,495 for the dispensing of hormonal contraception compared with the dispensing of condoms within schools.

The cost per pregnancy averted outcome, excluding government-funded Benefits, is £38 for the dispensing of condoms within schools compared with no dispensing of contraceptives within schools, and £443 for the dispensing of hormonal contraceptives compared with the dispensing of condoms within schools. Including all costs and effects within the analysis, the dispensing of condoms within schools (DC) is more effective and less costly than not dispensing contraceptives within schools (ND); however dispensing hormonal contraceptives within schools (DH) is more effective and less costly than dispensing condoms within schools. The undiscounted model results are similar to the discounted model results for all outcome measures.

Table 10: Deterministic results for Model 1 (discounted)

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,186	£7,047,616	£58,881,479	£1,527,318,794	-		Dominated by DC
DC	11,152	1,777	£7,242,615	£58,894,604	£1,519,502,350	£815	£32	Dominated by DH
DH	11,103	1,693	£7,317,040	£58,931,647	£1,517,930,119	£1,514 (compared with DC)	£441 (compared with DC)	Dominates DC & ND

Table 11: Expected results for Model 1 (discounted)

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,186	£7,058,144	£58,906,979	£1,524,992,647	-		Dominated by DC
DC	11,153	1,778	£7,254,066	£58,922,325	£1,517,222,105	£822	£38	Dominated by DH
DH	11,103	1,693	£7,328,359	£58,959,237	£1,515,641,998	£1,495 (compared with DC)	£433 (compared with DC)	Dominates DC & ND

Table 12: Expected results for Model 1 (undiscounted)

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	13,914	2,307	£8,592,568	£74,516,485	£2,307,407,787	-		Dominated by DC
DC	13,668	1,876	£8,801,586	£74,556,132	£2,297,207,297	£848	£92	Dominated by DH
DH	13,616	1,788	£8,880,384	£74,599,972	£2,295,126,146	£1,535 (compared with DC)	£488 (compared with DC)	Dominates DC & ND

Figures 9, 10 and 11 below show the results of the PSA in the form of scatter plots. The origin of each of these scatter plots denotes the costs and effects associated with current standard practice. The data points show the difference in costs and effects between the interventions and current standard practice. Each of the data points are potential estimates of the cost-effectiveness of the intervention generated from iterations of the model. All three figures show very little difference in both costs and effectiveness between dispensing condoms within schools and dispensing hormonal contraceptives within schools. There is the possibility that either one could be more effective and/or more costly than the other. Figure 9 suggests that dispensing contraceptives within schools is unlikely to result in net cost savings when considering only the costs and effects associated with abortion. Figure 10 suggests that when considering all costs and effects, excluding government-funded Benefits, there is around a 50% probability that the dispensing of contraceptives within schools will result in net cost savings. Figure 11 suggests that incorporating the impact of the interventions upon government-funded Benefits into the total costs is very likely to lead to net cost savings for both interventions assessed within the model. Note the change in scale on the cost axis from thousands in Figures 9 and 10 to millions in Figure 11.

Figure 9: Cost per abortion averted for dispensing contraceptives within schools

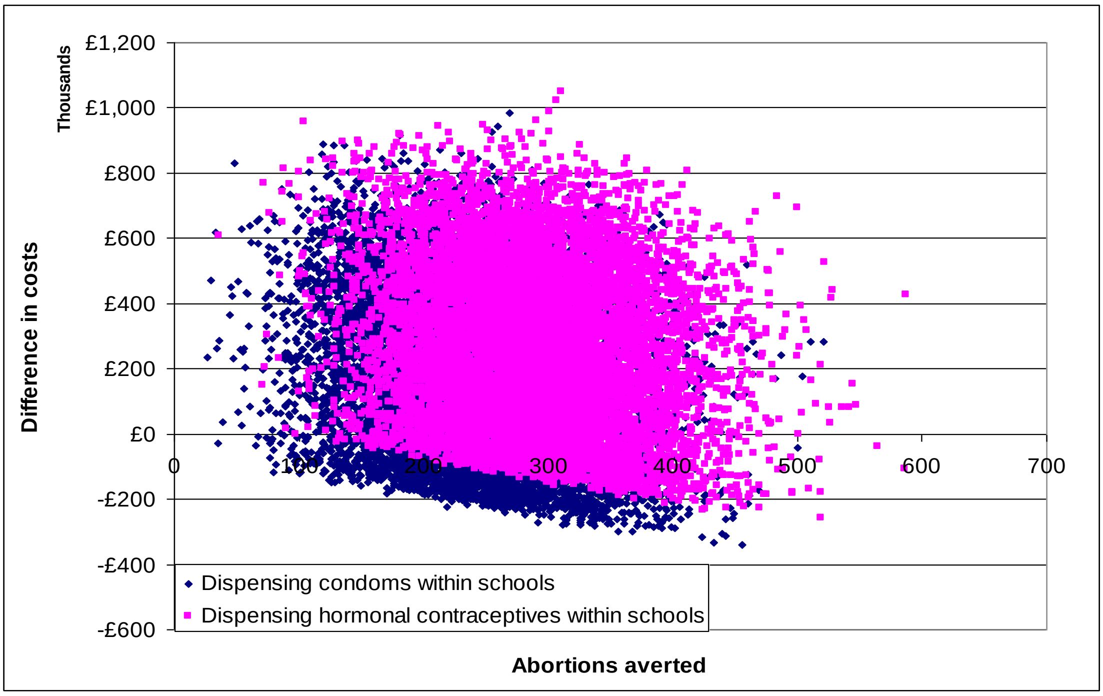


Figure 10: Cost per age 14 – 16 pregnancy averted (excluding Benefit payments) for dispensing contraceptives within schools

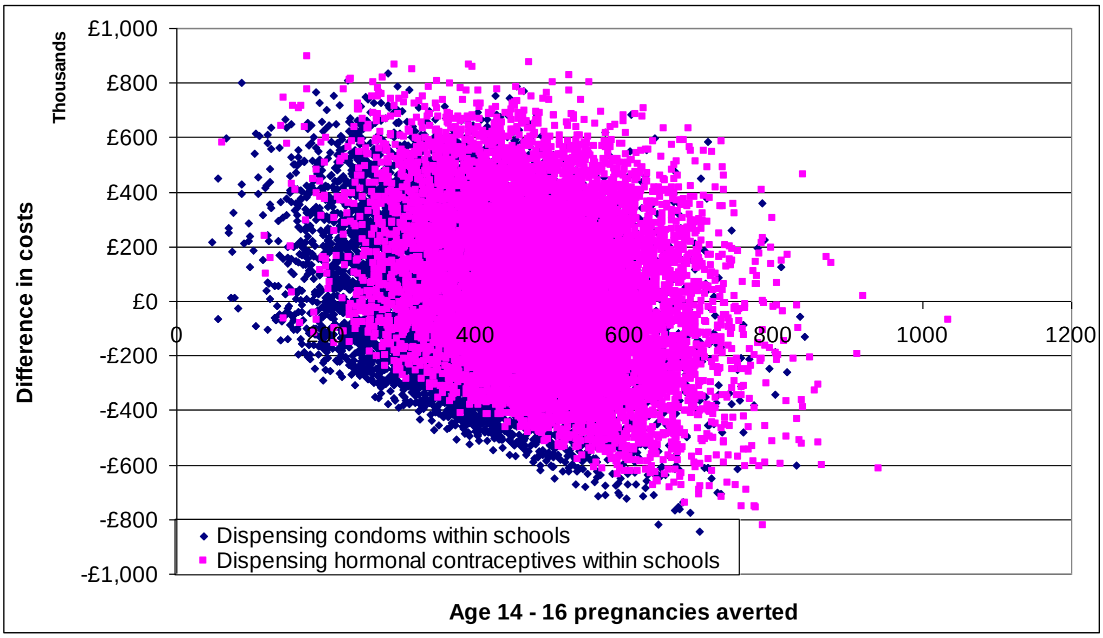
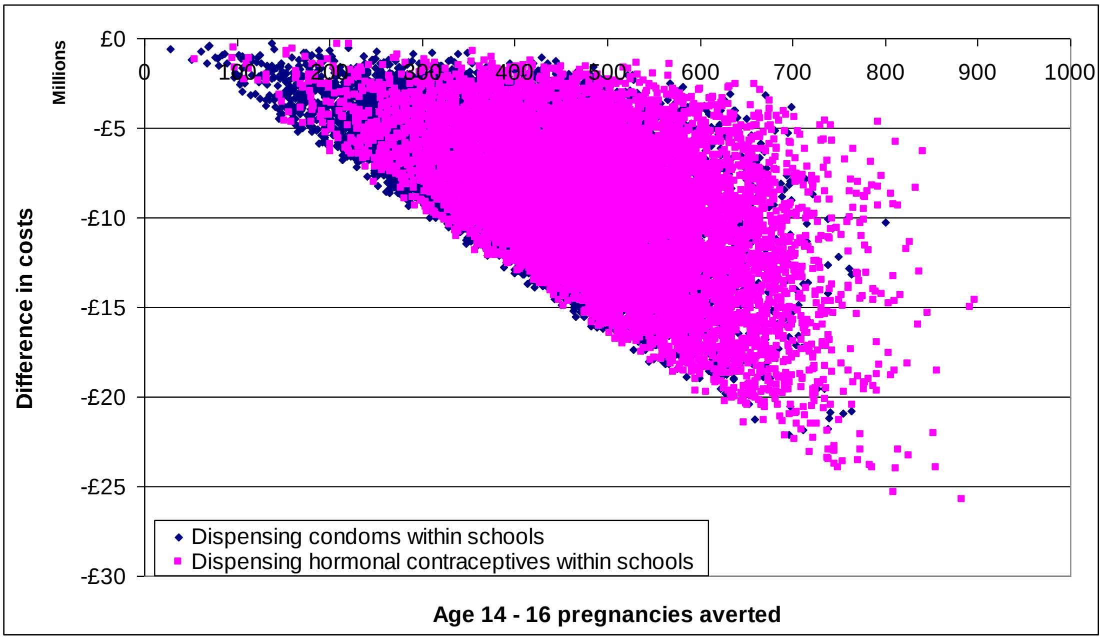


Figure 11: Cost per age 14 – 16 pregnancy averted (including Benefits payments) for dispensing contraceptives within schools



3.1.2 Results of the one way sensitivity analysis

Table 12 shows the results of a sensitivity analysis around the length of delay resulting from averting a birth between ages 14 – 16 years. Fewer benefits of the interventions are gained from the shorter delay and hence the cost-effectiveness ratios increase for the cost per abortion averted and the cost per age 14 – 16 pregnancy averted, excluding government-funded Benefits. However, the model predicts that the dispensing of condoms within schools would remain cost saving compared with no dispensing of contraceptives within schools for the cost per age 14 – 16 pregnancy averted including government-funded Benefits. Similarly, the model predicts that the dispensing of hormonal contraceptives within schools would remain cost saving compared with the dispensing of condoms within schools for this outcome.

If all teenage births which are averted as a result of the interventions would have resulted in an additional birth in the absence of the intervention, the cost-effectiveness ratio for the cost per abortion averted decreases as shown in Table 13. The costs associated with the dispensing of condoms within schools, excluding Benefits, become lower than those associated with no intervention; hence the dispensing of condoms within schools dominates no intervention under this assumption. The model predicts that the cost per age 14 – 16 pregnancy averted excluding Benefits associated with the dispensing of hormonal contraceptives within schools compared with the dispensing of condoms within schools would be reduced to £65. Including government-funded Benefits within the analysis results in greater cost savings than predicted within the base case analysis.

Table 14 shows the impact of doubling the condom failure rate associated with pregnancy and STIs to allow for greater user error upon the model results. Since the benefits associated with condom use are reduced, the dispensing of condoms within schools results in greater net costs than the dispensing of hormonal contraceptives within schools, including or excluding government-funded Benefits.

Table 12: All births averted at ages 14 – 16 years are delayed only until ages 17 – 19 years

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,186	£7,047,616	£58,881,479	£1,527,318,794	-		Dominated by DC
DC	11,211	1,777	£7,281,313	£59,084,036	£1,525,821,393	£1,297	£495	Dominated by DH
DH	11,174	1,693	£7,363,691	£59,160,014	£1,525,547,965	£2,224 (compared with DC)	£904 (compared with DC)	Dominates DC & ND

Table 13: Pregnancies averted at ages 14 – 16 years would have been additional

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,186	£7,047,616	£58,881,479	£1,527,318,794	-	Dominated by DC	Dominated by DC
DC	11,119	1,777	£7,221,719	£58,741,055	£1,515,198,994	£639	-	Dominated by DH
DH	11,063	1,693	£7,291,848	£58,746,537	£1,512,742,260	£1,253 (compared with DC)	£65 (compared with DC)	Dominates DC & ND

Table 14: The probability of condom failure is doubled

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,186	£7,047,616	£58,881,479	£1,527,318,794	-		Dominated by DC
DC	11,285	2,005	£7,352,939	£59,082,268	£1,524,048,469	Dominated by DH	Dominated by DH	Dominated by DH
DH	11,103	1,693	£7,317,040	£58,931,647	£1,517,930,119	£934 (compared with ND)	£102 (compared with ND)	Dominates DC & ND

Table 15 suggests that if the proportion of pregnancies resulting in miscarriage, ectopic pregnancies or stillbirths is doubled from the base case estimates of 6% (<20 years) and 8% (≥20 years), then the dispensing of condoms within schools is estimated to result in net cost savings compared with not dispensing contraceptives within schools, both including and excluding government-funded Benefits. The estimated cost per age 14 – 16 pregnancy averted excluding Benefits for the dispensing of hormonal contraceptives within schools compared with the dispensing of condoms within schools is £378. When government-funded Benefits are included within the analysis, the dispensing of hormonal contraceptives continues to dominate the dispensing of condoms within schools.

Table 16 suggests that increasing the proportion of medical abortions which are treated as elective inpatient cases from 50% to 100% also leads to predicted net cost savings of the dispensing of condoms within schools compared with not dispensing contraceptives within schools. The estimated cost per age 14 – 16 pregnancy averted excluding Benefits for the dispensing of hormonal contraceptives within schools compared with the dispensing of condoms within schools is £396. As for the previous analysis, when government-funded Benefits are included within the analysis, the dispensing of hormonal contraceptives continues to dominate the dispensing of condoms within schools.

Table 17 suggests that increasing the relative risk of both interventions for preventing pregnancies by 10 percentage points results in higher cost-effectiveness ratios than predicted within the base case analysis.

Finally, the model results were not substantially affected by the sensitivity analysis assuming no difference in annual Income Support receipt (instead of a 4% difference) between teenage mothers and older mothers (see Appendix 2).

Table 15: The proportion of pregnancies ending in miscarriage is doubled

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,346	£7,047,616	£60,753,034	£1,529,190,348	-	Dominated by DC	Dominated by DC
DC	11,152	1,907	£7,242,615	£60,752,033	£1,521,359,778	£815	-	Dominated by DH
DH	11,103	1,817	£7,317,040	£60,786,172	£1,519,784,644	£1,514 (compared with DC)	£378 (compared with DC)	Dominates DC & ND

Table 16: The proportion of medical abortions which are treated as elective inpatient is increased from 50% to 100%

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,186	£7,886,070	£59,719,933	£1,528,157,248	-	Dominated by DC	Dominated by DC
DC	11,152	1,777	£8,062,600	£59,714,589	£1,520,322,334	£738	-	Dominated by DH
DH	11,103	1,693	£8,133,228	£59,747,835	£1,518,746,307	£1,437 (compared with DC)	£396 (compared with DC)	Dominates DC & ND

Table 17: The relative risk of both interventions increases by 10 percentage points

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,186	£7,047,616	£58,881,479	£1,527,318,794	-		Dominated by DC
DC	11,276	1,989	£7,323,182	£59,069,556	£1,523,740,526	£2,395	£956	Dominated by DH
DH	11,225	1,902	£7,396,324	£59,103,814	£1,522,100,854	£1,430 (compared with DC)	£392 (compared with DC)	Dominates DC & ND

3.2 Results of Model 2

3.2.1 Base case results

The base case results for model 2 are shown in Tables 18, 19 and 20 below. These tables show that intensive case management for preventing repeat pregnancies (ICM) is predicted to result in a cost per repeat teenage pregnancy averted of around £15,000 excluding Benefits and £4,000 including Benefits. This is due to the high costs of the intervention per person and the smaller benefits associated with preventing a second birth.

Table 18: Deterministic results for Model 2 (discounted)

	Repeat teenage pregnancies	Costs (excluding Benefits)	Total costs	Cost per repeat teenage pregnancy averted (excluding Benefits)	Cost per repeat teenage pregnancy averted (including Benefits)
No follow up	31,464	£133,548,263	£655,572,463		
ICM	19,022	£322,108,597	£705,730,087	£15,155	£4,031

Table 19: Expected results for Model 2 (discounted)

	Repeat teenage pregnancies	Costs (excluding Benefits)	Total costs	Cost per repeat teenage pregnancy averted (excluding Benefits)	Cost per repeat teenage pregnancy averted (including Benefits)
No follow up	31,419	£133,432,383	£654,756,538		
ICM	18,980	£322,205,231	£705,164,857	£15,175	£4,052

Table 20: Expected results for Model 2 (undiscounted)

	Repeat teenage pregnancies	Costs (excluding Benefits)	Total costs	Cost per repeat teenage pregnancy averted (excluding Benefits)	Cost per repeat teenage pregnancy averted (including Benefits)
No follow up	35,461	£160,651,036	£825,978,232		
ICM	21,523	£372,323,094	£866,883,550	£15,186	£2,935

Figures 12 and 13 below show the results of the PSA in the form of scatter plots. Figure 12 suggests that intensive case management for preventing repeat teenage pregnancy is unlikely to result in net cost savings when excluding Benefit payments. The model predicts that there is around a 20% probability that intensive case management for preventing repeat teenage pregnancy will result in net cost savings when including government-funded Benefits compared with no follow up after first teenage pregnancy, as shown in Figure 13. Please note that the scale on the cost axis is in millions.

Figure 12: Cost per repeat teenage pregnancy averted (excluding Benefit payments) for intensive case management

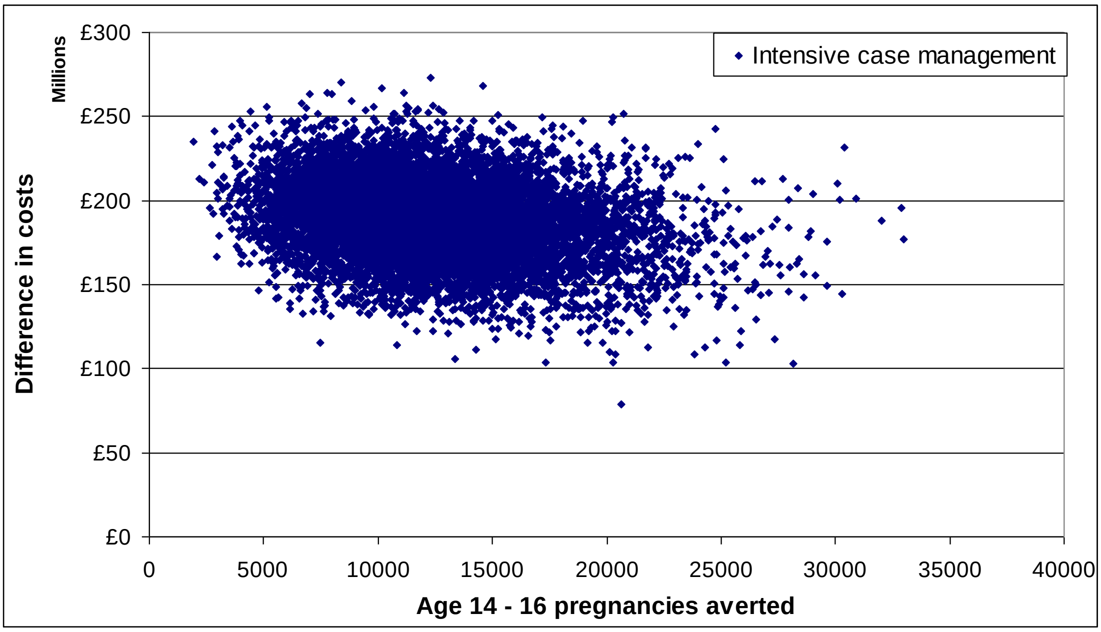
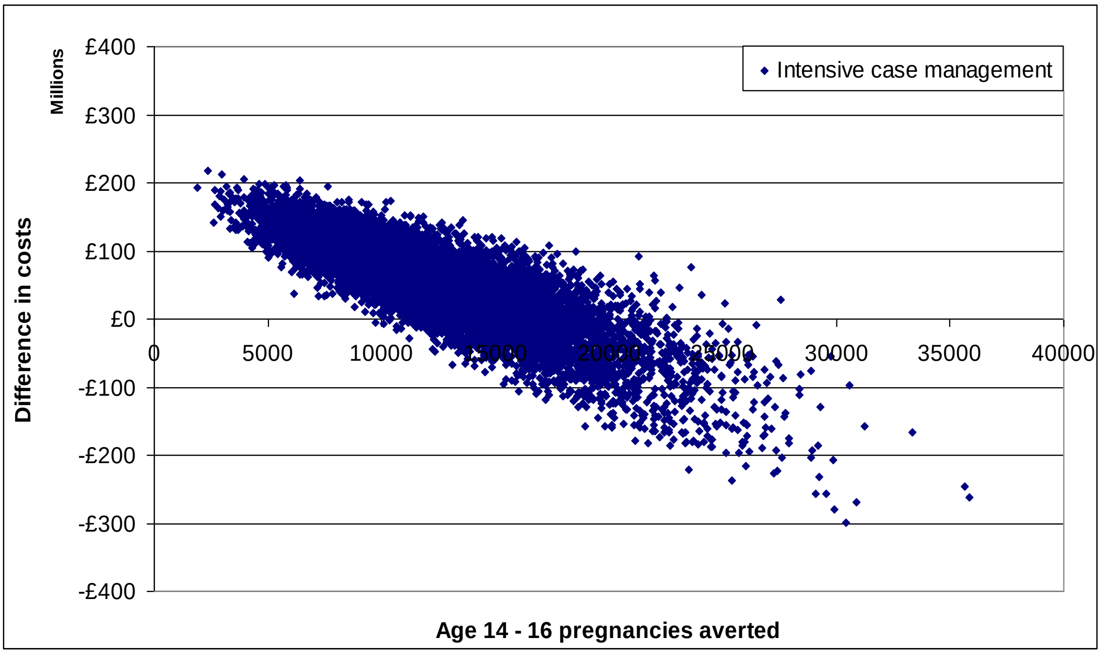


Figure 13: Cost per repeat teenage pregnancy averted for intensive case management (including Benefit payments)



3.2.2 Results of the one way sensitivity analysis

Reducing the cost of the intervention from £764 to £382 per person per year results in a cost per repeat teenage pregnancy averted excluding Benefits of £6,844. However, if Benefits are included within the analysis, the model predicts that intensive case management will dominate no follow up after a teenage birth, as shown in Table 21 below.

Table 21: Cost of intervention is halved

	Repeat teenage pregnancies	Costs (excluding Benefits)	Total costs	Cost per repeat teenage pregnancy averted (excluding Benefits)	Cost per repeat teenage pregnancy averted (including Benefits)
No follow up	31,464	£133,548,263	£655,572,463		Dominated by ICM
ICM	19,022	£218,705,183	£602,326,674	£6,844	Dominates

Varying the proportion of pregnancies ending in miscarriage, the proportion of medical abortions which are treated as elective, decreasing the difference in annual Income Support between teenage mothers and older mothers, and increasing the relative risk of repeat teenage pregnancy to 0.65 from 0.55 does not have a substantial impact upon the model results (see Appendix 2).

3.3 Results of Model 3

3.3.1 Base case results

The base case results for model 3 are shown in Tables 22, 23 and 24 below. These tables show that the model predicts that advanced provision of emergency hormonal contraceptive (AP) is less costly and more effective than no advanced provision in terms of the cost per age 15 – 19 pregnancy averted (including Benefit payments). Considering only abortion outcomes, however, leads to less favourable results for the intervention. The cost per abortion averted is estimated to be around £3,000. This is mainly due to the high cost of the intervention since it is assumed to be given to all young people that are sexually active and only around 30 – 40% of these will have unprotected sex.

Table 22: Deterministic results for Model 3 (discounted)

Intervention	No. of abortions	No. of pregnancies (age 15-19)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 15 - 19 pregnancy averted (excluding Benefits)	Cost per age 15 - 19 pregnancy averted (including Benefits)
No AP	11,241	11,363	£7,338,478	£59,090,538	£1,524,674,862	-		Dominated by AP
AP	10,352	8,984	£9,825,550	£59,827,388	£1,447,599,721	£2,795	£310	Dominates

Table 23: Expected results for Model 3 (discounted)

Intervention	No. of abortions	No. of pregnancies (age 15-19)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 15 - 19 pregnancy averted (excluding Benefits)	Cost per age 15 - 19 pregnancy averted (including Benefits)
No AP	11,241	11,365	£7,350,262	£59,117,265	£1,522,349,457	-		Dominated by AP
AP	10,354	8,990	£9,836,691	£59,863,590	£1,445,477,341	£2,803	£314	Dominates

Table 24: Expected results for Model 3 (undiscounted)

Intervention	No. of abortions	No. of pregnancies (age 15-19)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 15 - 19 pregnancy averted (excluding Benefits)	Cost per age 15 - 19 pregnancy averted (including Benefits)
No AP	13,764	12,929	£8,935,607	£74,777,693	£2,303,763,945	-		Dominated by AP
AP	12,803	10,226	£11,769,519	£75,844,069	£2,198,049,915	£2,948	£395	Dominates

Table 25: Increased probability of taking EHC without emergency provision (29% to 50%)

Intervention	No. of abortions	No. of pregnancies (age 15-19)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 15 - 19 pregnancy averted (excluding Benefits)	Cost per age 15 - 19 pregnancy averted (including Benefits)
No AP	11,241	11,363	£7,619,395	£59,371,454	£1,524,955,778	-	Dominated by AP	Dominated by AP
AP	9,169	5,823	£9,045,114	£56,721,443	£1,341,105,495	£688	Dominates	Dominates

Figures 14, 15 and 16 show the PSA results as scatter plots. Figure 14 suggests that advanced provision of EHC is unlikely to result in net cost savings using the cost per abortion averted outcome. The model predicts that there is around a 24% probability that the advanced provision of EHC will result in net cost savings when using the cost per age 15 – 19 pregnancy averted outcome and Benefit payments are excluded from the analysis, as shown in Figure 15. However, Figure 16 suggests that the advanced provision of EHC is likely to be cost saving using a cost per age 15 – 19 pregnancy averted outcome when Benefit payments are included. Please note that the scale on the cost axis varies from thousands in Figure 14 to millions in Figures 15 and 16.

Figure 14: Cost per abortion averted for advanced provision of EHC

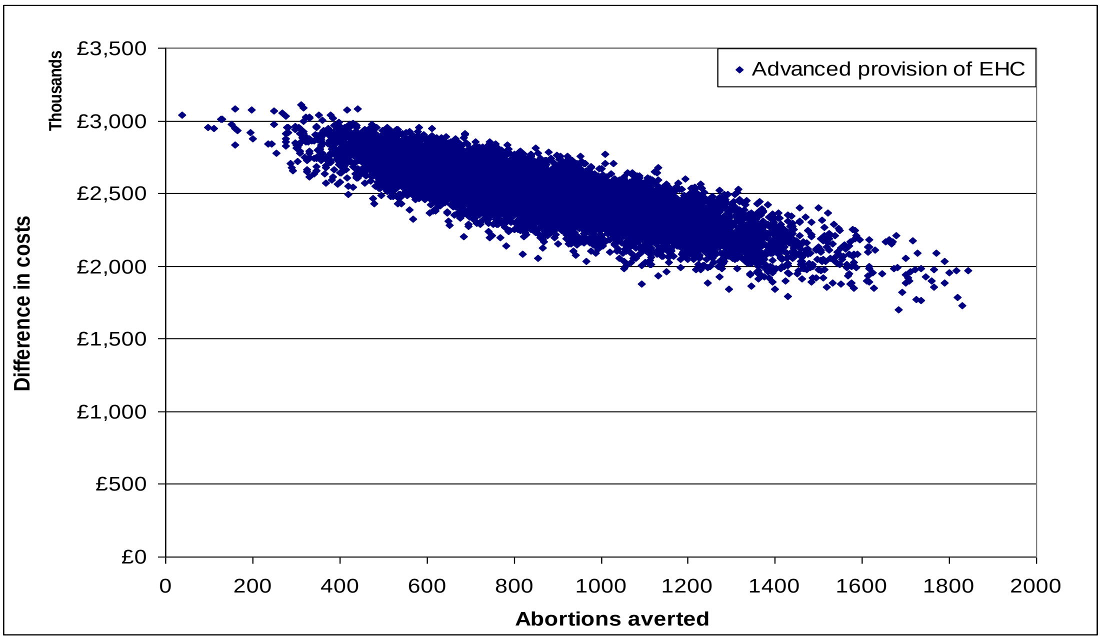


Figure 15: Cost per age 15 – 19 pregnancy averted (excluding Benefit payments) for advanced provision of EHC

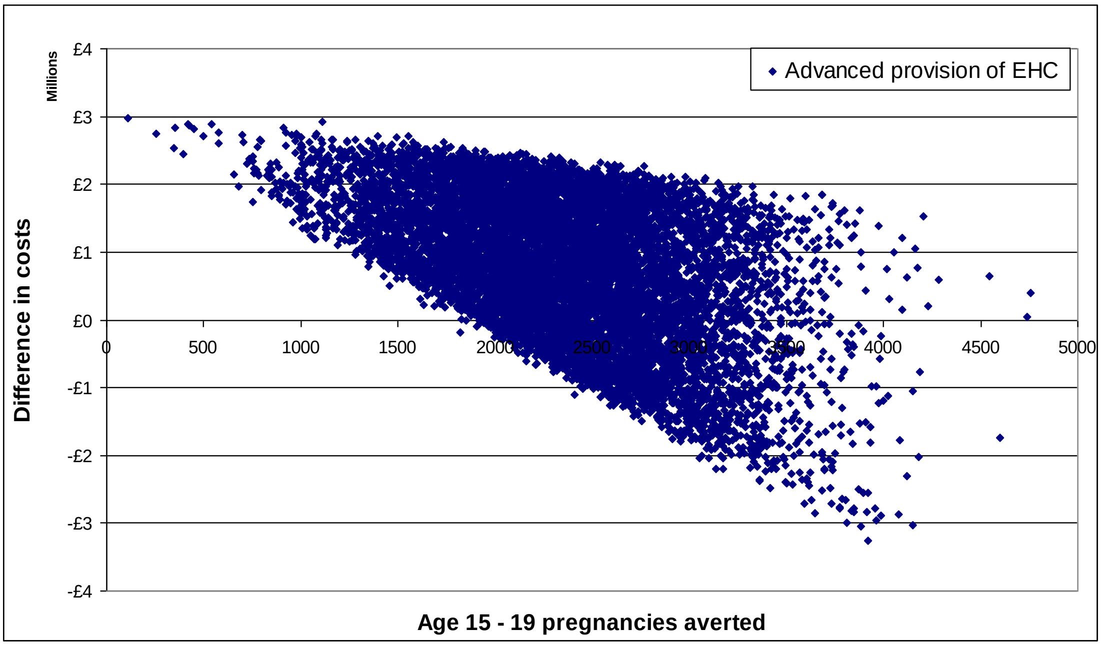
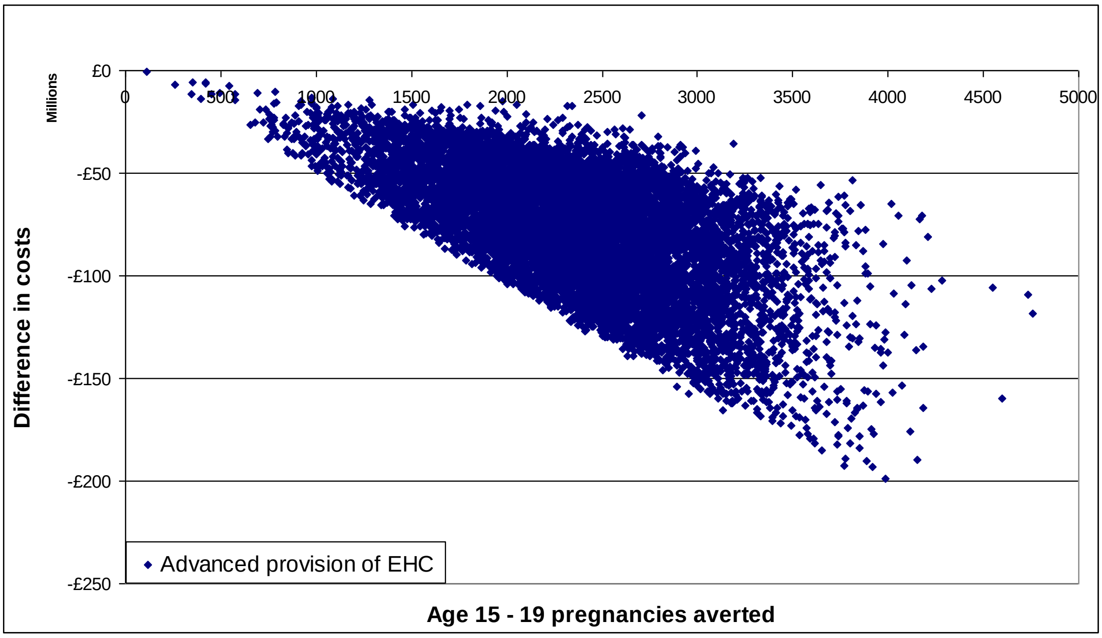


Figure 16: Cost per age 15 – 19 pregnancy averted for advanced provision of EHC (including Benefit payments)



3.3.2 Results of the one way sensitivity analysis

Table 25 above shows the model results for increasing the baseline usage of EHC (without advanced provision) following unprotected sex from 29% to 50%. Advanced provision of EHC is predicted to dominate no advanced provision of EHC for the cost per age 15 – 19 pregnancy averted, both including and excluding government-funded Benefit payments. The estimated cost per abortion averted associated with advanced provision of EHC decreases to £688 compared with no advanced provision. The increase in cost-effectiveness is due to the fact that, whilst an increase in baseline usage of EHC makes no difference to the costs of the advanced provision (as all sexually active young people receive EHC), for the comparator group an increase in baseline usage directly increases the costs of EHC.

Varying the proportion of pregnancies ending in miscarriage, the proportion of medical abortions which are treated as elective, the failure rate of advanced provision of EHC and decreasing the difference in annual Income Support between teenage mothers and older mothers does not have a substantial impact upon the model results (see Appendix 2).

3.4 Results of the additional analysis of advanced provision of EHC in combination with the dispensing of contraceptives within schools

Tables 26 and 27 present the estimated discounted deterministic results of the cost-effectiveness of the advanced provision of EHC in combination with the dispensing of contraceptives within schools compared with the dispensing of contraceptives within schools alone. The model predicts that advanced provision of EHC in combination with the dispensing of condoms within schools is associated with a cost per abortion averted of £11,581 compared with the dispensing of condoms within schools alone. The corresponding figure for the dispensing of hormonal contraception within schools is £4,595. In terms of a cost per teenage pregnancy averted including Benefits, the model predicts that advanced provision of EHC in combination with dispensing of condoms or hormonal contraceptives will dominate the dispensing of condoms or hormonal contraceptives alone.

Table 26: Deterministic results for advanced provision of EHC in combination with the dispensing of condoms within schools (discounted)

Intervention	No. of abortions	No. of teenage pregnancies	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per teenage pregnancy averted (excluding Benefits)	Cost per teenage pregnancy averted (including Benefits)
Dispensing of condoms only	11,152	11,195	£7,176,666	£58,828,656	£1,519,436,401			Dominated by dispensing of condoms & AP
Dispensing of condoms & AP	10,881	10,454	£10,318,738	£61,419,186	£1,497,531,264	£11,581	£3,497	Dominates

Table 27: Deterministic results for advanced provision of EHC in combination with the dispensing of hormonal contraceptives within schools (discounted)

Intervention	No. of abortions	No. of teenage pregnancies	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per teenage pregnancy averted (excluding Benefits)	Cost per teenage pregnancy averted (including Benefits)
Dispensing of hormonal contraception only	11,103	11,122	£7,168,251	£58,782,859	£1,517,781,330			Dominated by dispensing of condoms & AP
Dispensing of hormonal contraception only & AP	10,473	9,394	£10,061,841	£60,387,335	£1,462,144,566	£4,595	£929	Dominates

4 DISCUSSION & CONCLUSION

4.1 Discussion of results

The results suggest that dispensing contraceptives in schools will both be effective and lead to net cost savings compared to no intervention from a public sector perspective using the cost per age 14 – 16 pregnancy averted outcome. This appears robust to changes to model parameters and assumptions within the sensitivity analysis. Where government-funded Benefits are excluded from these analyses the probability that the interventions are cost saving is reduced to around 50%. Key drivers of the model results are the short term and long term effectiveness of the interventions. The model predicts that the dispensing of hormonal contraceptives in schools is likely to lead to greater benefits and further cost savings than the dispensing of condoms in schools. However, the comparison between the methods of contraception is subject to considerable uncertainty (discussed further within the model limitations section below). Moreover, it is likely that a choice of contraceptive methods will increase overall effectiveness.

The model suggests that intensive case management to prevent repeat teenage pregnancies is likely to result in a cost per repeat teenage pregnancy averted of around £15,000 excluding Benefits and £4,000 including Benefits. This is due to the high cost of the intervention and the assumption that there are reduced benefits associated with averting a second child. If, whilst maintaining the effectiveness of the intervention, the cost of intensive case management was halved from £764 to £382 per person per year (given the high uncertainty around this cost within a UK setting), the intervention would become cost saving compared with no follow up following a teenage birth.

The model suggests that advanced provision of EHC is likely to result in net cost savings compared with no advanced provision of EHC in terms of the cost per teenage pregnancy averted. As for the other analyses, the long term economic negative outcomes associated with teenage birth are a key driver of the model results. The baseline usage of EHC also has a substantial impact upon these results. Finally, the analysis suggests that the advanced provision of EHC is likely to remain cost saving from a public sector perspective when provided alongside the dispensing of contraceptives within schools.

Key structural uncertainties

A PSA has been undertaken with the aim of characterising the uncertainty around the model results. PSA is useful for assessing uncertainty around model parameter values; however it is more difficult to incorporate uncertainties around the structural assumptions of the model into the PSA. There are several key structural uncertainties within the model which it was not feasible to assess within the PSA. These include:

- **Uncertainty around the long term negative impacts on employment and education of a teenage birth.**

  Evidence suggests that there is minimal to no negative impacts on employment and education of a teenage birth. If there was a small negative impact, this would result in the interventions becoming more cost-effective.

- **Uncertainty around the estimated STI infection rates.**

  The model assumes that STIs are only transferred to one other person since an infectious disease model would be required to assess infection rates of STIs to more than one person. The STI rate is therefore likely to be underestimated within the model, and this underestimate may be substantial. Hence the effectiveness of the dispensing of condoms within schools is likely to be underestimated within the model.

- **Uncertainty around long term impacts of the interventions.**

  The effectiveness of the intervention over time involves a complex relationship between the potential long term impacts of the intervention, the age at which the individual wants a baby, whether the intervention has an impact upon the age at which the individual wants a baby, whether an averted pregnancy would have been additional or mistimed and, if the pregnancy would have been mistimed how long the intervention will delay it. Within the model, it was assumed that the intervention would reduce the number of teenage pregnancies during the time it is provided and that after that point there is a 50% probability that the averted pregnancy would have been an additional pregnancy and a 50% probability that averted births would be delayed. No births were assumed to be delayed beyond age 24 years. If the intervention would reduce the number of teenage pregnancies beyond the time it is provided, then the effectiveness of the interventions may be underestimated. Similarly, if a proportion of births which would have been teenage births are delayed beyond age 24 years, then the effectiveness of the interventions may be underestimated. Conversely, if teenage births are generally only delayed by a year or two by the intervention, then the effectiveness of the interventions may be overestimated.

In general, these key uncertainties which it was not feasible to assess fully within the model are likely to underestimate rather than overestimate the effectiveness of the interventions; this suggests that cost-effectiveness ratios are more likely to be overestimated than underestimated.

Other model limitations

All models are limited by the quality of the evidence used to parameterise them. There are a large number of uncertainties within the model due to a paucity of evidence. The majority of the effectiveness evidence is based in the US, and many of the study populations are ethnic minority groups within the US, such as Hispanics. It is unclear whether it is possible to generalise evidence from this population to young people within the UK who are at increased risk of pregnancy. There are a number of factors linking people to pregnancy at a young age; the studies tend to target these groups of people such as young people from deprived areas or ethnic minorities. If more or less people that are predisposed to teenage pregnancy are represented by the studies than in practice, the effectiveness of the interventions may be over- or underestimated respectively. Therefore, if the interventions reported in the US studies target a group of young people where the incidence of teenage pregnancy is likely to be higher than that targeted in the UK, then the estimates of effectiveness will be overestimated for the UK group. In addition, studies reporting contraceptive use outcomes are self-reported by the participants, leading to potential bias from young people misreporting contraceptive use. This is likely to lead to an overestimate of the impact of the intervention and hence may provide optimistic cost-effectiveness results.

The effectiveness evidence generally reports the percentage of young people either using contraceptives or becoming pregnant over a relatively short time period, for example, 6 months or 12 months. There are only three studies identified by the literature review which provide follow up at more than one time point; none of which provide sufficient information around the way in which effectiveness may alter over time. It is therefore not possible to know the long term impacts of the interventions upon contraceptive use or pregnancy rates. Future studies should report the effectiveness results of the interventions at several time points in order to understand the long term impacts of the interventions.

The evidence around the long term outcomes of a teenage birth is varied in terms of quality and results, leading to considerable uncertainty around the negative consequences of teenage births. In addition, evidence suggests that following a miscarriage, those young people that are predisposed to teenage pregnancy are likely to become pregnant within the next few years. The outcomes for teenage pregnancies are thus being compared with the outcomes for women who become pregnant in their early twenties. It could be argued that people who have a baby in their early twenties have poorer outcomes than those who have a baby in their late twenties or early thirties. However, the model is consistent in that it also assumes that the interventions only delay child bearing until the early twenties.

A further limitation of this evidence is that it is not reported by age (apart from the evidence around low birth weight babies). This means that while the evidence suggests that there is only a small negative effect of a birth upon these teenagers, it may be that there is a bigger impact for those women who are aged less than 17 years since these constitute a small proportion of the study samples. If, for example, women who became mothers at 14 had incredibly poor long term socioeconomic outcomes, this would not be apparent within the evidence because incredibly poor long term socioeconomic outcomes for <1% of the study population would have very little impact upon the average outcomes estimated. In addition, the outcomes are measured at only one time point which means that there may have been medium term negative outcomes of a teenage birth which plateau out by the age of 30 years. This would, however, lead to greater benefits associated with preventing a pregnancy, and hence interventions would become more cost saving than currently estimated.

Limited evidence exists around the outcomes of the child of a teenage birth, adjusting for the characteristics which might predispose a woman to teenage birth. Furthermore, no evidence was identified around how outcomes may change as a result of whether the child was initially wanted or not. The model assumes that there is no difference between the outcomes of a child born to a teen mother or a child born to an older mother, but it may be that those born to older mothers have slightly better outcomes because they are more likely to be wanted than those born to younger mothers. The evidence around the outcomes of a father who conceives with a teenage woman are even sparser, although the little evidence that there is suggests that there are no negative consequences of fathering a child born to a teenage mother. There are also a number of outcomes which are not measured in these studies including the probability of breastfeeding, the impact of social support/ social exclusion, poor child health/ diet, domestic violence and the probability that the child will go into social care or adoption. Again, any such negative impacts would lead to greater benefits associated with preventing a pregnancy, and hence interventions would become more cost saving than currently estimated.

It was not feasible to express model outcomes in terms of a measure which would enable comparisons of the cost-effectiveness of interventions across different health topics/ diseases such as the quality-adjusted life year. The majority of the results suggest that the interventions are all more effective and cost saving when compared with current standard practice. However, where this is not the case, such as within the NHS and PSS perspective for Models 2 and 3, the outcomes become difficult for decision makers to interpret and compare with other health interventions or technologies within different contexts.

In addition, the health economic model does not capture the variability between young people. For example, some people aged 17 years may be in a long-term relationship, have high levels of support from family and friends, be financially stable and be emotionally and mentally mature. In contrast, some 17-year olds may have no support, be financially unstable and be emotionally and mentally immature. The outcomes for these two hypothetical individuals may be very different because of the differences between them. In addition, for some groups it is considered unfavourable not to have a child at a young age and hence outcomes for this group may be very different. There is insufficient evidence to consider how outcomes may change for different individuals. Similarly, it is not possible to consider specific groups such as looked after children or homeless people within the model due to lack of evidence around specific subgroups of young people who may become pregnant. Further research is therefore required before an assessment of the effectiveness, and hence the cost-effectiveness, of interventions for these specific groups is feasible.

The comparison within Model 1 of dispensing of condoms at school and the dispensing of hormonal contraceptives at school is highly dependent upon the true effectiveness of each of the methods of contraception (including user failure). It also depends upon the trade off between the negative consequences of a birth compared with the negative consequences of STIs; both of which are highly uncertain within the model. The model does not include the health consequences of HIV or account for STIs being transmitted to more than one person. Both of these assumptions will lead to underestimates around the benefits from dispensing condoms of preventing STIs. However, conservative estimates have also been made around the long term negative outcomes of a teenage birth. In addition, there may be other smaller positive or negative implications associated with each type of contraception such as the impact upon cancer risk with long term usage of hormonal methods which have not been incorporated into the model.

Research comparing the cost-effectiveness of different methods of contraception in terms of both STIs and contraception is sparse due to the limitations around which outcome measure can reasonably capture both effects. A UK NICE economic evaluation of Long Acting Reversible Contraceptive methods by Mavranezouli *et al.* (2008) also suggests that the condom methods are likely to be less cost-effective than other more effective methods of contraception for preventing pregnancy. However, Mavranezouli *et al.* also only consider the costs associated with STIs and not the health outcomes such as the reduced life years and quality of life associated with HIV for example. The study does suggest that dual methods (condom + non-barrier methods) are likely to be more cost-effective than barrier methods alone. The NICE assessment of the cost-effectiveness of SRE by Nherera *et al.* (2009) suggests that the health impacts associated with STIs are relatively small.

Finally, the cost of maternity services may differ for teenage mothers compared with older mothers. Teenage mothers are likely to access maternity services later than older mothers on average; however there are also additional maternity resources available for teenage mothers. It is expected that the overall cost of these services would be approximately equivalent for teenage mothers and older mothers. It should also be noted that models 1 and 3 do not adjust for the reduced government-funded Benefits associated with having a second child compared with the first child; however this would have a minimal impact upon the model results.

4.2 Other issues and further research

Only those interventions for which there is published evidence have been modelled. There are numerous potential interventions for encouraging young people to use contraceptives and contraceptive services for which there is no published evidence. The analysis presented here is therefore not intended to be an exhaustive group of interventions that could be provided. Additional UK trial evidence is required so that the effectiveness and cost-effectiveness of other interventions can be assessed.

One such example is that the interventions within Model 1 are focused solely upon pupils who go to school and do not consider those who attend a further education college. It is likely that more people would be sexually active within this latter population; however they may also be more likely to access contraceptive services without the interventions than school pupils. In addition, if these older pupils become pregnant, they are, on average, less likely to have an abortion than school pupils. It is therefore expected that the interventions would not be as effective within a college population; and hence the interventions are likely to be less cost-effective within this population. Further primary research is required before a more formal analysis can be undertaken around this population. It would also be useful to have more primary research undertaken outside of the education setting.

Similarly, the analysis is not intended to focus upon specific contraceptive methods. The cost-effectiveness of the dispensing of condoms and the dispensing of hormonal contraception within schools is assessed because there was evidence around the dispensing of these particular contraceptive methods within schools. This does not mean that these are the only effective and cost-effective methods of contraception that should be considered for dispensing within schools. For example, it may be useful to collect some UK data around the use of long-acting reversible contraception methods within schools. However, currently there is no evidence of the effectiveness of such methods for this age group and therefore it is not possible to assess the cost-effectiveness of these methods within this context.

Interventions to encourage the use of contraceptives and contraceptive services are likely to increase awareness of sex, and hence could lead to an increase in sexual activity amongst young people. However, the evidence used to model the dispensing of condoms within schools suggests that pupils attending those schools which had implemented the intervention were slightly *less* likely to report having sex than the comparators (Blake et al., 2006). The dispensing of hormonal contraceptives within schools is targeted at pupils who have already accessed the family planning service (Zimmer-Gembeck *et al*., 2001); and hence they are likely to either already be sexually active or be thinking about having sex and therefore have an awareness of sex. Hence it is unlikely to increase sexual activity within this population. The remaining interventions assessed within models 2 and 3 are targeted at school pupils who are already sexually active (preventing repeat pregnancy and emergency hormonal contraception).

There are a number of schemes for teenage mothers currently being piloted within the UK such as the Family Nurse Partnership (Directgov, 2009). These schemes which are targeted specifically at teenage mothers will obviously increase the cost of a teenage birth; however it is expected that these schemes will also improve outcomes. Incorporating the cost-effectiveness of these new schemes into the model is outside the scope of this work. Moreover these schemes are not currently rolled out throughout the UK.

There are also a number of schemes which provide support to young people generally such as the Connexions Targeted Youth Support Services and the Intensive Personal Advisors or the SureStart Children's Centres (Directgov, 2009). It may be that teenage parents benefit from these schemes; however given current evidence it is not possible to quantify the costs and benefits of these schemes for teenage parents specifically. In addition, the majority of the schemes are also available to young people in their early twenties (under a different name); hence there would be minimal difference in costs or benefits between these age groups, provided that uptake of these schemes does not vary substantially with age.

Evidence suggests that there are generally no long term health problems or mental health problems associated with abortion in itself (American Psychological Association, Task Force on Mental Health and Abortion, 2008). This means that there are two factors differentiating abortion from contraception; cost and ethical issues. Within the model all costs associated with abortion and with contraception have been included, however it should be noted that any ethical valuations associated with abortion have been excluded. This means that if the cost of abortion was in fact lower than the cost of contraception, the model would predict that it would be better for all people to have an abortion than to use contraception. It should be noted that the intention of the model is not to compare abortion and contraception; this is merely an outcome of comparing costs and consequences of contraceptive services. In the UK, the costs of contraceptive services are much lower than those of abortion, which means that it is cheaper to provide contraceptive services than abortion services. However, further research is required around the valuation of abortion.

Whilst the evidence suggests that there is very little difference between the long-term outcomes of teenage mothers and the long-term outcomes of non-teenage mothers with the same socioeconomic characteristics as teenage mothers, it is important to note that there is a substantial difference between the long-term outcomes of teenage mothers and the long-term outcomes of non-teenage mothers generally. It is therefore important to understand those factors that might predispose young people to becoming teenage mothers and also develop interventions to improve these factors in addition to interventions to prevent unintended pregnancies.

The current economic climate has increased the proportion of people in unemployment from around 5% in 2007 to around 8% in 2009 (or 14% and 20% for people aged 16 – 24 years in 2007 and 2009 respectively). Evidence suggests that unemployment is a key determinant of teenage pregnancy; hence the current unemployment rate may increase the probability of becoming pregnant and hence the benefits of any interventions which are implemented may not be immediately observable.

Further research is required in the following areas:

- UK research around the effectiveness and cost of interventions which may reduce teenage pregnancy rates, including subgroup analyses to determine whether particular groups should be targeted;

- UK research around the effectiveness and cost of interventions targeted at young people aged 20 – 24 years aiming to reduce abortion rates;
- Research to quantify the long term negative implications of a teenage birth for the mother, father and child within the UK;
- Analyses of the implications of current strategies which are being rolled out or piloted such as the Family Nurse Partnership scheme which are likely to impact upon the long term outcomes of teenage/ young mothers;
- Analyses of the quality of life over time of the mother, father and child dependent upon mother's age at first birth;
- Potential valuations of abortion.

4.3 Conclusion

The economic analysis indicates that, from a public sector perspective, the dispensing of contraceptives within schools is effective and results in net cost savings compared with no dispensing of contraceptives within schools. This result is robust to changes in the key model assumptions if government-funded Benefits are included within the analysis; however if government-funded Benefits are excluded from the analysis, dispensing contraceptives within schools has around a 50% probability of resulting in net cost savings. The analysis also suggests that dispensing hormonal contraceptives within schools is likely to be more effective for preventing pregnancies and may lead to greater cost savings than dispensing condoms within schools, although this comparison is subject to considerable uncertainty.

The economic analysis also suggests that, from a public sector perspective, intensive case management results in a cost per repeat teenage pregnancy averted of £4,000 compared with no follow up following a teenage birth. Excluding government-funded Benefits from the analysis leads to an estimated cost per repeat teenage pregnancy averted of £15,000.

Advanced provision of emergency hormonal contraception is estimated by the model to be more effective and less costly than no advanced provision of emergency hormonal contraception from a public sector perspective; however when government-funded Benefits are excluded from the analysis (i.e. an

NHS & PSS perspective), the intervention is estimated to have a cost per age 15 - 19 pregnancy averted of £310 compared with no advanced provision. Finally, the analysis suggests that the advanced provision of EHC is likely to remain cost saving from a public sector perspective when provided alongside the dispensing of contraceptives within schools.

These results are limited by the data used within the model, particularly around long term outcomes of a teenage pregnancy and around both the short and long term effectiveness of the interventions. The evidence around the costs and effectiveness of the interventions is based upon studies carried out in non-UK countries. Differences in the health care systems and cultural differences around contraceptive behaviour and attitudes lead to questions around the generalisability of these studies within the UK setting. Thus, these results should be treated with caution. Further research is recommended as described in Section 4.3 above.

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6 APPENDICES

6.1 Appendix 1

Table i: PDG elicitation summary – median values of number of births averted to provide equivalent benefits

	Age	14	15	16	17	18	20	24
Severe learning difficulties	Wants a baby	1	1	1	1.5	2	2	1
	Does not want a baby	1	1	1	1	1.75	2	1
Homeless heroin addict	Wants a baby	1	1	1	1	1	1	1
	Does not want a baby	1	1	1	1	1.4	1.7	1
Excluded from school due to bullying	Wants a baby	1	1.5	1.6	2	2.2	4.5	1
	Does not want a baby	1	1.5	2	3	5	10	1
Excluded from school due to truancy	Wants a baby	1	1.6	2	2	3.75	7	1
	Does not want a baby	1	1.6	2	3	4.5	10	1
Looked after child	Wants a baby	1	1	1	2	2.5	2.75	1
	Does not want a baby	1	1	1	3	3	4	1

Table ii: Additional comments from the PDG about their valuations

Type of social disadvantage	Comment by PDG member
Severe learning difficulties	It may be difficult for these girls to make an informed choice as they may not be aware what is required in being a mother
	Less support as older
	Learning difficulties trump physical impact of pregnancy
	Support needs to be similar after 18
	Support? Nature of difficulties? Too many assumptions. Struggled with this one.
	Looked at it from a mental age not probably changing therefore amount of services required/needed would not change
	Learning age not likely to change. Ongoing support needed
	Consistent care is needed until adulthood for child's sake
Homeless heroin addict	These mothers are unlikely to be able to care for their babies – no home and possibly driven mostly by their addiction. Only difference would be if being pregnant was a trigger for overcoming their addiction and finding help to seek out
	Homelessness & substance misuse are very likely to result in child being taken into care at birth
	Nature of homelessness? Available services? Too many assumptions.
	Regardless of whether wanting a baby services involved would be the same
	Likely to be non-attender. Risk to baby
	Provision is essential for child and mother to stop it
Excluded from school due to bullying	Depending on the cause of the bullying, it is unlikely that these girls will provide adequate mothering
	Negative social consequences of exclusion
	Care is needed until young woman can control emotion this takes time
Excluded from school due to truancy	If the girl has a baby, it is unlikely she will get back into education and this is more damaging the younger she is
	Young mother will have low educational attainment as well as trouble finding a job or accessing further education
Looked after child	Need consistent care for reassurance to young person until 20/24 they can get better work more life experience
Possess at least one of the following factors: -Low household social class as a child -Own mother has no qualifications -Own mother was a teen mother -Poor vocabulary at age 5 -Poor child behaviour at age 10 -Low self-esteem at age 10	Mothers who do not want a child are likely to care for it less well than those who do
	Not wanting worse than wanting but all problematic due to social issues
	Not certain that wanted pregnancies to YP result in adverse outcomes
	Definition of disadvantage makes too many assumptions
	Age alone most important for me here. In all, having a baby you don't want is worse for society than having a baby you do; this is only partly offset by older age – difficult to articulate
	Has impact on society regardless of age
	Always need to consider weight & not wanting baby versus need
	Care is needed same for under 16 as there are restrictions on benefits for this age group

6.2 Appendix 2

Model 1 Sensitivity analysis results which did not differ substantially from the base case

Table i: Annual difference in Income Support receipt of teen and older mothers is decreased from 4% to 0%

Intervention	No. of abortions	No. of pregnancies (age 14-16)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 14 - 16 pregnancy averted (excluding Benefits)	Cost per age 14 - 16 pregnancy averted (including Benefits)
ND	11,392	2,186	£7,047,616	£58,881,479	£1,559,281,738	-		Dominated by DC
DC	11,152	1,777	£7,242,615	£58,894,604	£1,551,519,657	£815	£32	Dominated by DH
DH	11,103	1,693	£7,317,040	£58,931,647	£1,549,958,600	£1,514 (compared with DC)	£441 (compared with DC)	Dominates DC & ND

Model 2 Sensitivity analysis results which did not differ substantially from the base case

Table ii: The proportion of pregnancies ending in miscarriage is doubled

	Repeat teenage pregnancies	Costs (excluding Benefits)	Costs	Cost per repeat teenage pregnancy averted (excluding Benefits)	Cost per repeat teenage pregnancy averted (including Benefits)
No follow up	33,771	£136,333,375	£658,357,575		
ICM	20,416	£324,668,732	£708,290,223	£14,103	£3,739

Table iii: The proportion of medical abortions which are treated as elective is increased from 50% to 100%

	Repeat teenage pregnancies	Costs (excluding Benefits)	Costs	Cost per repeat teenage pregnancy averted (excluding Benefits)	Cost per repeat teenage pregnancy averted (including Benefits)
No follow up	31,464	£133,548,263	£655,572,463		
ICM	19,022	£322,108,597	£705,730,087	£15,155	£4,031

Table iv: Annual difference in Income Support receipt of teen and older mothers is decreased from 4% to 0%

	Repeat teenage pregnancies	Costs (excluding Benefits)	Costs	Cost per repeat teenage pregnancy averted (excluding Benefits)	Cost per repeat teenage pregnancy averted (including Benefits)
No follow up	31,464	£133,548,263	£658,475,676		
ICM	19,022	£322,108,597	£710,912,908	£15,155	£4,214

Table v: Increasing the relative risk of repeat teenage pregnancy to 0.65 from 0.55

	Repeat teenage pregnancies	Costs (excluding Benefits)	Costs	Cost per repeat teenage pregnancy averted (excluding Benefits)	Cost per repeat teenage pregnancy averted (including Benefits)
No follow up	31,464	£133,548,263	£655,572,463		
ICM	21,787	£326,163,373	£740,274,950	£19,904	£8,753

Model 3 Sensitivity analysis results which did not differ substantially from the base case

Table vi: The proportion of pregnancies ending in miscarriage is doubled

Intervention	No. of abortions	No. of pregnancies (age 15-19)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 15 - 19 pregnancy averted (excluding Benefits)	Cost per age 15 - 19 pregnancy averted (including Benefits)
No AP	11,241	12,196	£7,338,478	£60,953,392	£1,526,537,716			Dominated by AP
AP	10,352	9,642	£9,825,550	£61,630,450	£1,449,402,783	£2,795	£265	Dominates

Table vii: The proportion of medical abortions which are treated as elective is increased from 50% to 100%

Intervention	No. of abortions	No. of pregnancies (age 15-19)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 15 - 19 pregnancy averted (excluding Benefits)	Cost per age 15 - 19 pregnancy averted (including Benefits)
No AP	11,241	11,363	£8,165,384	£59,917,443	£1,525,501,767			Dominated by AP
AP	10,352	8,984	£10,582,576	£60,584,414	£1,448,356,747	£2,717	£280	Dominates

Table viii: Annual difference in Income Support receipt of teen and older mothers is decreased from 4% to 0%

Intervention	No. of abortions	No. of pregnancies (age 15-19)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 15 - 19 pregnancy averted (excluding Benefits)	Cost per age 15 - 19 pregnancy averted (including Benefits)
No AP	11,241	11,363	£7,338,478	£59,090,538	£1,556,637,806			Dominated by AP
AP	10,352	8,984	£9,825,550	£59,827,388	£1,480,750,947	£2,795	£310	Dominates

Table ix: The failure rate of advanced provision of EHC is assumed to be the same as using EHC without advanced provision

Intervention	No. of abortions	No. of pregnancies (age 15-19)	Costs (abortions)	Costs (excluding Benefits)	Total costs	Cost per abortion averted	Cost per age 15 - 19 pregnancy averted (excluding Benefits)	Cost per age 15 - 19 pregnancy averted (including Benefits)
No AP	11,241	11,363	£7,338,478	£59,090,538	£1,524,674,862			Dominated by AP
AP	10,453	9,256	£9,892,634	£60,094,368	£1,456,753,729	£3,241	£476	Dominates