A model to assess the cost-effectiveness of Sex and Relationship Education (SRE) developed for NICE public health guidance on personal, social, health and economic (PSHE) education

National Collaborating Centre for Women's and Children's Health

March 2009

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Background

PSHE are planned programmes which aim to improve to promote emotional and social development and health and wellbeing so that children and young people have the knowledge and practical skills for a healthy, safe, fulfilled and responsible life. In 2010, the provision of PSHE, including SRE, in schools will become a statutory requirement. This is an important development especially in the light of research which suggests that for most boys and girls, school is the preferred setting for sex and relationship education (Testa and Coleman 2006), even though 40% of children rated its current provision as poor or very poor (UK Youth Parliament 2007).

Although under 18 conception rates in the UK have generally been falling since 1999 (Teenage Pregnancy Unit), they remain amongst the highest in Europe. For example, in Denmark, Italy, Sweden, Germany, the Netherlands, France and Spain, births to mothers aged 18 years and under account for less than 2% of all births but in the UK this figure is 4% (Eurostat). Furthermore, rates of sexually transmitted infections remain on an upward trajectory in the 16-24 age group (Health Protection Agency). Therefore, there is potentially scope for evidence-based public health guidance on SRE to have a positive impact on young people's health.

However, in a world with finite resources devoting more resources to SRE means that fewer resources are available for alternative uses. This opportunity cost, as economists call it, implies that benefits might be foregone elsewhere. Therefore, it is important to demonstrate "value for money" in the use of public funds.

However, there is very limited published evidence on the effectiveness and cost-effectiveness of SRE. Therefore, the NCC-WCH was commissioned by the National Institute for Health and Clinical Excellence (NICE) to undertake an economic evaluation of SRE amongst primary and secondary school pupils to aid the recommendations of the programme development group (PDG).

Aims

To explore the cost-effectiveness of SRE interventions for children and young people aged 11 to19 years in education, children and young people who are looked after or are leaving care aged 21 and under, and those aged 25 and younger with learning disabilities.

Methods

The model was developed in Microsoft Excel™. A user-friendly interface allows the user to navigate the model using menus and on-screen buttons. The user is able to alter the model inputs and can view the results for any particular scenario they create. In addition, the user can set lower and upper bounds for pre-programmed one-way sensitivity analyses, in which one parameter's values are changed while holding all other values in the model constant.

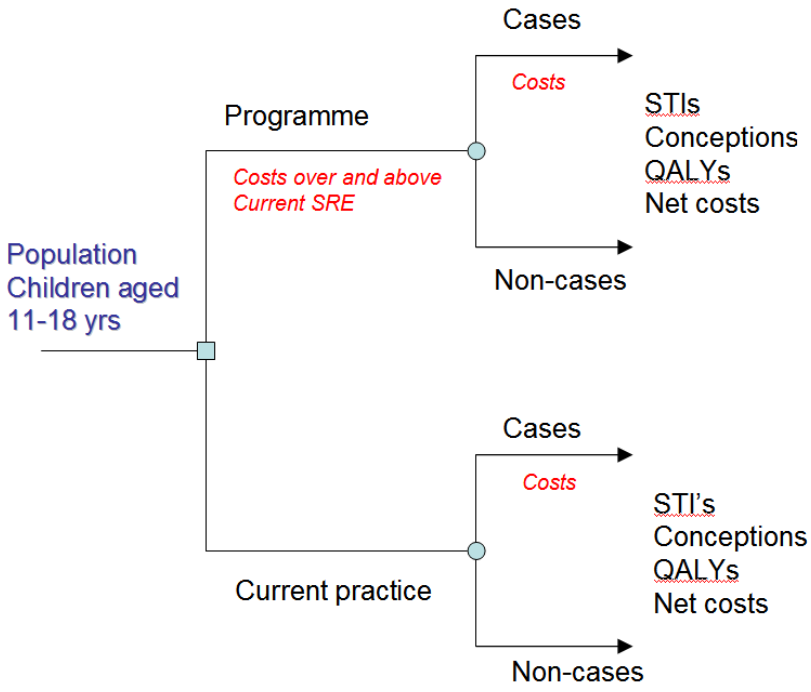
The basic analytic approach is illustrated by the simple schematic in Figure 1. Economic evaluation of an SRE intervention or programme involves comparing its net costs and effects relative to current practice. If a programme generates benefits alongside net savings (where programme costs are less than the 'downstream' savings resulting from averting unwanted outcomes such as STI cases or pregnancy) then the cost-effectiveness of the intervention is unambiguous. The intervention is said to *dominate* current practice. However, if the programme produces additional benefits but at a net cost, then the decision maker must decide whether this represents good value for money, based on the opportunity costs (benefits foregone) of not employing those resources in some alternative use.

Owing to the lack of evidence about the efficacy of such interventions, especially in a UK context, hypothetical scenarios were evaluated using a "what-if" approach which involves estimating the impact on various health outcomes if an intervention produced a certain change in behaviour. Using

this approach, it is possible to estimate various thresholds for cost-effectiveness. For example, what is the maximum a programme could cost and still be considered cost-effective at different levels of programme effectiveness?

In accordance with NICE methods for public health guidance (NICE, 2007) a public sector perspective, in addition to an NHS and Personal Social Services (PSS) perspective was adopted. It was assumed that any changes generated by a hypothetical programme would last for one year.

Figure 1: Schematic diagram showing the economic evaluation approach to SRE



It is assumed that the intervention is being delivered on an England-wide basis and the costs and benefits reported herein are predicated on that assumption. However, the model allows the population size to be easily varied. The population was sub-divided into various age groups to reflect the fact that not all ages are equally sexually active.

Table 1: The model population

Age	Females	Males
11	297,600	311,100
12	298,000	313,900
13	304,500	321,000
14	307,800	325,300
15	318,900	337,700
16	325,000	346,900
17	323,000	344,100
18	325,000	344,900
19	333,600	354,900

Source: (ONS, 2009)[1]

Modelling the health consequences of behavioural change

For the purposes of this model we make a simplifying assumption that the principle behavioural change targeted by a hypothetical SRE intervention would be an increase in the proportion of acts of sexual intercourse where a condom was used.

This analysis focuses on how any changes in behavioural inputs would affect the number of teenage conceptions and cases of sexually transmitted infections (STI), with particular reference to chlamydia, gonorrhoea, genital warts and HIV. In addition the impact of behavioural change on cases of pelvic inflammatory disease (PID) as sequelae of untreated chlamydia and gonorrhoea was also estimated.

In order to do this it is necessary to define a mathematical relationship between behaviour (i.e. condom use) and outcomes (see Appendix A). In defining this relationship the following simplifying assumptions were made:

- All acts of sexual intercourse are heterosexual vaginal intercourse
- Sexually active young people had only one sexual partner

[1] Mid-2007 population estimates

- The proportion of young people using condoms relates to a group who use condoms for each act of sexual intercourse. It is assumed that the remainder never use condoms[2].
- In each age group the population consisted of those who were and were not sexually active

Having defined a relationship between behavioural parameters and outcomes, it is necessary to provide numerical values for them. A fuller discussion of the data sources is provided in Appendix B, and the values used in the model are summarised in Tables 2-8 below.

Table 2: Condom usage

Variable Name	Value	Source	Notes
Proportion using condom pre-intervention	57%	Assumption	Baseline condom use, although the baseline can additionally be varied
Proportion using condom after-intervention	57% - 95%	"What-if"	

[2] At the other extreme it could have been assumed that all young people used condoms for that proportion of acts of intercourse. The reality of course, lies between these extremes.

Table 3: Sexual activity[3]

Age	Female		Male	
	Sexually active	Acts of sexual intercourse per annum	Sexually active	Acts of sexual intercourse per annum
11	1.8%	2	0.7%	2
12	1.8%	2	0.7%	2
13	1.8%	2	3.5%	2
14	3.7%	21	11.6%	21
15	14.7%	15	23.6%	15
16	38.6%	13	45.3%	13
17	60.4%	13	62.8%	13
18	76.2%	14	76.2%	14
19	84.0%	15	84.0%	15

Table 3: STI Transmission Rates per act of sexual intercourse

STI	Value	Source	Notes
Chlamydia	45%	Wang (2000)	
Gonorrhoea	53%	Wang (2000)	
Genital warts	60%	Barnabas (2006)	
HIV	0.07%	Wawer (2005)	
PID from chlamydia	25%	HPA	Based on an untreated infection
PID from gonorrhoea	15%	HPA	Based on an untreated infection

[3] Further detail on how the numbers in this table are derived is given in Appendix A. Data on which the proportion sexually active estimates was based are not available for 11 and 12 year olds separately (a single under 13 category is used). Similarly, conception data which is used to estimate the acts of sexual intercourse per annum in sexually active is not broken down by age for the under 14's. Therefore, the ages 11-13 are treated as a single category for females. Conception data is not relevant to males, but as for females the proportion of sexually active is estimated from data on those under 13. It is assumed that the number of sex acts per annum in sexually active males is the same as for females of the same age.

Table 4: STI Prevalence

STI	Value	Source
Chlamydia	8.1%	Adams (2004)
Gonorrhoea	4.1%	Rao (2008)
Genital warts	6.5%	Estimate
HIV	0.08%	HPA

Table 5: Condom failure rate

Outcome	Value	Source	Notes
Chlamydia	5%	CDC	
Gonorrhoea	5%	CDC	
Genital warts	5%	CDC	
HIV	5%	Wang (2000)	
Contraception	9%	Wang (2000)	Proportion experiencing failure within one-year

Table 6: Proportion treated

Outcome	Value	Source	Notes
Chlamydia	90%	Assumption	Can be varied as part of what-if analysis
Gonorrhoea	90%	Assumption	Can be varied as part of what-if analysis
Genital warts	90%	Assumption	Can be varied as part of what-if analysis
PID	100%	Assumption	
HIV	100%	Assumption	

Table 7: Conception probabilities

Probabilities	Value	Source
Ovulation in month can support pregnancy	45%	Becker (1993)
Fertilisation given sex act in fertile period	95%	Becker (1993)
Conception is recognised given fertilisation	61%	Becker (1993)

Table 8: Conception outcomes[4]

Age	Spontaneous termination	Medical/surgical termination	Birth
11-13	10%	54%	36%
14	10%	52%	38%
15	10%	47%	43%
16	10%	40%	50%
17	10%	36%	54%
18	10%	36%	54%
19	10%	36%	54%

Costs

This model is not evaluating any particular intervention and therefore there are no programme costs as such. Rather the model takes a threshold and/or "what-if" approach to programme costs.

a) for a hypothetical intervention producing a certain behaviour change what is the maximum a programme could cost and still be considered cost-effective?

[4] The outcomes of conceptions are based on published rates for England and Wales (ONS, 2006). We have followed McGuire and Hughes (1995) in assuming that 10% of conceptions end in spontaneous termination

b) for a given programme efficacy and cost, what is the cost-effectiveness?

It is assumed in the model that the programme or intervention costs are those over and above existing SRE provision rather than over and above 'do nothing'.

However, in addition to the resource use associated with delivering the intervention, it is important in economic evaluation to consider the impact of the intervention on "downstream" resource use arising from any impact on health outcomes and/or behaviour. If the intervention is effective, then more condoms are used and this clearly carries a cost. In the base case analysis condoms were costed at £0.66 each (Boots, 2009) but this can readily be varied. If it is deemed that such a cost is not relevant to the perspective of this analysis, the cost can be set to zero. We additionally assume that if an intervention is able to avert sexually transmitted infections and/or conceptions then there are concomitant savings. In Appendix C we outline how the savings associated with averting particular outcomes were estimated. These savings are summarised in Table 9.

Table 9: Savings per averted case

Outcome	Saving
Chlamydia	£44
Gonorrhoea	£44
Genital warts	£87
HIV	£14,000
PID	£2,846
Spontaneous termination	£460
Surgical/medical termination	£530
Birth	£3,400

Valuing Outcomes

NICE's preferred measure for economic evaluation is the quality adjusted life year (QALY) which facilitates a comparison of cost-effectiveness across health interventions which may differ in terms of their impact on the various dimensions of health. In this analysis we used the published literature to estimate the QALY loss associated with various STI outcomes and this is discussed at more length in Appendix D. This allows the model to adopt NICE's preferred approach with an incremental cost per QALY result. The utility associated with particular health states are shown in Table 10.

Table 10: Health state utility associated with STI outcomes

Outcome	Utility	Source
Chlamydia	0.90	Hu (2004)
Gonorrhoea	1.00	Hu (2004)
Genital warts	0.91	Insigna (2003)
PID	0.65	Hu (2004)
HIV	0.66	Maclean (2005)

However, not all outcomes of interest have been assigned a QALY weight and therefore the modelling also facilitates a cost consequences approach, with all the changes in model outcomes (the consequences) reported together with the net costs. In particular, we have not assigned any QALY to teenage conceptions (see Appendix D) but the model can explore the cost-effectiveness of reduced teenage conceptions based on willingness to pay criteria. For the base case we've assumed a decision maker willingness to pay of £20,000 per QALY, which is consistent with NICE advisory criteria (NICE, 2009) and a hypothetical willingness to pay of £2,000 per conception averted.

We recognise that SRE has wider benefits than those captured by changes in health outcomes. However, these are particularly difficult to quantify and therefore are not included in the model. It should be noted that the exclusion of such benefits may mean that the cost-effectiveness is under-estimated (i.e. has a lower cost per unit of benefit than that estimated).

Results

The" what-if" nature of the model means that no greater weight should be attached to base case results than those of alternative scenarios. In this paper by 'base case' we simply mean the default values of the model's inputs. Some of these have a definite source but others are purely hypothetical. In the analyses where a model input is varied, other model inputs are held constant.

Analysis 1 – The base case

An SRE intervention delivered in England and costing £20 million, approximately £3.50 per young person or £86 per class of 25 students, raises the proportion using condoms from 57% to 58%.

Table 11: Health consequences

Outcome	Pre-intervention	Post-intervention	Cases averted
Conceptions	101,376	99,460	1,917
Chlamydia	93,333	92,174	1,158
Gonorrhoea	49,157	48,602	555
Genital warts	80,441	79,603	838
HIV	7.33	7.18	0.15
PID	1,430	1,413	17

These results are shown graphically in Figures 2 and 3.

Figure 2: Teenage conceptions by age

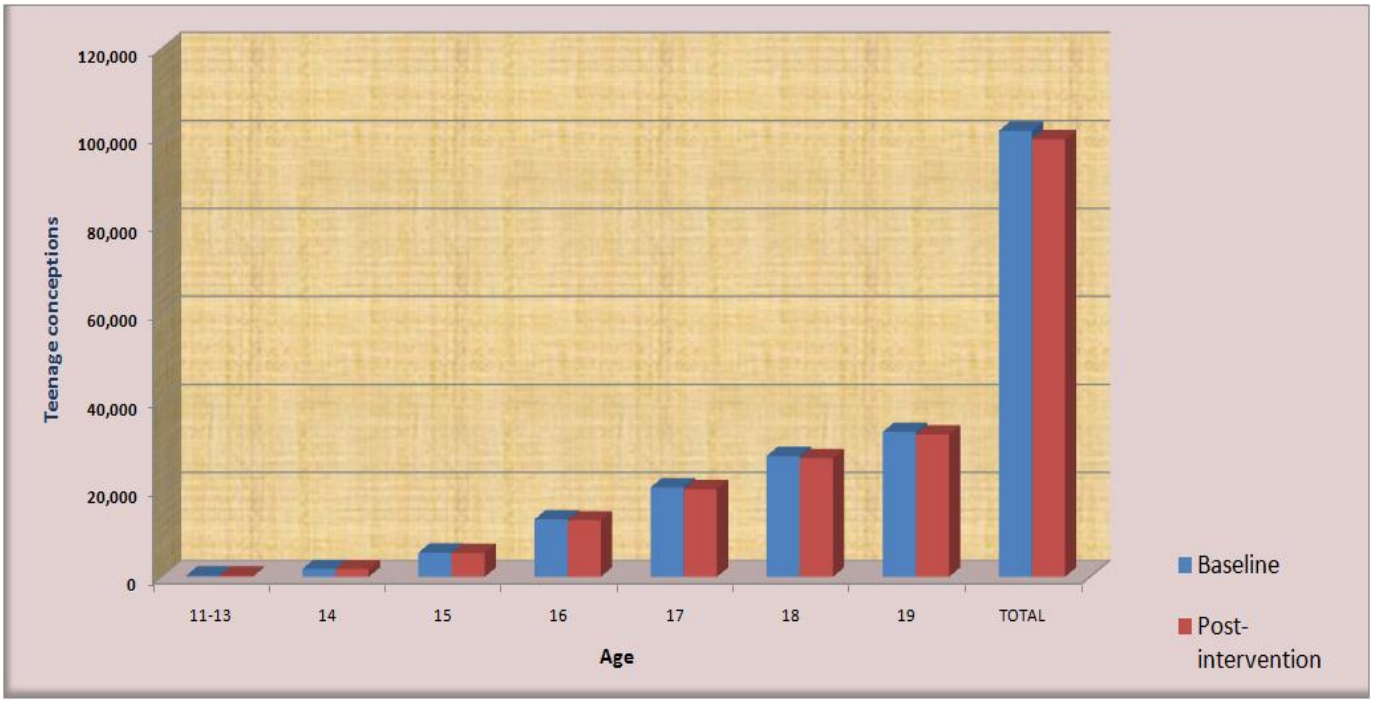


Figure 3: STI Cases by age

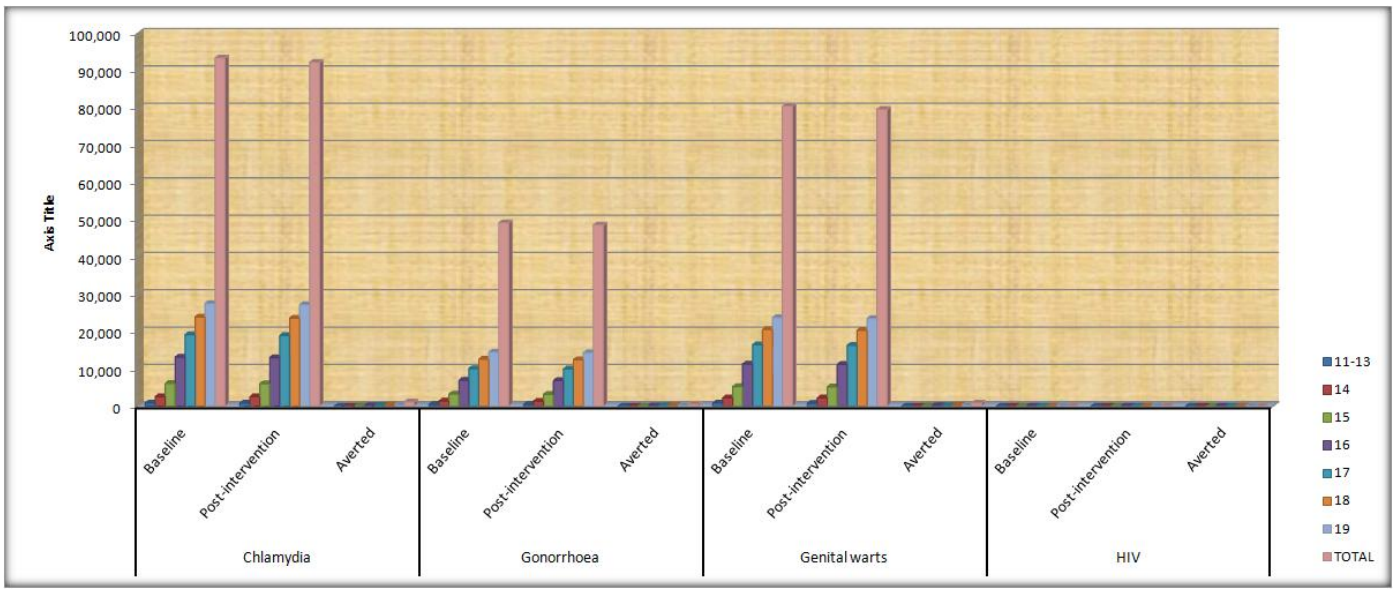


Table 12: QALYs gained from averted STI[5]

QALYs gained from averted STI	
Chlamydia	11.58
Gonorrhoea	0.00
Genital warts	7.54
HIV	0.05
PID	6.10
TOTAL	**25.28**

Notes on Table 12:

- The figure of 11.58 QALYs gained from reduction in Chlamydia is calculated by multiplying the cases averted (1158 from Table 11) by 0.1 QALYs (= 1 – utility for Chlamydia in Table 10) multiplied by 0.1 (= 1 – proportion treated in Table 6). Similar calculations for the other rows of Table 12.
- For HIV, only one year's gain in utility is assumed, which is consistent with the behavioural change lasting for one year. The gain of 0.34 QALYs per person with HIV assumes that a person newly infected would lose 0.34 in utility in the first year, which is probably an overestimate.
- Onward transmission of STIs has been ignored, resulting in a lower estimated QALY gain than the actual likely gain. This underestimation of QALYs gained could be substantial.

Table 13: Costs

Costs	
Programme	£20,000,000
Condoms	£87,765
less savings	
Chlamydia	£45,870
Gonorrhoea	£21,975
Genital warts	£65,615
HIV	£2,126
PID	£49,603
Conceptions	£4,061,976
NET COST	**£15,840,781**

Notes on table 13: Programme costs of £20 million approximate a steady state of about 700,000 students in any one school year in classes of 25

[5] In addition to the cases averted the QALY gain will also be determined by assumptions about the number of cases that would have been treated had they not been averted

having 20 lessons of 1 hour each at a cost of £34 per hour during their lifetime at school. No overheads or teacher training costs were assumed.

Table 14: Cost-effectiveness

Cost-effectiveness measures	
Willingness to Pay (WTP) for a QALY gained	£505,541
WTP conception averted	£3,833,467
WTP Public Health benefits of programme	£4,339,008
Net Benefit	**-£11,501,773**
Cost per QALY	**£475,000**

Notes on table 14:

- Net benefit consists of subtracting the WTP Public Health benefits from the Net Cost of table 13.
- Cost per QALY: subtract the WTP of conceptions averted from the net cost and divide the result by the QALYs gained.

The results summarised in Table 14 suggest that this hypothetical intervention would not be considered cost-effective, at least not without considering non-health benefits. The cost per QALY, is well in excess of the thresholds used by NICE to benchmark the cost-effectiveness of an intervention

However, the cost per QALY approach does not take into account the impact of the intervention on averted conceptions. An alternative way to assess the intervention is to use a modified cost-benefit approach, which involves assigning a monetary value to benefits as well as costs (but uses an NHS willingness to pay, rather than an individual willingness to pay). The monetary benefit of the QALYs gained and conceptions averted is given by the willingness to pay multiplied for them by their quantity:

Benefit: = (25.28 * £20,000) + (1,917 * £2,000) = £4.3 million

If the monetary valuation of the benefits exceeds costs (the 'Net Benefit', see Table 14) the intervention is considered cost-effective. However, even if we consider the monetary value placed on averted conceptions in addition to the QALY gain, the net benefit remains negative in this example, indicating that costs exceed benefits.

Of course, an advantage of a model of this type is that it allows the scenarios to be changed to estimate thresholds for cost-effectiveness. So in this analysis what would the willingness to pay to avert a teenage conception have to be to meet cost effectiveness criteria (i.e. Net benefits>Net costs)? The model suggests that if the willingness to pay for an averted conception was £8,001 then an intervention costing £20 million and increasing the condom proportion from 57% to 58% could be considered cost-effective.

This report differs from the counterpart report for Contraceptive Services (Pilgrim et al, 2009) in its treatment of government-funded Benefits for single mothers. In the Contraceptive Services modelling report, it is argued that by avoiding a birth, the government avoids paying Benefits that it would otherwise usually be required to pay. It is suggested in that report that this is a real saving and not a transfer payment from taxpayers. In the base case for the modelling in Contraceptive Services (see Table 10 of that report, in which some births are regarded as unwanted and some are postponed for a relatively short time rather than forever), it is estimated that £19,100 is saved in government-funded Benefits for each pregnancy averted (and about £39,000 per live birth averted). If that approach were to have been taken in this Report, then a change in condom usage from 57% to 58% would be cost effective and borderline cost-saving.

Analysis 2- Threshold analysis for cost-effectiveness of programme cost varying condom proportion

In this analysis we explore the programme cost threshold to produce an ICER of £20,000 per QALY for different programme effectiveness rates as measured by the condom use proportion. We evaluate the programme cost threshold if the decision maker is willing to pay £20,000 per QALY and additionally £2,000 per teenage conception averted[6]. The results are shown in

[6] This is the value the decision maker places on averting the "bad" and not on any expected savings that might be realised, as these are already included in the net costs of the programme on which the calculation is based.

Table 15. They show that the greater the effectiveness of the programme the higher the willingness to pay under standard NICE cost-effectiveness criteria.

Table 15: Programme cost threshold for cost-effectiveness using cost per QALY and Net Benefit as criteria at different rates of programme effectiveness

Percentage point increase in condom use proportion	Programme cost threshold for a WTP of £20,000 per QALY	Programme cost threshold for a WTP of £20,000 per QALY and a WTP of £2,000 per teenage conception averted
0.5	£2.3 million	£4.2 million
1.0	£4.6 million	£8.4 million
1.5	£7.0 million	£12.7 million
2.0	£9.3 million	£16.9 million
2.5	£11.6 million	£21.2 million
3.0	£14.0 million	£25.4 million

For a programme generating a 0.5 percentage point increase in the condom use proportion the willingness to pay would be in the order of £0.39 per student (£9.86 per class of 25) if only QALY outcomes are considered. For a programme producing a three percentage point rise in the condom use proportion, the willingness to pay threshold would rise to £2.40 per student (£60 per class of 25). As Table 15 shows the willingness to pay for a given programme effectiveness could substantially increase if outcomes other than QALYs were valued.

Analysis 3 – Sensitivity analysis varying the effectiveness of the programme

Figure 4: Cost per QALY varying the condom proportion post-intervention

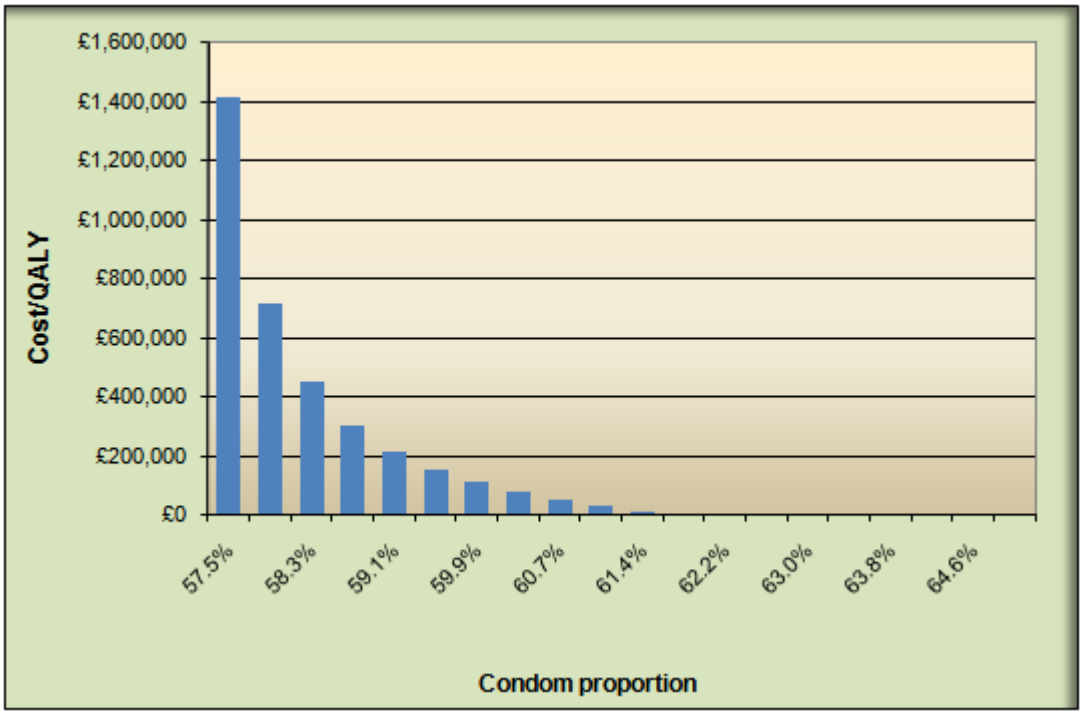
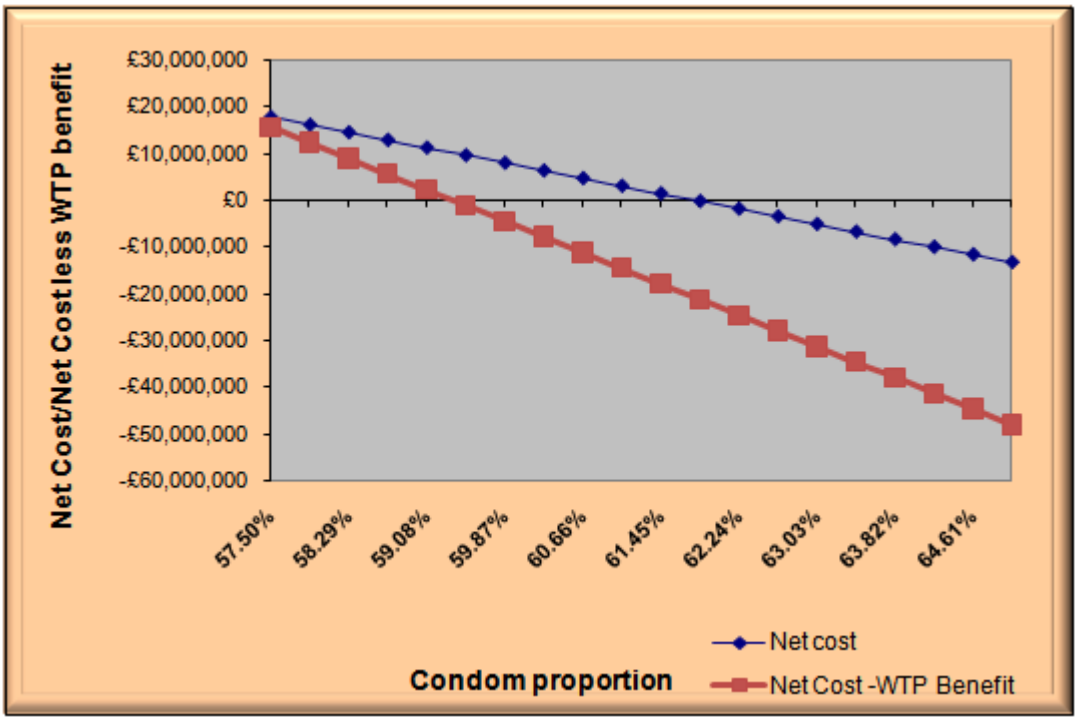


Figure 4 shows how important a driver programme effectiveness is in driving cost-effectiveness. A 0.5 percentage point increase in the condom proportion does not appear cost-effective at £1.4 million per QALY. However, a 4 percentage point increase brings the cost per QALY down to a point that would be considered borderline cost-effective. Indeed, as Figure 5 shows, the intervention becomes cost-saving if there is a 5 percentage point increase or greater in the condom proportion. If the willingness to pay to avert teenage conceptions is taken into account then the intervention becomes cost-effective if the rise in condom proportion is around 2.6 percentage points or greater.

Figure 5: Net costs varying the condom proportion post-intervention



Analysis 4 – Sensitivity analysis varying the cost of the programme

Figure 6: Cost per QALY varying the programme cost

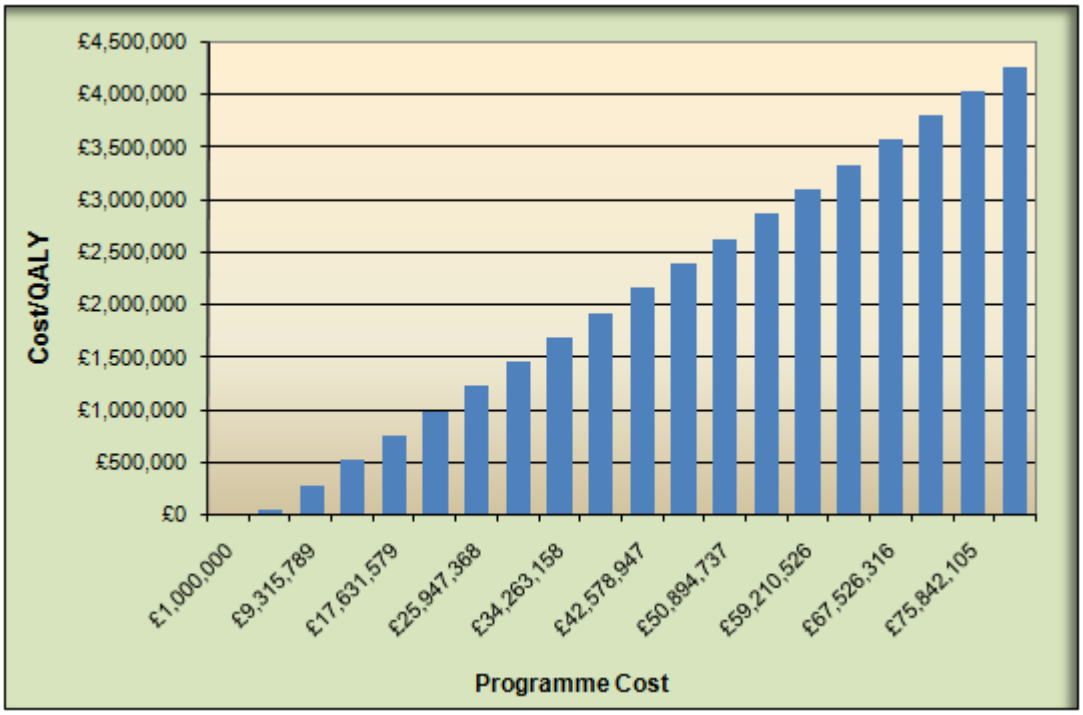
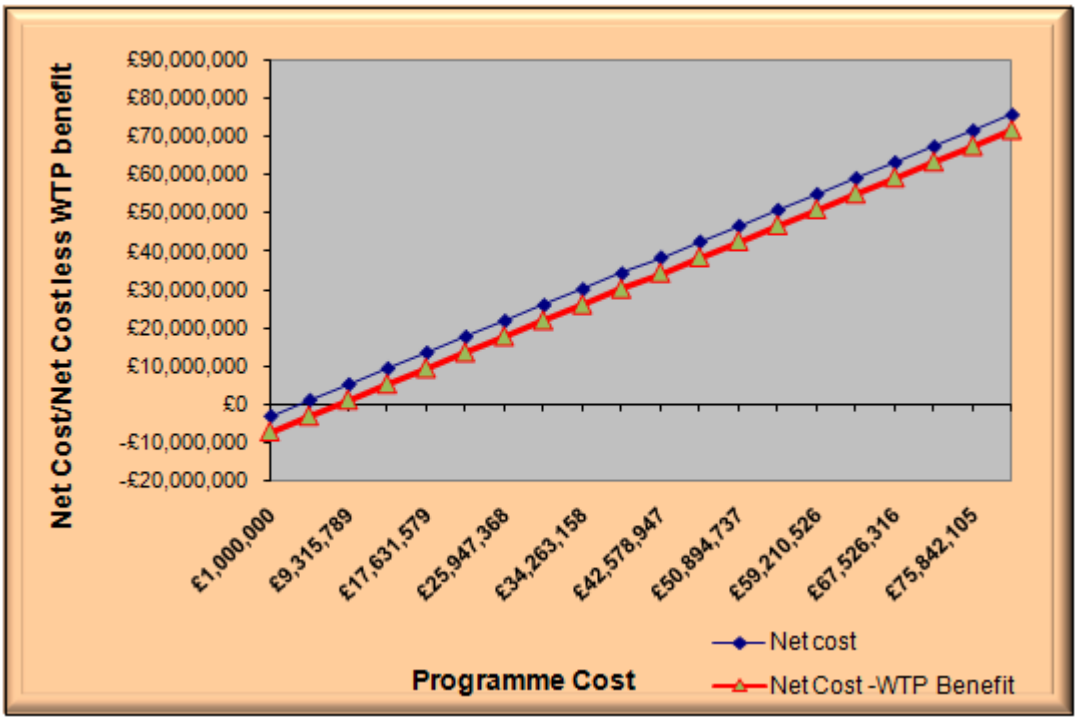


Figure 7: Net costs varying the programme cost



Again this result is intuitively unsurprising. The greater the cost of the intervention for a given effect the less cost-effective the intervention is as illustrated in Figures 6 and 7.

Analysis 5 – Sensitivity analysis varying the savings of an averted birth

As alluded to in Appendix C and D, measuring the savings and benefits associated with an averted conception and even more so an averted birth is methodologically complicated. This analysis is intended to show how sensitive the results are to different assumptions about the savings from an averted birth.

Figure 8: Cost per QALY varying the saving per averted birth

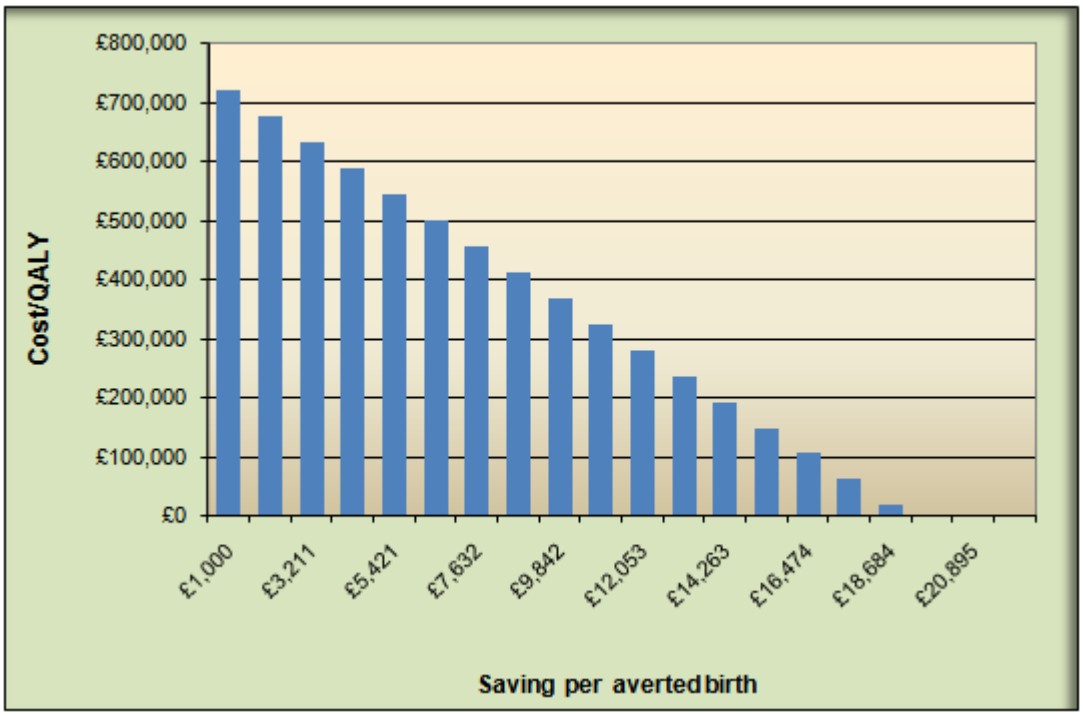


Figure 8 shows how the cost-effectiveness of the programme markedly improves when higher savings per averted birth is assumed. If an averted birth yielded savings of approximately £18,600 then an intervention costing £20 million and producing a one percentage point increase in the condom use proportion would be cost-effective using a £20,000 per QALY willingness to pay threshold.

Figure 9: Net costs varying the saving per averted birth

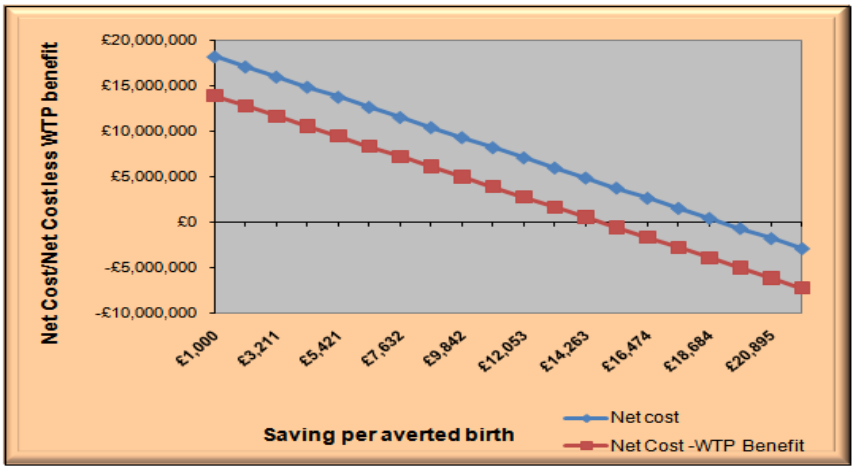


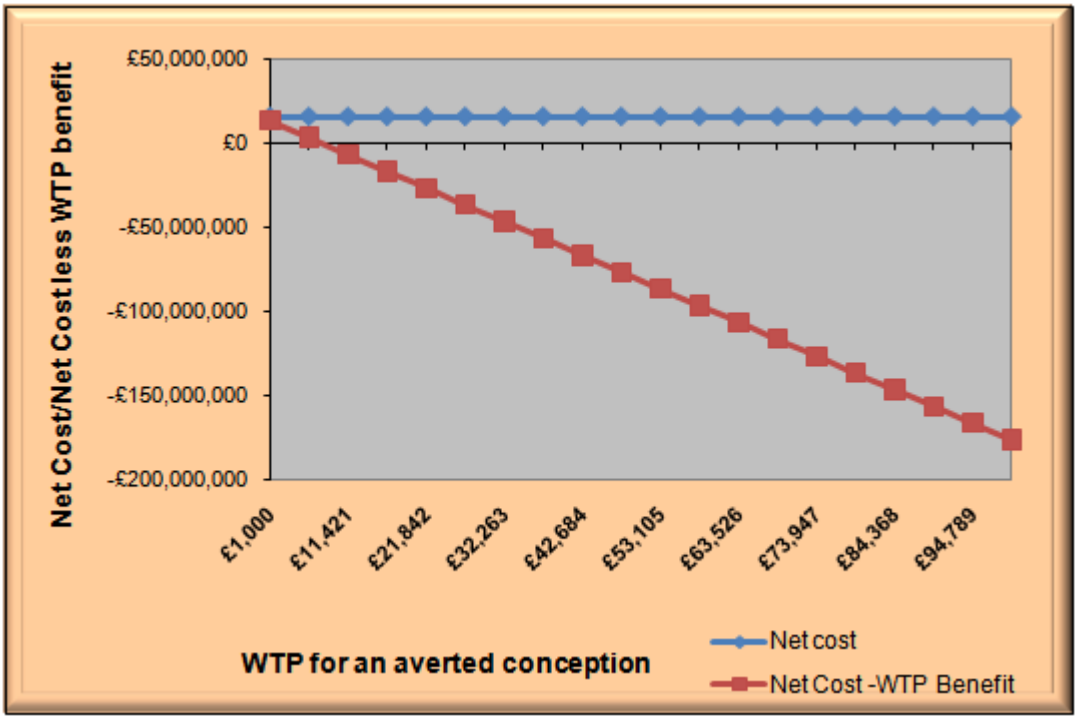
Figure 9 shows that the intervention would become cost saving if the saving per averted birth was approximately £19,200

Analysis 6 – Sensitivity analysis varying the willingness to pay for an averted conception

This is an important analysis as, unlike the cost per QALY, there has been no formal consideration of what society is willing to pay to avert a teenage conception. The base case value was arbitrarily chosen, although it seemed reasonable to the authors that it would be lower than the willingness to pay for a QALY.

Clearly, the willingness to pay for an averted teenage conception has no bearing on the cost per QALY measure of cost-effectiveness, affecting neither health outcomes nor the net costs of the programme. However, it is important when considering a net benefit approach.

Figure 10: Net costs varying the willingness to pay for an averted teenage conception



Clearly, as Figure 10 highlights, the willingness to pay to avert teenage conceptions is very important in determining the cost-effectiveness using a net benefit approach.

Analysis 7 – Sensitivity analysis varying the cost of HIV treatment

HIV has long-term costs but in the base case analysis this is restricted to a single year of treatment. This is because it is assumed that the effects of the intervention, unless repeated, would last only one year. This analysis shows the impact of considering the longer term costs of HIV.

Figure 11: Cost per QALY varying the cost of HIV treatment

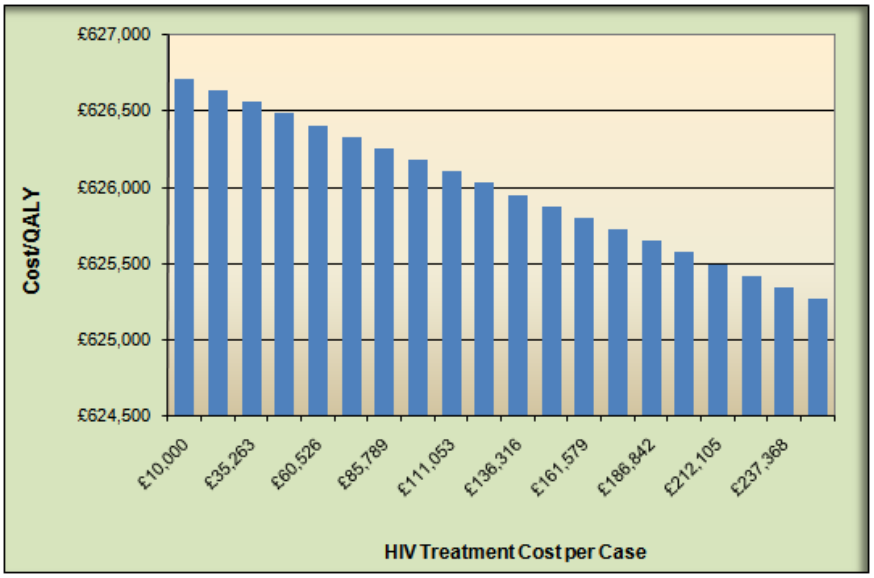
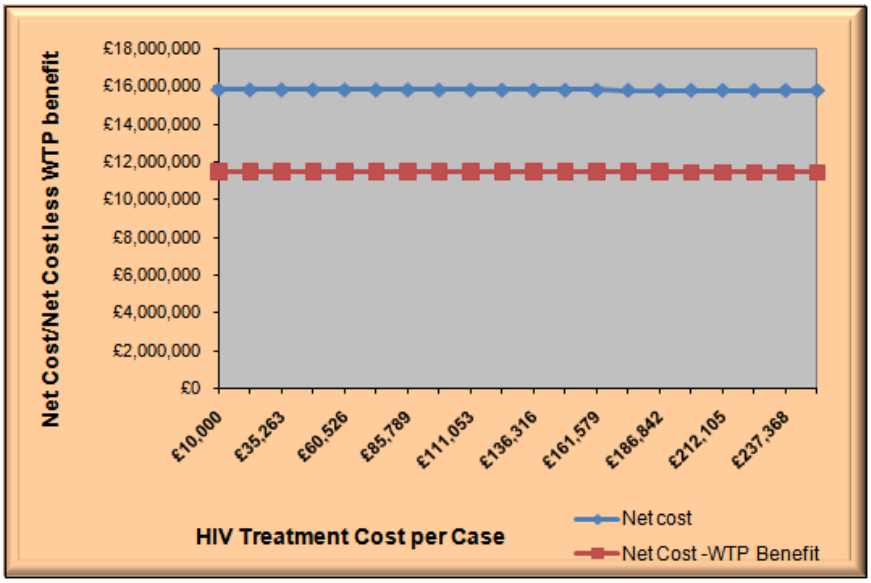


Figure 12: Net costs varying the cost of HIV treatment



As Figures 11 and 12 show, the cost-effectiveness results are not sensitive to the treatment costs of HIV used in the model. This is because of the very low number of HIV cases that would be averted, especially when the programme produced only relatively minor changes in behaviour.

Analysis 8 – Sensitivity analysis varying the proportion of chlamydia/gonorrhoea cases treated

Figure 13 shows that the cost-effectiveness of the intervention increases the lower the rate of gonorrhoea/chlamydia treatment. Although lower treatment means there are less 'downstream' savings from averted treatment (see Figure 14) the health gains from averted cases is increased due to avoiding damaging long term sequelae.

Figure 13: Cost per QALY varying the proportion of Chlamydia and gonorrhoea cases treated

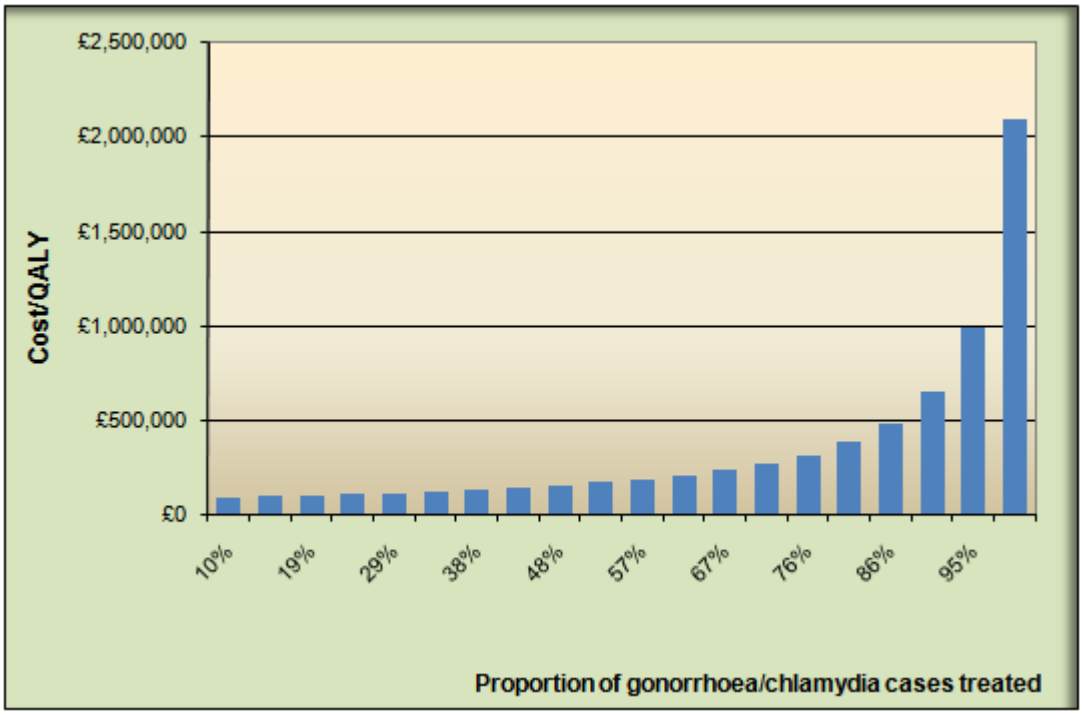
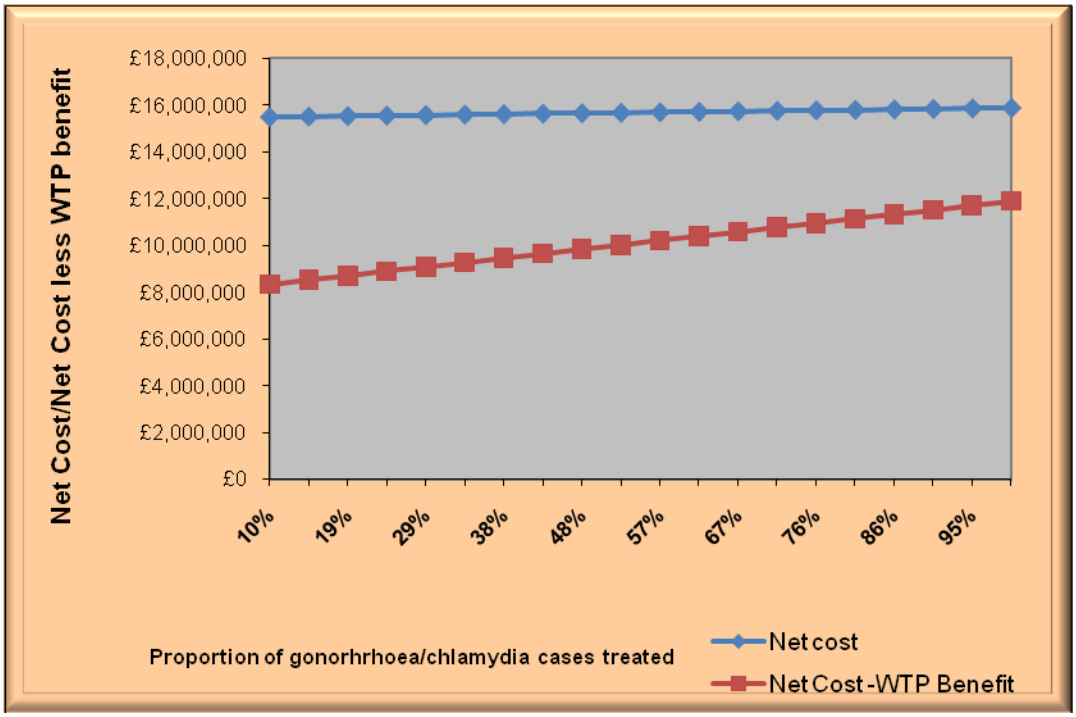


Figure 14: Net costs varying the cost of proportion of chlamydia and gonorrhoea cases treated



Discussion

The analyses presented above are illustrative and, in the absence of information about the specific costs and effectiveness of any programme, are rightly considered hypothetical. Furthermore, in that context it should be borne in mind that the results presented above are not an exhaustive analysis of all possible scenarios. For example, most of the analyses above assume a very limited increase in the condom use proportion but similar analyses could additionally have been undertaken assuming a much higher intervention efficacy.

As with all models, there are caveats concerning the model's simplifying assumptions and data sources to be considered. We used published mathematical equations to model the relationship between behaviour and outcomes. Nevertheless, the actual relationship is almost certainly much more complicated than the equations suggest. For example, prevalence of sexually transmitted infection is determined exogenously to the model, whilst in practice changes in behaviour which reduce the risk of STI transmission will

ultimately feed into lower prevalence, ceteris paribus[7]. Furthermore, the model relationship between behaviours and outcomes does address the influence of multiple partners on risk of STI and therefore, only addresses primary transmission.

However, simplifying assumptions does not imply that the model is not relevant to the real world. For example, the model assumes that all young people who are sexually active are equally sexually active, when in practice some will be more sexually active, with a higher risk of adverse outcomes, than others, who have a lower risk of adverse outcomes. By assuming an average sexual activity there is no real reason to expect that absolute number of adverse events will differ substantially from a more complex model which used the actual distribution of activity rates.

Clearly heterosexual vaginal intercourse is not the only source of STI, although it is the only mechanism of conception, an important model outcome. To the extent that rates of sexual activity have been estimated using conception data, then it is surely a possibility that overall sexual activity measured by all sexual acts might be being under-reported. To the extent that these acts carry significant risks of STI then the benefits of the intervention are likely to be being under-estimated to some extent. However, this needs to be seen in the broader context of the uncertainty surrounding the model estimates of sexual activity, especially in boys. It is also possible that the model over-estimates heterosexual vaginal intercourse in males. The issue, ultimately, is to what extent the sexual activity estimates give a reasonable approximation of the risk of acquiring an STI in England and Wales.

Another simplifying assumption of the model is the focus on condoms as the only method of contraception, although for an intervention geared to reducing STI, it is reasonable that increased condom use would be the primary outcome in measuring intended behaviour change. However, modelling all the different contraception options would add a great deal of complexity without

[7] 'Ceteris paribus' means that all other model inputs are held constant

fundamentally changing the results of the model. After all, the condom is an effective device for achieving all the desirable health outcome endpoints in the model.

Aside from the simplifying assumptions, some of the base case model inputs appear slight anomalous. For example, we would probably expect the number of sexual acts to be an increasing function of age rather than the slightly irregular pattern shown in Table 3. However, the method used for deriving these numbers is transparent and is based on real data. The reason why it fails to show clearly the expected relationship with age is probably a consequence of the limitations of survey data for this type of question. Relatively minor adjustments in the numbers assumed to be sexually active at any given age have a big impact on the average number of acts of sexual intercourse per annum.

The model measures effectiveness only by changes in behaviour which generate improved health outcomes. However, education and knowledge have their own intrinsic worth and therefore it could be reasonably argued that the focus on health outcomes leads to a systematic under-reporting of the cost-effectiveness of any SRE intervention. Whilst this may be right, it should be remembered that SRE interventions are likely to displace other opportunities to acquire knowledge in different subjects and disciplines. If so, it is possible that the real-added value of SRE is its ability to improve public health.

The analyses above show some of the key drivers of the cost-effectiveness. The programme cost, programme effectiveness, the savings per averted birth and the willingness to pay for an averted teenage conception all have a marked effect on cost-effectiveness estimates when their values are altered as part of a “what-if” analysis. Therefore, in attempting to evaluate a real-world SRE intervention these would be research priorities for good quality evidence. On the other hand, HIV treatment costs made a negligible difference to the model’s results. The importance of establishing the proportion of treatment for chlamydia and gonorrhoea was more ambiguous.

At lower rates of treatment, changes in the proportion made only a slight difference to the incremental cost effectiveness ratio (cost per QALY). However, at very high levels of treatment, the cost per QALY rises rapidly, because the scope for QALY gains by prevention is greatly diminished if the long term effects of chlamydia and gonorrhoea are addressed by effective treatment.

Conclusion

It is important to be clear that the model does not say whether SRE is or is not cost-effectiveness. A dearth of good quality evidence applicable to the UK means that the cost-effectiveness of SRE interventions in the UK cannot be readily established.

The model takes a “what-if” approach, to explore what the cost-effectiveness would be under various scenarios. The scenarios were all hypothetical in that the intervention (with concomitant programme expenditure) necessary to produce a given change in behaviour is not known.

Nevertheless, the model did show that it could reasonably be expected that an intervention that produced relatively modest but genuine changes in behaviour would be cost-effective providing that the programme cost was not itself prohibitively expensive.

Two additional points need to be made. After this report had substantially been completed, it was pointed out that a similar report for NICE on Contraceptive Services (Pilgrim, 2010) had come to a different conclusion as to whether government-funded Benefits averted by a reduction in teenage pregnancies should be included as a cost saving to society. That report suggested that it should be, while in this report, the view has been taken that the government-funded Benefits averted should be regarded as a transfer payment and therefore should not count as a cost saving. If the interpretation taken in Pilgrim (2010) is accepted, interventions to increase condom usage are much more likely to be cost effective than this report would suggest.

Second, this report has not included the onward transmission of an STI from one person to another. Only the “first-round” effects of increases in condom usage have been accounted for. However, it is beyond the scope of this report to have undertaken a fully-dynamic analysis. Suffice to say that the inclusion of knock-on benefits would significantly improve the probability of any intervention being cost effective in this area.

Appendix A: Modelling the relationship between behaviour and outcomes

Below we outline the mathematical relationships which were used in the model to estimate changes in outcomes that would result from particular behavioural changes. A simplifying assumption is made that the proportion who wear condoms do so all the time and that the remainder never wear condoms.

i) Conceptions

A model developed by Wang et al. (2000) was used to estimate a relationship between condom use and conception:

$$Y = N \times ((gK+(1-g))L$$

Where

Y = Conceptions
N = Number of girls
g = Proportion of students using condoms[8]
K = Condom failure rate
L = Probability of getting pregnant in a year without contraception

$$L=1-((1-Q)\ ^{12})$$

Where

Q = Probability of getting pregnant in first month without contraception

$$Q=q1 * q2 * q3 * q4$$

Where

q1 = Probability that ovulation in month can support pregnancy

[8] The model makes a simplifying assumption that the proportion g use condoms for all acts of sexual intercourse and that the proportion 1-g never use a condom

q2 = Probability of coitus in the fertile period

q3 = Probability of fertilisation given sex act in the fertile period

q4 = Probability that conception is recognised given fertilisation

q2 =1-((1-(2/28))^s)

Where

s = Acts of sexual intercourse per month

ii) Sexual activity

The proportion of males and females sexually active in each age group was estimated using the 1990/91 National Survey of Sexual Attitudes and Lifestyle (NATSAL). One of the questions asked in that survey was age at first intercourse and we assumed that once people became sexually active they would remain sexually active. It is then possible to use the percentage who had their first intercourse at each age as a cumulative frequency – the percent having their first sexual intercourse at a given age, when added to the percentage sexually active at earlier age, gives the cumulative frequency of those having sex at that age or before. We took this cumulative frequency for each age group to be an approximation of the proportion sexually active in each age group. We used the responses of the 20-24 age group in this survey for our estimate.

Table A1: Percentage distribution according to the age when respondents (aged 20-24) first had intercourse

Age	Females		Males	
	1st intercourse (%)	Cumulative freq (%)	% 1st intercourse	Cumalative freq
<13	0.6	0.6	0.7	0.7
13	0.6	1.2	2.8	3.5
14	2.5	3.7	8.1	11.6
15	11.0	14.7	12.0	23.6
16	23.9	38.6	21.7	45.3
17	21.8	60.4	17.5	62.8
18	15.8	76.2	11.7	74.5
19	7.8	84.0	7.8	82.3

Source: NATSAL, 1990-91

In addition to this data we also have official statistics for conceptions by age (ONS, 2007) and the mid-population estimates by age 2007 (ONS, 2009). Whilst population estimates are available for England separately, data on the actual number of conceptions for each age category is only available for England and Wales collectively. Therefore, the number of English conceptions for each age category was estimated by assuming an identical conception rate across England and Wales, although a small difference is reported[9].

[9] ONS 2009 estimates an under 20 conception rate of 61.3 per 1,000 for England and 64.9 per 1,000 for Wales

Table A2: Conceptions and population of females by age in England and Wales (based on)

Age	Population	Conceptions
11-13	900,100	359
14	307,800	1,789
15	318,900	5,574
16	325,000	12,787
17	323,000	19,980
18	325,000	27,270
19	333,600	32,277

Source: ONS, 2009

Then, using the formula used by Wang et al. (2000), it is possible to use the data in Tables A1 and A2 to solve for S, the number of acts of sexual intercourse per annum in the sexually active population. This is shown for the age 14 age group below:

$Y = N \times ((gK+(1-g))L$

Where

- Y = **1,764** *Conceptions*
- N = 326,500 x 0.037 = **12,080** *Sexually active girls*
- g = **0.57** *Baseline condom use*
- k = **0.09** *Annual condom failure rate*

→ L = 1,764 ÷ (12,080 * ((0.57 *0.09) + (1-0.57)))

L = **0.303**

But

L=1-((1-Q) ^12)

→ Q = 1 - $\sqrt[12]{(1-L)}$

Q = **0.0297**

Q = q1 * q2 * q3 * q4

where

- q1 = 0.45 *Probability that ovulation in month can support pregnancy*
- q3 =0.95 *Probability of fertilisation given sex act in the fertile period*
- q4 = 0.61 *Probability that conception is recognised given fertilisation*

→ q2 = Q ÷ (q1 * q3 * q4)

q2 = **0.1138**

But

q2 = 1-((1-(2/28))^s)

→ s = ln 0.8862 ÷ ln (1-(2/28)) *Acts of sexual intercourse per month*[10]

s = 1.630

S = s x 12 *Acts of sexual intercourse per annum*

S = 19.56

No equivalent method was available for calculating sexual activity in males and therefore it was assumed that the males had the same sexual activity rates as females for each age category. The model allows the baseline condom proportion to be adjusted. It should be noted that changing this baseline value, causes sexual activity rates to be recalculated to achieve consistency with actual conception rates. Nevertheless, the model does allow

[10] ln in this equation is the natural logarithm

the user to adjust rates of sexual activity if they wish but the model assumes that sexual activity does not change as a result of the intervention.

iii) STI cases (Chlamydia, Gonnorhoea, Genital warts, HIV)

We used a Bernoulli model of HIV transmission developed by Pinkerton and Abramson (1993) and adapted by Wang et al. (2000) to estimate the relationship between condom use and HIV and other STI cases. We limited our model to primary transmission, which is transmission from already infected partners. The model does not address secondary transmission, which is transmission from a partner who was previously uninfected.

$$Z = (g * (1-((1-tk)^s))) + ((1-g) * (1-((1-t)^s)))$$

Where

Z = Probability of transmission if partner has STI
g = Proportion of students using condoms
t = Transmission rate
k = Condom failure rate
s = Acts of sexual intercourse per annum

$$W = vZ$$

Where

W = Proportion acquiring STI
v = Prevalence of STI (or probability partner has STI)

New cases of STI = N * W

Where

N = Population

iv) Pelvic inflammatory disease cases

It is estimated that between 10-40% (mid-point 25%) of untreated women infected with genital chlamydial will develop pelvic inflammatory disease (http://www.hpa.org.uk). If gonorrhoea is left untreated it is estimated about 15% will develop PID.

Appendix B: Data sources for the model's input parameters

i) STI transmission rates

A study on HIV transmission rates in Uganda by Wawer (2005), noted that the overall HIV transmission rate per act of vaginal sex was 0.0012. The risk of transmission was highest in the first two and a half months of HIV infection at 0.0082, before decreasing to 0.0015 during the next ten months. This was not significantly different to individuals with chronic HIV infection, the rate being 0.0007 per act of vaginal sex. Thus for our model we used the transmission rate of 0.07% which applies to pupils with chronic HIV infection. This was also the value used by Wang et al (2000).

Transmission rates of chlamydia and gonorrhoea per sexual act were obtained from Wang et al. (2000). For Genital Warts we followed Barnabas (2006) in assuming a transmission rate of 60% per act of sexual intercourse.

ii) STI prevalence

Prevalence data, where available, was obtained from the literature. The prevalence of chlamydia was obtained from Adams (2004) for the under 20s and was estimated to be about 8.1% (95% CI 6.5-9.9). Prevalence for gonorrhoea from Rao (2008) and was estimated to be 4.1% (95% CI 3.7-4.5). We could not find data on the prevalence of genital warts. However, the HPA reports that genital warts are the next most common STI after Chlamydia. Therefore, we have thus assumed the prevalence to be less than Chlamydia but more than gonorrhoea and have used a point estimate of 6.5% in the model

Appendix C: The savings from averted cases

i) Chlamydia, gonorrhoea and genital warts

The drug costs of treating chlamydia, gonorrhoea and genital warts were taken from the BNF (number 56, 2008). In addition we assumed that treatment would involve one general practitioner (GP) visit lasting 11.7 minutes and costing £36.00 per infection (Curtis, 2008). For chlamydia and gonorrhoea we assumed people were treated with azithromycin and for genital warts we assumed the treatment was imiquimod. The model assumes one course of treatment for cure. The treatment costs are summarised in Table C.1.

Table C.1: Resource items for Chlamydia, gonorrhoea and genital wart treatment

Description	Duration	Total cost
Doctors consultation	11.7 minutes	£36.00
Azithromycin	-	£8.95
Imiquimod	-	£51.32

ii) HIV

A conference abstract by Hill et al (2007) estimated the annual cost of care depending on the level of CD4 counts (see Table C.2). The costs ranged from £5,322 for those with CD4 counts >350 cells/µl (stable patients) to £21,684 per year for those with CD4 cells/µl L<50 (very sick patients). These costs excluded the costs of HIV drugs which range from approximately £1,000 per year if the patient is on monotherapy to £8,000 per year for combination therapy. We estimated the average cost of HIV per year to be about £14,000 per year which was the average of people on no drug treatment and those on medication with different levels of CD4 count cells, with the assumption that HIV patients are evenly distributed across the listed CD4 count levels. For those on medication we took an average of the annual antiretroviral costs

(see Table C.3), with the assumption that each of the treatments are equally used.

Table C.2: Annual cost of care for HIV patients with different CD4 count cells

CD4 count	Cost/year
CD4 cells/µl L<50	£21,684
CD4 cells/µl L 50-200	£12,160
CD4 cells/µl L 200-350	£5,356
CD4 cells/µl L>350	£5,322

Source: Hill (2007)

Table C.3: Annual costs of HIV drugs

Antiretroviral Drug	Cost/year
Cheapest NRTI (lamivudine)	£1,018
2 NRTI (Combivir)	£3,876
3 NRTI (Triziv)	£6,575
Cheapest PI (nelfinavir)	£997
2 PI (Kaletra)	£1,870
NNRTI (efavirenz)	£2,536
NNRTI (nevirapine)	£1,947
3 NNRTI (Atriopla)	£7,627

Source: BNF no/56 Sept 2008

iii) PID

Costs of PID were taken from the PHIAC report by Bolton et al. (2006).

iv) Teenage conception

To calculate the cost of a teenage conception, it was necessary to obtain a weight for various outcomes and episodes of care associated with conception. Unit costs were then assigned to each of these episodes and outcomes in order to calculate a weighted average cost per conception.

Below, we list the outcomes of conception and how the cost of each of these outcomes was estimated. The weight for these outcomes has been reported earlier (see Table 7) and varies according to age.

a) Spontaneous termination

Table C.4. Costs of a threatened or spontaneous termination

Cost	Admission	
£364	Elective	(NHS 2008/09 Tariff)
£469	Non-elective	(NHS 2008/09 Tariff)

Data from on finished consultant episodes from NHS Reference Costs (2006/07) suggested that 91% of procedures were non-elective.

Therefore, we use the following for the cost of a spontaneous termination:

(£364 * 0.09) + (£469 * 0.91) ≈ **£460**

b) Medical/surgical termination of pregnancy

Table C.5. Costs of medical/surgical termination

Cost	Type	Admission	
£536	surgical	Elective	(NHS 2008/09 Tariff)
£1,050	surgical	Non-elective	(NHS 2008/09 Tariff)
£447	medical	Elective	(NHS 2008/09 Tariff)
£706	medical	Non-elective	(NHS 2008/09 Tariff)

Data on finished consultant episodes from NHS Reference Costs (2004) suggested, assuming that day cases are elective, the following weights:

Table C.6. Weights for medical/surgical termination

Surgical elective = 0.63
Surgical non-elective = 0.02
Medical elective = 0.28
Medical non-elective 0.07

Therefore, we use the following for the cost of a medical/surgical termination:

(£536 * 0.63) + (£1,050 * 0.02) + (£447 * 0.28) + (706 * 0.07) ≈ **£530**

c) Birth

The NHS Tariff (2008/09) gives the following costs. Weights are based on finishes consultant episodes in NHS Reference costs (2006/07):

Table C.7. Cost of birth

Delivery[11]	**Cost**	**weight**
Normal cc	£996	0.036
Normal	£996	0.628
Assisted cc	£2,029	0.010
Assisted	£1,422	0.100
Caesarean cc	£3,077	0.033
Caesarean	£2,190	0.191

The weighted cost of birth is approximately **£1,350**

However, there are other episodes of care associated with maternity care. These are not currently covered by the NHS Tariff. However, estimates of these costs per birth were estimated in the National Evaluation of the Teenage Pregnancy Strategy Final Report Synthesis of an independent evaluation of the strategy published in 2005 (http://www.everychildmatters.gov.uk/health/teenagepregnancy/research/). Episodes per birth were estimated by dividing finished consultant episodes by the number of births and the costs and weights used in that report are summarised in Table C.7.

[11] cc means with complications

Table C.8: A table showing episodes of care and weights

Outcome	Unit cost	Episodes per birth
GP fees	£250.00	1
Other maternity events	£469.00	1.03
Ante-natal outpatient visits	£51.00	2.47
Obstetric outpatient visits	£101.00	1.97
Other outpatient	£81.00	0.4
Health visiting	£35.00	5.64
Intensive Care (bed days)	£805.00	0.53
Neonatal care (episodes)	£995.00	0.12
Mother & Baby Units (inpatient bed days)	£405.00	0.05
Mother & Baby Units (outpatient)	£164.00	0.02
Tests	£32.00	0.65

These additional costs per birth are approximately £1,860. Updating this to 2007/08 prices using the Hospital and community health services (HCHS) inflation index gives the additional maternity costs per birth as approximately **£2,060.**

Adding this to the cost of birth gives approximately **£3,400** per conception leading to maternity.

The base case model restricts itself to these immediate costs of birth. The National Evaluation of the Teenage Pregnancy Strategy Final Report Synthesis (1995) estimated a net present value saving in state welfare payments of £45,000 per averted teenage conception. The

model allows the analysis to reflect such savings as part of a sensitivity analysis. The perceived benefits of teenage conception can also be captured in the value, or willingness to pay, that is put on averting teenage conceptions. The issue of costing teenage pregnancy is hugely complex. To what extent does teenage pregnancy contribute to social exclusion and its associated problems? Or does causation run the other way, with social exclusion making teenage pregnancy more likely? Are conceptions truly averted or merely delayed and what advantages both in terms of economics and health outcomes if any are accrued by delayed pregnancy? Furthermore, if the averted conceptions are more likely to be “unwanted” than is generally the case then the cost per conception averted will be over-estimated by giving insufficient weight to termination vis-a-vis birth. Finally, whilst from the perspective of this analysis welfare payments might be considered important, in a strict economic sense they are not costs at all but rather transfer payments (i.e. they redistribute resources from taxpayers to pregnant mothers).

Appendix D: Assigning utility weights

A search of the Harvard Cost Effectiveness Analysis Registry showed quality of life weights for HIV, ranging from values of 0.2 for poor health status with HIV/AIDS to 1.0 for HIV infection for the first 6 years. Maclean et al. (2005), reported QoL of 0.45 and 0.877 for people with AIDS and asymptomatic HIV respectively. We averaged the two and used a QoL weight of 0.66 for HIV. Hu (2004) used a utility weight of 0.90 for symptomatic acute urogenital chlamydial infection in a cost effectiveness analysis of Chlamydia screening in women aged 15 to 29 years old. Another study by Aledort (2005) in a cost-effectiveness of Gonorrhea Screening in Urban Emergency Departments used a utility weight of 1.0 for a history of acute gonorrhea. For PID we used an estimate of 0.65 was from a study by Hu (2004). For genital warts we took the QoL weight of 0.91 from a study by Insiga (2003).

We took the decision not to assign a utility weight to pregnancy. The position of this guideline is that, from a public perspective health perspective, teenage conception is a “bad”. Whilst this is also a widely held societal view, it is not a universal one (Lawlor and Shaw, 2002). However, to the extent that teenage conception is something to be avoided we don’t consider that this can be readily captured with a QALY approach. Pregnancy is not a disease and it is not by any means certain that pregnancy as a health state generally diminishes health related quality of life. Many women choose to become pregnant in their life-time suggesting that, for them at least, that the perceived benefits outweigh the cost. The “bad” of teenage conception probably relates more to its impact on risk of poor social and economic outcomes.

References

Aledort j, Hook EW, Weinstein, MC, Goldie SJ;The Cost Effectiveness of Gonorrhea Screening in Urban Emergency Departments Sexually Transmitted Diseases, July 2005, Vol. 32, No. 7, p.425–436

Barth, R. P., Fetro, J. V., Leland, N., & Volkan, K. 1992, "Preventing adolescent pregnancy with social and cognitive skills", *Journal of Adolescent Research*, vol. 7, no. 2, pp. 208-232.

Basen-Engquist, K., Coyle, K. K., Parcel, G. S., Kirby, D., Banspach, S. W., Carvajal, S. C., & Baumler, E. 2001, "Schoolwide effects of a multicomponent HIV, STD, and pregnancy prevention program for high school students", *Health Education and Behavior*, vol. 28, no. 2, pp. 166-185.

Becker S. The determinants of adolescent fertility with special reference to biological variables. In Gray R, Leridon H, Spira A, eds. Biographical and Demographic Determinants of Reproduction. New York, NY: Oxford University Press Inc; 1993:21-49

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Boots (http://www.boots.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10052&productId=1719&callingViewName=&langId=-1&catalogId=11051/)

Coyle, K., Kirby, D., Parcel, G., Basen-Engquist, K., Banspach, S., Rugg, D., & Weil, M. 1996, "Safer Choices: a multicomponent school-based HIV/STD and pregnancy prevention program for adolescents", *Journal of School Health*, vol. 66, no. 3, pp. 89-94.

Coyle, K. K., Kirby, D. B., Robin, L. E., Banspach, S. W., Baumler, E., & Glassman, J. R. 2006, "All4You! A randomized trial of an HIV, other STDs, and pregnancy prevention intervention for alternative school students", *AIDS Education and Prevention*, vol. 18, no. 3, pp. 187-203.

Coyle, K., Basen-Engquist, K., Kirby, D., Parcel, G., Banspach, S., Harrist, R., Baumler, E., & Weil, M. 1999, "Short-term impact of safer choices: a multicomponent, school-based HIV, other STD, and pregnancy prevention program", *Journal of School Health*, vol. 69, no. 5, pp. 181-188.

Curtis, L. & Netten, A. (2008) Unit Costs of Health and Social Care 2005, Personal Social Services Research Unit, University of Kent, Canterbury

Department of Health (2008) NHS Reference Costs 2006-07, Department of Health, London.

European Commission, EUROSTAT: accessed at The Guardian Data Store http://spreadsheets.google.com/pub?key=phNtm3LmDZEMgZPBjdipMfw&gid=2 on 31st March 2009

Flay, B. R., Graumlich, S., Segawa, E., Burns, J. L., Holliday, M. Y., & Aban, A., I 2004, "Effects of 2 prevention programs on high-risk behaviours among African American youth: a randomized trial", *Archives of Paediatrics and Adolescent Medicine*, vol. 158, no. 4, pp. 377-384.

Health Protection Agency website (http://www.hpa.org.uk).

Hill A, Wilson B, Hemmett Tibotec L, Mechelen, Belgium, Tibotec, Saunderton, Analysis of UK costs of patient care versus antiretroviral treatment in the POWER 1 and 2 trials (BHIVA conference abstract 2007)

Hu D, Hook EW Goldie SJ; Screening for Chlamydia trachomatis in Women 15 to 29 Years of Age: A Cost-Effectiveness Analysis Ann Intern Med. 2004; 141:501-513.

Insinga RP, Dasbach EJ, Myers ER. The health and economic burden of genital warts in a set of private health plans in the United States. Clin Infect Dis 2003; 36:1397-403.

Maclean, Courtney C, Stringer, Jeffrey S A, J Acquir Immune Defic Syndr, 2005-Apr-15; 38(5):570-7

National Evaluation of the Teenage Pregnancy Strategy Final Report Synthesis of an independent evaluation of the strategy published in 2005. (http://www.everychildmatters.gov.uk/health/teenagepregnancy/research/)

National Institute for Health and Clinical Excellence (2006) The public health guidance development process: an overview for stakeholders including public health practitioners, policy makers and the public.

National Institute for Health and Clinical Excellence (January 2009) The guidelines manual. London: National Institute for Health and Clinical Excellence. Available from: www.nice.org.uk

National Survey of Sexual Attitudes + Lifestyles (NATSAL); 1990-91

O'Donnell, L., Stueve, A., San, D. A., Duran, R., Haber, D., Atnafou, R., Johnson, N., Grant, U., Murray, H., Juhn, G., Tang, J., & Piessens, P. 1999, "The effectiveness of the Reach for Health Community Youth Service learning program in reducing early and unprotected sex among urban middle school students", *American Journal of Public Health*, vol. 89, no. 2, pp. 176-181.

Office of National Statistics

Pilgrim H, Payne N, Chilcott J et al (2010) *Modelling the cost-effectiveness of interventions to encourage young people, especially socially disadvantaged young people, to use contraceptives and contraceptive services* www.nice.org.uk

Pinkerton SD, Abramson PR. Evaluating the risks: a Bernoulli process model of HIV infection and risk reduction. Eval Rev. 1993; 17:504-528

Pinkerton SD, David R. Holtgrave DR, and Jemmott JB; Economic Evaluation of HIV Risk Reduction Intervention in African-American Male Adolescents *JAIDS Journal of Acquired Immune Deficiency Syndromes; 2000* **25:**164–172

Sonnenberg, Frank A, Burkman, Ronald T, Hagerty, C Greg, Sonnenberg, Frank A, Speroff, Leon, Speroff, Theodore, , Contraception,2004-Jun; 69(6):447-59

Testa AC, Coleman LM. Accessing research participants in schools: a case study of a UK adolescent sexual health survey. Health Education Research 2006 21(4):518-526

Wang LY, Davis M, Robin L, Collins J, Coyle K, Baumler E. Economic evaluation of Safer Choices: a school-based human immunodeficiency virus, other sexually transmitted diseases, and pregnancy prevention program. Archives of Paediatrics and Adolescent Medicine 2000; 154(10):1017-1024.