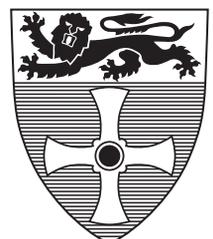fpa

putting sexual health on
the agenda

The Economics
of Sexual Health

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NEWCASTLE UPON TYNE

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Introduction

In recent years there has been increasing acknowledgement of the need for significant improvements in sexual health services in England, which have been described as being in "crisis". In recognition of this need, in 2001 the Department of Health (DH) published the first National Strategy for Sexual Health and HIV[1], with associated guidance to encourage PCTs to make improvements in sexual health services across England[2].

However, very little economic evidence was used as the basis for the policy recommendations included in the Strategy, particularly those relating to contraception and abortion services (also known collectively as fertility control). This raises two key questions: firstly, does such economic evidence exist? Secondly, if there are gaps in the evidence, in terms of interventions covered or quality of studies, can research be conducted to fill these gaps and provide robust economic evidence for sexual health policy? These questions are particularly relevant now as the last key report in this area, on the economics of contraception, was published over ten years ago[3]. In addition, despite increased Government commitment to and investment in sexual health services since the launch of the Strategy, it is clear that there are not unlimited resources within the NHS for sexual health.

In this context, we must also raise the question of whether it is possible to meet the needs and preferences of users of sexual health services more effectively within the current budget, or even with some budget savings. To address this question, **fpa** commissioned a two-stage research study into the economics of sexual health in England, focusing on contraception and abortion services. The two main aims of the research were:

1. To assess the existing literature on the economics of contraception and abortion services, in terms of both its quality and its relevance to current policy questions.

2. Building on this assessment, to model the economic impact of changes in contraception and abortion services.

The research was carried out between April 2003 and July 2005 at the Centre for Health Services Research at Newcastle University, and was particularly timely given the renewed focus on sexual health in the Public Health White Paper *Choosing Health*, published in November 2004[4]. The DH has committed £300 million towards the implementation of the White Paper's sexual health proposals, of which £40 million has been earmarked for contraception services[5].

The research produced some strong findings, which are detailed in this report:

- **Part 1** details the first stage of the research, which reviewed existing evidence, and shows quite clearly that there is a significant lack of economic evaluation studies for contraception and abortion services which are meaningful for decision-makers, and

therefore that there is scope for further research in this area to improve the evidence base for policy-making.

- **Part 2** outlines key findings from the second stage of the research, which modelled the costs and benefits of policy changes for contraception and abortion services. These changes would produce significant cost savings for the NHS, which in the medium term could amount to over £60 million per year.

Overall, the research shows that not only is it feasible to improve contraception and abortion services in ways that better meet the preferences of service users, but also that there is a considerable net saving of up to £1 billion over 15 years to be made from doing so. This report therefore provides both up-to-date research on the cost savings to be made nationally from implementing improvements to contraception and abortion services; and also important evidence and input for PCTs as they determine how best to improve these services at a local level, in particular how they allocate any new funding for this purpose.

Part 1:

A systematic review of economic evaluations of contraception and abortion services and methods: their relevance to current policy in England

The intention of this systematic review is to assess the extant economic literature, judging its quality by its:

- ability to support the classification of the interventions studied in the literature in terms of their efficiency

- relevance to current policy questions, according to the recommendations of key stakeholders in sexual health.

As far as we know this is the first systematic review of economic evaluations in this area. It will be presented in six main parts. Firstly, a framework for our analysis is outlined, covering the basic principles of economic evaluation and a decision matrix based on these principles (which aids the classification of interventions in terms of their efficiency). Secondly, a set of criteria for judging the quality of each study that informs the classification is presented. This includes a listing of costs and benefits of fertility control technologies that ought to be considered for estimation. Thirdly, the methods used to identify studies and extract data from them are outlined. Fourthly, the results of the studies are classified in terms of which part of the decision matrix the interventions fall into regardless of individual study quality. Fifthly, the quality of the studies is evaluated through a discussion of key methodological issues. The classifications are then re-presented in the light of study quality. Finally, the value of the evidence in supporting the stated policy of key stakeholders in sexual health is discussed and, by implication, the degree of support for such policy recommendations from economic literature. We conclude with recommendations for further research with respect to both methodological developments that are required and policy questions that remain to be addressed.

1. Framework for analysis

1.1 Basic principles

Economics examines how best to use resources. The need to do this is based on the undeniable fact that resources are scarce in the sense of not having enough to meet all needs. If this statement is taken as given, there should be no dilemma in accepting that choices have to be made about what health services to provide. No matter what worthy statements are made about rights of access to care and meeting needs, therefore, some rights and needs will be met while others will not (at least, not immediately).

How then, do we decide which needs to meet? The theoretical basis of the economic approach to this question is the principle of opportunity cost. Because of scarcity and the need to choose, certain opportunities will be taken up while others will be discarded. Meeting one right or need means that the opportunity to meet another is missed. Economists refer to the benefits or 'utility' associated with forgone opportunities as opportunity costs. If the aim of decision makers (DMs) is to maximise benefits to the community, and thus minimise opportunity cost (i.e. minimise benefits forgone), there is a need to *consider* gathering evidence on both the costs and benefits of health care. By measuring costs and benefits, we can choose that combination of resources which maximises benefits (and, consequently, the amount of need met) from available resources (a given *budget*, whether for health services as a whole or for an area like fertility control).

1.2 A decision matrix

The type of evidence that includes both costs and benefits is known as economic evaluation. Economic evaluation is "the comparative analysis of alternative courses of action in terms of both their costs [resource use] and consequences [health and other effects on well-being]"[6]. In this study "alternative courses of action" can be equated with different ways of providing contraception or abortion services, for example a change from one contraceptive method to another. "Consequences" might also be equated with benefit. However, this will only be true when the consequences are a measure of the extent of fulfilment of DM goals. *Effectiveness* is the term most commonly used to denote only *health-related* consequences, but for the moment, although *benefit* is broader, for exposition it can be considered equivalent to effectiveness. Later, when discussing contraception specifically, it will become more convenient to use *effectiveness* to denote a narrower measure of benefit, for example pregnancy prevention.

We have adapted a simple framework for putting into practice the concept of opportunity cost in systematic reviews of economic evaluations that was developed by Vale et al[7]. By deriving and linking estimates of relative costs and benefit for alternative procedures *for a given population*[8] under consideration it should be possible to determine whether one procedure is:

- less costly and at least as beneficial as its comparator, in which case it would be judged, unequivocally, to be a better use of resources (i.e. more technically efficient and often referred to as *dominant*); or

- more costly, and more beneficial, than its comparator, in which case there would be *insufficient* information from an economic evaluation for a single population (in effect, a single economic evaluation)[9]. This raises an allocative efficiency question, as the extra resources required would have to be found from within the budget, e.g. for fertility control, or elsewhere within the NHS. A DM would only want to take resources from elsewhere in the budget, e.g. from an abortion service to expand contraception services in some way, if the opportunity cost (the loss in benefit from doing so) was less than the gain from adopting the new contraceptive. This question cannot be answered by an economic evaluation for a single population, but at least the study will have highlighted the magnitude of additional costs incurred and benefits gained for that population.

Data on benefit and costs can be brought together in a matrix format (Figure 1) to aid in the judgement about whether, for a given population, one procedure (say, a new therapy) is preferable to a comparator (often, current practice). Under the matrix in Figure 1 it can be seen that relative to the comparator, a new procedure could achieve (1) greater benefit, (2) the same level of benefit or (3) less benefit. A final alternative (4) is the possibility of there being no or unreliable evidence on relative benefit. In terms of cost, a procedure could (A) save costs, (B) result in no difference in costs or (C) increase costs. Again, there is a further possibility (D) where there is no evidence on relative costs. Figure 1 is adapted from that which appeared in early additions of the Cochrane Collaboration Handbook[10] and which was later updated[11].

Figure 1: **Matrix linking benefit with cost**

Benefit

Compared with the control treatment the experimental treatment has:
1. Evidence of greater benefit
2. Evidence of no difference in benefit
3. Evidence of less benefit
4. Insufficient evidence to judge difference in benefit

Cost

Compared with the control treatment the experimental treatment has:
A. Evidence of cost savings
B. Evidence of no difference in costs
C. Evidence of greater costs
D. Insufficient evidence to judge difference in costs

The results of studies from the systematic review will be placed in the matrix. For any new procedure being compared with current practice, evidence producing either a tick (implying adoption of the new procedure) or a cross (implying rejection of the new procedure) allows a decision to be made without gathering further evidence (i.e. the evidence is sufficient). When there is an 'equals', sign the DM would be *indifferent* and therefore probably stick with the status quo. Question marks indicate that there is insufficient evidence for the technology change for that population (in effect, insufficient study *quality*)[12], although this does imply a decision to stick with the status quo.

The shaded squares indicate that there is an opportunity cost to adopting or rejecting the new technology. In cell C1 benefit can be gained, but at the expense of increased use of resources. In order therefore to make a decision, the evidence we have is again insufficient but here in the sense that we need evidence for at least one other population. If the technology change for the first population is to be funded, it must come from a technology change to some other population(s). The technology change for the first population can then only be shown to be efficient if, and only if, there is a *net benefit* increase when adding the benefit increase for this population to the opportunity cost (benefit increase or decrease) for the other population(s). In order to accommodate this broader perspective, at least to a degree, our review has considered all economic evaluations in the area of *fertility control,* covering contraception and abortion. Therefore, the evidence can be judged by its sufficiency to inform decision-making both in terms of individual study quality and as a body of evidence to estimate the opportunity cost and thereby, net benefit[13].

2. Judging quality

To assess the validity of classifying technologies in the above matrix, it is important to make judgements on the quality of evidence underlying these placements. We have decided not to attempt to score or rank or use a threshold in terms of quality. This is because we would argue that such standards should not be rigidly applied: ultimately the quality of a study should be judged by the extent to which it helps DMs fulfil their goals i.e. how beneficial it is. A poor quality study as judged by a set of criteria might nevertheless be useful, particularly if accompanied by a well-informed critique[14].

The following is a discussion of those characteristics of studies that are considered most important, particularly to this review. They are based on guides to judging the quality of economic evaluations[15-18].

2.1 Defining costs and benefits of sexual health services

It is important to delineate the types of cost and benefit that should be looked for when reviewing economic evaluations, especially for complex areas such as sexual health services. Which categories are included and how they are presented are just as relevant to consider in judging the quality of studies as, for example, design of the study.

2.1.1 Costs

These can either be direct or indirect, where direct costs are "the value of all resources consumed in the provision of a health care intervention" and indirect costs are the costs of lost productivity, for example due to taking time off from work to use a service[19].

Direct costs can be further subdivided by the perspective of the analysis (essentially whose budget is affected). Different perspectives can be those of: an institution (e.g. hospital/clinic); consumer/user or her/his relatives/carer (including person accompanying the user to an appointment); health service (where costs are incurred by more than one institution or centrally); other public sector agencies, for example in providing income maintenance payments. Table 1 gives a simple description of cost categories relevant to each perspective.

Table 1: **Costs (and cost savings) of contraception and abortion services**

Costs to:	Type of cost incurred/averted
User/carer	Travel
	Lost work
	Out-of-pocket expenses
Institution/health service costs of contraception	Contraceptive method (e.g. drugs or devices in different quantities)
	Staff time in dispensing or fitting drugs/devices
	Education and counselling/support
	Training staff
	Treatment of side-effects and complications
	Contraceptive failure (resulting in costs of unintended births and abortions)
	Treatment of HIV, sexually transmitted infections (STIs) and pelvic inflammatory disease (PID)
Institution/health service costs of abortion	Termination method (e.g. drugs – including anaesthetic for surgical abortion – and surgical equipment)
	Staff time in carrying out the procedure
	Counselling
	Pregnancy testing (including ultrasound)
	Testing for infection and/or antibiotic treatment
	Treatment of complications
	Surgical abortion following incomplete medical abortion
	Abortion 'failure' (resulting in costs of births)
Litigation costs	E.g. for problems leading to sterilisation failure, IUD insertion problems
Other public sector costs[20]	Payment to family for child (e.g. child benefit)
	Payment due to low income (e.g. income support)
	Payment for child (outside of family) (e.g. residential services or for adoption)

To provide a full costing one would need both quantities of each category as well as unit costs (prices) because such factors will vary across settings (e.g. country)[21,22]. However, such data can be difficult and costly to collect in detail. A partial remedy is sensitivity analysis, whereby different values of such variables can be assumed and their impact on the final results tested. However, there are limits to the number of different unit costs that can be varied, the ranges that they are varied through and the knowledge of the researchers, or even experts, of relevant values for such an analysis.

It is also important to note that cost savings are implicitly included in this table. For example, unwanted pregnancies (contraceptive failure) prevented will result in substantial savings in the costs of pregnancies, births and abortions (induced or spontaneous) as well as in benefit payments. The term 'abortion failure' is used to mimic 'contraceptive failure', but of course only refers to the *absence* of abortion where the pregnancy was unintended. Just as for contraception, the extent to which costs can be counted depends on whether, given an abortion had occurred, such costs would have been incurred anyway with another pregnancy at a later date (see sub-section on *pregnancy timing assumption* in 'Key methodological issues' below). Often these avoided costs are thought of as 'benefits' of interventions. However, here, we have chosen to think of all positive and negative resource impacts on the cost side: the following section, on benefits, focuses on what DMs are trying to achieve, given such costs, from their fixed budgets. That way, DMs can judge, for any given service or intervention, what are the net gains in benefit relative to any net costs incurred to achieve such gains. This also fits with the matrix presented in Figure 1.

2.1.2 Benefits

In this sub-section we first consider what is meant by benefit – based on a brief summary of some qualitative research and interviews with DMs in the area of sexual health in England – to compile a corpus of measures of benefit, which is summarised in Table 2. We then go on to discuss what this means in the context of the review.

Qualitative research summary

Essentially, benefits are what DMs are trying to achieve with their limited resources and, as such, benefit was defined as the extent of fulfilment of DM goals. We began with the assumption that we needed to gather evidence on what these measures were. The initial hypothesis was that extant fertility control literature would have used only a very small number of measures of outcome, which therefore did not permit direct measure of benefit. Therefore, we wanted to show the variability in measures rather than estimate their value. This implied a qualitative approach, with data coming from individual in-depth interviews rather than focus groups.

Sampling was done to maximise coverage of terms and therefore seven DMs representing different perspectives (e.g. NHS management, physician, public health, user advocacy) were chosen. The measures were arranged into theoretical categories, according to common

representation in health economic literature. This was done to facilitate elicitation during interviews and to most efficiently represent the products of the interviews. Table 2 provides a summary of the categories and example of sub-categories (we recognise that these are not exhaustive). The categories are defined below.

Table 2: **Benefits of contraception and abortion services**

Main category:	Sub-category:
Health	Sexual health, fertility control, prevention of: unwanted/unplanned pregnancies and births, ectopic pregnancies, infections, stroke, thrombosis, uterine wall perforation, etc
Quality of life	Happy/reasonable/good life, self-esteem, knowledge/understanding/education, ability to work or study, and avoidance of: feeling ill, stress/hassle, pain, worry
Equality of	Provision, access, benefit, standards, availability, fertility control, choice, health, resources, competencies/skills of commissioners, skills of clinicians
Equality by	Age, location, capacity to benefit, probability to access, initial health, ethnic group, service, culture, choice, deprivation, disability
Access to	Fertility control (contraception and abortion) methods and services, sex education in schools/sex and relationships education, knowledge, understanding
Other access issues	Waiting time, availability
Social	Benefit, cost, choice, health, preference, values
Individual benefit	Choice, fulfilment of aspirations, goal achievement, respect of individual perspective/values/importance, satisfaction, empowerment/control, happiness

Health and *quality of life* (*QoL*) are the most obvious outputs of a health care technology and therefore an obvious goal is to improve health or its constituent parts. It is, however, not easy to define, although it should logically include *sexual* health. What is important to state here is that we have included prevention of unintended or unwanted pregnancy. This is because, although they might not easily fit with a definition of health, they are the most obvious outputs of contraception. Health is also differentiated from QoL, which is just as difficult to define[23]. Generally, QoL would be accepted as being broader such that one component of it could be health. The World Health Organization (WHO) defines health as "A state of complete physical, mental, and social well-being not merely the absence of disease". It defines QoL as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns"[24]. Here, because we are using benefit to capture fulfilment of goals, QoL is not as broad. In fact, it might be closer to the WHO definition of health, which we might call 'health-related QoL', with health referring more to the most obvious outputs of health care technologies and the absence of disease.

Equity is yet another difficult concept. A recent discussion paper considering whether the NHS is equitable states: "an equitable service is defined as one that offers equality of access to health care to individuals in equal need (often referred to as horizontal equity)"[25]. However, at its most general, it is simply defined as 'fairness', which might be interpreted as

'treating people equally'. The difficulties in defining the term have been discussed at length[26]. Essentially, equity is used to refer to a set of terms for describing *distributional equality* i.e. how some attribute (*equality of*) is distributed between individuals who differ by some measure (*equality by*), such as gender, age or socioeconomic status. This attribute could be, as above, access to health care, but it could be health itself or expenditure. Although these concepts are challenging to define, it is crucial to understand which one is the goal of the DM since it can be shown that fulfilment of one might prevent fulfilment of the others[27]. It is clear that equity terms, like social ones, qualify others. For example, one can have a goal of improving health and one of improving health equality.

Accessibility is used interchangeably with *access*. It is distinguished from equity in that, although one DM goal might be to increase equality of access, another might be to increase access irrespective of its distribution. Yet again it is not straightforward to define, and includes utilisation and costs incurred in receiving health care[28].

Social is more a qualifier for other terms in that it refers to goals for any people other than the service user. These include family but also non-family, such as society as a whole. For example, 'public health' is translated to *social health.*

Individual benefit refers to measures which are related to the way in which the extent of fulfilment of a goal of the DM is derived from the benefit of other individuals or, in economic terms, by maximising the utility of others i.e. a DM might have a goal of fulfilling the goals of individual service users or society as a whole. Therefore measures of preference or the values of individual members of defined groups would be relevant here.

Relevance to the review

The predominant measure of benefit for contraceptive technologies is rate of unintended/ unwanted pregnancies prevented and, thus, births and abortions prevented, which is referred to generally as contraceptive *effectiveness*. These can also imply substantial cost-saving effects, where costs are expressed as the costs of *failure.* However, measurement is not straightforward. As surveys have revealed, just because a woman gets pregnant whilst using contraception and thus might be inferred as having not intended to, does not mean that she does not *want* to be pregnant or to give birth and subsequently bring up the child[29]. Therefore the benefit and savings of preventing unintended pregnancies might be reduced by that proportion that turns out to be wanted. One way in which this is modelled is to assume that, although some births turn out to be wanted, it would have been preferable for them to have occurred later. This is known as the *delayed or mistimed birth* model[30], as opposed to the *averted* birth model, which assumes that all births from unintended pregnancies are unwanted.

Another obvious measure is related to STIs, where, in theory, one method might be superior to another in preventing pregnancies but inferior in preventing STIs, which highlights the difficulty in measuring benefit given multiple goals/dimensions. The quality adjusted life year

(QALY)[31] is an attempt to weigh up multiple dimensions of benefit in terms of the dimensions of health-related QoL. It is currently the most prevalent way of measuring individual health and well-being in economic evaluations in the UK and is the method adopted by the National Institute for Health and Clinical Excellence (NICE) in assessment of technologies. The technology with the highest benefit in this sense would produce the most QALYs per individual. User satisfaction is related in the sense that one would expect someone to be more satisfied with the option that gives the highest number of QALYs. However, this research has focused specifically on fertility control, i.e. the prevention of pregnancy as a measure of benefit for contraception, therefore we have not taken into account the measures of benefit relating to STIs.

Another measure of benefit is the range of choices of methods (*profile*) of contraception or abortion available where the goal would be *to increase the range of methods available.* Of course, although increasing the range of choices could be a goal, it might also be instrumental in increasing the benefit of users and both goals could be instrumental in increasing compliance in order to increase effectiveness. This is particularly so with contraception, there being some evidence that increasing the range (width of profile) leads to a reduction in unintended pregnancies through women being able to obtain the method they prefer and, therefore, increased compliance.

So far we have discussed benefit as it accrues to an individual, which can then be aggregated across individuals to estimate total incremental change in implementing a new technology. However, benefit can also be expressed in terms of some concept of equity such as equality of access or equality of health. It is a key aim of the National Strategy for Sexual Health and HIV that there is increased equality of access to contraception. Increasing the proportion of abortions funded by the NHS across all PCTs is another. However, very few health care intervention studies, either effectiveness only or economic evaluations, have been designed to measure the effect of technologies on inequalities[32].

Finally, it has been argued, given that welfare *costs* of raising a child are measured in contraceptive and abortion technologies, that the *benefit* of the life of the child should also be measured. On this basis contraception and abortion might result in a gain in maternal QALYs but a loss in QALYs of the child. However, it is certainly the predominant belief, as reflected in law, policy and opinion that women should be able to choose to have an abortion without this formal method of weighing up consequences, which highlights the difficulty in measuring the benefit of these technologies.

2.2   Method of estimation of costs and benefits

The two basic designs are *sample-based*, such as a randomised trial, where novel individual patient-level data is obtained for interventions being compared, and *modelling*, where data from various sources are used, including possibly sample data as well as locally determined data (e.g. unit costs, expert opinion or assumptions).

Details on how to review sample-based designs, both trial and observational, can be found elsewhere[33]. Those issues that are most important in this review are discussed in the section on key methodological issues. Those to do with the sample include size and representativeness of the population of interest. Issues of design cover whether and how randomised, whether prospective or retrospective and extent of blinding. Control for bias covers the accounting for losses to follow-up (including analysis by intention to treat [ITT] or treatment completers only [TCO]) and comparison of groups by baseline characteristics.

Given the ethical and practical difficulties of randomisation in sexual health, particularly with contraception, it is not surprising that the vast majority of studies use modelling. For modelling studies, validity is related largely to the methods for obtaining the parameter estimates that populate a model. There is no Gold Standard, but a systematic review of the literature is preferred[34,35]. Other points to be aware of in the section on key methodological issues are: model structure, which includes any assumptions, particularly those regarding contraceptive failure rate and switching/continuation, which indicate most of the central assumptions for estimating effectiveness; pregnancy timing, which indicates whether an *averted* or *delayed birth* model has been used; and, in the studies comparing whole contraception services, a consideration of contraceptive method prevalence. One would also expect some form of sensitivity analysis given that there is always doubt as to choice of structure and estimation methods for a model, although the choice of analysis is also largely subjective.

2.3 How cost and benefit information has been combined (incremental analysis)

Where a new intervention (or profile of interventions) is compared with the status quo, and where the new intervention is both more costly as well as being more beneficial (as in cell C1 in Figure 1), it is best to present these results in an incremental fashion, thus examining the extra costs per extra unit of benefit gained. Such a 'rate of return' is useful for DMs in terms of thinking whether the extra gains are worth the extra costs incurred. Therefore, if cost and benefit information is combined as a ratio it should be the ratio of *incremental* cost and benefit (often referred to as an incremental cost-effectiveness ratio [ICER]). The alternative is the ratio of average cost/benefit (of a single technology). However, a decision to adopt the technology with the lower average could be incorrect since a lower average, even with an increase in benefit, does not reveal how much higher the cost is and therefore prevents calculation of the opportunity cost.

Where, as is frequently the case for contraception, there are more than two technologies, in order to compare on this basis they should each be compared with the next most/least beneficial/costly. For example, a new more effective method of contraception might be more costly than the status quo. However, a third method, which is more effective again should have its cost compared to the next most effective. However, this assumes that the methods

are *mutually exclusive* i.e. only one can be implemented for all *suitable* users. For example, for all current oral contraceptive users, some might require or prefer IUDs and some implants. Strictly speaking, those most suitable for IUDs and those most suitable for implants belong to different *populations,* and should be analysed separately. Therefore, as will be noted in the context of the actual studies, this might be too strong an assumption for contraceptive methods.

2.4   Timing issues

One final point is that the difference in benefit and cost between technologies can vary with time horizon. For example, vasectomy will incur larger costs initially than oral contraceptives. However, those for the former are non-recurring, in contrast with the latter. Therefore, the longer the time horizon the more favourable vasectomy will become, all other things being equal.

3.   Search strategy

As shown above, a DM demanding evidence in the form of economic evaluations, where there might be an opportunity cost, will need economic evaluations for more than one population. It was therefore decided, given the *a priori* belief that the number of economic evaluations would be small enough to accomplish the task within a year, to review economic evaluations for all populations within the area of fertility control (contraception and abortion)[36]. Therefore we could test the hypothesis that current literature is lacking both in quality of *individual* studies and *as a body* for helping DMs fulfil their goals. This would then inform the design of future research.

Each population is essentially defined according to the technology used, for example *contraceptive method* users (with particular characteristics e.g. female, aged 18–49, not intending to get pregnant). Therefore, studies were searched by *technology category* (corresponding to a broad population). These are individual methods of contraception or abortion (referred to as *contraceptive methods* and *abortion methods*) as well as what we called 'service delivery modes'. This latter category included comparisons of whole *contraception services* as in the study by McGuire and Hughes[37], which might be described as consisting of a contraception profile (reflecting the prevalence of individual methods). Other categories added during the review were *contraception other* or *abortion other*, to contain components of provision (e.g. direct referral for laparoscopic sterilisation or prophylactic antibiotic treatment for abortion), and *emergency contraception* (EC) reflecting comparison of methods and means of delivery (e.g. pharmacy prescribed).

The search strategy was designed in order to be broad enough to encompass all of these categories as well as not exclude on the basis of standard quality criteria e.g. randomisation or systematic review to obtain parameter estimates for modelling. A pilot search was done in

the belief that the number of economic evaluations would be so small as to warrant retrieval additionally of effectiveness only studies. However, this produced over 40,000 studies, which was considered far too many to screen. The strategy was then revised to incorporate a highly sensitive economic filter used to locate economic evaluations for the NHS Economic Evaluation Database (NHS EED)[38]. The database is recommended to be searched to increase sensitivity in Health Technology Assessment (HTA)[39]. This filter was then attached to one that was devised in collaboration with the expert group (see Appendix 1 for full membership of the group) to locate the relevant interventions. The strategy was then adapted for use in four databases, as recommended[40]: Medline, EMBASE, SCI and Popline to cover the period from 1980 to December 2003. The NHS EED was also searched and the pharmaceutical company Schering provided a list of studies from a prior search of the Health Economic Evaluation Database (HEED); this was used to validate the search strategy. An update was also performed to cover the period from January until end of August 2004.

3.1   Retrieval and screening

References were retrieved from Medline first, then EMBASE, SCI, Popline and finally NHS EED, removing duplicates at each stage. In fact, unsurprisingly since we used the same filter as for NHS EED, no studies were found additional to those found in the other databases. Where references included an abstract, these were sorted out. Another filter was then applied to include only those that included the free text items: 'cost', 'economic' or 'price' in either the title or the abstract. The basis for this was the experience of the author in filtering studies for the NHS EED that if a study had an abstract it would contain some details on the method and/ or results in terms of cost, and that any study that did not contain such information in the abstract was very unlikely to contain any useful cost information. A sample of the references with abstracts revealed no loss of sensitivity. All titles were examined in the references without abstracts. Studies that appeared to be economic evaluations and/or that required viewing of the full paper were screened according to the exclusion criteria as set out below, and if in doubt about relevance to the UK a second reviewer from the expert group saw them.

3.2   Exclusion criteria

Studies were excluded prior to seeing the full text version if they were in a foreign language. From the full text article, studies were not counted as economic evaluations if they contained *insufficient cost data*, on the basis that an economic evaluation is useful in that it provides an estimate of the association between benefit and cost. Therefore resource use data should either be derived from the same sample as the benefit data or, in a modelling study, cost should be a product of the model and not simply taken from another source. Economic evaluations were excluded in two categories: interventions not relevant to the UK and those studying use of condoms only to affect HIV transmission. However, ostensibly *cost only* studies were included, which measured benefit as savings as mentioned in the section on costs above. This is because, for contraception studies, either service or method comparisons,

assuming that pregnancy prevention outweighs any bad effects of contraception, savings due to pregnancy prevention *imply* an overall benefit increase. On a similar basis, abortion service studies were also included, although the assumption of an overall benefit increase through prevention of birth (as opposed to pregnancy) might be more controversial.

Table 3 shows the results of the retrieval and screening process.

Table 3: Results of retrieval

Database	Total retrieved	Full text screened	Economic evaluations	Not relevant to UK	HIV only	Reviewed
Medline	3092	105	35	8	7	20
EMBASE	2382	37	24	10	6	8
SCI	131	20	1	0	0	1
Popline	16	4	4	2	0	2
Update	225	2	1	0	0	1
Total	5846	168	64	20	13	32

To this were added two studies not referred to on any of the databases[41,42] to make a total of 34 studies.

3.3 Summary of characteristics of studies reviewed

The 34 studies have been data extracted and a brief summary provided in Appendix 2. Of these, 11 compared whole contraception services with no service, one a service with over the counter (OTC)[43] oral contraception to without, nine individual contraceptive methods, three contraceptive other, three EC, and two abortion services and two each of abortion methods or abortion other. One study[44] was largely a contraceptive method comparison but did also compare *contraceptive profiles* i.e. in the manner of contraception service comparisons. Another[45] was essentially a service comparison but incorporated a comparison of individual methods, which was reproduced (with minor alterations) in another publication[46]. Six were from the 1980s, 18 from the 1990s and ten from 2000 to 2004. Eighteen were conducted in the US and ten in the UK with one each from Canada, Mexico, Peru, Portugal, Thailand and Turkey. The vast majority (27) derived estimates of benefit and/or cost via modelling as opposed to sample. All 25 contraceptive method, EC or service studies used modelling. Four out of six abortion studies were sample based; only the service ones used modelling.

4. Results

4.1 Classification of interventions according to decision matrix (without considering study quality)

In order to find the position of the results from each study in the matrix one needs incremental cost and incremental benefit. So an unequivocal improvement would be where one technology dominates (is more beneficial and less costly than) the other, represented by cell A1 in the matrix. It is very important to understand that discussion of the quality of the evidence is left until the key methodological issues section below and therefore any inferences made in this section are only preliminary. However, it might reasonably be inferred that the greater the number of studies that showed the same outcome in terms of both a decrease in cost and increase in benefit of a similar technology change, despite methodological variation, the stronger the recommendation. Therefore, bearing in mind the important caveat mentioned above, within each technology category, interventions are classified in terms of the degree of consensus (*number of studies* with given classification for an intervention *out of number of studies* comparing that intervention) for the decision matrix position.

For **contraception services** *11 out of 11*[47-56] studies showed that, despite much variability in configuration, providing a public service dominates (saves costs and increases benefit in comparison to) not having one (cell A1). Put another way, on this basis if a DM was to consider removing the service, they should choose not to. This assumes that we consider preferences of service users to be paramount and, thus, averting unwanted pregnancies to be beneficial. Essentially, the increase in benefit is due to replacing existing methods with more effective ones. Such is the assumption that explains the results of the only other study in this category: the dominance of a service with OTC oral contraception over one without OTC availability i.e. that users of less effective methods switch to oral if it becomes available OTC[57].

For **abortion services** the conclusions are less certain, since there is no clear summary measure of benefit, although *two out of two* studies[58,59] show a decrease in cost through prevention of unwanted *births*, instead of pregnancies in the case of contraception. They would be dominant (cell A1) if we assume that prevention of unwanted births is an adequate summary measure. This is more controversial in the US and therefore it is not surprising that both studies of this type were conducted there.

For **contraceptive method** comparisons the results are more mixed. They are also difficult to interpret, given that no two studies compare the same methods and methods are defined with different degrees of precision (e.g. 'IUD'[60], 'copper-T IUD'[61] and 'copper T 380A'[62]). However, vasectomy dominated in *three out of five* studies[63,64]. It was the most effective and second cheapest in another (incremental cost per pregnancy prevented of $7157.89 versus copper-T IUD, which was the cheapest)[65] and the second cheapest in the fifth

(copper-T IUD was also the second cheapest, but effectiveness was not reported)[66]. In the last study by Trussell et al (1997) they measured STI rates as well as unintended pregnancies and therefore, whilst vasectomy would have ranked top in terms of pregnancy prevention, it did not in terms of STI prevention. Because effectiveness was not reported it is impossible to calculate incremental cost per pregnancy prevented. Also, in the Trussell et al (1997) study for adolescents vasectomy is not seen as an option and, perhaps surprisingly, condom plus withdrawal was the cheapest, probably swung by the low STI rates.

Two out of six studies showed copper-T IUD to be the cheapest and, in each, vasectomy was the most effective[67]; in three of the other studies vasectomy dominated. In the other study[68] IUS dominated all but tubal ligation, which had an incremental cost of $1148 per pregnancy prevented, although vasectomy was not compared. In *one out of six* studies[69] Depo-Provera (medroxyprogesterone acetate injection) was found to dominate, although neither vasectomy, IUS or IUD were compared in this study. It was also the cheapest in another[70], where vasectomy was the most effective with an incremental cost per QALY of $18,064 versus Depo-Provera. Implanon (etonogestrel subdermal implant) was only compared in one study[71] (assuming that 'implant' in other studies refers to Norplant – levonorgestrel implant) and was found to be the most effective: only Norplant was cheaper. Also, French et al[72] showed that Norplant was dominated by Depo-Provera using effectiveness data from one primary study, but, using effectiveness data from other studies, was more costly and more effective than either Depo-Provera or oral. These findings, though, are made irrelevant due to Norplant having been discontinued. The study by French et al is more difficult to interpret since it is actually a set of comparisons between only Norplant or IUS and one other method, based on effectiveness only studies, and copper-T IUDs are subdivided by quantity of copper. IUD>250mm^2 dominated IUS using effectiveness data from a study with a one-year time horizon, although using effectiveness data from studies with time horizons from two to five years, IUS was more effective and more costly (incremental cost per pregnancy prevented between £721 and £17,739) than IUD regardless of quantity of copper.

In *two out of two* studies EC dominated no EC[73,74]. In one of the studies[75] advance provision also dominated obtaining following unprotected intercourse. Progestogen-only was always more effective than combined (progestogen plus oestrogen) and dominated combined in the averted birth model in one study and, with regular use of some methods, in the averted birth model in the other study. Copper-T IUD was the most effective but also most costly in the only one of the studies where it was compared[76]. However, as the authors highlighted, the study was biased against IUD in that it only considered one episode of unprotected intercourse and that the IUD would be effective for more episodes. In the only other EC study by Marciante et al[77], pharmacy prescription dominated non-pharmacy (general practitioner [GP] or none) provision.

For **contraceptive other** comparisons, in the laparoscopic tubal ligation studies there was evidence of dominance by microscopic (2mm aperture) over standard (10mm aperture)[78],

outpatient over inpatient[79] and direct (GP) access over via gynaecology outpatient department[80].

For **abortion method** comparisons the only study comparing medical to surgical (manual vacuum aspiration [MVA])[81] showed that for women of less than nine weeks gestation, surgical was more beneficial in terms of percentage who would change procedure if they were to have an abortion again, and in terms of pain experienced, but was more expensive. The only study comparing different types of medical abortion[82] showed that, for women with a mid-trimester pregnancy, pre-treatment with mifepristone dominated pre-treatment with prostaglandin E2 (PGE2) on the basis of a reduction in induction to abortion interval.

For **abortion other** one study[83] showed that screening dominated no screening for infection prior to abortion and one study[84] showed that prophylactic treatment dominated screening.

In summary, the classifications given are supported by the evidence of at least one economic evaluation and in some cases more than one, providing a degree of consensus. However, none of these classifications have accounted for issues of individual study quality, which will now be discussed.

5.   Key methodological issues

This section provides qualifications to the classifications in the decision matrix. Much of the evidence shows technologies to be dominant such that, minus any issues to do with the quality of the individual studies, no further evidence would be required to make a decision. Even where there is already doubt due to the insufficiency of a single economic evaluation, i.e. where there is both *increased* cost as well as *increased* benefit, the following discussion will cast further doubt. Attention will be drawn to the variability in key characteristics between studies *within the same technology category*. In many cases it will be clear what the standard is, but in some significant areas such clarity is lacking and here the standard is to conduct a sensitivity analysis. Therefore, where studies appear to have sufficient similarity (across several characteristics), the effect of variability in another characteristic on the decision matrix (e.g. whether a technology remains dominant) is explored. Attention is also drawn to where such comparisons using sensitivity analysis have been made *within* an individual modelling study and again whether the decision would be sensitive to this variability.

Firstly, the variability in how technologies were compared will be presented as:

- comparisons and incremental analysis.

Then the following costing issues will be discussed:

- presentation of results
- costing contraceptive failure
- pregnancy timing assumptions

- costing in abortion service studies.

After this there will be a critique of the categories of benefit found in the studies.

Following this the issues related to modelling contraceptive effectiveness will be discussed under the headings:

- source of estimates
- modelling contraceptive prevalence
- effectiveness assumptions
- EC studies.

Finally, issues are addressed relating specifically to the minority of sample-based studies in the areas of:

- contraception other
- abortion method
- abortion other.

5.1 Comparisons and incremental analysis

Recall that each technology ought to be compared to the next best, thus constituting an incremental analysis. However, ten studies, which were all contraceptive method or EC studies, compared all to only one comparator, no method or vasectomy. Of course, this takes no account of user preference or suitability, except by users not intending to get pregnant and being at risk of getting pregnant (and adolescent versus all users in only one study[85]). In other words, it assumes that users would *switch* from the method they currently use to the method that, *on average* for all users, has been shown to be cost effective. As demonstrated in the contraceptive service studies, there is a profile of methods and, although this is likely to be partly a reflection of *availability* (*supply*), it is also a reflection of *suitability* according to preference (*demand*). Preference has been shown to depend on the perceived value of the different characteristics of each method, including effectiveness, as well as, for example, side effects, reversibility and user characteristics, for example age[86]. No methods were compared on this basis.

The one study where preference was used to sub-divide populations was that comparing surgical to medical abortion for women of less than nine weeks gestation[87]. Those who preferred medical/surgical abortion received medical/surgical abortion: only those who were indifferent were randomised. However, such a design does not allow comparison of interventions within the population of those who prefer medical or those who prefer surgical since each group only received one intervention. Therefore, we can most safely draw conclusions regarding a comparison of cost and benefit on the population who were indifferent between surgical and medical abortion.

Another problem is where studies vary in the actual methods analysed. This is only a problem if one is choosing between alternatives and a better one has not been included. For example, vasectomy was found to dominate in three studies[88] and Implanon to be the most effective in another[89]. However, in none of these studies were the two compared.

5.2   Costs

As discussed above, the standard is a full breakdown of costing into resource quantities and unit costs *given by* category of cost. The most limited is costs *given by* technology i.e. without any breakdown. There was huge variability in costing between the studies, which is largely an issue of transparency. Only one study[90] took a societal perspective and therefore measured indirect costs (in terms of lost productivity of users in visiting the physician). However, the main focus of the following discussion is on the area of costing that essentially is responsible for saving resources and money by preventing unintended pregnancy or birth i.e. the costs of the failure of contraception and also, to a lesser extent, lack of abortion.

5.2.1   Presentation of results

Costs in service comparisons and contraceptive method studies were not always presented in the studies transparently. In the case of contraception or abortion service studies (comparing having a service to not having a service) they were presented usually as 'service cost only' (excluding the cost of failure) and savings (cost *without* the service minus cost *with* the service) excluding or including service cost. Savings including service cost is clearly the total incremental cost, whereas savings excluding service cost is incremental failure cost only. The total cost of having no service, which was not given in these studies, is service cost equal to only the (failure) cost of unwanted pregnancies and/or births *without* the service. Similarly, the total cost of having a service is the service costs plus the (failure) cost of unwanted pregnancies and/or births *with* the service, which was also not given in these studies. The one exception was Chao and Allen[91] where results were presented most transparently: service cost and failure costs were presented separately and incremental cost combined.

For contraceptive method studies, the analogous terms are '*method* cost only' and 'savings including or excluding *method* cost'. For these studies however, it was more common to incorporate the two types of costs, method (provision) and failure, by the given method. Exceptions were Hughes and McGuire[92] and Trussell et al[93], although with the former the savings were not given either.

The ratio of savings (minus service cost) to service cost only was also given in all service studies except that by Zhu et al[94]. A ratio of '1' would indicate that there was no incremental cost. All showed a result above '1', indicating an incremental decrease by having a service.

5.2.2   Costing contraceptive failure

Contraceptive failure was in all 24 cases unintended pregnancy. For a minority it also included STIs, but for all studies the greatly reduced cost of having a contraception service or a more effective contraceptive method lay in the costs of the consequences of failure. For three service studies[95] prevention of births only (as opposed to pregnancies) were considered. The Nortman et al[96] study only added incomplete abortion to that picture and the Cakir et al study[97], although it gave the unit cost for abortion, was not clear in whether the costs of induced as well as spontaneous were included. The other 21 studies divided abortion into induced and spontaneous and 12 included a separate cost for ectopic pregnancy.

In order to compare the percentage of each consequence of failure (birth, spontaneous abortion, induced abortion, ectopic pregnancy), all were converted by us, either from probabilities or gross numbers, to percentages. Here the huge variability can be seen between studies, which might reflect different countries, populations (e.g. age groups) or time periods as well as author assumptions. Only the study by Marciante et al[98] accounted for any uncertainty in the values using a range of 25% and conducting a probabilistic sensitivity analysis by varying with other uncertain parameters. This produced a 95% confidence interval, although it did not show any effect on the position in the decision matrix. In fact, Marciante et al gave the lowest estimate of births of 28.03% with French et al[99] giving the highest of 67%. This difference could be explained by Marciante et al examining EC, for which, although not stated, a younger population would be most appropriate. French et al on the other hand were considering longer acting methods, for which an older population might be more appropriate.

These differences could be significant given that the costs associated with birth are generally much higher than those associated with abortion. This is where the economic perspective and time horizon for the child born from the unintended conception as well as the coverage of the welfare system become crucial. To illustrate this, consider two extremes: health service only perspective with one-year horizon and poor welfare system compared to public sector perspective with 16-year horizon and comprehensive welfare system. It should be quite clear which of the two would have the higher failure costs and therefore the most to save from preventing unintended pregnancy. In fact, these two scenarios mirror those of studies conducted respectively in the US and the UK. In the UK study by McGuire and Hughes[100] the savings to cost (of service) ratio was 11.09 (versus condom) to 29.39 (versus withdrawal). In the Forrest and Samara 1996 study set in the US the time horizon was only until hospital discharge and the ratio varied from 3.0 (versus an average of contraceptive profiles) to 7.8 (versus no method).

Time horizon also matters in terms of the period over which a method acts. For example, longer acting methods will be relatively cheaper the longer this is. Two studies[101] allowed variation depending on the duration of the product, although this biased in favour of longer acting reversible method because they took no explicit account of discontinuation. Most

studies used the same time horizon for all methods, the longest having 15 years[102] and the rest having five years[103].

5.2.3   Pregnancy timing assumption

As highlighted above, averted costs due to birth are the most important source of savings, but this also depends on whether those costs would have occurred anyway, given a woman's/couple's family size intention. Nineteen out of 23 appropriate studies implicitly assumed or stated that an *averted birth* as opposed to *delayed birth* model had been used i.e. all unintended pregnancies were assumed to be unwanted rather than at least some mistimed.

Of the studies examining contraception services all except Laing essentially appeared to use an averted birth model. In fact, only McGuire and Hughes[104] explicitly stated this. However, their method of calculating savings by adjusting costs averted by subtracting the probability of claiming welfare payments by families who are not 'typical' (married with one to two children) from that by 'typical' families is difficult to follow. Laing[105] implicitly assumed 100% mistimed, but did not specify the delay and therefore did not apply discounting. He appropriately adjusted any savings due to prevention of unplanned pregnancies by the relative probability, or relative risk (RR), of claiming benefit by families given unplanned versus planned. He assumed that the increased cost of an unplanned pregnancy is entirely due to the increased probability of that child growing up in a one-parent family.

Consistent with the delayed birth model Laing also did not include hospital costs since they would be incurred later anyway. The terminology used appears similar to that of McGuire and Hughes in the other UK study in terms of categories of claimants; however this is misleading. For example, 'typical' refers to all unplanned conceptions in the Laing study (as opposed to married with one to two children in the McGuire and Hughes study). Laing also refers to 'premarital (illegitimate)' conceptions. For both of these categories the RR of claiming given unplanned versus planned is equal to the RR of claiming given the conception grows up in a one-parent family. However, for the category of a family with more than three children, the model is tantamount to one of averted birth since the saving is due to not having an additional child. Given Laing and McGuire and Hughes conduct studies from essentially the same economic perspective and in the UK and use the same time horizon of 16 years, allowing for the methodological caveats just mentioned, one can make a rough estimate of the effect of averted versus delayed birth models. Indeed the highest savings to service cost ratio from Laing is only 5.3 (versus condom) or 15 (versus withdrawal), about half that from McGuire and Hughes.

The Forrest et al studies[106], set in the US, use a more transparent approach of modelling the increase in cost due to the addition of another member to the family, which would be saved had the pregnancy been averted. Of course, despite the differences between these studies, they all show a net financial benefit. On the other hand, as stated above, the UK studies in particular consider rather a drastic change in service provision: a smaller (perhaps more

realistic) investment in services might be more sensitive to the methods used, as well as more relevant to the current policy position.

The contraceptive method and EC comparisons all used an averted birth model except for three out of four of the Trussell et al studies[107], which used both averted and mistimed. Two of the studies specified the percentage mistimed, which differed slightly, and the length of the delay. Where both were used there was a difference for EC in that, although progestogen-only pills were always more effective they produced net savings (minus method cost) compared to combined (oestrogen and progestogen) only with the averted birth model. For non-EC methods the model made no difference in terms of the decision matrix position.

5.2.4   Costing in abortion service studies

Many of the issues discussed above apply also to the Evans et al[108] and Torres et al[109] studies comparing restricted (only where maternal life is threatened) with unrestricted access to abortion. Of course, here savings are due to births only prevented and produced a net saving. The applicability to the UK is limited by the fact that a policy of restriction would not be considered. Of course, as with the McGuire and Hughes and Laing studies, the consequences of having no public service could be modelled but again are not policy relevant. Also issues as discussed above in terms of time horizon, economic perspective and extent of the welfare system would apply. Generally, as with contraception, a more realistic scenario would be to consider *increasing* access to abortion, the savings from which are likely to be much more receptive to such issues.

5.3   Benefits

In this section comparison should be made with the standard of the measures of benefit elicited from interviews with DMs and shown in Table 2. Nineteen out of the 25 contraceptive modelling studies where savings were made by prevention of pregnancies (the other modelling study by Hendrix et al[110] assumed tubal ligation and vasectomy had equal benefit in this way and therefore only measured savings due to avoidance of complications) were essentially cost only studies. In fact, nine out of the 12 contraception service studies provided a summary measure anyway in terms of either number of unintended pregnancies/ births or incremental change in number of unintended pregnancies or births over the given time horizon for provision of the service. Of the four contraceptive method studies that were essentially cost only[111], only Trussell et al[112] provided a summary measure, in terms of number of pregnancies averted. Of the three EC studies, only one[113] provided a summary measure, in terms of absolute risk (of unintended pregnancy) difference, from the original trial of pharmacy versus no pharmacy provision. Even so, all imply benefit due to pregnancy prevention and, as stated above, a cost saving implies benefit increase, given that the saving is through reduction in unintended pregnancies.

This leaves six studies, which were all contraceptive method comparison. They provided measures of cost effectiveness in terms of cost per pregnancy averted only[114], or additionally, cost per couple-year of protection (CYP)[115] or cost per QALY[116].

Of the five studies measuring savings also by STI prevention, no summary measure of benefit in these terms was given. However, Sonnenberg et al[117] multiplied expected duration in various 'health states' including PID and HIV, as well as pregnancy, by utility values in order to calculate QALYs. The technique used to elicit these values (time trade-off) is well established[118], although not without controversy regarding validity, and the sample was only one of convenience.

Patient satisfaction was measured in only two studies both examining tubal ligation[119], as was the only other non-modelling contraception study[120]. In only the McKessock et al study[121] was there any kind of process measure, that of mean waiting time: clinician satisfaction was also measured in this study. The other two tubal ligation studies were about the surgical procedure itself and also measured rate of complications amongst other things. One of the abortion method studies[122] used process measures (number of gemeprost pessaries, induction to abortion interval) as well as rate of incomplete abortions. The other[123] used the proportion that would opt for the other procedure in the future. This showed that of those women who were randomised to either surgical or medical, a statistically significantly greater proportion would switch from medical to surgical than the reverse. However, it was shown that this was critically dependent on gestational age, i.e. the earlier the more likely that a woman would prefer medical, and that reduced pain might play a large part in this. Both abortion other studies[124] used rate of PID as a measure of benefit.

In none of the studies was any notion of equity or a measure of the distribution between individuals (e.g. of health or access) used.

5.4 Modelling contraception effectiveness

5.4.1 Source of estimates

Of the modelling studies only one study, by French et al[125], provided evidence of a systematic review of the literature in order to estimate effectiveness. Eleven did not mention a review at all, 12 stated that a review had been performed but did not state that it had been systematic and provided no evidence of its method, and the final two[126] implied a systematic review but gave insufficient details for scrutiny.

5.4.2 Modelling contraceptive prevalence (in contraception service studies)

All of these studies measured cost as service cost plus failure cost where both are essentially a function of the contraceptive methods provided. However, studies divide into two categories: 1) those that used a contraceptive profile[127]; and 2) those that considered the service as a whole[128]. Chao and Allen[129] explicitly used a regression model to control for the confounding

influence of income in order to estimate the relationship between service cost and fertility. Chamie and Henshaw[130] took estimates from the literature, which we can infer are derived in a similar way given that they stated that they also controlled for income, but also demographic and other unspecified factors. Levey et al[131] used Chamie and Henshaw's estimates. The majority of studies estimated profiles, one each for comparator (no service) and intervention (service). In fact the main justification for the majority of these studies is a threat to the current service: thus in theory this is the comparator and no service is the intervention. However, all of these studies expressed incremental costs as savings (cost without service minus cost with).

For example, McGuire and Hughes[132], in comparing having a publicly funded service to one without public funding, perform an incremental analysis, with the assumption that the contraceptive profile (all users) will switch to withdrawal or the only method that was available privately, condom. However, it does seem unrealistic to consider no other use of contraception. In the US studies by Forrest et al[133] they used four scenarios of profiles in the absence of public funding, which as well as no method, allowed for uncertainty and included an attempt at more realism: methods prior to obtaining free contraception, those purchased in the private market and those of women who discontinue oral contraception. However, all of these scenarios might be considered a little drastic in the UK where there seems to be no intention of stopping services entirely; in contrast, in the US some states allow providers, for moral reasons, not to provide fertility control services at all. The most realistic scenario is that in the Foreit et al study[134] where they used modelling prior to a decision to invest in a service. Here the comparator was the absence of a service and the intervention was an estimate of the profile based on a survey of the contraceptive desire of the women for whom the service was provided. They also tested their prediction and therefore the external validity of their model by gathering data prospectively post-implementation of the service.

The strength of the regression approach seems to be its use of data on the fertility and service expenditure for the population who have received the service, especially since the effectiveness of an individual method depends on extraneous factors of provision such as concomitant advice. Its weaknesses are in terms of data availability, especially for confounders, and that historical data does not necessarily predict the effects of future investment. This is particularly the case with the introduction of new methods, which is where the profile method comes into its own. Contraceptive prevalence and effectiveness can be amended according to any assumption or updated with new evidence. Its transparency also allows for much greater generalisability. For example, the UK and US studies can be directly compared in order to see the sensitivity of cost to input parameter estimates.

5.4.3 Contraceptive effectiveness assumptions

In modelling effectiveness, one question is whether *first 12 month failure rates* are used, or whether, because of less effective users dropping out and therefore making these an overestimate, one should make an adjustment. Another issue is whether *typical* (*average of*

perfect and imperfect) or *perfect* use is assumed. Only three out of 17 appropriate studies[135] provided both pieces of information, all of which used first year rates and assumed typical use. Seven studies stated that they used first year rates[136]. Three studies[137] showed how first year rates had been adjusted downwards for subsequent years. McGuire and Hughes[138] used the average of the first five years of use from a population-based study, which would approximate to typical use. Sonnenberg et al[139] used the 'average' of the highest and lowest estimates from population-based studies for most methods, although for the newer ones (e.g. patch) they stated that only efficacy data was available, which probably equates to perfect use. Definitions of 'typical' also varied in the proportion of perfect and imperfect. For example, Trussell et al conducted two studies on EC, using 90% perfect for the 1997 study and 80% perfect for the 2001 one[140]. However, only in one study, that by Trussel et al 2001[141], was a comparison made between different models; this showed no change in the decision matrix position.

The final set of assumptions used in modelling effectiveness is continuation/switching assumptions. The term *switching* could be applied to the change in technology modelled in service comparisons where one whole profile 'switches' to another. However, this does not affect effectiveness of individual technologies. One study by Zhu et al[142], in which the use of the term is ambiguous, models new technology by assuming a probability of switching from each of the currently available methods to OTC oral. However, 'switching' still refers to the change in technology rather than a change in the effectiveness of an individual technology. The effect of switching or discontinuation depends on the time horizon and the change in effectiveness during the switch, which depends on the effectiveness of methods between which switching occurs. If the time horizon is no more than a year, consideration of switching is inappropriate. Of course, using such a time horizon might itself be inappropriate.

There are two main issues to consider in terms of switching. The first is its validity and the second the source of estimates. *Modelling* switching is done because switching *actually* occurs and because this implies a change in outcome, in particular rate of unintended pregnancies. However, although the reason that an individual user might switch might not always be known, switching occurs largely because of a problem with the method or a change in need of the user. The latter implies a different population and therefore it is not valid for it to be modelled by a probability of switching: examples include a change from casual to stable relationship (perhaps requiring a less effective method) or completion of family (generally requiring a more effective method). The probability of switching from method 'a' to 'b', due to a problem with method 'a', highlights the issue of source of estimates. It depends on the probability of identifying the problem AND the *belief* (by user alone or in consultation with others, in particular the prescriber) that 'b' is likely to be better. It also depends on the probability that 'a' was the *best* method in the first place. However, both the belief that 'b' is better than 'a' (given the identification of a problem) and the probability of 'a' being the best method in the first place depend on the evidence or lack of it *at the time of the decisions*.

There is therefore a paradox, which highlights the problem of producing *new* evidence using extant population- (observational) based data to estimate switching probabilities: they are the result of decisions based on the *old* evidence. To illustrate this, consider the belief during a historical period that combined oral contraceptives (COCs) carry a high risk of stroke. All decisions made by women with that belief implied an increase in the probability of switching from COCs to less effective methods as well as no method. However, let us imagine that the model that we are now constructing uses data gathered during this period. The effectiveness, as estimated by the model, of COCs *given* switching probabilities from this data will be biased downwards. This might result in a policy of too little funding for COCs as well as continuing to keep the probability of correctly prescribing COCs too low and subsequently the probability of switching too high.

Of those 14 studies where it would be applicable, nine did not state any switching or discontinuation assumption, two of which also did not state their assumptions regarding typical use or first-year rates. The others varied in their assumptions with the Trussell et al study[143] assuming no discontinuation for five years and the most sophisticated, by Chiou et al[144] and Sonnenberg et al[145], using a Markov model, which models yearly probabilities of switching over the same period of five years. In both studies switching probabilities were in proportion to the prevalence of the method, derived from population studies. No study compared different assumptions.

5.4.4   EC studies

Many of the relevant issues have already been discussed, but EC effectiveness modelling often requires assumptions regarding the *interaction* with other (regular) methods. The Marciante et al study[146] avoided these assumptions by using trial data on effectiveness. Unfortunately, details regarding the population were omitted so that the concomitant use of regular methods and how well they were used is not known. The other two studies, by Trussell et al[147], explicitly provided this information in their assumptions about: the effectiveness of the EC regardless of when it is obtained (after unprotected intercourse or in advance); and, for advance provision only, the effectiveness of regular methods (which is the probability of the user noticing a failure) and a probability of using EC given that a failure has been noticed. The latter was given only in the Trussell et al 2001 study, as 100% (representing *consistent use* of EC) or 75% (representing *inconsistent use* of EC). Also, as the authors mention, the only study that compared IUD[148] was biased, in terms of cost against IUD, given that only one incident of unprotected intercourse was considered and yet the IUD would continue to be effective. All three studies allowed for uncertainty; the first, as mentioned above, by conducting a probabilistic sensitivity analysis, the other two by one-way sensitivity analyses for consistency, which both showed no change in the decision matrix position.

5.5 Contraception other studies

The three studies in this category[149] are very different to the other contraception studies not only in how they measure benefit, but also in design, all being sample-based. They considered different aspects of laparoscopic sterilisation (tubal ligation), either the type of surgery, the location of the surgery or access in terms of method of referral for the surgery. Because of their sample-based design their key methodological issues are the same, relating to design, sample size and also transparency of reporting. Essentially, all three suffered from potentially serious flaws: only the McKessock et al study[150] used randomisation, but it suffered from small sample size and losses to follow-up, which were greater in the direct referral group and not controlled for by using an ITT analysis instead of TCO analysis. The other two studies also had very small samples. Given the lack of randomisation, comparability at baseline would have been useful to show, but neither of the two studies provided baseline characteristics. The McKessock et al study did use randomisation, but this is no guarantee of baseline comparability, especially with a high dropout rate, and baseline characteristics were only given by referral criteria. Generally, depending on the prior beliefs of DMs, as influenced by any other evidence, e.g. from effectiveness-only studies, any conclusions found in the decision matrix should therefore be viewed with caution.

5.6 Abortion method and other studies

These are discussed separately here because they are, like contraception other studies, sample-based. Measures of benefit have already been discussed above. Therefore the key issues to discuss here are: design, sample, population and costing.

In terms of design, the Tewari et al[151] study probably suffered from most problems since it was observational and had a statistically significant difference ($p<0.007$) in gestational age in favour of pre-treatment with mifepristone in terms of induction to abortion interval, which was both a measure of benefit and the main cost driver. Two of the other studies[152] had randomised designs and the Henshaw et al[153] study included a preference component. However, as stated above, such a design makes inferences about the difference in cost and benefit of treatments for any population other than those where more than one treatment was compared (i.e. those who were indifferent between medical and surgical abortion) highly questionable. The fourth study[154] did not require a randomised design given that it was a test evaluation where individuals acted as their own control. However, the Tewari et al[155] and Penney et al[156] studies had no blinding. In particular, the latter might have been biased due to the fact that the GPs who made the diagnosis of PID were not blinded and there were no specific criteria for diagnosis. Knowing that some women had not already been given antibiotics (prophylactically) might have made them more cautious and therefore 'over diagnosed', thus making the screen and treat arm appear less beneficial and more costly. However, the difference was not statistically significant; on the other hand, the sample was probably too small.

5.*7* Classification of interventions according to decision matrix (considering study quality)

In summary, the discussion of key methodological issues shows that any classification of interventions in terms of efficiency based on the extant economic literature must be made with caution. This is for two main reasons: for the modelling studies, no single study conducted all possible sensitivity analyses and the lack of comparability prevented this being performed between studies; and the sample-based studies were limited as individual studies in a number of ways but also in number, thus preventing any pooling. Therefore, bearing in mind the important caveats mentioned above, the degree of consensus (*number of studies*) for the decision matrix position that implies that an intervention would be an efficient use of resources (gain in benefit as well as reduction in cost) is given below:

- Availability of a contraception service (*11 out of 11*).
- Availability of OTC oral contraception (*1 out of 1*).
- Unrestricted (not only due to threat to maternal life) access to abortion (*2 out of 2*).
- Switch from any method to:

  (a) vasectomy (*3 out of 5, although no comparison with IUS*)

  (b) IUS (*1 out of 2, although no comparison with vasectomy*)

  (c) Depo-Provera (*1 out of 6, although no comparison with vasectomy or IUS*).
- Availability of EC (*3 out of 3*).
- Pre-abortion infection screening as opposed to no screening (*1 out of 1*).
- Pre-abortion universal prophylaxis as opposed to screening (*1 out of 1*).
- Pre-treatment with mifepristone instead of PGE2 in medical abortion for women at mid-trimester (*1 out of 1*).
- Surgical instead of medical abortion for women of less than nine weeks gestation (*1 out of 1, at least for those who are indifferent between surgical and medical, although the earlier the gestation the more medical is preferred*).
- Laparoscopic sterilisation:

  (a) direct (GP) access (*1 out of 1*)

  (b) smaller aperture entry (*1 out of 1*)

  (c) outpatient as opposed to inpatient surgery (*1 out of 1*).

The interventions below had some evidence for being the cheapest and second most effective; therefore whether they or the most effective intervention would be the most efficient depends on the opportunity cost (of taking resources from elsewhere):

- Switch from any method to:

  (a) copper-T IUD (*2 out of 6, where vasectomy was the most effective*)

(b) IUS (*1 out of 1, where tubal ligation was the most effective, although no comparison with vasectomy*)

(c) Depo-Provera (*1 out of 6, where vasectomy was the most effective*).

It is also worth reiterating that, for contraceptive methods, generally the studies showed that the more effective the method, the lower the cost, and therefore, as a rule of thumb, switching from a less to a more effective method, on average, would be an efficient use of resources. However, this takes no account of user preference as a measure of benefit or as an instrument in achieving compliance.

However, as stated in the section on judging quality, the ultimate value of an extant piece of evidence is its usefulness in decision-making. This depends on the belief of DMs about the comparison between the value of implementing any of the set of technologies over which they actually have a choice *with* this evidence and the value of implementing any of the technologies *without* it. In other words, does the existing evidence make any difference to the actual decision that a DM faces? This in turn depends on 'how strongly' the DM believes it is the correct choice (i.e. the one 'most likely' to fulfil his goals) and the extent to which he believes the evidence supports or contradicts this belief. The final question, therefore, is the extent to which these classifications are policy relevant and therefore the extent to which policy recommendations have the support of economic evidence.

6. Relevance of evidence to policy

Superficially, the results of the decision matrix indicated some consensus (*number of studies*) between studies, within the same technology category, in terms of which technologies should be resourced given that in many cases, not only would there be increased benefit but a decrease in cost (i.e. dominance). However, closer examination of key methodological areas has revealed variation in methodology, which makes pooling of results questionable, as well as potentially serious flaws in sample-based study design. The qualitative research regarding DM goals also indicated appropriate dimensions of measures of benefit, but very few of these were incorporated in the reviewed literature. Also, some of the comparisons are inappropriate for current decision-making (policy). For example, Norplant and combined progestogen and oestrogen EC are no longer available in the UK, and contraception and abortion service studies were largely based on an intervention of stopping entirely public provision, which is not on the policy agenda.

The final part of the picture is an impression of the *beliefs* of DMs as to which specific technology changes would be most beneficial (efficient in fulfilling these goals). DM beliefs can be represented by stated policy, which we have sampled in the form of *key documents.* These represent the major sources of policy or policy advice: DH[157]; Royal College of Obstetricians and Gynaecologists (RCOG)[158,159]; and charity/user perspective[160,161]. The value of the evidence can then be judged by its policy relevance i.e. the extent to which the

classifications from the economic evidence match the recommendations from the policy documents. Of course much of the policy recommendations is *evidence-based*, but the focus here is the extent to which *economic* evidence from the review can be used to inform them. It is important to realise that almost all of the recommendations in the key documents are based on effectiveness only evidence, i.e. some measure of benefit, however limited[162], but no measure of cost. In fact, although it is not the remit of this research to review the literature in these documents, the RCOG guidance on abortion[163], for example, contains no reference to any economic evaluations and only two references with cost data. Of course, in the context of this review, it is hardly surprising given the lack of studies and the lack of quality of these studies.

The degree of match between the evidence-based classifications given above and stated policy will be analysed in three parts:

- classifications that support stated policy
- classifications that do not support stated policy
- stated policy without the support of economic evidence.

6.1   Classifications that support stated policy

- Availability of a contraception service (*11 out of 11*).
- Unrestricted (not only due to threat to maternal life) access to abortion (*2 out of 2*).
- Availability of EC (*3 out of 3*).
- Pre-abortion infection screening as opposed to no screening (*1 out of 1*).
- Pre-abortion universal prophylaxis as opposed to screening (*1 out of 1*).
- Pre-treatment with mifepristone instead of PGE2 in medical abortion for women at mid-trimester (*1 out of 1*).
- Laparoscopic sterilisation: direct (GP) access (*1 out of 1*).

Given that contraception is provided mostly free of charge in England and that none of the documents consider changing this, the economic evidence generally supports current policy.

The policy recommendations for EC are generally for increased access through one of three main changes: pharmacy prescription, advance prescription and 'out of hours' availability. Only the third is *not* directly addressed in the studies reviewed and the first two are shown, depending on assumptions, to be efficient[164]. **fpa**[165] and the Faculty of Family Planning and Reproductive Health Care (FFPRH)[166] also make recommendations regarding the IUD as EC for which again there is a little direct evidence.

Pre-surgical screening and prophylaxis to avoid infective complications are also recommended and again there is a little supportive evidence from the review[167], specifically that screening is better than not screening, but that universal prophylaxis might be both more beneficial and cheaper.

The FFPRH of the RCOG recommend direct (GP) referral for tubal ligation, which is supported by one study[168]. None of the policy documents mention the detail of the surgical procedure.

6.2 Classifications that do not support stated policy

- Availability of OTC oral contraception (*1 out of 1*).
- Switch from any method to:

    (a) vasectomy (*3 out of 5, although no comparison with IUS*)

    (b) IUS (*1 out of 2, although no comparison with vasectomy*)

    (c) Depo-Provera (*1 out of 6, although no comparison with vasectomy or IUS*).

What is not mentioned in any of the policy documents is the possibility of providing access to oral contraception OTC, as found to be efficient in the US study by Zhu et al[169]. Currently no hormonal methods are available in the UK OTC. EC is available by pharmacist prescription and so other oral contraception might also be deemed to be suitable for prescription in this way. However, crucial to the analysis are the assumptions regarding switching from less effective methods to oral contraception given its availability other than from general practice. These will depend, among other things, on user preference, including price and the user's perceived probability of obtaining their preferred method (given their knowledge and the expertise of the prescriber).

As for specific methods of contraception, there is no recommendation that states that, in the absence of contraindications, any method should be prescribed. The emphasis, as will be discussed below, is in terms of providing users with a choice of methods.

6.3 Stated policy for which there is no economic evidence

The intention in this section is not to analyse the policy documents. However, many of the recommendations from all of the documents are made with respect to access or inequality in access to contraception. These can be subdivided into those addressing access as waiting time or method of referral for a given method, and those addressing availability of method. The latter could be rephrased as method choice. Only the document by **fpa**[170] directly advocates full access to (access to the full range of) contraceptive methods. The DH Sexual Health Strategy[171] mentions nothing specific, although one could infer that the organisation in terms of levels of provision is intended partly to increase choice through increased access to, for example, longer acting reversible methods.

The subsequent DH document, the Implementation Action Plan[172], makes this clearer by recommending guidelines on IUDs and sub-dermal implants. The latest standards emphasise the role of choice and equity of access to both contraception and abortion services and methods[173]. This is most clearly shown by the stated aim of the standards to "… define a level of care that is achievable in all parts of England …" and "… ensure equity of access to services for all". As shown above, the economic evidence does provide some tentative support for

increasing choice and greater use of longer acting methods. In the former case contraception service studies show the benefit of contraception generally and more effective methods more specifically. However, none examine the incremental effect of a change from the current supply profile of methods in the UK to one that better reflects user preference or a reduction in inequality of access according to user preference. The individual method comparisons do provide some support for the efficiency of switching from less effective to the most effective method, for example, in three studies[174], vasectomy. Therefore, if an individual were to either be indifferent or prefer such a switch, this would appear to be efficient. Of course, vasectomy is not acceptable to many individuals. Thus prescribing only the *average* most effective methods, given that preference is also affected by many other factors[175], might be less beneficial overall. However, there is no direct evidence from the reviewed literature, thus implying the need to consider further research.

Although for EC there is some evidential support for stated policy, there is no support for charging for it, as is currently the case if obtained from the pharmacist. If an aim is to reduce inequality in access, particularly by income or other social disadvantage, then such a policy will probably be counterproductive: charging will be a larger disincentive to those who are poorer. Therefore what benefit is gained in terms of increased access through pharmacy provision, might be lost in terms of increased inequality of access. The size of this effect must be found empirically and requires research on the relative values of access and equality of access as well as the size of the disincentive.

As for abortion, the main policy recommendations again address access, although vary in strength with **fpa**[176] recommending a maximum delay of one week and ideal of 72 hours, and the DH[177] and the RCOG[178] of three weeks and ideal of one week between first appointment and procedure. However, no studies address this directly. Indirectly there is some evidence from the study by Henshaw et al[179], since one of the main arguments for reducing the delay is to allow a greater proportion of early medical abortions[180]. Henshaw et al showed that, the earlier the abortion, the more likely a woman is to prefer medical to surgical, although cost might be slightly higher, thus possibly requiring an estimation of the opportunity cost of finding resources from elsewhere. The other main argument for reducing delay is reduction in complication rate independent of change from surgical to medical, for which there was no economic evidential support.

There are also recommendations regarding access in terms of NHS funding with **fpa**[181] recommending 90% and the DH, through the Commissioning Toolkit[182], 75% as targets for each PCT. What the two US studies[183] showed on abortion service provision is that money could be saved through less welfare payments for unwanted births. However, although this methodology is similar to that for contraception, the measure of benefit, unlike prevention of unwanted pregnancies, is more controversial. Unfortunately, no study measured benefit in any other way (e.g. in terms of the welfare of the woman or society as a whole). This is perhaps because it provides such a challenge. However, perhaps this shows the limitation

of usual measures of benefit, which focus on the individual or the average for a given population. Instead or additionally, benefit here comes most clearly from reduced inequality of access (or funding). Such a change in funding would also have an effect on the cost saving of contraception due to prevention of unintended births. There is thus an implied need to consider further research.

Another part of the recommendations from the key documents for abortion concerns, as with contraception, increased choice; in particular, the encouragement to offer the choice of early medical abortion instead of surgical[184,185]. Unfortunately, only one study addressed this issue. Although surgical appeared to be, at least for those who were indifferent between medical and surgical, more acceptable and cheaper than medical, it was shown to depend on gestational age, which suggests a need to consider both in any future research. Also, as has been discussed elsewhere[186] the cost of medical is highly dependent on the precise model (e.g. how much can occur unsupervised and at home).

7.   Discussion

This systematic review of economic evaluations in the area of fertility control has shown some concurrence between studies, despite much methodological variability, for the efficiency (reduced cost and increased benefit as measured in the studies) of some interventions, namely the continued public funding of contraception provision and the provision of methods of contraception that are more effective in preventing unintended pregnancy. However, most classifications of interventions in terms of efficiency had the support of few and, in the case of those that were sample-based, methodologically limited, studies. Indeed, it has been shown that generally the extant economic literature is very limited by itself in providing evidence for decision-making. There is a mismatch between the demand for and supply of evidence for decision-making. This manifests in two main ways: inappropriate or limited measures of benefit and, given current beliefs as reflected in key policy documents, a lack of comparisons to reflect or assess those beliefs. DMs, as shown through the key policy documents representing various stakeholders, seem to believe that interventions should increase access to services as well as reduce inequalities in access, particularly in abortion funding, contraceptive and abortion method choice, EC, and reduced delay in obtaining abortion. Only for access to EC and abortion method was there direct evidence. In none of the studies was equality of access or any other distributional measure used and in only one study was consumer/user preferences measured.

There are some limitations of the project. For example, every review has to have a limit, but we have chosen on the basis of time and predicted quality not to pursue unpublished sources. Also, we did not have access to any unpublished pharmaceutical industry studies: we did make an enquiry of Schering, who stated that they had no such literature and knew of no other source. Also, there has been no attempt to score or grade quality for the reasons given. We do recognise that DMs might find this useful, but hopefully the conclusions in terms of the

degree of match of the extant literature to address current policy questions, regardless of any other measure of quality, are clear enough without this. Finally, we did not attempt to perform any kind of *post-hoc* mathematical sensitivity analysis. Where we tentatively examined the relationship between variability in assumptions and effect on the decision matrix position, a more formal analysis could be attempted. However, it seems more useful to conduct such sensitivity analysis as a component of the second part of the research by modelling a specific policy relevant question.

Of course, a lack of evidence does not imply that a decision cannot be taken. DMs should and do act according to their beliefs, given the available evidence. However it is clear, without the need for a detailed analysis of the evidence base for the policy recommendations found in the key documents, that it is based almost entirely on an absence of explicit economic evidence. If it is reasonable to assume that resources are scarce, then evidence-based decisions need evidence of both cost and benefit. We conclude, therefore, with recommendations for further research.

8.   Research recommendations

We propose the design of research that would provide more direct/useful evidence for DMs. In particular we recommend that, for ALL health care technologies, research evidence should:

- measure both cost and benefit
- measure benefit in terms that are relevant, in particular:

    (a) taking account of the range of measures

    (b) attempting to value these according to DM preference

    (c) including measures of distribution, access and user preference

- have a design that is appropriate for the measures above
- permit the measurement of opportunity cost either:

    (a) with a hypothesis of dominance ie one technology is both cheaper and more beneficial, or

    (b) by including the comparison of sufficient sets of independent technologies from the same budget, some of which would be predicted to be more beneficial but also more costly.

In addition, to address policy questions in the area of fertility control specifically, research evidence should:

- compare any proposed technology to that currently provided
- define technologies clearly, in particular IUDs
- in individual method comparisons, clearly define the suitable population (i.e. those currently using method 'a' for whom method 'b' would also be appropriate)

- take account of the preferences of users, either:

  (a) in defining the population i.e. by preference for method, or

  (a) in valuing the measures of benefit

- in measuring preferences, use economic (choice) methods, which allow the trade-off between measures of benefit/characteristics of methods

- investigate the value of using QALYs in measuring benefit

- investigate ways of designing research to measure change in distributional measures (e.g. equality of 'rate of unintended pregnancy' or access)

- be clear in any assumptions, particularly regarding time horizon, pregnancy timing and contraceptive effectiveness

- compare a direct (regression) approach to estimating service or contraceptive method effectiveness to one based on the synthesis of evidence via decision modelling

- find ways of modelling contraceptive method switching that are less biased by the influence of historical evidence on method choice

- estimate the efficiency of reduced waiting time to abortion and increased equality of access to NHS funding for abortion

- estimate the efficiency of increasing the equality of access to the range of contraceptive and abortion methods.

In Part 2, we model increased equality of access by PCT to early abortion with a change in contraception profile, to reduce inequality of access (by PCT) according to user preference. The hypotheses are that, from the perspective of the NHS in England, the first will be cost increasing and the second cost saving, thus producing a change that will be, at worst, cost neutral. Measures of benefit will include: equality of access to abortion; equality of access to contraceptive and abortion methods, as measured by contraceptive profile estimated according to demand (preference); rate of unintended pregnancy and abortion; and complication rate following abortion.

Part 2:

Increasing access to contraception and abortion: modelling the economic impacts

1.   Context

The first part of this research involved a systematic review of the literature on the economics of sexual health. It confirmed that little research had been undertaken in the area of fertility control and that the research that had been undertaken was of little relevance to the policy questions that now need to be addressed in the UK. Hence the study question of whether services can be reoriented, within budget, to better meet the needs and preferences of fertility control service users.

The particular policy changes in fertility control services to be evaluated in this paper were chosen for two main reasons: the expert group felt that this was equitable; and there was a belief that the contraception service change, as well as being beneficial, would be cost saving and that some of this saving could be used to fund any cost increase for the abortion service change, which was also believed to be beneficial.

It will be seen that modelling the cost impacts and benefits to service users in these areas is very challenging. However, it will also be seen that it has been possible to make an initial attempt at this through combining data from various sources and through making some key assumptions. As a result, it is important to view the research presented as an initial estimate of the economic impact of policy change in fertility control and, thus, for debate and further refinement.

Firstly, the proposed policy changes will be described. Then the theory underlying the method of economic evaluation is briefly described, which leads to the specification of a general model for analysis as well as specific details of application of the model to assessment of the contraception and abortion policy changes. (Methodological details are excluded from this document, but a set of technical appendices are referred to, which are available from the authors.) The results for each part are then presented, followed by a discussion of each part. The report then concludes from the perspective of fertility control as a whole, leading to a set of policy recommendations

2. The proposed policy changes

Following the review of the research literature and various policy documents, the expert group agreed to assess the following policy changes:

- A change in the NHS supply of contraceptive methods in order to better reflect the preferences of women[187].

- Reducing delay in obtaining an abortion as reflected in reducing the gestational age at which the procedure is carried out.

The review of the literature showed that these proposals meet concerns expressed in a set of key policy documents reflecting the views of several key stakeholders: the DH[188]; the RCOG[189]; and the charity/user perspective[190].

3. Economic evaluation

Addressing the above questions requires 'economic evaluation' of the proposed policies. The theoretical basis of economic evaluation is the principle of opportunity cost. Accepting that we do not have enough resources to meet all needs, and thus the inevitability of making choices, certain opportunities will be taken up while others will be missed. Economists refer to the benefits or 'utility' associated with forgone opportunities as opportunity costs. If the aim is to maximise benefits to the community, and thus minimise opportunity cost (i.e. minimise benefits forgone), there is a need to *consider* gathering evidence on both the costs and benefits of health care. By measuring costs and benefits, we can choose that combination of resources which maximises benefits (and, consequently, the amount of need met) from available resources (available resources being represented by a given *budget*, whether for health services as a whole or for an area like fertility control).

The type of evidence that includes both costs and benefits is known as economic evaluation. Economic evaluation is "the comparative analysis of alternative courses of action in terms of both their costs [resource use] and consequences [health and other effects on well-being]"[191]. Given the information demands of economic evaluations, it is rarely possible to obtain all of the relevant information from just one study, as was the case with the majority of studies obtained from Part 1 (the systematic review). The logical approach is to consider synthesising evidence from several sources, based on a *decision analytic model* (DAM)[192]. It might be said that such a model provides the *functional form* for the *production function* for each technology i.e. the relationship between resource inputs (or costs) and outputs (or benefits). Once such relationships are shown, decisions can be made about whether to change service provision and, if so, how.

4. Model specification

4.1 General approach

Since the evidence is intended to inform decision-making for the English NHS, the DAM parameters must reflect this perspective. Hence, there are three general parameters of importance:

1. The current NHS budget for fertility control.

2. Costs and benefits of fertility control services of relevance to DMs.

3. Estimates of how each of these would change in the light of policies to change the profile of available contraceptive methods and enhance access to abortion.

The current situation with respect to spending on fertility control is essentially a function of what the NHS is able to supply, provider preferences and what users demand. For example, current supply of contraceptive methods will partly reflect the preferences and knowledge of GPs and other health care professionals, and partly those of users; similarly for any delay to obtaining an abortion. As well as only being able to approximate the current situation, without data on 'pure' preferences of service users, and coupled with some interventions (such as condom use and EC) being available through wider sources such as pharmacies, it is difficult to disentangle what the ideal changes in contraception and abortion services should be. Therefore, as will be seen below, the policy changes evaluated are not defined precisely.

Nevertheless, with respect to benefits, there is not only one outcome measure: the main attributes of importance were obtained from the qualitative enquiry of DMs' views as to what these should be, reported in Part 1. This work showed that, according to such views, fertility control services should provide:

- increased access to contraceptive methods according to preference
- a reduced rate of unintended pregnancy and abortion
- reduced delay in obtaining an abortion
- reduced rates of complications of abortion
- increased access to abortion methods according to preference.

It should be noted at this point that there is also potentially benefit conferred in other ways by fertility control methods and services, not least of which is the reduction in STIs by condoms. However, as will be clarified below, this research excludes the prophylactic use of condoms as the focus is on *fertility control* per se.

4.2 Changing the contraception profile

Increasing access to contraceptive methods according to preference implies that current *supply* does not reflect the *preferences* of users. Indeed, this belief is reflected in the **fpa**

policy document, which argues for making the 'full range' of contraception alternatives available[193]. There are two main reasons for wanting to better reflect user preferences in service provision. The first is if user preference is of value in itself, for which there is some support in the aims and language of policy documents in terms of providing choice. The second is if preference is instrumental in achieving other policy goals. In particular, the effectiveness, in terms of preventing unintended pregnancy, of a method is likely to be a function of preference. Also, there is some evidence that the methods that women would prefer, on average, will be more effective. For example, one survey showed that the most important consideration for not only using a method for the first time, but *switching* methods, was effectiveness in preventing pregnancy[194]. Also, given the large cost associated with unintended pregnancy (depending on perspective), the bigger the increase in effectiveness, the bigger the cost saving (see Part 1).

Therefore, the accuracy of estimation of both *current profile* (i.e. the prevalence of each method of contraception) and *ideal profile* (and the prevalence of each method which would result from that) is crucial, as the cost and benefit of the policy change will equal the sum of the cost and benefit of each method weighted by the prevalence of each method before and after the said change. This implies that data are required on: current (NHS) profile of contraceptive methods; the *ideal* (according to women's preferences) profile; and cost and effectiveness (in terms of reduction in unintended pregnancy/abortion) of each method.

To estimate the current profile, the methods that were considered were all those that are currently supplied by the NHS, excluding the contraceptive patch[195]. It was not possible to obtain reliable data on the current provision of vasectomies, tubal ligation, withdrawal or 'safe period/rhythm method/Persona', which are included in the ideal profile (see below); they were therefore excluded from the current profile and comparison with the ideal profile. EC was also excluded because data was only available on prescriptions in general practice and a method of comparing it to other methods by converting to CYP was not found. This then left a reduced range of methods, ones that are *general practice prescribable* (currently prescribed in general practice) i.e. combined oral, progestogen-only oral, implant, injection, IUD, IUS and diaphragm/cap.

The most recent source of data on contraceptive use in England is the Contraception and Sexual Health Survey, 2003[196]. However, the current profile ought to be that actually supplied by the NHS. Therefore, more accurate sources were believed to be prescription analysis and cost (PACT) data collected by the Prescription Pricing Authority (PPA) from pharmacies, which reflects prescriptions from general practice, and DH data from family planning clinics (FPCs). This raw data was converted into prevalences (percentage of all methods prescribed in one year) by a set of methods described fully in Technical Appendix 1. Unfortunately, general practice data was not available by age. This meant that, although for comparing ideal to current profile prevalences only (and not cost and effectiveness of each method), prescription data was used, when comparing cost and effectiveness, the Sexual Health Survey data was used. Sensitivity analysis examined the effect of this difference.

Estimation of the ideal prevalence of methods is very challenging. Previous studies have attempted to estimate demand under the assumption that there would be no public provision. In the UK this simply assumed that all users would use either no method[197], withdrawal or condom[198]. In the US users were assumed to use different methods, for example, as used immediately prior to becoming eligible for the public service[199]. Only one study surveyed women for their preferences prior to designing the service, but this was in Peru, where the range of methods was very limited[200].

On this basis, and particularly as there is limited information available on women's preferences, we chose to estimate the ideal profile using a consensus approach. It was therefore decided to use a sample of experts who might reasonably be described as representing various decision-making perspectives. The ideal profile was estimated in age bands. This was done partly because effectiveness and cost of each method could be estimated in different age bands but largely in order to estimate preferences more accurately. Although preference for method is likely to depend on individual user characteristics other than age, such as number of children and desired family size, age was thought to be a reasonable proxy for variability in preference. It was also thought that subdividing the user population any further would be cognitively too challenging for the participants in the consensus process. Full details of methods used in the consensus approach are given in Technical Appendix 2.

The cost and effectiveness (in terms of rate of unintended pregnancy) of each method are eventually intended to be estimated using the model developed by Sonnenberg et al[201]. Essentially, this model simulates a population of women aged 15 to 49 in seven age bands who are at risk of becoming, but who do not want to become pregnant, and who, at the outset, use one of the general practice prescribable methods of contraception. Over a specified period, for example 15 years, the rate of pregnancy depends on the joint probabilities of becoming pregnant in each year, which are determined by several factors, including the effectiveness of the contraceptive method and the probability of switching to another method should an adverse event (e.g. cervical cancer) or pregnancy occur. The probability of switching to a given method depends partly on the estimated prevalence of each method. As discussed in the key methodological issues section of Part 1, these prevalences ought to be contingent on the preferences of users given the most recent evidence (i.e. if fully informed). This is exactly what the ideal profile is an estimate of and therefore, for the current profile, these prevalences will be used[202]. All methods and consequences will be costed for 2005/2006 from the perspective of the NHS. An economic evaluation based on this model[203] was reviewed in Part 1 of this document and details of the model structure and parameter estimates are given in Technical Appendix 3.

However, another model to estimate the costs and effectiveness of contraception has recently been developed for some guidelines on long acting reversible contraceptives (LARC) in England and Wales[204]. It was not possible to include it in the review in Part 1, and, although it does not consider diaphragm/cap or differentiate between combined and progestogen-only

oral contraception, due to its England relevance its estimates have been used here. Therefore, the main differences with the Sonnenberg model will briefly be outlined. Firstly, LARC uses data to populate the model on the average of women aged 15 to 49 rather than in age bands. Secondly, instead of modelling switching to another method as a function of specific adverse events as well as unintended pregnancy, it uses the possibility of discontinuation, assuming any reason. Discontinuation rates were sourced from evidence and expert opinion. Thirdly, instead of switching to another method, the probability of which depends on the prevalence of that method, it assumes an *average* method, i.e. the effectiveness of which is the mean of all methods, weighted by their prevalence. The sources of effectiveness are similar to those in the Sonnenberg model, and the prevalences are those of the 2003 Contraception and Sexual Health Survey[205]. Fourthly, unlike the LARC model, the Sonnenberg model includes the possibility and cost of treatment of adverse events including menstrual related, cancer, cardiovascular and STIs. Finally, the cost of all unintended pregnancies is counted, implying that all unintended pregnancies are unwanted. In the Sonnenberg model, a percentage is assumed to be mistimed, thus incurring an additional cost only insofar as future costs are discounted. It is hoped very soon to gain full access to these models in order to fully test the sensitivity of the outcomes to any differences, although the key methodological issues section of Part 1 should be referred to for a general discussion of the possible effect of such variability.

As stated above, the expected individual user cost and rate of unintended pregnancy of each method is then summed across all methods, weighted by the prevalence of each method in the profile. The change in cost and rate of unintended pregnancy for the whole user population is then that for the ideal minus that for the current profile.

4.3   Reducing delay to abortion

The need to address increased access to abortion was identified in the National Strategy for Sexual Health in 2001[206]. It led, through a series of other policy documents, to the regular collection of data by PCTs on the time between referral and termination of pregnancy, given the target of three weeks set by the DH[207]. The latest (2002/3) figures that are available from the Commission for Health Improvement (CHI)[208] show, across procedures, a mean of 51% hit the target, with a low of 9% and high of 79%.

There are several reasons for interest in reducing this waiting time. One, which is mentioned on the CHI website, is that reduction in waiting time would increase the proportion of abortions performed before nine weeks, which is the recommended cut-off for early medical abortion[209]. This would reduce the number of surgical abortions and the consequent problems associated with general anaesthesia and surgery. There is also evidence that the rate of complications, independent of procedure, increases with gestational age, and therefore reason to believe that reduced delay would reduce the complication rate. Evidence from the only economic evaluation in the review[210] showed a slight decrease in cost associated with medical compared to surgical abortion, although this was not statistically significant at the

5% level. Cost will also depend on many other factors, in particular the precise nature of the medical procedure, although, for example, current restrictions do not allow the use of the woman's own home[211]. However, cost of medical abortion is also likely to have changed due to the increased use of misoprostol instead of the more expensive gemeprost[212]. Another issue in counting the cost is that not all women receive NHS funding for their abortion, which has led to a DH target of 75% for each PCT. Clearly the net cost (and benefit) for each PCT will depend on their current status.

Of course, not all women would prefer a medical abortion if offered the choice. Evidence does vary: in a US study[213], 92% of women said that they would choose the method again, whereas in a UK study[214], for those who were randomised to either surgical or medical, this figure was 78%, and that for surgical, 98%. However, this was highly dependent on number of weeks gestation, with 100% of those presenting at up to six weeks stating that they would opt for medical if they needed an abortion again.

One other potential source of benefit and cost saving was the switch from general to local anaesthetic for early surgical termination (using MVA). No preference data was available with only one source for the percentage of providers offering it[215].

Therefore, again for status quo and the new policy, cost is the sum across all gestational ages and all methods of abortion and its associated complication costs. Benefit, here, is estimated as: the better meeting of preferences arising from a changed profile and potential for reduced complications arising from a change in the profile of gestational age as a result of reducing the mean delay to abortion. To arrive at an estimate of this, it is necessary to have data on the following parameters: the current profile of abortion methods; a new profile as a result of some hypothetical intervention to reduce delay (assuming no change in abortion method profile for a given gestational age); this new profile adjusted to better reflect women's preferences for method (medical versus surgical and, for surgical, local versus general anaesthetic); complication rates given current and new profiles; and the associated costs.

The current profile was estimated from DH data for 2002. That for 2003 and 2004, the most recent, was not used due to lack of data on complication types. The categories were reduced in the base case to only medical, surgical (dilatation and evacuation [D&E]), surgical (MVA), and feticide due to the rarity of other methods and the availability of cost data. Gestational age bands were those in the DH data (0–9, 10–12, 13–19 and 20–24 weeks).

The new profile was estimated by application of a hypothetical intervention. This was done in order to estimate the relationship between gestational age profile and average gestational age, which is a function of delay. This can be explained by considering that reducing the delay to obtaining an abortion will reduce gestational age at abortion. However, any such intervention might differentially affect women according to gestational age. For example, women presenting earlier might be affected more than those presenting later, or vice versa. Therefore, a literature search was performed to try to find a study of such an intervention. Unfortunately, only one study could be found[216]. The results from this study were used

to estimate the profile of abortion in the gestational age bands of the DH data and the concomitant expected (mean) gestational age for before and after the intervention, assuming the same hazard ratio for each age band (see Table 4). Full details of the method of estimation are given in Technical Appendix 4.

Table 4 (a): **New vs current profile for abortion as a function of hazard ratio from Glasier and Thong, 1991**

Gestational age period	Current percentage	New percentage	Hazard ratio
0-9	57.15	78.14	1.79
10-12	30.20	10.99	1.35
13-19	11.01	4.69	0.29
20 and over	1.64	6.19	0.11

(b) **Results of Glasier and Thong, 1991 adjusted to Department of Health age bands**

	Pre intervention	Post intervention	Hazard ratio
0-9	40.00	60.00	1.79
10-12	47.13	35.00	1.35
13-19	12.52	4.96	0.29
20-24	0.31	0.04	0.11

(c): **Results of Glasier and Thong, 1991 in original age bands**

	Pre intervention	Post intervention
0-9	40	60
10-11*	39	30.5
12-24	21	9.5**

Imputed from the other values, which were reported
**Reported as 'less than 10'*

A literature search was also performed to try to find estimates of women's preferences for abortion method. However, no studies other than that in the systematic review by Henshaw et al[217] comparing vacuum aspiration to medical were found. Unfortunately, this produced either unbiased estimates without direct experience (those who expressed a preference *ex ante*) or biased estimates (those who expressed a preference *ex post*, but only known to have had the recent experience of one method). Therefore, sensitivity analysis was used to vary the estimate based on various assumptions (base, mid and best) (see Table 5). Full details of the method of adjusting the abortion profile to account for preferences for medical abortion are given in Technical Appendix 5.

Table 5: **Gestational profiles for abortion (percentages within age band) according to medical abortion preference assumption**

(a) base case (DH, 2002)

Gestation	Vacuum aspiration	D&E	Medical	Feticide
0-9	81.05	1.16	17.79	0.00
10-12	93.38	1.97	4.66	0.00
13-19	57.76	23.45	18.25	0.54
20-24	6.29	25.86	15.87	51.98

(b) mid (0 to 9 only, conservatively using Henshaw et al, 1994)

Gestation	Vacuum aspiration	D&E	Medical	Feticide
0-9	57.73	0.82	41.45	0.00
10-12	93.38	1.97	4.66	0.00
13-19	57.76	23.45	18.25	0.54
20-24	6.29	25.86	15.87	51.98

(c) best (0-12, optimistically using Henshaw et al, 1994)

Gestation	Vacuum aspiration	D&E	Medical	Feticide
0-9	32.65	0.47	66.88	0.00
10-12	32.43	0.68	66.88	0.00
13-19	57.76	23.45	18.25	0.54
20-24	6.29	25.86	15.87	51.98

(d) Results of Henshaw et al, 1994

		If have another abortion		
		opt for medical	opt for vacuum aspiration	undecided
Treatment arm	**prefer medical**	94.44	4.17	1.39
	prefer vacuum aspiration	3.57	90.48	5.95
	randomised to medical abortion	74.47	22.34	3.19
	randomised to vacuum aspiration	2.11	87.37	10.53
	total	41.45	53.04	5.51

Conservative assumption (mid): count only those who stated they would opt for medical if have another abortion

Optimistic assumption (best): count also those who were undecided and those who were randomised to vacuum aspiration in same proportion as those who were randomised

to medical abortion. (NB This assumes that those who were randomised, a priori were indifferent and therefore biased by the experience of only one method [medical or vacuum aspiration]. Therefore, it is plausible that those who were randomised to vacuum aspiration might have been more likely to opt for medical if they had had the experience of medical.)

Complication rates were those produced from the data collection exercise of the DH for 2002. These complication rates were expressed as a percentage of each method for each gestational age such that a change in profile (according to gestational age or preference for method) produced a change in complication rate (see Table 6). This assumed no learning effect i.e. for doing more of a procedure. These complication rates were found to be similar to those quoted in the RCOG guideline.

Table 6: **Complication profiles by abortion type (percentage of each procedure in each age group, DH, 2002)**

0-9	Vacuum aspiration	D&E	Medical	Feticide
sepsis	0.02	0.43	0.01	0.00
perforation	0.03	0.17	0.01	0.00
haemorrhage	0.13	0.35	0.18	0.00
other	0.01	0.00	0.06	0.00
10-12				
sepsis	0.03	0.00	0.04	0.00
perforation	0.04	0.00	0.00	0.00
haemorrhage	0.20	0.10	0.25	0.00
other	0.02	0.00	0.04	0.00
13-19				
sepsis	0.05	0.00	0.06	0.00
perforation	0.05	0.04	0.00	0.00
haemorrhage	0.28	0.09	0.72	0.00
other	0.01	0.02	0.21	0.00
20-24				
sepsis	0.00	0.00	3.69	0.00
perforation	0.00	0.32	0.92	0.00
haemorrhage	3.95	0.16	0.92	0.39
other	0.00	0.00	0.92	0.00

'other' was interpreted for costing as 'retained products' (see Costing)

All unit costs were those for financial year 2005/2006. There were insufficient resources to perform a 'bottom up' costing[218]. Therefore, unit costs were the mean national NHS reference costs (weighted by number of finished consultant episodes between elective and emergency), which were given only as medical or surgical (estimated from Human Resource Group [HRG] codes). This meant that D&E, MVA and feticide were costed the same and procedure costs did not vary with gestational age. Costs were only allowed to vary with gestational age by their association with complication rates. Complications were costed in the DH categories (sepsis, perforation, haemorrhage and other) by matching as well as possible to ICD 10 and OPCS codes used to create the HRG codes, given guidance from a member of the expert group and the coding department of the Newcastle Acute Trust and the NHS central coding department. In doing this, 'other' was reclassified as 'retained products' because it was believed that this would constitute the majority of such classifications and a code could be found to match. Each of these codes had been costed by the Newcastle Acute Trust Finance Department as part of the process of producing HRG costs, although crucially, the NHS reference costs of medical and surgical excluded the complication costs.

Change in cost to reflect preference for local anaesthetic (LA) was also considered, although no data was available on women's preferences and the DH data does not discriminate between local and general anaesthetic (GA) in MVA. Therefore, to estimate the current prevalence (percentage of MVA), the percentage of providers offering a LA (14%) was taken from a survey by the RCOG[219] and combined with an assumption for preference for LA compared to GA. The ratio of the cost of LA to GA MVA was estimated from an audit of the abortion service in Chesterfield[220]. These estimates were then used to adjust the mean unit cost for surgical abortion according to assumptions (base, mid, best) given in Table 7 by a method explained fully in Technical Appendix 6.

Table 7: **Unit costs for abortion methods, including variation in that for surgical depending on assumptions**

	Providers offering LA	Preference for LA vs GA	Unit cost of surgical*	Unit cost of medical
Base	14	33	778.78	548.02
Mid	100	33	652.16	548.02
Best	100	66	514.9805	548.02

Assume in the base case that unit cost of surgical=MVA=D&E=feticide
Ratio of unit cost of LA/GA=0.44

5.   Results

5.1   Changing the contraception profile

The mean of all of the subjects' estimates in the consensus process of the contraception profiles for each age group is shown in Table 8c and, alongside the full current profile, in Chart 1. Only one out of five subjects changed their estimates between rounds one and two: therefore very little change occurred in the means. The effect of the variability between subjects on change in profile and cost was tested in a sensitivity analysis (see below).

Chart 1 (a) **Current vs ideal contraception profile (15-19)**
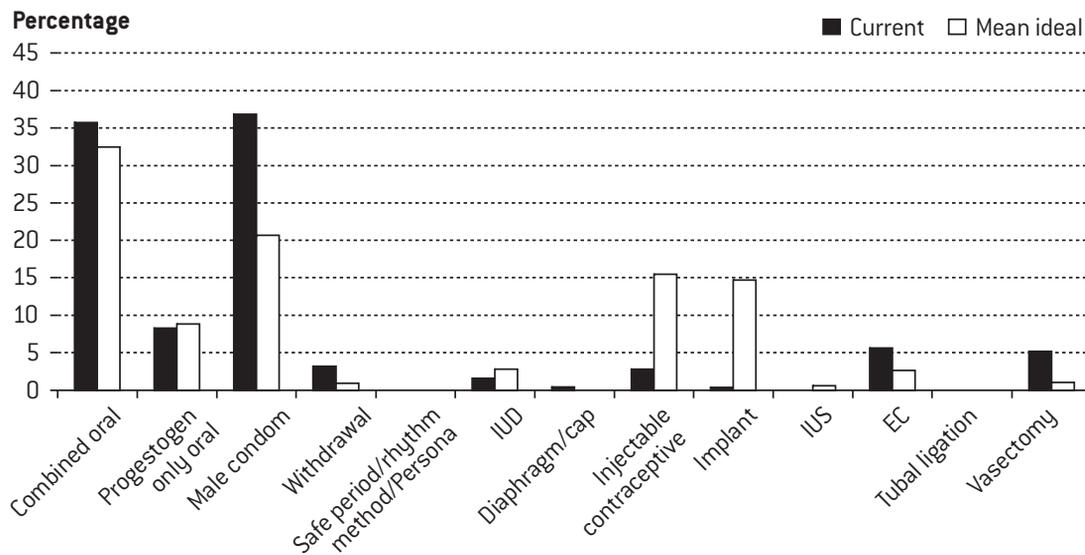
Chart 1 (b) **Current vs ideal contraception profile (20-24)**
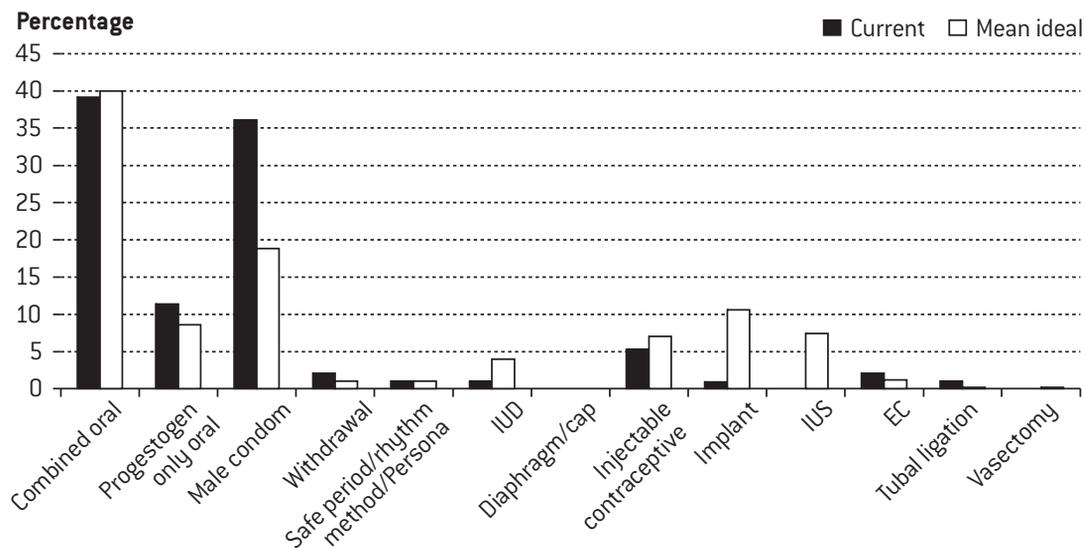
Chart 1 (c) **Current vs ideal contraception profile (25-29)**
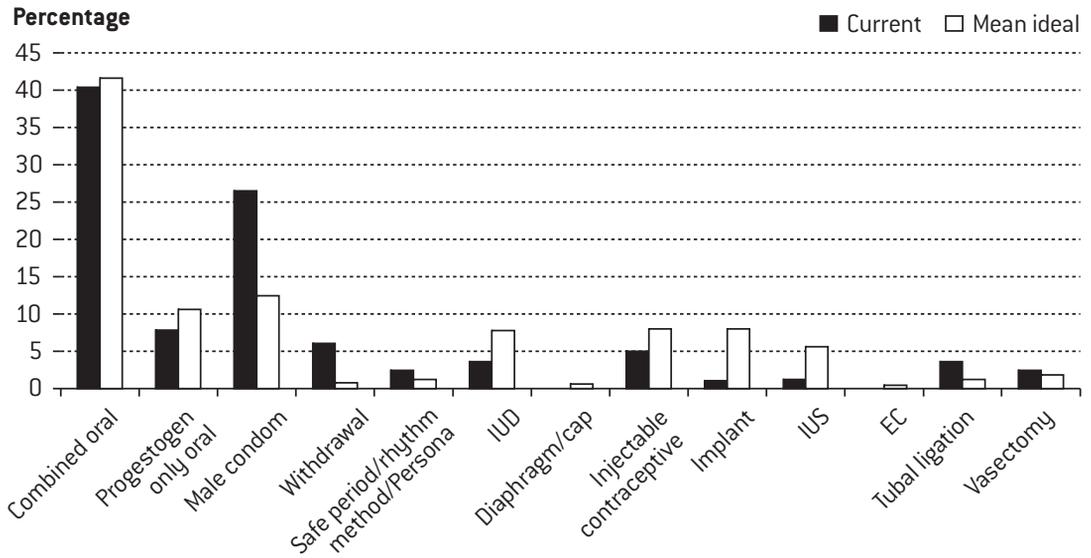
Chart 1 (d) **Current vs ideal contraception profile (30-34)**
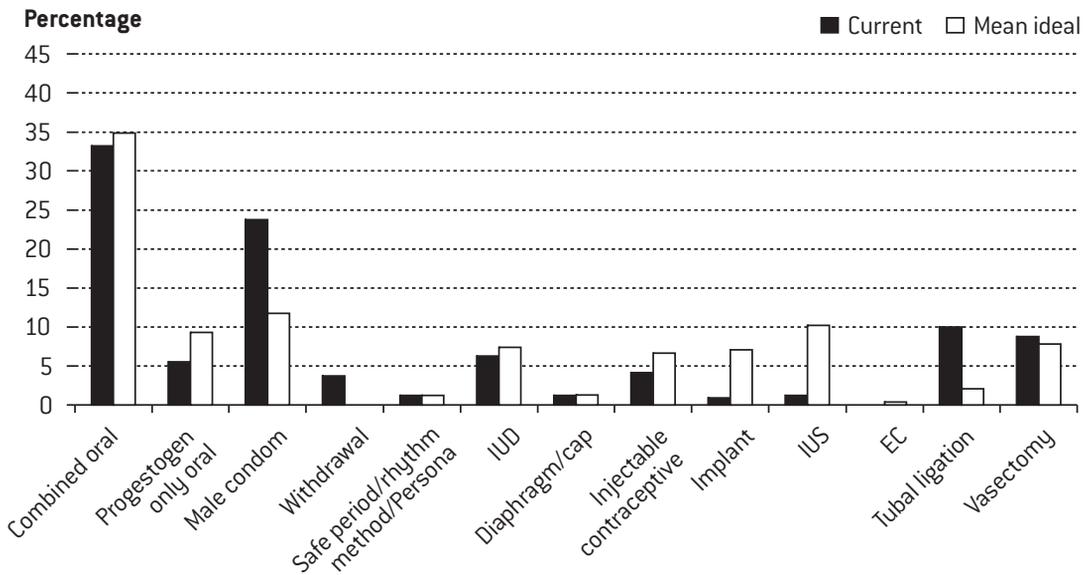
Chart 1 (e) **Current vs ideal contraception profile (35-39)**

Percentage ■ Current □ Mean ideal
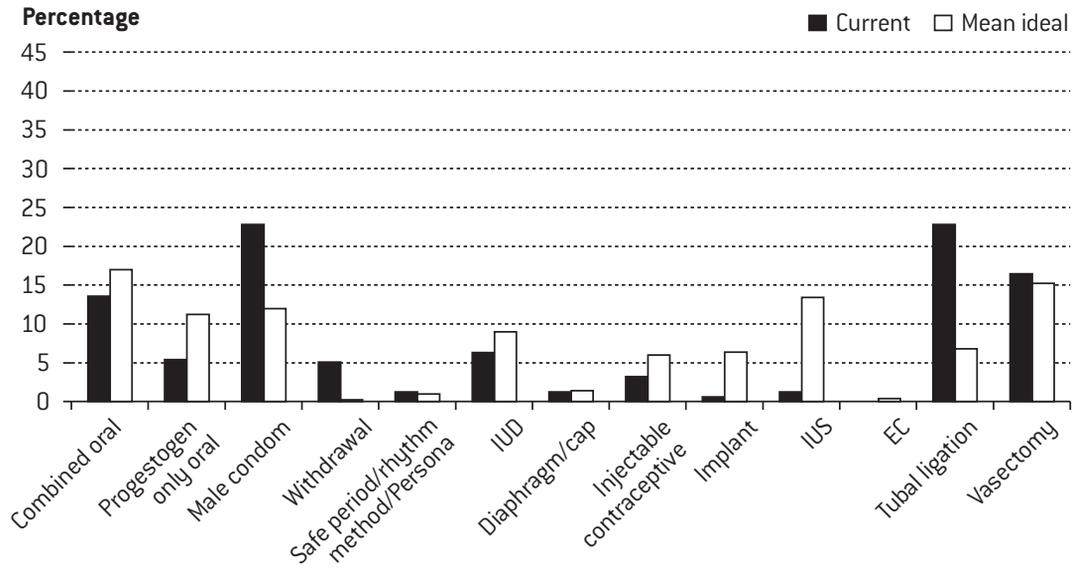
Chart 1 (f) **Current vs ideal contraception profile (40-44)**

Percentage ■ Current □ Mean ideal
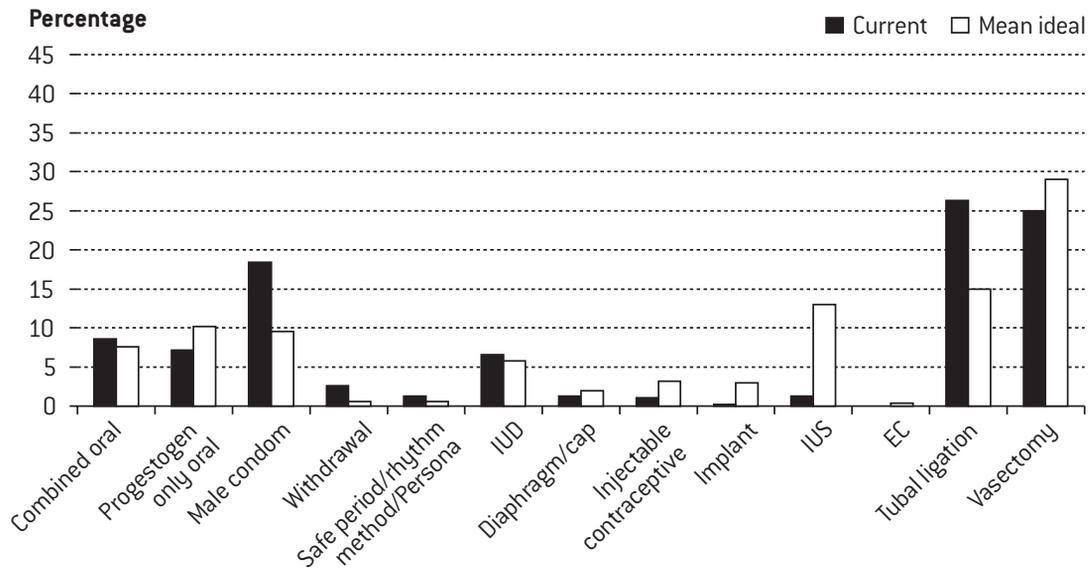
Chart 1 (g) **Current vs ideal contraception profile (45-49)**
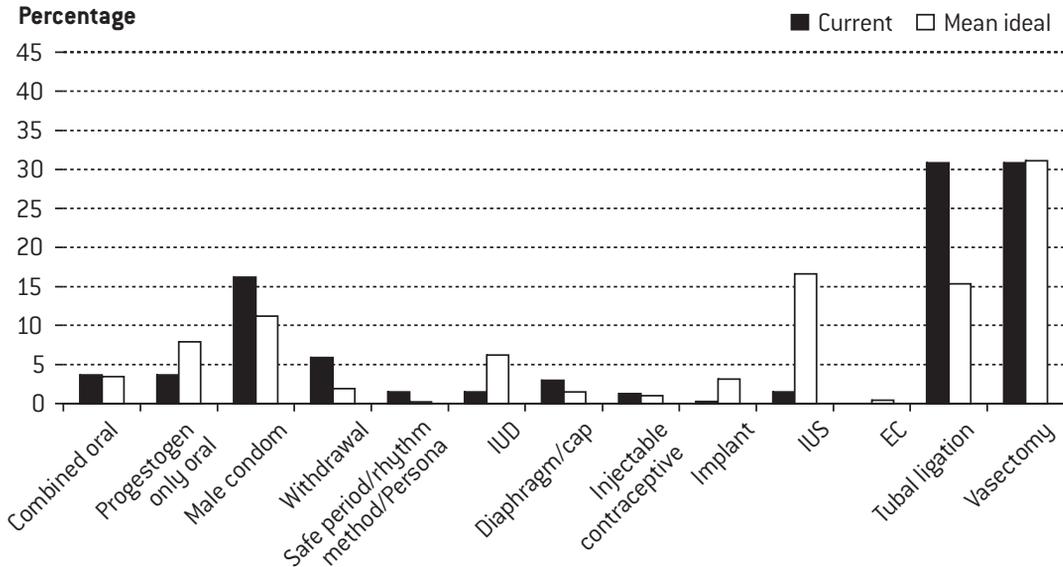
The current and ideal profiles for each age group for the general practice prescribable methods are shown in Tables 8a and b. The all ages profiles are compared for the NHS alongside the current for the NHS, general practice and FPC separately in Chart 2. That for FPCs was then standardised for age, given that data was available (unlike for general practice prescriptions) and presented in Chart 3 alongside the general practice profile as it would be after 'subtracting' the age standardised profile from the ideal. The current general practice prescribable profile is shown in Table 9, estimated from prescription data (general practice and FPC) and from the 2003 Contraception and Sexual Health Survey. The full profile is only available from the latter. It can be seen that both sources produce changes in the same direction for the largest areas of change, for example with combined oral, and of a similar magnitude.

Table 8 (a): **Current general practice prescribable profile (Contraception and Sexual Health Survey, 2003)**

	Combined	Progestogen only	Implant	Injection	IUS	IUD	Diaphragm/ cap
15-19	72.60	16.83	0.76	5.74	0.00	3.25	0.81
20-24	67.81	19.69	1.58	9.13	0.00	1.79	0.00
25-29	68.39	13.24	1.78	8.42	2.04	6.12	0.00
30-34	63.27	10.54	1.66	7.86	2.38	11.90	2.38
35-39	42.86	17.14	1.89	10.11	4.00	20.00	4.00
40-44	32.73	27.27	0.79	4.21	5.00	25.00	5.00
45-49	25.00	25.00	1.57	8.43	10.00	10.00	20.00

(b) **Ideal general practice prescribable profile (adjusted from full profile)**

	Combined	Progestogen only	Implant	Injection	IUS	IUD	Diaphragm/ cap
15-19	43.37	11.78	19.66	20.65	0.80	3.74	0.00
20-24	51.55	11.08	13.66	9.02	9.54	5.15	0.00
25-29	50.61	12.90	9.73	9.73	6.81	9.49	0.73
30-34	45.46	12.10	9.21	8.62	13.32	9.61	1.68
35-39	26.40	17.39	9.94	9.32	20.81	13.98	2.17
40-44	16.96	22.77	6.70	7.14	29.02	12.95	4.46
45-49	8.63	19.91	7.83	2.54	41.84	15.60	3.65

(c) **Ideal full profile (means estimated by consensus methods)**

Age group	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Combined oral	32.45	40.00	41.60	34.88	17.00	7.60	3.43
Progestogen only oral	8.82	8.60	10.60	9.29	11.20	10.20	7.91
Male condom	20.64	18.80	12.40	11.76	12.00	9.60	11.21
Withdrawal	0.91	1.00	0.80	0.00	0.20	0.60	1.92
Safe period/rhythm method/Persona	0.00	1.00	1.20	1.20	1.00	0.60	0.23
IUD	2.80	4.00	7.80	7.37	9.00	5.80	6.20
Diaphragm/Cap	0.00	0.00	0.60	1.29	1.40	2.00	1.45
Injectable contraceptive	15.45	7.00	8.00	6.62	6.00	3.20	1.01
Implant	14.71	10.60	8.00	7.07	6.40	3.00	3.11
IUS	0.60	7.40	5.60	10.22	13.40	13.00	16.63
EC	2.62	1.20	0.40	0.40	0.40	0.40	0.40
Tubal ligation	0.00	0.20	1.20	2.08	6.80	15.00	15.36

Chart 2: **Comparison between current profiles and ideal profile of contraception provision**
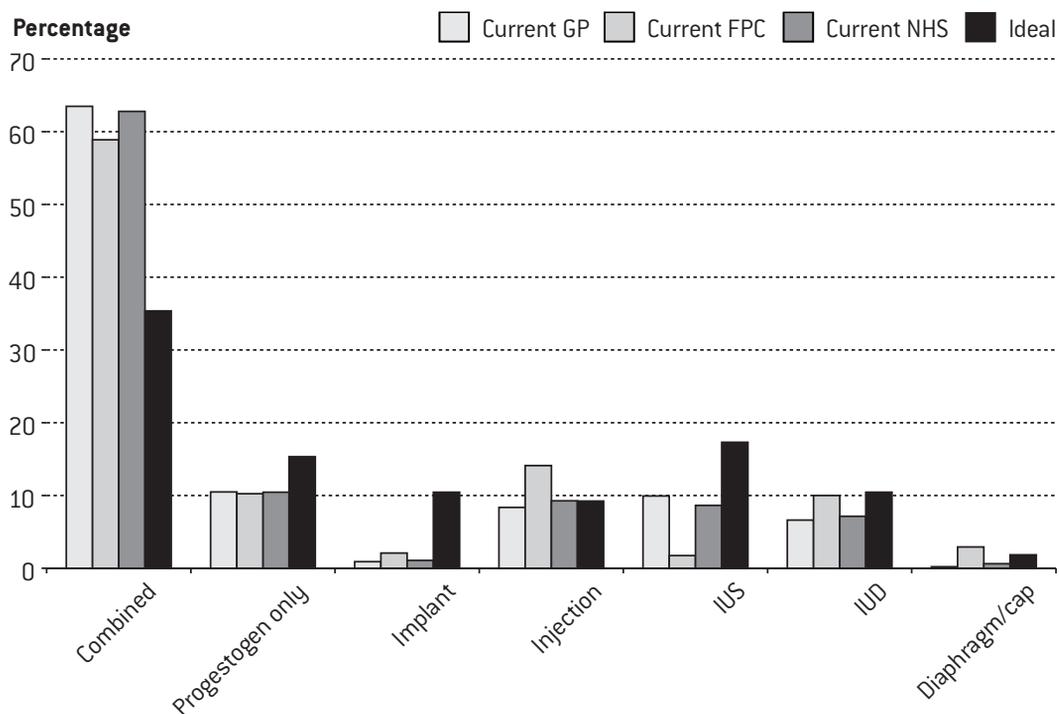
For the NHS as a whole, according to prescription data, there is a large (27%) decrease in combined oral and an increase in all other methods, especially implant (9%) and IUS (8%), except a very small (0.04%) decrease in injection. The interpretation of this is that the belief of the respondents used for the consensus methods is that women would prefer longer-term reversible methods and that supply does not currently meet this demand. These changes are also related to considering only general practice prescribable methods, the possible cost and effectiveness consequences of which are discussed below.

However, when comparing FPC to general practice provision in Chart 3 there is a difference. Because total general practice provision is much larger than FPC provision the pattern for general practice is similar to NHS, but current FPC provision is much nearer the ideal profile when standardised for age. For example the difference between FPC and ideal for combined oral is only 8%. There also appears currently to be an oversupply of implants and injections by FPCs given the age distribution of FPCs.

Chart 3: **Current versus ideal profiles for FPC provision standardised for FPC age distribution and GP provision after subtracting FPC from total NHS provision**

Percentage

Legend:
- Current FPC
- Ideal FPC standardised for FPC age dist
- Current GP
- Ideal GP if Ideal NHS and Ideal FPC standardised for age
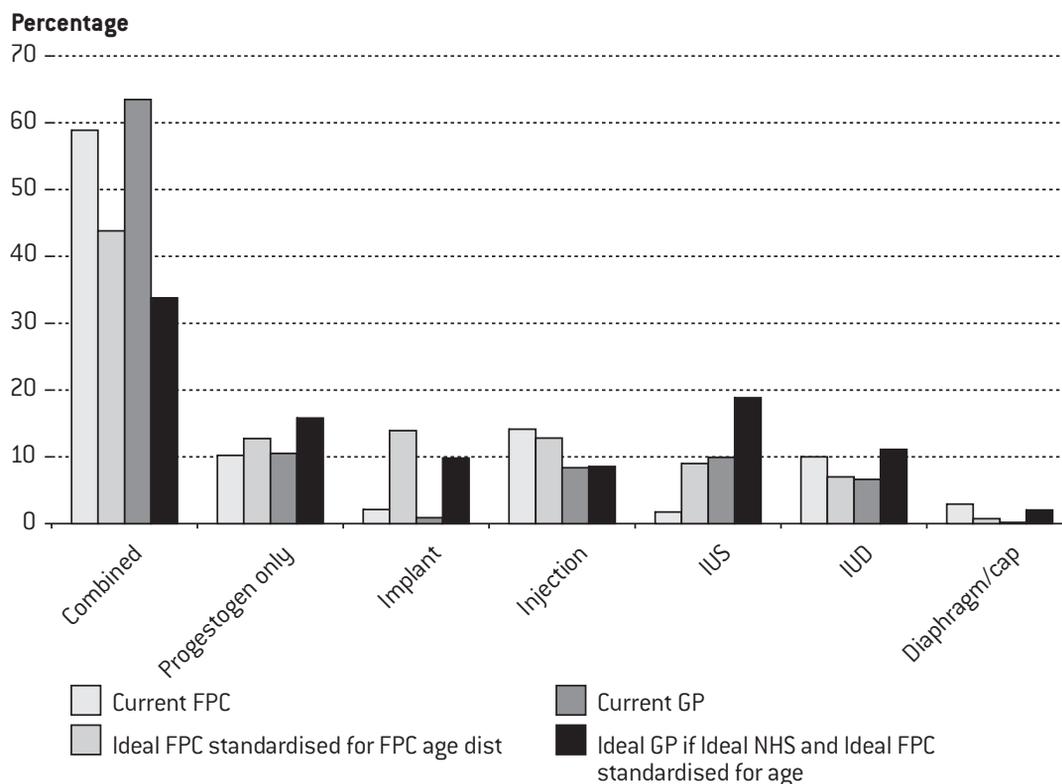
The cost and effectiveness implications of these changes are also summarised in Tables 9 and 10. Using data from the LARC economic evaluation it is clear that over 500,000 unintended pregnancies can be prevented, thus producing a net saving of over £650 million over 15 years. This varies little with source of current profile estimate (prescription or Contraception and Sexual Health Survey data).

Table 9: **General practice prescribable profiles for contraception and 15 year costs (based on two methods of estimation of current profile)**

	Combined	Progestogen only	Implant	Injection	IUS	IUD	Diaphragm /cap	All GP prescribable
Ideal	35.35	15.34	10.44	9.22	17.32	10.47	1.85	100
Current NHS (1)	62.91	10.48	1.09	9.29	8.67	7.16	0.39	100
Current NHS (2)	60.73	16.91	1.46	7.86	2.06	8.78	2.19	100
Difference (1)	-27.56	4.86	9.35	-0.07	8.65	3.31	1.46	0
Difference (2)	-25.38	-1.56	8.98	1.36	15.27	1.69	-0.34	0
Cost per user*	£2260.88**	£2260.88**	£1632.19	£1965.22	£1563.54	£1469.75	N/a	N/a
Cost ideal	£3,041,480,850	£1,319,984,569	£648,666,899	£689,528,436	£1,030,832,604	£585,620,996	N/a	£7,316,114,354
Current cost (1)	£5,412,965,320	£901,605,463	£67,750,948	£694,532,731	£516,155,584	£400,621,276	N/a	£7,993,631,323
Current cost (2)	£5,225,481,108	£1,454,589,286	£90,957,530	£588,085,357	£122,430,486	£491,034,177	N/a	£7,972,577,944
Cost change (1)	-£2,371,484,471	£418,379,106	£580,915,951	-£5,004,295	£514,677,020	£184,999,719	N/a	-£677,516,969
Cost change (2)	-£2,184,000,259	-£134,604,717	£557,709,369	£101,443,080	£908,402,118	£94,586,819	N/a	-£656,463,590

Total annual CYP (couple years of protection), used to calculate costs:

(NHS=3805525=GP only (3225326)+FPC only (580199)

(1)   estimated from 2003/2004 prescription data

(2)   estimated from Contraception and Sexual Health Survey, 2003

*from NICE guidance on long acting reversible contraceptive methods (Diaphragm/cap not included)

**in NICE guidance there was no differentiation between combined and progestogen only oral

Table 10: **GP prescribable profiles for contraception and 15 year unintended pregnancy number (based on two methods of estimation of current profile)**

	Combined	Progestogen only	Implant	Injection	IUS	IUD	Diaphragm/ cap	All GP prescribable
Ideal	35.35	15.34	10.44	9.22	17.32	10.47	1.85	100
Current NHS (1)	62.91	10.48	1.09	9.29	8.67	7.16	0.39	100
Current NHS (2)	60.73	16.91	1.46	7.86	2.06	8.78	2.19	100
Difference (1)	-27.56	4.86	9.35	-0.07	8.65	3.31	1.46	0
Difference (2)	-25.38	-1.56	8.98	1.36	15.27	1.69	-0.34	0
Number per user (1)	1.33	1.33	0.73	0.95	0.78	0.83	N/a	N/a
Number (ideal)	1,789,201.34	776,502.72	288,923.62	332,620.75	512,928.14	329,915.20	N/a	4,030,091.77
Number (current (1))	3,184,266.25	530,384.30	30,177.04	335,034.77	256,831.93	225,693.84	N/a	4,562,388.13
Number (current (2))	3,073,975.56	855,686.17	40,513.52	283,685.75	60,919.73	276,628.81	N/a	4,591,409.54
Change in number (1)	-1,395,064.91	246,118.42	258,746.57	-2,414.02	256,096.21	104,221.36	N/a	-532,296.35
Change in number (2)	-1,284,774.22	-79,183.45	248,410.10	48,935.00	452,008.41	53,286.39	N/a	-561,317.77

Total annual CYP (couple years of protection), used to calculate unintended pregnancies:
NHS=3805525=GP only (3225326)+FPC only (580199)
(1)   estimated from 2003/2004 prescription data
(2)   estimated from Contraception and Sexual Health Survey, 2003
*from NICE guidance on long acting reversible contraceptive methods (Diaphragm/cap not included)
**in NICE guidance there was no differentiation between combined and progestogen-only oral

5.2   Reducing delay to abortion

Chart 4 shows, through survival curves, the effect of the hypothetical intervention on the profile of gestational age at time of abortion. An expected (average) reduction in delay as measured by gestational age of about ten days is associated with a change in prevalence in the 0–9-week age group from 57% to 78%. This is well in excess of the DH target of 60%.

Chart 4: **'Survival' curve for abortion (percentage of women who have not yet had an abortion by number of weeks gestation: before and after intervention)**
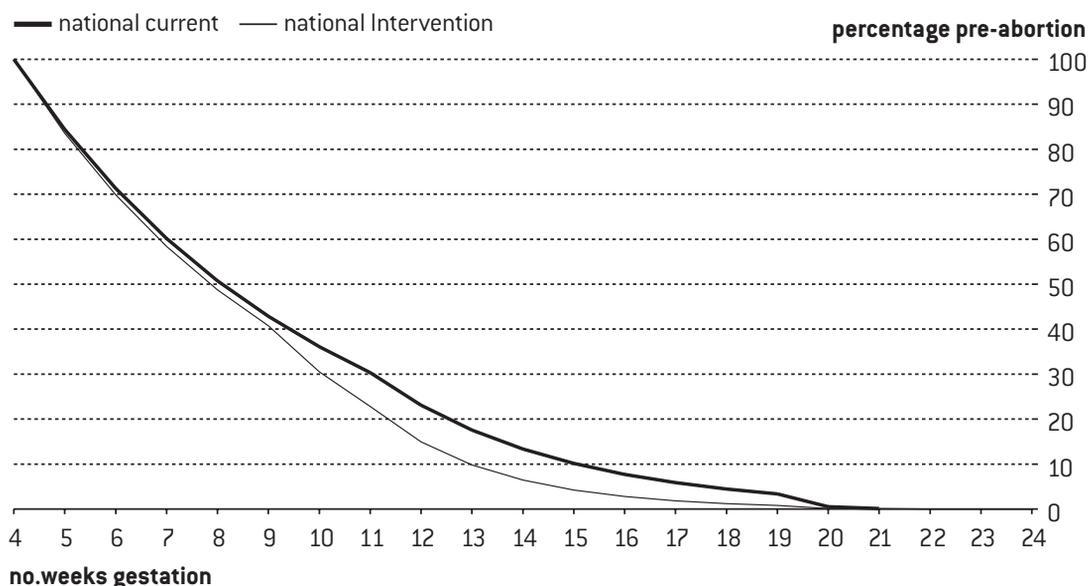
As shown in Table 11, this implies an annual cost saving in the base case (no change according to preference for method of abortion) of about £700,000, which could be much less, but only if there was virtually no effect of the hypothetical intervention. However, Table 11 also shows that this can be turned into a cost saving of between about £8 million and £38 million depending on the assumptions regarding preferences for abortion method and abortion method costs. For example, if the percentage of women who prefer medical abortion in gestational age 0–9 weeks is the same (41%) as the percentage who stated that they would opt for a medical abortion if they had another one in the future in the Henshaw et al study[221], then the saving would be about £8 million (mid case). If those who were *a priori* indifferent and then randomised to surgical, actually would have opted for medical at the same rate as those who were randomised to medical (as if they had been given the experience of medical), then the saving could be as high as £20 million (best case). Examining Table 7, all of these savings are also based on a national average unit cost of medical (£548) versus surgical (£778). However, in the best case, if surgical was, on average, cheaper than medical, due to all providers offering LA instead of GA and 66% of women preferring GA to LA, the average cost of surgical could be as low as £515 (ratio of LA to GA cost of 0.44). This could then produce savings of up to £38 million per year.

Table 11: **Cost results for abortion given varying assumptions for medical versus surgical preference and, for surgical, LA versus GA preference**

		LA assumption		
		base	**mid**	**best**
Medical assumption	base	£130,814,072	£130,814,072	£130,814,072
		£130,116,077	£111,927,886	£92,223,507
		-£697,995	-£18,886,186	-£38,590,566
	mid	£130,814,072	£130,814,072	£130,814,072
		£122,661,452	£108,508,713	£93,176,183
		-£8,152,620	-£22,305,360	-£37,637,889
	best	£130,814,072	£130,814,072	£130,814,072
		£110,195,803	£102,775,557	£ 94,736,750
		-£ 20,618,269	-£ 28,038,515	-£ 36,077,322

As far as complications are concerned, Table 12 shows that, in the base case (no change according to medical abortion preferences), there is a decrease in all complications and therefore a consequent cost saving. This can be understood from the dependence of the rates of complications on gestational age, shown in Table 6. Table 6 also explains why, when the percentage of medical abortions increases, for example in the mid case, the decrease in the rate of complications and cost reduction reduces. In detail, there are fewer still cases of sepsis and perforation, but the reduction in haemorrhage cases is less and there is an increase in cases of retained products. However, these are all relatively small numbers and subject to sources of error including misclassification. In particular, 'retained products' was attributed on the advice of an expert group member to the classification 'other' by the DH. Also, these classifications do not demonstrate severity, except perhaps for 'perforation' and 'sepsis', which in fact do decrease further with more medical abortions. Of course, it is also clear that, in terms of cost savings, there is little effect in comparison to those that are attributed to the procedures themselves.

Table 12: **Abortion: total annual complications number and change due to intervention**

(a) base case medical preference assumptions

	Sepsis	Perforation	Haemorrhage	Retained products	Total
Current number	61.24	65.03	325.12	42.87	494.26
New number	44.25	56.98	277.74	35.26	414.24
Change	-16.98	-8.05	-47.38	-7.60	-80.02
New cost	£39,165	£31,776	£109,707	£13,859	£194,506
Current cost	£35,400	£27,638	£115,253	£20,690	£198,982
Cost change	-£15,031	-£ 4,491	-£18,716	-£2,988	-£41,226

(b) mid case medical preference assumptions

	Sepsis	Perforation	Haemorrhage	Retained products	Total
Current number	61.24	65.03	325.12	42.87	494.26
New number	40.00	49.56	291.78	52.65	433.99
Change	-21.24	-15.47	-33.34	9.78	-60.27
New cost	£54,195	£36,267	£128,423	£16,847	£235,732
Current cost	£35,400	£27,638	£115,253	£20,690	£198,982
Cost change	-£18,795	-£8,629	-£13,169	£3,844	-£36,750

6. Discussion

6.1 Contraception

Generally, there is support for a change in the profile of methods supplied, mostly from combined hormonal oral methods to longer acting methods and that such a move would produce a very large cost saving to the NHS. These conclusions were shown to be robust to various sensitivity analyses. However, there are some reasons why one must be cautious in giving credibility to these conclusions. The main one is that the estimation of the ideal profile was based on expert opinion and not women's preferences, although inter-subject variability did not affect these conclusions. Also, there was an *a priori* belief by the expert group that current provision by FPCs was probably a better reflection of women's preferences than in general practice. This did turn out to be the case.

Despite these reassurances, the crucial question is the credibility of the experts, which should be judged in the context of the cost and effectiveness of intervention(s) that might be feasible in order to change prescribing practice. These are clearly unknown, but this study shows that the benefits and cost savings of taking such action could be considerable even without accounting for non-health service costs. For example, welfare payment cost

savings were shown in several previous studies, including by McGuire and Hughes[222], to be considerably larger. This study has shown large savings with an incremental change in profile, i.e. from current practice to an estimate of what women might prefer and not, as McGuire and Hughes did, by assuming that all women would switch from the least effective methods of condom or no method.

In terms of the resulting reduction in unintended pregnancies and consequent cost savings, use of the LARC model[223] has shown that these can be considerable. Although a full comparison with the Sonnenberg model[224] has not so far been accomplished, there are three overt likely sources of variability in outcome. The first is that in not using a mistimed birth model, cost savings are likely to be higher. The second is the lack of accounting for adverse events other than unintended pregnancy, the effect of which is likely to reduce cost savings through decreased prevalence of oestrogen-containing oral contraception. As mentioned earlier, there is also benefit in reducing such adverse events, although this is not the focus of the research. The third is the use of invariable discontinuation rates in the LARC model, which is likely to have produced conservative estimates of the saving, for a given ideal profile estimate. The basis for this is that the ideal profile implies a lower probability of discontinuation i.e. if these are the methods that women would prefer from the full range given that they were fully informed. Of course, even if women are fully informed, there will always be some switching due to the occurrence of adverse events, which are not predictable with certainty for an individual user. In this sense at least, the Sonnenberg model would probably have the better structure. However, the crucial question again is the credibility of this profile as an estimate of women's preferences.

6.2 Abortion

Unlike as hypothesised, the reduced delay was shown to be cost saving. This was largely driven by the lower price of medical abortion and its increased prevalence with lower gestational age and possibly LA instead of GA MVA. Therefore, by changing the profile to better reflect women's preferences, thus increasing the prevalence of medical abortion or LA MVA, a cost saving was produced. This was with the benefit of a preferred profile, reduced delay and, with some caveats, reduced complication rate. The main reason for doubting these conclusions is that the changes are based on estimating the effect of a hypothetical intervention to change practice, although sensitivity analysis showed that the difference in hazard rate for the gestational age range 0–9 weeks would still be cost saving. There is also doubt as to precisely what women's preferences for medical abortion are, although sensitivity analysis showed that savings were possible for even the most pessimistic scenario.

As with contraception, the credibility of any estimates needs to be considered in the context of the belief about the cost and benefit of an actual intervention to reduce delay. This study shows that there can be considerable cost savings (although much less than with contraception) as well as benefit by such a measure.

6.3 Contraception and abortion combined (from the perspective of a common budget)

What is clear methodologically is that not only does evaluating policy changes necessitate certain methods, but also these methods have been demonstrated to be feasible, namely:

- economic evidence, and thus an economic evaluation
- estimations of cost and benefit that are relevant to the DM and estimation of the opportunity cost.

The original hypothesis was that savings for the contraception policy change could be used to pay for any cost increase from the abortion policy change. However, both could produce savings and those for contraception could be considerable. Therefore, logically, there are three main next steps:

1. To decide what further research is required to improve the models, in particular in the main areas of doubt and on which the conclusions most depend, in terms of:

   (a) model structure, for example the use of only general practice prescribable methods and a comparison of the Sonnenberg and LARC models

   (b) model inputs, for example a survey of women's preferences for contraceptive and abortion methods.

2. To decide what research is required to evaluate any specific proposed interventions.

3. To decide in the meantime which interventions might be funded now on the basis of their likely benefit and cost.

7. Summary and conclusions

Despite a welcome increase in the prioritisation of sexual health at national policy level in recent years, and significant additional investment in services to support this, it is clear that there are not unlimited resources within the NHS for sexual health. Moreover, even with this additional prioritisation and investment, many women are not currently receiving high quality contraception and abortion services which truly meet their needs.

Is it, therefore, possible to improve service provision **and** make budget savings? This research shows that it is indeed feasible to improve contraception and abortion services in ways that better meet the preferences of service users, while also making a considerable net saving from doing so.

In the light of this unequivocal economic evidence, the onus must now be on the Government and PCTs to ensure that significant improvements are made to both contraception and abortion services. This is an urgent priority that will require not only direction and support at national level but also an informed and comprehensive approach within each PCT that includes general practice, family planning clinics, sexual health clinics, and both NHS

and agency providers of abortion services. With such a holistic approach in place, service providers will be able to improve the services they offer to users, and also contribute to budget savings across the NHS.

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8   Economic evaluation could theoretically consider changes in cost and benefit for more than one population, although it has become the norm not to do this.

9   Given that economic evaluations in practice never consider change in cost and benefit for more than one population, an *economic evaluation for a single population* can be considered equivalent to a *single economic evaluation*.

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12   The matrix could theoretically be used to consider economic evidence for not only one study but more than one study, as long as they estimated changes in cost and benefit for the technology change for a given population. Therefore, evidence would be judged to be insufficient in the sense that the study (or studies) examining the technology change for that population lacked quality or that there was an absence of cost or benefit evidence for the technology change for that population.

13   Of course, whether there is net benefit depends not only on information from an economic evaluation on the *average* cost and benefit change for a population, but the *total* change, which requires knowledge of the *size* of the population. This information can only be obtained locally and therefore, where economic evaluations in this review show a cost increase, no conclusion can be drawn regarding efficiency.

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30 One needs also to specify what the delay is since all costs (or benefits) incurred at a later date are usually discounted in line with the recommended Treasury rate (as we prefer to get benefits sooner and incur costs later).

31 Each set of values on each dimension is given a weight between 0 (representing death) and 1 (representing perfect health). They are then multiplied by the expected number of years in a health state corresponding to that set of values in order to calculate the expected number of QALYs. The weights are often referred to as *preference* weights on the basis that the technology producing the higher total ought to be the preferred alternative. The use of such a measure stems from the lack of opportunity to estimate *revealed* preference, inferred from actual choices of health care technologies, given that choice is constrained by supply in the absence of a free market (i.e. with public provision). However, constructing experiments to estimate *stated* preference and thereby produce weights is also challenging, given the complexities (multi-attribute nature) of choices and the propensity for confounding by *framing effects* (how the choices are described).

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36   This approach *contains* a typical systematic review of literature, which involves a *pooling* of studies *within the same population.* The basis for doing this is that the more studies that can be examined the better on the same principle as applies to a single study: the larger the sample the better. Therefore, the probability of getting an estimate that is unrepresentative of the population reduces. A review of studies for a given population also allows an analysis of heterogeneity (variability) i.e. different studies producing different results. The sensitivity of the result (place in the decision matrix) to such variability is investigated in the section on key methodological issues.

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140	Op.s Cit. see endnotes 73 and 74
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171   Op. Cit. see endnote 1

172   Op. Cit. see endnote 2

173   Op. Cit. see endnote 157

174   Op.s Cit. see endnotes 44, 46 ad 64

175   Op. Cit. see endnote 86

176   Op. Cit. see endnote 160

177   Op. Cit. see endnote 2

178   Op. Cit. see endnote 159

179   Op. Cit. see endnote 81

180   Op. Cit. see endnote 161

181   Op. Cit. see endnote 160

182   Op. Cit. see endnote 2

183   Op.s Cit. see endnotes 58 and 59

184   Op. Cit. see endnote 159

185   Hobden J (ed), *Medical abortion: meeting women's needs* (London: **fpa**, 1999).

186   Op. Cit. see endnote 161

187   Women's as opposed to couple's preferences were used because all methods are obtained by women other than condom and vasectomy, and for simplicity.

188   Op. Cit. see endnote 157

189   Op.s Cit. see endnotes 158 and 159

190   Op.s Cit. see endnotes 160 and 161

191   Op. Cit. see endnote 6

192   Kuntz K M and Weinstein M C, 'Modelling in economic evaluation', in Drummond MF and McGuire A (eds), *Economic evaluation in health care: merging theory with practice* (Oxford: Oxford University Press, 2001).

193   Op. Cit. see endnote 160

194   Op. Cit. see endnote 86

195   It was felt by the expert group that this was unnecessary to include due to its very low current prevalence and consequent difficulty in estimating women's preferences for it.

196   Dawe F and Rainford L, *Contraception and sexual health, 2003* (London: Office for National Statistics, 2004).

197   Op. Cit. see endnote 42

198   Op. Cit. see endnote 3

199   Op.s Cit. see endnotes 52, 53 and 54

200   Op. Cit. see endnote 51

201   Op. Cit. see endnote 44

202   In this part of the model, individuals can switch to any of the full range of methods (including 'no method' and not only those that are general practice prescribable). This makes the simulation more realistic in that the individuals from the population for whom general practice prescribable methods are prescribed can still end up using other methods due to the occurrence of individually unpredictable events. However, the more effective the method the less likely it is to switch. The prevalences of the full range come from the Contraception Survey, 2003.

203   Op. Cit. see endnote 44

204   National Collaborating Centre for Women's and Children's Health, *Long-acting reversible contraception: the effective and appropriate use of long-acting reversible contraception; final consultation draft* (London: National Institute for Health and Clinical Excellence, 2005).

205   Op. Cit. see endnote 196

206   Op. Cit. see endnote 1

207   Op. Cit. see endnote 2

208   CHI now known as the Healthcare Commission; <http://www.chi.nhs.uk/Ratings/Trust/Indicator/indicatorDescriptionShort.asp?indicatorId=4597>

209   Op. Cit. see endnote 159

210   Op. Cit. see endnote 81

211   Op. Cit. see endnote 185

212   Op. Cit. see endnote 159

213   Schaff E, 'Lose dose of mifepristol 200mg and vaginal mifepristol for abortion', *Contraception*, vol 59, (1999), 1-6.

214   Op. Cit. see endnote 81

215   Royal College of Obstetricians and Gynaecologists, *National audit of induced abortion* (London: Royal College of Obstetricians and Gynaecologists, 2001).

216   Glasier A and Thong J K, 'The establishment of a centralised referral service leads to earlier abortion', *Health Bulletin*, vol 49, no 5, (1991), 254-259.

217   Op. Cit. see endnote 81

218   This is being addressed in an ongoing trial to update Henshaw et al, 1994.

219   Op. Cit. see endnote 215

220   Searle S, *Audit of the cost of surgical abortion in Chesterfield: local versus general anaesthetic*, 2001: unpublished.

221   Op. Cit. see endnote 81

222   Op. Cit. see endnote 3

223   Op. Cit. see endnote 204

224   Op. Cit. see endnote 44

Appendix 1:
Expert group membership

Chair:

Professor Cam Donaldson, University of Newcastle

Members:

Toni Belfield, **fpa**

Caroline Davey, **fpa**

Professor David Hunter, University of Durham/UKPHA

Paul Lincoln, National Heart Forum

Margaret McGovern, **fpa**

Dr John McLeod, University of Birmingham

Dr Nick Payne, Department of Health

Dr Angela Robinson, BASHH

Dr Stephen Searle, High Peak and Dales PCT

Anne Weyman, **fpa**

Researcher:

Nigel Armstrong, University of Newcastle

Appendix 2:
Summary of studies reviewed

Authors	Title	Year	Technology category	Setting	Method of estimation of benefits and costs
Henshaw et al	A prospective economic evaluation comparing medical abortion (using mifepristone and gemeprost) and surgical vacuum aspiration	1994	abortion method	UK	sample
Tewari et al	Mifepristone in mid trimester termination of pregnancy-value for money?	1995	abortion method	UK	sample
Blackwell et al	Health gains from screening for infection of the lower genital tract in women attending for termination of pregnancy	1993	abortion other	UK	sample
Penney et al	A randomised comparison of strategies for reducing infective complications of induced abortion	1998	abortion other	UK	sample
Evans et al	The fiscal impact of the Medicaid abortion funding ban in Michigan	1993	abortion service	US	model
Torres et al	Public benefits and costs of government funding for abortion	1986	abortion service	US	model
Ashraf et al	Cost-effectiveness of levonorgestrel subdermal implants: comparison with other contraceptive methods available in the United States	1994	contraceptive method	US	model
Chiou et al	Economic analysis of contraceptives for women	2003	contraceptive method	US	model
French et al	Implantable contraceptives (subdermal implants and hormonally impregnated intrauterine systems) versus other forms of reversible contraceptives: two systematic reviews to assess relative effectiveness, acceptability, tolerability and cost-effectiveness	2001	contraceptive method	UK	model
Hendrix et al	Sterilisation and its consequences	1999	contraceptive method	US	model
Hughes and McGuire	The cost-effectiveness of family planning service provision	1996	contraceptive method	UK	model
Ortmeier et al	A cost-benefit analysis of four hormonal contraceptive methods	1994	contraceptive method	US	model

Authors	Title	Year	Technology category	Setting	Method of estimation of benefits and costs
Phillips	Economic analysis of long-term reversible contraceptives	2000	contraceptive method	UK	model
Sonnenberg et al	Costs and net health effects of contraceptive methods	2004	contraceptive method	US	model
Trussell et al	The economic value of contraception: a comparison of 15 methods	1995	contraceptive method	US	model
Trussell et al	Medical care cost savings from adolescent contraceptive use	1997	contraceptive method	US	model
Garcia et al	Economic and clinical outcomes of microlaparoscopic and standard laparoscopic sterilisation	2000	contraceptive other	US	sample
Lemos et al	The economic benefits of ambulatory surgery relative to inpatient surgery for laparoscopic tubal ligation	2003	contraceptive other	Portugal	sample
McKessock et al	A randomised controlled trial of direct access for laparoscopic sterilisation	2001	contraceptive other	UK	sample
Cakir et al	Comparative costs of family planning services and hospital-based maternity care in Turkey	1996	contraception service	Turkey	model
Chamie and Henshaw	The costs and benefits of government expenditures for family planning programs	1981	contraception service	US	model
Chao and Allen	A cost-benefit analysis of Thailand's family planning program	1984	contraception service	Thailand	model
Foreit et al	Costs and benefits of implementing family planning services at a private mining company in Peru	1991	contraception service	Peru	model
Forrest and Samara	Impact of publicly funded contraception services on unintended pregnancies and implications for Medicaid expenditures	1996	contraception service	US	model
Forrest and Singh	Public-sector savings resulting from expenditures for contraception services	1990	contraception service	US	model
Forrest and Singh (a)	The impact of public-sector expenditures for contraception services in California	1990	contraception service	US	model
Laing	Family planning: the benefits and costs	1982	contraception service	UK	model
Levey et al	A cost-benefit analysis of family planning services in Iowa	1988	contraception service	US	model

Authors	Title	Year	Technology category	Setting	Method of estimation of benefits and costs
McGuire and Hughes	The economics of family planning services: a report prepared for the Contraceptive Alliance	1995	contraception service	UK	model
Nortman et al	A cost-benefit analysis of the Mexican Social Security Administration's Family Planning Program	1986	contraception service	Mexico	model
Zhu et al	The financial impact of over-the-counter availability of oral contraceptive pills	2001	contraception service	US	model
Marciante et al	Modeling the cost and outcomes of pharmacist-prescribed emergency contraception	2000	EC	US	model
Trussell et al	Preventing unintended pregnancy: cost effectiveness of three methods of emergency contraception	1997	EC	US	model
Trussell et al	Cost savings from emergency contraceptive pills in Canada	2001	EC	Canada	model

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