



The Cost-Effectiveness of Immediate vs Routine Postpartum IUD Placement: a UK Perspective

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Abstract

OBJECTIVES: Preventing pregnancy in the year after childbirth provides health benefits, and an intrauterine device (IUD) placed immediately after birth is a cost-effective tool to prevent pregnancy in the US. However, it is not known if this strategy is cost-effective in the UK. The objective of this study is to identify the cost-effectiveness of immediate compared to routine IUD placement strategies in the UK.

METHODS: A decision tree cost-effectiveness model was constructed using inputs from published literature including data and costs from the National Institute for Health and Care Excellence (NICE). The study population for this evaluation is women in the UK who desire a postpartum IUD and are eligible for placement at the time of delivery and at low risk for an STI. The perspective of the study is payer with a time horizon of one year. The outcome measure is incremental cost-effectiveness ratio (2018 Great British Pound per quality-adjusted life-year [QALY] gained), with a threshold of an ICER < 20,000 considered cost effective.

RESULTS: The results of the analysis yielded an ICER of -£21,845, which is interpreted as a cost savings of £21,485 for every QALY gained with the immediate placement strategy. Our results and probabilistic sensitivity analysis both indicate that immediate placement is a consistently dominant strategy as compared to routine placement. Results are most sensitive to changes to the health utility assigned to pregnancy.

CONCLUSIONS: Immediate as compared to routine postpartum placement of an IUD is a dominant strategy and presents an opportunity for a cost saving policy. Budget impact analysis indicates that savings from the implementation of this strategy over a 5-year time horizon (2019-2023) would be over £15 million.

Keywords: Long-acting Reversible Contraceptive; Intrauterine Device; Cost-Effectiveness; Postpartum Contraception; Post-placental Contraception

Introduction

In the United Kingdom (UK), it is estimated that approximately 30% of pregnancies are unintended [1]. Unplanned pregnancies can adversely affect women's lives and are associated with a higher probability of adverse birth outcomes including low birth weight, pre-term and small for gestational age infants [2,3]. Furthermore, unplanned pregnancies cause additional health system costs, as they are associated with higher abortion rates, and with poorer health during childhood [3,4]. In England in 2010, the direct medical costs attributable to unintended pregnancies were estimated to be greater than £193 million [5].

There are negative health consequences for both mother and baby if a new pregnancy occurs within a short interval after a previous pregnancy. WHO recommends prevention of a subsequent pregnancy for two years after delivery of a child, based on evidence that short interval pregnancies (less than 18 months) are more frequently associated with adverse outcomes for both mother and child [6]. Specifically, there is increased maternal morbidity and likely maternal mortality risk if the interval is less than one year [6]. Furthermore, there is an increased risk of prematurity, fetal death, low birth weight and fetal growth restriction for birth intervals less than 18 months. While risks to the infant are higher among younger age women (20 to 34), maternal risks are higher among older women; though both age groups face higher risks if births occur at a short interval [7]. In a cohort of births in the United States (US), 35% were conceived in a short interval after a previous birth (less than 18 months). Of the short interval births, approximately one third were unintended, indicating a gap in knowledge and access to contraceptives. However, in women who initiated childbearing over the age of 30, those of higher socioeconomic status (SES) and white race were more likely to have a planned short interval pregnancy [8].

An intrauterine device (IUD) is a highly effective means of contraception with an efficacy rate greater than 99%. Approximately 4% of women of reproductive age in the UK use an IUD as their primary form of contraception [9,10]. An IUD can be placed immediately after the delivery of the placenta (within 10 minutes), which gives a woman an immediate and effective form of birth control [9,11]. This immediate form of birth control is important as ovulation may resume shortly after delivery of the child, and 41-57% of women may resume sexual intercourse before a postpartum visit [12-14]. Furthermore, since 20% of women in the UK fail to attend their planned postpartum visit [15], these women would not receive an IUD under routine practice.

It is also known that a certain number of IUDs placed will be expelled, which varies according to the timing of placement after birth. A worldwide meta-analysis showed that IUDs placed immediately (defined as within 10 minutes of delivery of the placenta after childbirth) have an expulsion rate of 10%. Expulsion rate rises to 29.7% when placed between 10 minutes to 4 weeks from delivery of the placenta after birth (defined as early placement). When placed at 4 weeks or later after birth (defined as interval or routine placement), the expulsion rate is 1.9% [16]. Given these data, immediate postpartum placement is superior to early placement because immediate placement allows for longer duration of pregnancy prevention with a higher likelihood of retention of the device. This study therefore compares only immediate to routine IUD placement.

Several analyses using US cost data have demonstrated that immediate postpartum LARC placement as compared to routine placement at the postpartum visit is highly cost effective [17-19]. Specifically immediate postpartum IUD placement as compared to delayed placement was demonstrated as a dominant strategy in a cost utility analysis of 1000 women with a cost

savings of \$282,540 and a gain of 10 QALYs [17]. An analysis based on a retrospective cohort of uninsured patients demonstrated that the state would accrue \$2.94 for every dollar spent on immediate postpartum IUD placement [18]. Another analysis of immediate postpartum IUD placement in the US estimated that delayed placement of an IUD resulted in a one year pregnancy rate of 24.6% as compared to pregnancy rates of 17.3% in a simulated vaginal birth cohort and 11.2% in a cesarean section cohort [19].

Given that the data support the immediate placement of an IUD as a safe and cost-effective means to prevent short-interval pregnancy, the American College of Obstetrics and Gynecology recommends immediate postpartum IUD placement for women desiring the method [11]. However UK guidelines indicate that an IUD should only be placed at a postpartum visit because there is no cost-effectiveness data in the UK for immediate postpartum IUD placement [20, 21].

This study seeks to determine whether immediate vs. routine placement of a postpartum IUD has a favorable incremental cost effectiveness ratio (ICER) in the UK context utilizing UK costs and quality adjusted life years (QALYs) associated with pregnancy outcomes. If the resulting ICER is favorable, the current guidelines should allow women who desire an IUD for birth control to elect for immediate placement instead of routine placement.

Methods

A review of the literature was conducted to determine if the central question of this paper had been answered previously. The PICO (population, intervention, comparison, outcome) construct was used to guide our search [22]. The population was women in the UK who desired IUD for birth control after delivery, who were eligible for immediate IUD placement, and who were considered low risk for STIs. The intervention was immediate IUD placement which was compared with routine placement. The outcome of interest was pregnancy rate. Combinations of search terms related to each of the PICO components were used to locate publications that addressed this topic. The main database used was Mendeley (Elsevier) with additional searches on PubMed, Medline, and Google Scholar. No publications were located that addressed this particular research question.

The population used in this study model is postpartum women in the UK who select an IUD as their primary form of contraception after delivery. The perspective of this analysis is that of a governmental payer, since the primary healthcare delivery model in the UK is the National Health Service (NHS) system. As such, the analysis is conducted in line with the National Institute for Health and Care Excellence (NICE) guidelines stipulating a 3.5% discount rate for costs and benefits of the intervention [23].

Model Design

The decision node of this model is the timing of placement of an IUD. The current standard of care in the UK is routine placement, which occurs 4 weeks or more after birth [10]. The comparator is the immediate placement of an IUD, which is defined as placement less than 10 minutes after delivery of the placenta [16]. Since the time frame of the cost effectiveness analysis is short (1 year) and events underlying the analysis are best represented as discrete decision points, a decision tree model was utilized. The full decision tree is displayed in Figure 1. Previous analyses of postpartum immediate vs delayed IUD placement have also used a decision tree format [17-19]. This model incorporated UK data for transition probabilities supplemented with other data as necessary.

Consistent with past cost-effectiveness models, a one-year time horizon was selected [19]. Furthermore, since IUD users in the UK context are older as compared to other contraceptive users [10], and older women are more likely to desire a short interval pregnancy [8], the assumption of desiring to delay pregnancy for a longer time horizon is less likely to be valid. Lastly, most of the differences between the costs and benefits of immediate vs. delayed treatment occur in the first year of placement, and IUD expulsion rates decrease with time since placement [24].

In order to construct this model, several assumptions were made about different branches of the decision tree and are summarized in Table 1 below.

Table 1: Assumptions by Branch of Decision Tree

Branch(es) of Decision Tree	Assumption(s)
Immediate placement, retained IUD at PP visit	Pregnancy rate is 0 [9,25,26]
Routine placement, lost to follow up	Use condoms for birth control
No IUD in place, not lost to follow up	Use mix of condoms and oral contraceptive pills based on UK average use [20]
Lost to follow up and average contraception arms	Pregnancy rates and cost based on forms of birth control used

Additionally, treatment costs for IUD side effects or rare adverse events (other than removal of IUD) are expected to be similar in both arms and minimal, and therefore such costs are not accounted for in the model [27,28]. Lastly NICE guidelines stipulate that gonorrhoea and chlamydia tests should be completed before IUD insertion in high risk groups [10]. Accordingly, this model includes only low risk patients. It is estimated that 2.5% of the overall population would fall into the category of high risk based on a 95% CI. Furthermore, chlamydia and gonorrhoea incidence is 1.5% and <0.1% respectively and is highest among people under 25 [29]. Since most chlamydia and gonorrhoea infections are asymptomatic and thus would not prompt testing, the exclusion of 2.5% of the sample is likely a likely an overestimation of the high-risk proportion of postpartum women.

Utility

The primary outcome that is considered in this analysis is the disutility associated with pregnancy. The QALYs used in this model are the weighted outcomes of pregnancy, abortion, and miscarriage. The outcome of no pregnancy was given full utility of 1 [17]. The final product of analysis is the incremental cost effectiveness ratio (ICER), which is calculated by dividing the difference in costs between the standard of care arm (routine placement of IUD) and the comparator arm (immediate postpartum placement of IUD) by the difference in QALYs. The ICER threshold at which NICE will determine an intervention to be cost effective is £20,000 [30].

Cost

The costs data were taken from National Health Service (NHS) England as unit costs, mostly published in 2018. Older costs were adjusted using a price index to 2018 figures. The cost of unwanted pregnancy was calculated as a weighted average with proportions assigned to likely pregnancy outcomes including live birth, abortion, miscarriage and ectopic pregnancy. Table 2 summarizes the probabilities, utilities and costs used in the model.

Table 2: Model inputs

Probability	Base case	Sensitivity distribution
Postpartum (PP) visit attendance	0.80 [15]	Beta distribution
IUD placement at PP visit	0.605 [25]	Beta distribution
IUD expelled by PP visit ¹	0.116 [31,32]	Beta distribution
IUD retained at yr 1, immediate placement ²	0.91 [33]	Beta distribution
IUD retained at yr 1, routine placement	0.87 [34]	Beta distribution
Pregnant at PP visit, no contraception	0.036 [25]	Beta distribution
Pregnant at PP visit, IUD expelled ³	0.018 [25]	Beta distribution
Pregnant in yr 1, IUD in place	0.003 [26]	Beta distribution
Pregnant in yr 1, average contraception	0.15 [20]	Beta distribution
Pregnant in yr 1, lost to follow up no IUD ⁴	0.17 [35]	Beta distribution
Pregnant in yr 1, lost to follow up with IUD ⁵	0.02 [25,35]	Beta distribution
Utility		
Pregnant ⁶	0.93 [36]	Beta distribution
Not Pregnant	1.00	
Cost		
Cost of IUD insertion	£ 187 [37]	Triangle, +/- 10%
Cost of average contraception (COC and condoms) ⁷	£ 75 [38,39]	Triangle, +/- 10%
Cost of unintended pregnancy when on IUD ⁸	£ 2,418 [37, 40-42]	Triangle, +/- 10%
Cost of unintended pregnancy on average contraception or male condom ⁸	£ 2,436 [37-42]	Triangle, +/- 10%

¹ All clinical studies reviewed only reported expulsion events at PP visit, no removals

² This is a calculated conditional probability = [prob. retained at 1 yr]/[prob. of retention at PP visit]

³ Probability is calculated based on the average of the probability of pregnancy at PP visit without contraception and the probability of pregnancy with IUD in place

⁴ All patients lost to follow up were assumed to use condoms as their primary pregnancy prevention method. Their probability of having an unintended pregnancy with a year of childbirth was thus set at 17% (0.17) which is the failure rate of contraception with a male condom.

⁵ This is a calculated probability based on the assumption that the same proportion of women lost to follow up will expel their IUD as was observed in clinical studies and will use condoms as their primary prevention method, the calculation is as follows: [prob expulsion]*[preg rate with condom use] + [prob retention]*[preg rate with IUD]

⁶ This is a calculated weighted utility based on the probability of live birth, miscarriage, abortion, and ectopic pregnancies.

⁷ It was assumed that 52 condoms were used annually based on the result of a Welsh survey of sexual practices.

⁸ Costs of unintended pregnancy were calculated based on weighted proportion of possible pregnancy outcomes including live birth (normal delivery and C-section), abortion, miscarriage and ectopic pregnancy.

Sensitivity Analysis

A one-way deterministic and probabilistic sensitivity analyses were used to test the robustness of the results. In the one-way sensitivity analysis, a triangle distribution of $\pm 10\%$ for all costs values was used, since all cost data was based on published NHS costs. A beta distribution was used for the probability and utility inputs to the model. A tornado plot was generated to represent the outcome of the one-way sensitivity analysis. A probabilistic sensitivity analysis was performed with 1000 draws for costs and effects using the same distributions to generate a cost-effectiveness plane of values.

A cost-effectiveness acceptability curve was also generated using varying willingness to pay thresholds. Additionally, a threshold analysis was done for the cost of postpartum IUD placement, since this value is not known precisely.

Results

In the base case, we calculated an ICER of -£21,845. The ICER is negative because the immediate placement group offers a higher QALY and lower costs as compared to the routine placement group. The results are presented in the Table 3.

Table 3: Cost effectiveness analysis results

Placement timing	Costs	Incremental cost	Effect	Incremental effect	ICER: GBP per QALY
Routine	£414		0.9584		
Immediate	£288	-£126	0.9641	0.006	-£21,845

Sensitivity Analysis

The tornado diagram in Figure 2 represents the one-way sensitivity analysis. This indicates that the findings are robust to a range of inputs, since none of the resulting ICER values even cross zero to positive values. The most influential variable on the ICER is the utility of pregnancy.

Using a probabilistic sensitivity analysis varying the values of inputs simultaneously, the average ICER generated was -£23,540 per QALY. Figure 3 depicts a scatter plot of all ICERs generated.

The cost acceptability curve is displayed in Figure 4, which shows the probability of an intervention to be cost-effective at different willingness to pay thresholds. The probability of immediate placement yielding a cost-effective intervention is nearly 1 (100%) at every threshold evaluated.

A threshold analysis was also conducted for the cost of postplacental IUD placement, as the true costs of immediate postpartum insertion of an IUD is not known (not published under NHS tariffs). The cost of immediate placement was estimated to be £172, equal to the cost of routine placement. Given that placement cost has more uncertainty than the other inputs, the cost of immediate insertion was simulated at higher levels, and it was determined that any cost level under £304.74 would still result in a negative ICER, indicating higher QALYs at lower costs. At a cost of £428.24, the ICER will be £20,000/QALY gained, which is the threshold at which NICE will consider an intervention cost-effective.

Budget Impact Analysis

The budget impact analysis indicated that for the estimated 782,621 births in 2019 in the UK [43], 97.9% would occur in a hospital setting [44]. An estimated 4% of postpartum women are predicted to choose IUDs – the usage rate in reproductive age women [10]. Of all births, approximately 10% will be ineligible due to a uterine infection (1% - 4%) or a postpartum hemorrhage (6%) as these are contraindications to immediate placement [45, 46]. Furthermore 2.5% of women desiring postpartum IUD are considered high risk for STI infection and are therefore excluded in the budget impact analysis [29, 47]. Using these inputs, an estimated number of IUDs, QALYs and the corresponding savings was calculated. The rest of the budget impact analysis is provided in Table 4 and uses a 3.5% discount rate for subsequent years from the base year of 2019. The five-year cumulative cost savings for 2019-2023 is over £15 million (£15,683,206).

Table 4: Budget impact analysis

	2019	2020	2021	2022	2023
Predicted live births in the UK	782,621	780,584	777,068	773,372	770,163
Number of births in a hospital setting	766,969	764,972	761,527	757,905	754,760
No. of women who can receive IUD	671,098	669,351	666,336	663,166	660,415
No. of IUDs inserted	26,844	26,774	26,653	26,527	26,417
No. of QALYs gained from immediate IUD insertion	155	154	154	153	152
Savings if immediate IUD insertion (£)	3,380,431	3,371,633	3,356,446	3,340,481	3,326,620
Discount rate adjusted yearly savings (£)	3,380,431	3,257,616	3,133,278	3,012,923	2,898,958

Discussion

The results of this study indicate that providing immediate postpartum (defined as post-delivery of placenta or post-placental) IUD placement is a cost saving strategy. For every QALY gained, the NHS would save an estimated £21,845. This finding is robust to simulation of input variables across wide ranges. Given the uncertainty around the actual cost of a postpartum IUD placement, the costs could range up to £428 and the calculated ICER would still fall within the willingness to pay ICER threshold set by NICE. Since this value is more than double the cost of routine placement, it is highly unlikely that actual costs would make immediate postpartum IUD placement cost ineffective.

The most influential variable on the value of the ICER was the utility of pregnancy. The QALYs assigned to a pregnancy do not account for the intentionality of the outcome, as this is a standardized measure. Analyses comparing the utility of unintended to intended pregnancies suggests a lower utility associated with unintended pregnancies on a visual analog scale. However, time trade off and standard gamble approaches did not show a statistically significant difference between groups [48].

Although the findings of this study were robust and statistically significant in our analysis, there are several limitations to the findings. This model used many inputs from clinical studies mostly conducted in the US and other international settings. Although NICE also uses US-based studies as needed for decision-making, some of the studies may not be representative of UK populations. For example, if the UK has a much higher exclusive breastfeeding rate as compared to the study populations that determined the input parameters, then this study will overestimate the pregnancy rate and costs of pregnancy in the routine IUD placement arm. It is noted in the NICE LARC Guidelines that the IUD is more commonly used by older women, who thus have lower average fertility as compared to younger reproductive age women [10]. As a result of this usage pattern, this study may tend to overestimate the cost savings from IUD use after pregnancy, as these women may have lower than population average fertility. Another variable that may have significant variation is the proportion of women that attend a postpartum visit who receive an IUD during this visit, since the data used for this variable in this study was from the US. This may be a reasonable estimate because many general

practitioners who women follow-up with may not be IUD trained and women may need to seek another provider, which could lead to further drop-out. However, varying this proportion from the literature value of 0.605 up to 1 makes the ICER only slightly less negative at -£21,810, which indicates slightly lower cost savings, though it does not change the conclusion of the model.

There are also several costs that are not accounted for in this model that would make the ICER more negative, indicating more cost savings. The literature indicates that short interval pregnancies are more commonly associated with preterm birth and other adverse maternal outcomes [6], the costs of which are not accounted for in this model. If unintended pregnancy has a lower utility than that used in this study model, then this result is an underestimate of the benefit of immediate IUD placement [48]. Additionally, if the IUD is used beyond the one-year time horizon of this study, the benefit of the intervention may be underestimated since 60 percent of women who receive an IUD keep their IUD for 2 years or longer [49].

This model indicates that immediate postpartum IUD placement for women who desire a postpartum IUD should be clearly promoted as the preferred strategy. The calculated cost-saving finding is consistent with the results of past studies of cost effectiveness of immediate postpartum IUD placement conducted in the US [17-19]. However, it would be a worthwhile direction for future research to utilize more UK specific estimates based on NHS data, as this would give a better estimation of the expected ICER in the UK context. The authors hope that the NHS will consider repeating this analysis with UK specific data if it becomes available.

Conclusion

This study concludes that immediate postpartum IUD placement is cost saving. The next step is to train providers to place post-placental IUDs. A survey of UK community providers indicated willingness to better advertise post-placental IUDs and suggested post-placental IUD placement could be incorporated into the Royal College of Obstetricians Training [21]. There are readily available training videos and descriptions of insertion methods, and training could be completed at a relatively minor cost for existing providers [50]. Midwives attend the majority of births in the UK and post-placental IUD training would need to be integrated into their curriculum (although this is not the subject of this study). In light of this study, the NHS should consider this potentially cost saving change to practice guidelines.

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