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Cost-effectiveness of emergency contraception options over 1 year

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Abstract

BACKGROUND: The copper intrauterine device is the most effective form of emergency contraception and can also provide long-term contraception. The levonorgestrel intrauterine device has also been studied in combination with oral levonorgestrel for women seeking emergency contraception. However, intrauterine devices have higher upfront costs than oral methods, such as ulipristal acetate and levonorgestrel. Health care payers and decision makers (eg, health care insurers, government programs) with financial constraints must determine if the increased effectiveness of intrauterine device emergency contraception methods are worth the additional costs.

OBJECTIVE: We sought to compare the cost-effectiveness of 4 emergency contraception strategies—ulipristal acetate, oral levonorgestrel, copper intrauterine device, and oral levonorgestrel plus same-day levonorgestrel intrauterine device—over 1 year from a US payer perspective.

STUDY DESIGN: Costs (2017 US dollars) and pregnancies were estimated over 1 year using a Markov model of 1000 women seeking emergency contraception. Every 28-day cycle, the model estimated the predicted number of pregnancy outcomes (ie, live birth, ectopic pregnancy, spontaneous abortion, or induced abortion) resulting from emergency contraception failure and subsequent contraception use. Model inputs were derived from published literature and national sources. An emergency contraception strategy was considered cost-effective if the incremental cost-effectiveness ratio (ie, the cost to prevent 1 additional pregnancy) was less than the weighted average cost of pregnancy outcomes in the United States (\$5167). The incremental cost-effectiveness ratios and probability of being the most cost-effective emergency contraception strategy were calculated from 1000 probabilistic model iterations. One-way sensitivity analyses were used to examine uncertainty in the cost of emergency contraception, subsequent contraception, and pregnancy outcomes as well as the model probabilities.

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RESULTS: In 1000 women seeking emergency contraception, the model estimated direct medical costs of \$1,228,000 and 137 unintended pregnancies with ulipristal acetate, compared to \$1,279,000 and 150 unintended pregnancies with oral levonorgestrel, \$1,376,000 and 61 unintended pregnancies with copper intrauterine devices, and \$1,558,000 and 63 unintended pregnancies with oral levonorgestrel plus same-day levonorgestrel intrauterine device. The copper intrauterine device was the most cost-effective emergency contraception strategy in the majority (63.9%) of model iterations and, compared to ulipristal acetate, cost \$1957 per additional pregnancy prevented. Model estimates were most sensitive to changes in the cost of the copper intrauterine device (with higher copper intrauterine device costs, oral levonorgestrel plus same-day levonorgestrel intrauterine device became the most cost-effective option) and the cost of a live birth (with lower-cost births, ulipristal acetate became the most cost-effective option). When the proportion of obese women in the population increased, the copper intrauterine device became even more most cost-effective.

CONCLUSION: Over 1 year, the copper intrauterine device is currently the most cost-effective emergency contraception option. Policy makers and health care insurance companies should consider the potential for long-term savings when women seeking emergency contraception can promptly obtain whatever contraceptive best meets their personal preferences and needs; this will require removing barriers and promoting access to intrauterine devices at emergency contraception visits.

Keywords

cost-effectiveness analysis; emergency contraception; incremental cost-effectiveness ratio; intrauterine device

Introduction

Nearly half of all pregnancies in the United States are unintended.¹ Annually, unintended pregnancy costs the US health care system approximately \$11 billion.^{2,3} Among women seeking emergency contraception (EC), oral levonorgestrel (LNG) remains the most commonly used method due to lower up-front costs and over-the-counter availability. However, more effective forms of EC are available, including ulipristal acetate (UPA) and the copper T380 (Cu) intrauterine device (IUD).^{2,4-6} In addition to being useful for EC, the Cu IUD can provide highly effective long-term contraception for up to 12 years.^{2,6-9} While the Cu IUD has been well studied as EC, US women have a strong preference for the LNG IUD, which reduces menstrual bleeding.¹⁰ The LNG IUD has been studied in combination with oral LNG EC for women seeking EC.⁸ However, no IUD is currently labeled for use as EC, and women seeking EC are rarely offered the option of an IUD.^{2,11}

Health care payers and decision makers, such as health care insurers and government programs, have been hesitant to allow use of IUDs for EC due in part to higher up-front cost and uncertainty about continued use of IUDs placed as EC.^{2,11} Given their financial constraints, health care payers and decision makers must determine if the increased effectiveness of IUD EC methods are worth the additional costs.^{5,6,8} Building on prior evaluations of contraceptive cost-effectiveness, this study assessed the cost-effectiveness of 4

EC methods (ie, oral LNG, UPA, Cu IUD, and oral LNG + LNG IUD) from a US payer perspective over a 1-year time horizon.

Materials and Methods

Model description and analysis

We developed a decision analytic model using TreeAge Pro 2017 (TreeAge software, Williamstown, MA) to examine the cost-effectiveness of EC in a population of women of childbearing age presenting to a clinical setting for EC after an unprotected sexual encounter. We used a 28-day cycle length to represent menstrual cycles and included 13 cycles over the 1-year time horizon.

The decision analytic model estimated the costs and number of unintended pregnancies that would occur in 1000 women over 1 year for each EC strategy. We used the cost and pregnancy outcomes to calculate incremental cost-effectiveness ratios (ICERs), which are interpreted as the incremental cost to prevent 1 additional pregnancy, for each EC strategy. We also calculated incremental net monetary benefit, which rearranges the traditional ICER and directly incorporates willingness-to-pay (WTP) values (ie, how much one is willing to pay to prevent a pregnancy), to determine if the benefits of each strategy outweighed the costs (see online Appendix for detailed description of incremental net monetary benefit).¹² We used a weighted average cost of pregnancy outcomes in the United States of \$5167, which was derived from the Healthcare Cost and Utilization Project (HCUP), as our WTP threshold.¹³

In our model, EC could either be successful in preventing pregnancy or fail (Figure 1). EC failure could result in an ectopic pregnancy, spontaneous abortion, induced abortion, or live birth. The Markov model consisted of health states based on pregnancy outcomes and continuing contraception use: (1) not pregnant and using contraception, (2) not pregnant and not using contraception, (3) ectopic pregnancy, (4) spontaneous abortion, (5) induced abortion, and (6) live birth. After EC, 3 continuing contraception groups, tiered by effectiveness, were included as separate health states. Highly effective (tier 1) methods included IUDs and contraceptive implants. While permanent contraception methods (ie, sterilization) are also highly effective, our model assumed all women used reversible contraception. Moderately effective (tier 2) methods included injectable, patch/ring, and oral contraceptives. Methods with the lowest effectiveness (tier 3) included condoms, diaphragm, sponge, fertility awareness methods, and withdrawal.

Women using an IUD as their EC method could continue using it for contraception. Those using oral EC methods could start using a tier-1, -2, or -3 contraceptive, or not use any contraception. Each cycle thereafter, women could: (1) continue their current contraception, (2) switch tiers, or (3) discontinue contraception (see Tables A1 and A2 for probabilities).

Model parameters

We derived EC effectiveness, continuing contraception effectiveness, and costs from published literature (see Table 1 and online Appendix for details of the search strategy and parameter synthesis as well as the probability of continuing contraception).¹² Oral LNG and

UPA EC effectiveness estimates, stratified by body mass index (BMI), were derived from a meta-analysis comparing these oral EC methods.⁴ We used Centers for Disease Control and Prevention epidemiological data to assign proportions for normal ($<25 \text{ kg/m}^2$), overweight ($25\text{--}29.9 \text{ kg/m}^2$), and obese ($\geq 30 \text{ kg/m}^2$) BMI for women aged 20–34 years.¹⁴ Cu IUD EC effectiveness estimates were obtained from randomized controlled trials and observational studies.^{9,15,16} Only 1 study was found that examined the effectiveness of the oral LNG + LNG IUD as EC.⁸

We employed a US payer perspective for this analysis and thus included only direct medical costs (2017 US dollars) in the model. Costs were obtained from the HCUP diagnosis-related groups, the Centers for Medicare and Medicaid Services reimbursement fee schedule, Red Book online database average wholesale price, and published literature (see online Appendix for details on costs).^{13,17,18} The mean EC costs used in the primary analysis were \$29 for oral LNG, \$43 for UPA, \$887 for Cu IUD, and \$917 for LNG IUD (Table 1).

Model assumptions

The model made the following assumptions: (1) pregnancy intentions remained stable over the 1-year time horizon; (2) women giving birth would not get pregnant again within 1 year; (3) women who discontinued contraception would not start again, except possibly after a pregnancy that did not result in a live birth^{19,20}; (4) in keeping with a previous cost-effectiveness analysis, women with an ectopic pregnancy were assumed not to be at risk for pregnancy for 2 menstrual cycles²¹; (5) similarly, after a spontaneous or induced abortion women were assumed not to be at risk for pregnancy for 3 cycles²¹; (6) effectiveness estimates and probability of discontinuation accounted for contraceptive adherence; (7) side effects of contraception resulted in negligible direct medical costs; and (8) the effectiveness of oral EC decreased as BMI increased.⁴

Analysis

To incorporate the impact of uncertainty in the estimates for probability and cost inputs on model outcomes, we used a probabilistic approach for the primary analysis.²² The probabilistic approach randomly draws values for each model parameter from predefined distributions to estimate costs and pregnancy outcomes for each EC strategy. The model then repeats this process 1000 times to give 1000 estimates of costs and pregnancy outcomes for each strategy, which are then used to estimate cost-effectiveness. We used beta distributions for probabilities and gamma distributions for costs. This approach allowed us to describe the uncertainty intervals (UIs) around direct medical cost and pregnancy outcomes as well as determine the probability that an EC strategy was the most cost-effective across a range of WTP thresholds.²²

We performed several sensitivity and scenario analyses. We performed 1-way, deterministic sensitivity analyses, which vary each model parameter over a range of plausible values while holding all other parameters constant, to determine the impact of each parameter on the model (see online Appendix for details on the 1-way sensitivity analyses). Given the wide variation in obesity rates between communities across the United States, we performed a separate 1-way sensitivity analysis to examine the sensitivity of the model to the proportion

of obese women in the population. To estimate the impact of uncertainty around the duration of time of ectopic pregnancies as well as induced and spontaneous abortions, we ran a scenario analysis in which it was assumed women could become pregnant as soon as the next cycle. We also performed a 2-way sensitivity analysis examining the impact on cost-effectiveness of simultaneously varying the cost of Cu IUDs and the cost of LNG IUDs. Since much of the benefit of using IUDs for EC is the continuation of effective contraception, we examined how the cost-effectiveness of each strategy changed at the end of each menstrual cycle. As women seeking EC may be more likely to terminate a pregnancy, we also performed a 1-way sensitivity analysis examining higher than average rates of induced abortion. Finally, as nonprofit clinics eligible for 340B pricing can now obtain LNG IUDs for \$50 and are able to acquire other EC options at significantly reduced costs, a post hoc scenario analysis using these reduced costs was performed. For this post hoc scenario analysis, EC costs were \$125 for LNG IUD (\$50 IUD cost, \$75 insertion fee), \$325 for Cu IUD, and between \$010 for both oral LNG and UPA. All other parameters remained unchanged.

Because this study involved secondary analyses of publicly available, deidentified data, institutional review board approval was not required.

Results

Model validation

The proportion of women experiencing any pregnancy outcome with each strategy was captured in a microsimulation adaptation of the model and used to internally validate the model against published estimates. The microsimulation adaptation of the model predicted EC failure rates similar to estimates from published literature (Table A3). Additionally, the cumulative incidence of pregnancy outcomes during the year after EC use, accounting for contraceptive discontinuation and switching, was predicted for oral LNG and Cu IUD and compared to those reported by Turok et al.⁹ Because the model used the EC failure rate from Glasier et al.⁴ for oral LNG, the predicted EC failure rate for oral LNG was higher than observed in Turok et al.⁹ However, the pregnancy cumulative incidence curves were similar (Figure A1 and Table A3). The model predicted 1-year pregnancy rates of 7.1% in women choosing Cu IUD and 13.9% in women choosing oral LNG, which are comparable to the published estimates of 6.5% for Cu IUD and 12.2% for oral LNG.⁹

Cost-effectiveness analysis

In 1000 women seeking EC, the model estimated direct medical costs would be \$1,227,902 with UPA, compared to \$1,376,199 with Cu IUD (incremental costs for Cu IUD vs UPA: \$148,297 [95% UI -\$611,664 to 659,303]) (Table 2). UPA use was estimated to result in 137 unintended pregnancies, compared to 61 with Cu IUD (incremental pregnancies prevented for Cu IUD vs UPA: 76 [95% UI 52-109]). The resulting ICER for Cu IUD vs UPA was \$1957 per additional pregnancy prevented (Figure 2, A, and Table 2). At a WTP threshold of \$5000, there was a 63.9% probability that Cu IUDs would be cost-effective; at a WTP threshold of \$10,000, this probability increased to 84.8% (Figure 2, B). Oral LNG was dominated by UPA (ie, oral LNG cost more and prevented fewer pregnancies than UPA) and

oral LNG + LNG IUD was dominated by Cu IUD. Oral LNG alone was not cost-effective at any WTP threshold.

Sensitivity and scenario analyses

The 1-way sensitivity analyses showed the model estimates were most sensitive to Cu IUD cost, the cost of birth, the cost of induced abortion, the probability of using tier-3 methods after IUD EC, and the cost of tier-2 methods (Figure 3). Cu IUD was the most cost-effective strategy even when varying the model parameters over the specified ranges except when: the cost of Cu IUD was at its highest (oral LNG + LNG IUD was then most cost-effective), the cost of a live birth was at its lowest value (UPA was then most cost-effective), or the cost of LNG IUD was at its lowest (oral LNG + LNG IUD was then most cost-effective).

In the 1-way sensitivity analysis that varied the proportion of obese women in the model, Cu IUD remained the most cost-effective EC strategy regardless of the proportion of obese subjects (Figure A2). Additionally, the ICER was similar to the primary analysis when women could become pregnant in the next cycle following an ectopic pregnancy, or spontaneous or induced abortion (Cu IUD vs UPA ICER \$1805). The 2-way sensitivity analysis of IUD costs found that Cu IUD remained the most cost-effective EC strategy for most of the ranges of costs examined (Figure A3). However, when the cost of Cu IUD approached \$100 more than the cost of LNG IUD, oral LNG + LNG IUD became more cost-effective.

The time horizon analysis demonstrated that Cu IUDs become cost-effective after approximately 9 months, even when accounting for contraceptive discontinuation and switching (Figures A4). When examining higher than average rates of induced abortion, Cu IUD remained cost-effective even when up to 75% of the population terminated pregnancies that resulted from contraceptive failure. The post hoc scenario analysis using nonprofit clinic (340B) pricing for LNG IUD showed oral LNG + LNG IUD to be the most cost-effective strategy (ICER for Cu IUD vs oral LNG + LNG IUD: \$221,428 per additional pregnancy prevented), while UPA and oral LNG dominated (Table A4).² These results did not vary significantly when the cost of UPA and oral LNG ranged from \$0-10.

Comment

Our model accurately predicted pregnancy outcomes up to 1 year after using EC and showed Cu IUD was the most cost-effective EC option from a US payer perspective over a 1-year time horizon. In fact, the Cu IUD remained the most cost-effective EC strategy across a variety of sensitivity and scenario analyses. The initial increased up-front costs of the Cu IUD were only offset by its improved effectiveness in preventing pregnancies after about 9 months. Existing data support the idea that the majority of women who receive IUDs for EC continue use >9 months.²³ In settings with access to 340B pricing, use of a LNG IUD with oral LNG was the most cost-effective option for EC.

While we adhered to current best practices for conducting cost-effectiveness analyses (Table A5), there are several considerations to keep in mind while interpreting these results. Although we accounted for EC effectiveness based on variations of BMI, we did not

consider differences in pregnancy complications and costs due to obesity, which may be considerable. Because obese women experience higher rates of pregnancy complications and cesarean delivery, the true cost-effectiveness for alternatives to oral LNG may be even greater for obese women than we reported. Also, we performed our analysis from a payer perspective and thus did not include in our analysis indirect and intangible costs to the individual or society that occur with undesired pregnancy.

A potential limitation of our study is that we may have overestimated assumed pregnancy rates for those not using contraception since they were only available for women who self-report “trying to conceive.” EC users are trying to avoid conceiving and may have lower rates of pregnancy from single acts of intercourse aided by the use of withdrawal, condoms, or timed intercourse methods. However, EC seekers may also be younger and have higher fecundity than the individuals trying to conceive. Pregnancy rate overestimation may have also occurred by assuming women who discontinued contraception methods would not restart them for the remainder of the time horizon.

Another potential limitation is that we assumed population estimates of method continuation and 1-year pregnancy rates for oral LNG + LNG IUD were the same for all highly effective reversible contraceptive (tier 1) methods. While large, rigorously conducted prospective studies report lower 1-year pregnancy rates for IUD users, they do not account for IUD discontinuation and switching to less effective methods, which may differ between the IUD types.²⁴ Additionally, continuing contraception effectiveness estimates were pooled into tiers rather than reported for individual types of contraception, which may overestimate or underestimate the effectiveness of some types of contraception.

Nonetheless, there are a number of strengths to our analysis. We employed multiple 1-way sensitivity and scenario analyses to assess for changes in cost or pregnancy outcomes. These analyses suggest that when the cost of the LNG IUD decreases to <\$773, oral LNG + LNG IUD becomes cost-effective. In settings eligible for 340B pricing, oral LNG + LNG IUD is the most cost-effective approach to EC. Given many women’s preference for the LNG IUD over the Cu IUD, efforts to reduce the cost of this contraceptive option in all settings is important. Our analysis also incorporated published findings representative of typical EC use and accounted for the initiation of other contraceptive therapies in the year following EC. Finally, as it includes multiple pregnancy outcomes (ie, spontaneous abortion, induced abortion, ectopic pregnancy, and live birth), the use of \$5167 for the WTP is a more realistic estimate of the cost to avoid a pregnancy than the cost of abortion that has been used in prior contraceptive cost-effectiveness analyses.²⁵ However, our analysis does not include payer costs related to a newborn over the first 3 months of life, which significantly increase the true costs of each live birth, and would increase the WTP to prevent an undesired birth.

Although women can now obtain oral LNG over the counter, many women still go to clinics to obtain EC. When a woman presents for EC, clinicians should recognize her to be at increased risk of unintended pregnancy in the near future, and offer her all available options for EC and continuing contraception. Facilitating use of any IUD as EC will require provider training, patient education, and removal of economic barriers.²⁶ Research has shown that every dollar spent on contraceptive services saves >\$5.68 in public expenditures.²⁷ Oral

LNG remains an important EC option due to its wide accessibility and lower up-front cost. However, for women presenting in clinic seeking EC, this analysis supports the cost-effectiveness of EC IUDs. Policy makers and health care insurance companies should consider the potential for longterm savings when women seeking EC can promptly obtain whatever contraceptive best meets their personal preferences and needs; this will require removing barriers and promoting access to IUDs at EC visits.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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FIGURE 1. Detailed decision analytic model structure

Blue square represents decision node, or point at which treatment is chosen. Green circles represent chance nodes after which probability is assigned to each event. Purple “M” circles represent Markov nodes after which women transition between health states each menstrual cycle. Red triangles represent terminal nodes, which, in Markov node, indicate state to which women will transition in next cycle. Women accrue costs and effectiveness throughout time horizon based on health states and events that occur during each cycle. Model assumed that women who discontinued contraception would not use contraception for remainder of time horizon. However, if they experienced pregnancy outcome, they may have started contraception. Ectopic pregnancy, induced abortion, and spontaneous abortion health states were tunnel states where patients spent 2–3 menstrual cycles before being forced into nonpregnant health state. Patients who became pregnant and went on to a live birth were assumed to not get pregnant again during time horizon. Tier-1 methods include

intrauterine devices (IUDs) and implants; tier-2 methods include injection, pill, patch, ring; and tier 3 includes barrier methods.

Cu, copper T380; *EC*, emergency contraception; *LNG*, levonorgestrel; *UPA*, ulipristal acetate.

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FIGURE 2. Cost-effectiveness of emergency contraception (EC) over 1 year

A, Incremental cost-effectiveness scatterplot of each EC strategy vs ulipristal acetate (UPA) in model 1000 iterations. Each point on scatterplot represents mean incremental costs and incremental pregnancies prevented in 1000 women in 1 iteration of model compared to UPA. Larger diamonds represent mean incremental costs and mean incremental pregnancies prevented over all 1000 model iterations. Dashed line represents willingness-to-pay (WTP) threshold of \$5167 to prevent pregnancy. On average, oral levonorgestrel (LNG) cost more and was less effective than UPA. In contrast, on average copper T380 (Cu) intrauterine device (IUD) cost more than UPA, but also prevents more pregnancies and does so at acceptable cost. **B**, Cost-effectiveness acceptability curve shows probability that each EC strategy is most cost-effective across range of WTP values over 1000 model iterations. **B**, Cu IUD had highest probability of being most cost-effective EC when WTP to prevent pregnancy was above about \$3000.

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FIGURE 3. Ten most influential input parameters

Ten most influential variables are shown using INMB framework with UPA as reference group. Horizontal bars represent range of highest INMBs obtained with any emergency contraception (EC) strategy when that variable was varied across range shown at ends of each bar. Dotted and dashed lines represent deterministic INMB for each EC strategy vs UPA. Copper T380 (Cu) intrauterine device (IUD) was preferred strategy (ie, most cost-effective) across nearly all of 1-way sensitivity analyses. Change in preferred EC strategy to UPA (black bars) or oral levonorgestrel (LNG) + LNG IUD (gray bars). In this analysis, change in preferred strategy only occurred at extreme values in 1-way sensitivity analyses. Tier-1 methods include IUDs and implants; tier-2 methods include injection, pill, patch, ring; and tier 3 includes barrier methods.

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TABLE 1

Cost-effectiveness model input parameters

Variable	Mean	Low	High	Source
BMI distribution				
Normal <25 kg/m ²	0.448	0.403	0.493	14
Overweight 25–29.9 kg/m ²	0.252	0.205	0.299	14
Obese ≥30 kg/m ²	0.300	0.275	0.326	14
Probability of EC failure				
Oral LNG				
Normal	0.013	0.008	0.022	4
Overweight	0.025	0.014	0.048	4
Obese	0.058	0.036	0.097	4
UPA				
Normal	0.011	0.007	0.019	4
Overweight	0.011	0.005	0.029	4
Obese	0.026	0.014	0.059	4
Cu IUD	0.001	0.0004	0.003	9,15,16
LNG IUD + oral LNG	0.002	0.0007	0.013	8
Probability of continuing contraception failure per cycle				
Tier-1 methods	0.001	0.001	0.003	9,28
Tier-2 methods	0.004	0.003	0.007	9,28
Tier-3 methods	0.012	0.009	0.016	9,29
No method	0.020	0.008	0.077	9,21
Contraception failure pregnancy outcomes				
EC—probability of ectopic pregnancy				
Oral LNG	0.010	0.004	0.031	30
UPA	0.006	0.003	0.019	30
Cu IUD	0.029	0.021	0.043	31
LNG IUD + oral LNG	0.516	0.403	0.641	32,33

Variable	Mean	Low	High	Source
Continuing contraception—probability of ectopic pregnancy				
Tier-1 methods	0.192	0.147	0.252	34
Tier-2 methods	0.026	0.010	0.100	34
Tier-3 methods	0.010	0.003	0.062	25
No method ^a	0.010	0.003	0.062	Assumption
Nonelectopic pregnancy probabilities ^b				
Live birth	0.422	0.393	0.452	Assumption
Spontaneous abortion	0.168	0.148	0.192	25
Induced abortion	0.400	0.372	0.430	35
Contraception method selected continuing contraception				
Oral LNG and UPA EC				
Tier-1 methods	0.063	0.041	0.103	9
Tier-2 methods	0.320	0.268	0.382	9
Tier-3 methods	0.557	0.498	0.619	9
No method	0.059	0.038	0.098	9
Cu IUD and LNG IUD EC				
Tier-1 methods	0.800	0.739	0.854	9
Tier-2 methods	0.072	0.045	0.123	9
Tier-3 methods	0.117	0.080	0.175	9
No method	0.011	0.004	0.044	9
Postectopic pregnancy/abortion contraception method selected				
Tier-1 methods	0.293	0.288	0.297	19,20
Tier-2 methods	0.439	0.434	0.444	19,20
Tier-3 methods ^c	0.218	0.214	0.222	19,20, Assumption
No method ^c	0.050	0.048	0.053	19,20, Assumption
Costs				
EC methods				

Variable	Mean	Low	High	Source
Oral LNG	\$29	\$22	\$36	18
UPA	\$43	\$30	\$51	18
Cu IUD	\$887	\$627	\$1045	18
LNG IUD	\$917	\$665	\$1109	18
IUD insertion	\$74	\$56	\$93	17
Continuing contraception methods				
Tier-1 methods	\$899	\$737	\$1061	18
Tier-2 methods	\$58	\$42	\$73	18
IUD removal	\$97	\$72	\$121	17
Pregnancy outcomes				
Live birth	\$10,858	\$2181	\$13,936	13,36,37
Spontaneous abortion	\$1366	\$330	\$3538	17,36
Induced abortion	\$705	\$607	\$6694	38,39
Ectopic pregnancy	\$7590	\$5692	\$9488	13

Tier-1 methods include IUDs and implants; tier-2 methods include injection, pill, patch, ring; and tier-3 includes barrier methods.

BMI, body mass index; *Cu*, copper T380; *EC*, emergency contraception; *IUD*, intrauterine device; *LNG*, levonorgestrel; *UPA*, ulipristal acetate

^aNo contraception ectopic pregnancy outcomes assumed to be same as tier-3 methods

^bOther pregnancy outcomes were assumed to be same as tier-3 pregnancy outcome distribution—pregnancies not resulting in ectopic pregnancy, spontaneous abortion, or induced abortion were assumed to result in live birth—as ectopic pregnancies vary between methods, ectopic pregnancy was included as separate branch and remaining pregnancy outcomes used Dirichlet distribution to ensure they always summed to 1

^cProbability of no contraception after pregnancy was assumed—women not using tier-1, tier-2, or no methods were assumed to be using tier-3 methods.

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TABLE 2
Costs, pregnancies, and incremental cost-effectiveness ratio of emergency contraception methods in 1000 women over 1 year

Emergency contraception	Mean cost	Incremental cost (95% UI)	Mean pregnancies	Incremental pregnancies prevented (95% UI)	ICER ^a	Probability cost-effective ^b
UPA	\$1,227,902	–	137.2	–	–	25.2%
Oral LNG	\$1,278,877	\$50,975 (–\$22,788 to 208,392)	150.0	–12.8 (–29.7 to 1.1)	Dominated by UPA	1.5%
Cu IUD	\$1,376,199	\$148,297 (–\$611,664 to 659,303)	61.4	75.8 (52.3 to 108.8)	\$1957	63.9%
Oral LNG + LNG IUD	\$1,557,610	\$181,412 (–\$137,314 to 542,283)	62.7	–1.3 (–7.1 to 1.3)	Dominated by Cu IUD	9.4%

Incremental costs, incremental pregnancies prevented, and ICER are in reference to next least costly, nondominated option—option is dominated if it costs more and is less effective than another option, eg, Cu IUD incremental costs are in reference to UPA as oral LNG was dominated by UPA.

Cu, copper T380; ICER, incremental cost-effectiveness ratio; IUD, intrauterine device; LNG, levonorgestrel; UI, uncertainty interval (ie, 2.5th–97.5th percentile); UPA, ulipristal acetate.

^aCost to prevent 1 additional pregnancy

^bWillingness-to-pay to determine if option was cost-effective was set at \$5167 to prevent pregnancy based on calculated weighted average cost of any pregnancy outcome if no emergency contraception was used.

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