

Cost-Effectiveness of Contraceptives in the United States

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ABSTRACT

Objective: The study was conducted to estimate the relative cost effectiveness of contraceptives in the United States from a payer's perspective.

Methods: A Markov model was constructed to simulate costs for 16 contraceptive methods and no method over a 5-year period. Failure rates, adverse event rates, and resource utilization were derived from the literature. Sensitivity analyses were performed on costs and failure rates.

Results: Any contraceptive method is superior to "no method". The three least expensive methods were the copper-T IUD (\$647), vasectomy (\$713) and LNG-20 IUS (\$930). Results were sensitive to the cost of contraceptive methods, the cost of an unintended pregnancy, and plan disenrollment rates.

Conclusion: The copper-T IUD, vasectomy, and the LNG-20 IUS are the most cost-effective contraceptive methods available in the United States. Differences in method costs, the cost of an unintended pregnancy, and time horizon are influential factors that determine the overall value of a contraceptive method.

BACKGROUND

- Nearly half (49%) of the 6.4 million pregnancies each year in the United States are unintended.¹
- In 2001, there were more than 3 million unintended pregnancies.¹ The direct medical costs of these unintended pregnancies totaled \$5 billion.²
- Contraceptive use saves nearly \$19 billion in direct medical costs each year.²
- Currently available contraceptive methods vary greatly in their efficacy and overall cost.

Long-acting methods, such as intrauterine contraceptives and implants, have large upfront costs but are highly effective over a long time period. In contrast, user-dependent methods (e.g., condoms, oral contraceptives) incur pregnancy-related costs that may greatly exceed the method costs themselves.

There is a need for good evidence on the costs and effectiveness of different contraceptive options so that individuals can make an informed choice and health plans can provide the right mix of contraceptive options.

OBJECTIVE

- The purpose of this study was to conduct a cost-effectiveness analysis of contraceptives available in the United States from a private payer's perspective.

METHODS

A Markov model was constructed from the health care payer perspective to evaluate the costs and effectiveness of using 16 contraceptive methods: vasectomy and tubal ligation as well as 14 reversible methods (oral contraceptives (OCs), transdermal contraceptive patch, vaginal ring, copper-T intrauterine device (IUD), levonorgestrel (LNG)-20 intrauterine system (IUS), male condom, female condom, injectable contraceptive, implant, diaphragm, spermicides, sponge, withdrawal, and fertility-awareness-based methods). We also compared these estimates with the cost and effectiveness of using no method (chance alone).

Study population: The model applies to all couples using contraception during the time horizon of the analysis.

Model time horizon: 5 years

In each yearly cycle, subjects transition to "continue contraception", "method failure" (with one of four outcomes: ectopic pregnancy, spontaneous abortion, induced abortion, or birth) or "plan dropout". Subjects remain on the method for the model duration after method failure or adverse event (Fig. 1). Effectiveness was defined as the estimated average annual probability of not becoming pregnant over a 5-year period, assuming typical use.

Discount rate: 3% per year (range 0% to 5%)

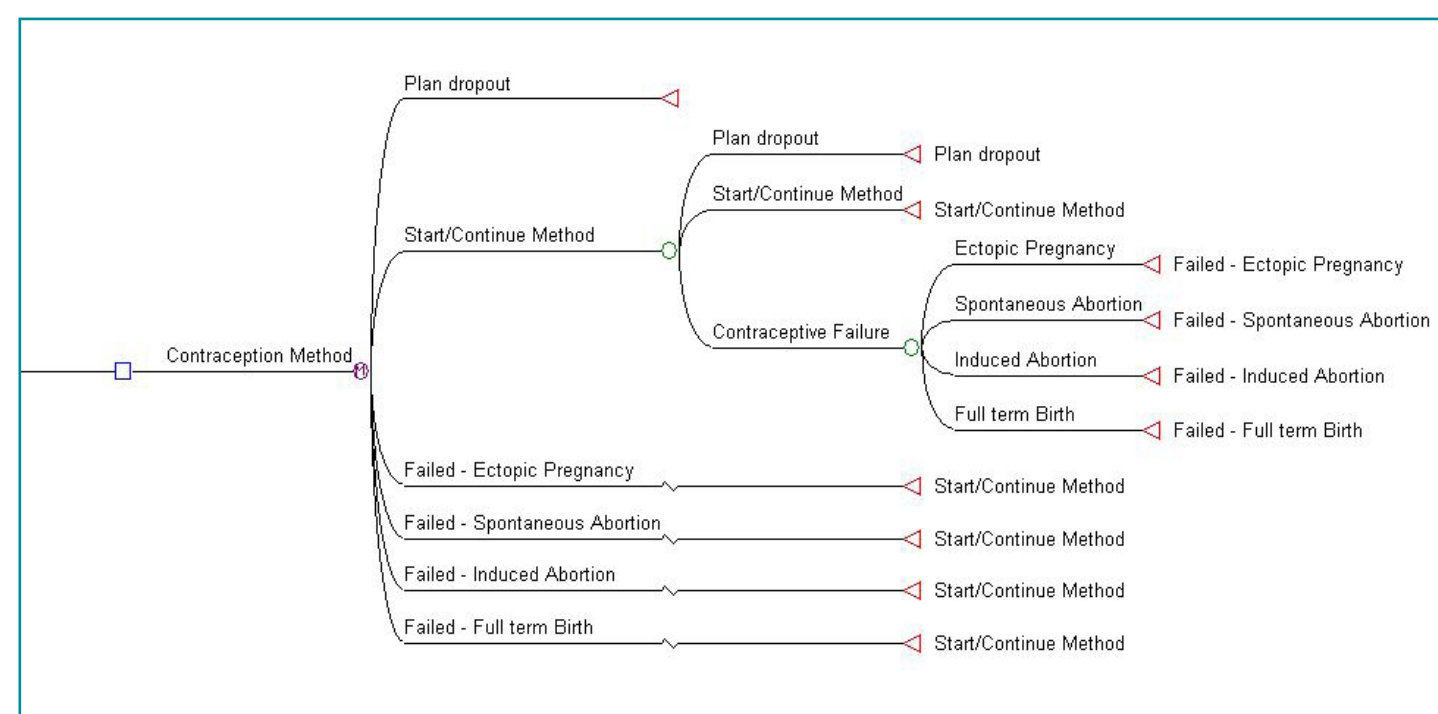


Figure 1: Model structure

Figure 1 illustrates the model structure, with branching for one of the contraceptive methods displayed in its entirety to illustrate the format. The model structure was the same for all methods.

- We assumed that 60% of unintended births are mistimed and would occur two years later.²
- Costs included those for the drug or device, physician services (device fitting, insertion, and removal), method failures, and side effects (Table 1).
- Unit procedure costs were obtained from published fee schedules and product prices from the 2007 Red Book Average Wholesale Price (AWP).
- All costs were adjusted to 2007 US dollars using the Medical Care Services component of the Consumer Price Index.

Table 1: Model inputs: Cost of method failures and side effects

Parameter	Point Estimate
Cost of Method Failure	
Birth	\$4,048.00 ^a
Induced abortion ^b	\$536.87 ^c
Spontaneous abortion ^c	\$536.87 ^c
Ectopic pregnancy (DRG 378)	\$10,613.00 ^d
Cost of Side Effect	
Amenorrhea ^e	\$52.58 ^{e,5}
Urinary tract infection ^f	\$97.29 ^{e,5}
Venous thromboembolism (DRG 125)	\$4,213.46 ^g
Post-operative complications of tubal ligation (DRG 452)	\$5,209.72 ^g
Post-operative infections of vasectomy	\$144.00 ^g

^aCalculated based on the March of Dimes study⁷ that reported \$8,236 as health plan cost for pregnancy in 2004. Inflated using the medical component of CPI to 2007\$. Assuming 60% births are mistimed and would occur 2 years later, a 3% discount rate per year is applied. $\$9,318 \times (1.0-0.60(1.03))^2$.

^bAssuming 95% of abortions are performed in the hospital.⁸ Cost of hospital abortions based on DRG 380 and 381. Cost of non-hospital abortions calculated from Henshaw⁹ and CDC incidence rates.¹⁰

^cBased on the same DRG codes and proportion of in-hospital abortions as induced abortion.

^dCalculated from Medical Expenditure Panel Survey (MEPS) 2004¹¹ and HCUP 2005 data^{12,13}. Inflated using the medical component of CPI to 2007\$.

^eIncludes the cost of pregnancy test and office visit.

^fIncludes the cost of ciprofloxacin 7-day course, office visit and lab tests.

Failure rates, probabilities of outcomes following failure, and adverse event rates were derived from a comprehensive literature review and supplemented with expert opinion (Table 2).

Probabilities of all failures except ectopic pregnancy were assumed to have the following distribution, 37% birth; 17% spontaneous abortion and 46% induced abortion, regardless of method¹ (Source: Personal communication from L. Finer, August 30, 2007).

One-way and two-way sensitivity analyses were conducted to handle the uncertainty around model inputs.

Table 2: Model inputs: Annual failure rates for contraceptive methods

Method	Percent of women experiencing an unintended pregnancy assuming 'typical' use ¹⁴
LNG-20 IUS	0.2
Copper-T IUD	
Year 1	0.8
Year 2	0.6
Year 3	0.4
Year 4	0.2
Year 5	0.1
Implant	0.05
Injectable contraceptive	3
Tubal ligation	
Year 1	0.55
Year 2	0.29
Year 3	0.15
Year 4	0.19
Year 5	0.13
Vasectomy	
Year 1	0.15
Year 2	0.01
Year 3	0.01
Year 4	0.01
Year 5	0.01
Oral contraceptive	8
Transdermal patch	8
Vaginal ring	8
Male condom	15
Female condom	21
Diaphragm	16
Spermicides	29
Sponge	24 ^a
Fertility-awareness-based methods	25
Withdrawal	27
No method	85

^aAverage of parous and nulliparous

RESULTS

- Any contraceptive method is superior to chance (no method) in terms of costs and effectiveness.
- The average expected effectiveness ranged from 48% to nearly 100% (99.96%). The most effective methods were vasectomy, the implant, tubal ligation, the LNG-20 IUS and the copper-T IUD (Table 3).
- Five-year costs ranged from \$647 to \$4,739. The three least expensive methods were the copper-T IUD (\$647), vasectomy (\$713) and the LNG-20 IUS (\$930).
- Results at 5 years show that costs of unintended pregnancies reflect the majority (>90%) of the total costs for contraceptive methods that have low effectiveness rates (no method, withdrawal, fertility-awareness-based methods, and the male condom).
- In contrast, for highly effective methods, such as tubal ligation, vasectomy, the implant, the Copper-T IUD and the LNG-20 IUS, the method or device cost represents the majority of the costs.

Table 3: Cost effectiveness (C/E) of contraceptive methods at 5 years

Method	Method-related Costs (\$)	Failure Cost (\$)	Cost of Side Effects (\$)	Total Cost (C) (\$)	Marginal Cost ^c (\$)	Eff ^b (E)	Marginal Eff ^b	C/E (\$)	ICER (\$)
Copper-T IUD	605	42	0	647	99.6	99.6	6.50		
Vasectomy	710	3	0	713	66	100.0	0.4	7.13	164
LNG-20 IUS	823	58	49	930	283	99.8	0.2	9.32	1415
Male condom	358	1217	0	1575	928	86.6	-13.0	18.19	(Dominated) ^d
Fertility-awareness-based methods	0	1892	0	1892	1245	79.2	-20.4	23.89	(Dominated) ^d
Withdrawal	0	2017	0	2017	1370	77.8	-21.8	25.92	(Dominated) ^d
Diaphragm	764	1288	119	2171	1524	85.8	-13.8	25.31	(Dominated) ^d
Implant	2142	5	31	2178	1531	100.0	0.4	21.78	3828
Spermicides	431	2104	112	2647	2000	76.6	-23.0	34.55	(Dominated) ^d
Female condom	1043	1633	0	2676	2029	76.8	-22.8	34.85	(Dominated) ^d
Injectable contraceptive	2341	300	40	2681	2034	97.0	-2.6	27.64	(Dominated) ^d
Sponge	969	1829	0	2798	2151	79.8	-19.8	35.06	(Dominated) ^d
Tubal ligation	2866	59	53	2978	2330	99.8	0.2	29.84	(Dominated) ^d
Vaginal ring	2467	683	8	3158	2511	92.4	-7.2	34.18	(Dominated) ^d
Oral contraceptive	2630	682	69	3381	2734	92.4	-7.2	36.59	(Dominated) ^d
Transdermal patch	2774	683	1	3458	2811	92.4	-7.2	37.42	(Dominated) ^d
No method	0	4739	0	4739	4091	48.0	-51.6	98.72	(Dominated) ^d

IUD, intrauterine device; IUS, intrauterine system; ICER, incremental cost-effectiveness ratio.

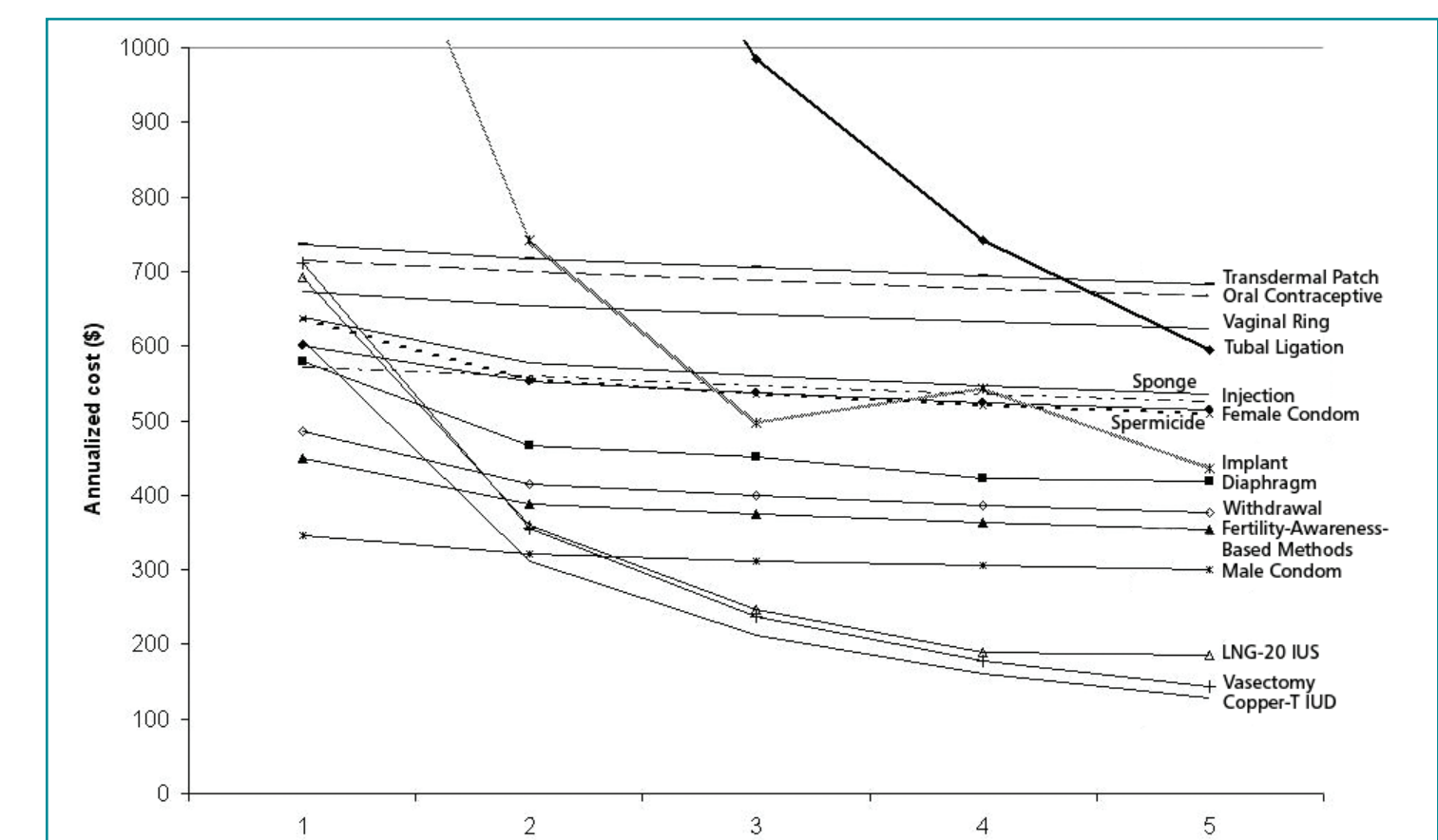
^aCompared to the least costly method over 5 years (i.e., copper-T IUD).

^bAverage annual rate of not becoming pregnant over 5 years.

^cDominated means this contraceptive option cost more and was less effective than the reference contraceptive, in this case, copper-T IUD.

Sensitivity analyses:

- Results were sensitive to variations in the cost of contraceptive methods and the cost of unintended pregnancy.
- With a longer time horizon, methods with high initial costs (i.e., the copper-T IUD, vasectomy and the LNG-20 IUS) and high effectiveness become more cost effective (Fig. 2).
- When the cost of a birth was increased to \$9,318, corresponding to a scenario in which all women want no more children, the ICER for vasectomy and the LNG-20 IUS compared to the copper-T IUD dropped to \$78 and \$1,270 per percent increase in effectiveness, respectively.
- One and two-way sensitivity analysis on method costs showed the LNG-20 IUS to dominate the copper-T IUD when its cost was less than \$300 and vasectomy to be the dominant method when its cost was less than \$640.



Note: the annualized cost at year x is the total cost for x years divided by x. The annualized costs for tubal ligation for year 1 and 2 (not shown in graph) were \$2,912 and \$1,470 respectively. The annualized cost for implant for year 1 was \$1,477.

Fig. 2: Annualized costs associated with contraceptive methods

Limitations of Analysis

- In this model, switching between methods was not allowed even when failure occurred. In reality, given their changing preferences and situations, individuals do switch between different methods. However, there are no nationally representative data on probabilities of switching among all methods. Moreover, allowing switches precludes a pure comparison of different contraceptive methods. If all switches are assigned an average cost of a mix of contraceptive methods, then the costs of the different methods will converge over time.
- The model time horizon was restricted to 5 years only.
- The model did not account for certain costs incurred by women with tubal ligation, including reversal costs for those desiring pregnancy. Non-contraceptive beneficial effects and associated cost savings (e.g., the reduction in need for surgical treatment of menorrhagia following IUS use¹⁵ and the protective role of condoms against sexually transmitted infections) were not considered.

CONCLUSION

Copper-T IUD, vasectomy and LNG-20 IUS are the most cost-effective methods currently available in the US market.

ACKNOWLEDGEMENT

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