Published in final edited form as:

Obstet Gynecol. 2015 July ; 126(1): 47–55. doi:10.1097/AOG.0000000000000907.

Cost-Effectiveness of Immediate Compared With Delayed Postpartum Etonogestrel Implant Insertion

Aileen M. GARIEPY, MD, MPH^a, Jennifer Y. DUFFY, MD^b, and Xiao XU, PhD^a

Aileen M. GARIEPY: aileen.gariepy@yale.edu; Jennifer Y. DUFFY: jyduffy@uci.edu; Xiao XU: xiao.xu@yale.edu

^aDepartment of Obstetrics, Gynecology, and Reproductive Sciences, Yale School of Medicine, 310 Cedar Street, New Haven, CT 06520

^bDepartment of Obstetrics and Gynecology, University of California, Irvine, 101 The City Drive S, Orange CA 92868

Abstract

Objective—To evaluate the cost-effectiveness of immediate versus delayed (6 weeks) postpartum etonogestrel implant insertion in preventing future unintended pregnancy.

Methods—We constructed a decision-analytic model to examine a hypothetical population of women who request a contraceptive implant after giving birth. The timeframe for analysis was from the time of childbirth to one year postpartum. Model inputs were derived from a comprehensive literature review. We compared immediate (before discharge from the childbirth hospital stay) versus delayed (at first postpartum office visit) postpartum placement of the contraceptive implant from a health care system's perspective. Implant insertion and removal, loss to follow-up at postpartum visit, use of alternative contraceptive methods, and contraceptive failure were incorporated into the model. We calculated the incremental cost of immediate insertion for each pregnancy prevented during the first postpartum year and cost savings associated with pregnancies prevented. One-way sensitivity analyses were also performed. Cost estimates are reported in 2014 U.S. dollars.

Results—Immediate postpartum implant insertion is associated with higher expected cost than delayed insertion (\$1,091 per patient versus \$650 per patient), but is more effective in preventing pregnancies (expected pregnancy rate: 2.4% and 21.6%, respectively). This results in an incremental cost-effectiveness ratio of \$2,304 per pregnancy prevented. When taking into consideration medical costs of the resulting unintended pregnancies that could be avoided, immediate implant insertion is expected to save \$1,263 per patient.

Conclusions—Immediate postpartum provision of the contraceptive implant is cost-effective in preventing unintended pregnancies, and should be provided to women requesting this form of contraception.

Corresponding Author: Aileen Gariepy, MD, MPH, Department of Obstetrics, Gynecology and Reproductive Sciences, 310 Cedar Street, New Haven, CT 06520, Phone: 203-737-4665, aileen.gariepy@yale.edu.

Presented as a poster at the North American Forum in Family Planning, Seattle, Washington, October 6–7, 2013.

Financial Disclosure:

Aileen Gariepy is a Nexplanon trainer for Merck & Co. The other authors did not report any potential conflicts of interest.

Introduction

Over half of U.S. pregnancies are unintended.¹ Maternal and infant care costs for unintended pregnancies amount to \$11.1 billion annually for public insurance programs alone.² Immediate postpartum period (after delivery but before discharge home) provides an ideal opportunity for initiating contraceptives as patients are motivated and timing is convenient.^{3,4}

The etonogestrel subdermal contraceptive implant (Implanon[®], Nexplanon[®]), a long-acting reversible contraception (LARC) method, is safe and effective for immediate postpartum insertion, including for breastfeeding women.^{4–6} Studies showed that adolescents with immediate postpartum implant insertion have lower repeat pregnancy rates within two years than adolescents with delayed insertion,⁷ as sexual activity without contraception before the insertion visit and failure to return for the visit can increase unintended pregnancy risk.^{4,8–10} However, there are no similar studies of adult women.

Moreover, cost-effectiveness of immediate versus delayed postpartum implant insertion (e.g., at 6 week postpartum visit) is not established, even though cost-effectiveness of other LARC methods inserted in the postpartum period, such as IUDs, has been demonstrated.¹¹ The implant has several advantages over IUDs and warrants separate assessment. Implants are permitted regardless of obstetric complications that preclude IUD insertion (e.g., chorioamnionitis) and are unaffected by concerns for expulsion.⁵

Therefore, we evaluated the cost-effectiveness of immediate versus delayed postpartum implant insertion and potential cost savings from avoiding unintended pregnancies.^{2,8} Obstetric “global delivery fees” which preclude separate reimbursement of individual procedures, are one important barrier to immediate postpartum LARC use.^{3,9,10} Understanding cost-effectiveness of immediate postpartum implant insertion can inform policy discussions regarding reimbursement for contraception.^{3,9,10}

Materials and Methods

We constructed a decision analytic model for a hypothetical cohort of postpartum women of reproductive age at risk for repeat pregnancy (i.e. without prior sterilizations or hysterectomies) desiring the contraceptive implant following delivery. Decision analysis is a modeling method for comparing two or more interventions by mapping the clinical pathways following each intervention and incorporating uncertainty in occurrence of health events and outcomes. The analysis was conducted from the health care system’s perspective and therefore only included medical care costs. We compared the number of subsequent unintended pregnancies for a policy offering immediate postpartum implant insertion compared with the current practice of delayed insertion.

Immediate postpartum placement was defined as insertion of the implant at any time after delivery but prior to discharge from the hospital. Delayed placement was defined as insertion of the implant at the first postpartum visit. The postpartum visit was assumed to occur at six weeks after delivery to be consistent with the current standard of practice. A decision tree was constructed to map out contraceptive events (implant insertion and

removal, implant continuation or discontinuation, use of alternative contraceptive methods, lactational amenorrhea secondary to exclusive breastfeeding, contraceptive failure, and lost to follow-up) and outcomes (pregnant or not pregnant) over the one-year period after, but not including, the index delivery (Figure 1). We evaluated the cost-effectiveness and cost benefit of immediate versus delayed implant placement. Effectiveness was measured as pregnancy avoidance during the one-year period, while benefit was assessed by cost savings associated with pregnancy prevention.

Assumptions of the model:

1. Women were assumed to be anovulatory for the first 4 weeks postpartum and therefore not at risk of pregnancy, regardless of sexual activity.¹²
2. Due to a lack of age-specific data in current literature regarding the parameters in the model, we estimated the average experience of women of reproductive age, consistent with prior cost-effectiveness research.¹³
3. We assumed that distribution of contraceptive method choice among postpartum women was the same as an average woman's experience reflected in 2011–2013 national data from the National Survey of Family Growth (NSFG), focusing on women who used reversible methods. The NSFG is a national survey conducted by the Centers for Disease Prevention and Control of men and women ages 15–44 about contraceptive practices, pregnancy, and pregnancy outcomes.¹⁴ We also used national estimates of exclusive breastfeeding to estimate the contraceptive protection provided by lactational amenorrhea.¹⁵
4. There are a lack of data regarding the contraceptive methods used by women who do not return for a postpartum visit. Therefore, we assumed that they engaged in contraception beginning at the mid-point of the year and that they would use reversible contraceptive methods (both prescription and non-prescription forms of birth control) with the same distribution as those found in the NSFG.
5. Women who initiated a birth control method other than the implant continued that method for the study duration.
6. Women who discontinued the implant either proceeded without a contraceptive method or immediately initiated another (non-implant) reversible contraceptive method for the remainder of the year. We assumed that distribution of reversible contraceptive methods in these women was the same as that found in the NSFG.
7. We assumed that women not undergoing implant insertion at their postpartum visit (unless they were exclusively breastfeeding) or choosing to have the implant removed started their alternative method of contraception at the same visit where the implant was not placed or removed.
8. Implant discontinuations were assumed to occur at the midpoint of the study year (for immediate insertion) or midpoint of the remainder year (for delayed insertion).¹⁶

9. Individuals were assumed to have intercourse at a rate of 83 times per year, consistent with previous literature on the cost-effectiveness of contraception.¹⁷
10. We assumed that exclusive breastfeeding (and its contraceptive effects) will end by 6 months postpartum.

Probability estimates for each health event in the model were obtained through a thorough literature review (Table 1). Online searches were conducted on PubMed, Medline and relevant websites (Centers for Disease Control and Prevention website, the Guttmacher Institute website, and Kaiser.org) from database inception through March 2015 using the following keywords and MeSH search terms: Implanon, Nexplanon, etonogestrel, implant, subdermal, immediate, delayed, cost, cost-effectiveness, failure, postpartum, pregnancy, unintended pregnancy, pregnancy rates, follow-up, compliance, continuation, contraception, breastfeeding, and combinations of these terms.

Failure rates for each reversible contraceptive method reflects typical use and were based on annual or monthly failure rate reported in the literature.^{34–36} This information was then used to construct a weighted average failure rate in our model for women who chose to use reversible contraceptive methods other than the implant or who had the implant removed, based on the percentage of women using each method of contraception (other than implant) and the expected failure rate associated with each of those methods. A similar approach was used to estimate the weighted average failure rate for women who did not return for postpartum visit but used a reversible contraceptive method (including implant). These weighted average failure rates were then used to calculate expected pregnancies during the applicable time period (e.g., between postpartum visit and end of first year). Unless they already received the implant, women who were exclusively breastfeeding were assumed to initiate other contraceptive methods after they stopped breastfeeding. All pregnancies resulting from implant discontinuation or contraceptive failure were assumed to end in ectopic pregnancy, miscarriage, abortion, or delivery based on published data regarding the relative proportion of these outcomes.^{37,38}

Cost estimates for each form of contraception in our model accounted for the cost of the device or drug, as well as the cost of the contraceptive counseling visit and the insertion or removal procedure where applicable (Table 2). Cost for the contraceptive counseling visit and procedures included the full expenses of providing services, including providers' effort as well as practice expenses. We did not include the cost of the 6-week postpartum visit itself, as it is not affected by immediate versus delayed implant insertion. Cost estimates were obtained from several data sources including the published literature^{35,41} (e.g., implant device, IUD device, patch, ring, condom), the 2010 Red Book Drug Topics (e.g., oral contraceptive pills), and the Medicare fee schedule (e.g., implant insertion and removal procedure, IUD insertion, depot injection).^{40,42} Because the oral contraceptive pill, vaginal ring and depot injections are purchased by complete cycles (28 days and three months, respectively), we did not allow for fractions of per cycle costs. However, we accommodated fractions of per cycle costs for condom use. Costs associated with oral contraceptive pill were based on a weighted average of the most commonly used oral contraceptives.⁴³ We included cost of a contraceptive counseling visit when women had implant removal or did not return for postpartum visit but obtained contraceptives from other sources.

Costs associated with subsequent unintended pregnancies were based on published estimates for childbirth expenses (including prenatal care) for commercially insured and Medicaid funded women and the percentage of U.S. deliveries funded by Medicaid.^{37,39} We also accounted for the costs of abortion, miscarriage, and ectopic pregnancy consistent with previous contraception cost-effectiveness studies.³⁷ All cost estimates were reported in 2014 U.S. dollars. Cost estimates from other years were inflation adjusted to 2014 dollars using medical care component of the Consumer Price Index.⁴⁴

For both immediate and delayed implant insertion, we calculated the expected costs and pregnancy rates. Incremental cost-effectiveness ratio (ICER) of immediate versus delayed insertion indicates the additional costs associated with immediate insertion for each additional pregnancy prevented. One-way sensitivity analyses were conducted to investigate the impact of uncertainty in model parameters on the results. When data ranges were not available from the literature, we used $\pm 25\%$ of the base value for the sensitivity analysis.⁴⁵ To demonstrate the potential net savings of immediate postpartum implant insertion, we also conducted a cost-benefit analysis by accounting for avoided costs associated with potential subsequent pregnancies from the health care system's perspective. All analyses were conducted with TreeAge software (TreeAge Pro 2012, TreeAge Software, Inc., Williamstown, MA). This study was exempt from Institutional Review Board review as it only used published data.

Results

At one year postpartum, immediate insertion is associated with a higher expected per patient cost of \$1,091 (versus \$650 for delayed insertion) (Table 3). However, immediate postpartum implant insertion has a lower expected pregnancy rate than delayed insertion: 2.4% and 21.6%, respectively. In other words, for each 1,000 women planning to receive implant postpartum, immediate insertion is expected to prevent 191 unintended pregnancies, compared with delayed insertion. Therefore, compared to delayed insertion, immediate insertion is associated with an ICER of \$2,304 per pregnancy prevented (Table 3).

In subsequent cost benefit analysis, we considered medical costs (including prenatal care) associated with unintended pregnancies in each arm of the model. Accounting for the likelihood of ectopic pregnancy, miscarriage, abortion, and delivery, the expected medical cost of each unintended pregnancy is estimated to be \$8,907. Because immediate implant placement is associated with a much lower unintended pregnancy rate compared with the delayed insertion arm (2.4% versus 21.6%), immediate implant insertion is expected to save \$1,263 per patient after we take into consideration the costs of unintended pregnancies (Table 3). In sensitivity analyses using per pregnancy cost based on Medicaid expense versus commercial insurers, immediate implant insertion is associated with an expected net saving of \$703 and \$1,781 per patient, respectively.

In one way sensitivity analysis, the ICER of immediate versus delayed insertion in preventing unintended pregnancy was most influenced by the rate at which women become pregnant when not using contraception, cost of the implant device, probability of removing the implant within 1st year of use, probability of women returning for postpartum visit, and

the probability of pregnancy before postpartum visit (Figure 2). For example, when annual pregnancy rate increased from 63.75% to 100% for women not using contraception, the ICER associated with immediate insertion decreased from \$3,054 to \$1,491 per pregnancy prevented. When cost of the implant was varied from \$645 to \$1075, the ICER increased from \$1,697 to \$2,911 per pregnancy prevented. However, immediate insertion was more effective in preventing pregnancy than delayed insertion in all scenarios, and the ICER ranged from \$1,491 to \$3,054 for each pregnancy prevented.

Discussion

Employing a cost-effectiveness analysis from a health care system's perspective, immediate postpartum implant insertion is cost-effective in preventing pregnancies compared with delayed insertion. Because immediate placement prevents more pregnancies, it results in net savings of \$1,263 per patient. Based on these estimates, for every 1,000 women using postpartum implant, immediate placement is expected to avert 191 unintended pregnancies and save \$1,263,000 compared with delayed insertion.

Higher expected cost of immediate insertion is because some women in the delayed insertion arm did not receive the implant. With delayed insertion, 35% of women did not return for their postpartum visit and 27% attending the visit declined the implant. By using less expensive, non-LARC methods or no contraception, these women would incur lower costs following delayed compared to immediate insertion.¹⁴ However, use of non-LARC methods or no contraception result in higher unintended pregnancy risk.^{34–36} When considering medical costs of subsequent unintended pregnancies, immediate postpartum implant insertion is associated with net savings. These findings support prior research demonstrating the cost-effectiveness of LARC.^{11,13,35,37}

Given LARC's high efficacy and few contraindications, the American College of Obstetricians and Gynecologists (ACOG) advocates for obstetrician-gynecologists and insurance providers to reduce barriers to immediate postpartum LARC initiation.^{4,26,46} In general, women without insurance coverage of LARC methods are eleven times less likely to receive one.⁴⁷ Insurance coverage of immediate postpartum LARC would expand access and facilitate uptake. Immediate insertion is ideal as motivation and doctor-patient interaction are high, no return visit is required, and the method starts before resumption of ovulation and sexual activity.⁴ Early implant initiation (1 to 3 days postpartum) shows no concerning effects on maternal or infant health, including breastfeeding outcomes.^{6,48}

We also need to understand more about the approximately 27% of women who initially desire the implant but do not receive it at the postpartum visit.^{10,18} Are women receiving alternative contraception because they no longer want the implant, or are there barriers to care such as an additional office visit for insertion? Further research on this patient population would be informative in order to provide more patient-centered care and meet their contraceptive needs.

We recognize that our study had several limitations. First, our analysis was limited to the first postpartum year, which is shorter than the 3-year maximum duration of use for the

contraceptive implant. However, given the upfront cost of the implant with minimal costs in subsequent years, extending the model for an additional two years would result in more favorable findings for immediate implant insertion. Likewise, we did not account for cost savings of immediate postpartum implant insertion (due to its lower expected pregnancy rate compared to delayed insertion) related to reduced likelihood of short inter-pregnancy intervals and associated adverse perinatal outcomes.^{49,50} Hence our estimates provide a conservative view for the cost-effectiveness of immediate insertion.

Second, there are still important gaps in current literature and we had to make assumptions in our analysis. For example, we know little about contraceptive methods used by women who do not attend their postpartum visit and among women awaiting delayed implant insertion. The literature also lacks representative estimates of the impact of unintended pregnancy on employment or education, household expenses (e.g. diapers, child care), or patients' quality of life, which were therefore not accounted for in the model, biasing our results against immediate insertion.

Furthermore, consistent with previous contraception cost-effectiveness research,³⁷ we assumed that women choosing non-LARC methods in the model did not discontinue or switch those methods. Since non-LARC methods have higher discontinuation rates than LARC methods³⁶ and method switching can also be associated with a gap in use of any contraception which could therefore result in a higher pregnancy risk, our model likely underestimates the benefits of immediate insertion. Future research characterizing patterns of contraceptives used by postpartum women is warranted.

In summary, findings from this analysis suggest that immediate postpartum insertion of the contraceptive implant is expected to be cost-effective compared to delayed insertion and to result in a decrease in unintended pregnancy and net savings for the health care system in the long run. Effort should be made to offer the contraceptive implant in the immediate postpartum period to all women who desire it and do not have contraindications.

Acknowledgments

Dr. Gariepy is funded by CTSA Grant KL2 TR000140 from the National Institutes of Health.

References

1. Finer LB, Zolna MR. Shifts in intended and unintended pregnancies in the United States, 2001–2008. *Am J Public Health*. 2014 Feb; 104(Suppl 1):S43–8. [PubMed: 24354819]
2. Sonfield A, Kost K, Gold RB, Finer LB. The public costs of births resulting from unintended pregnancies: national and state-level estimates. *Perspect Sex Reprod Health*. 2011; 43(2):94–102. [PubMed: 21651708]
3. Aiken AR, Creinin MD, Kaunitz AM, Nelson AL, Trussell J. Global fee prohibits postpartum provision of the most effective reversible contraceptives. *Contraception*. 2014 Nov; 90(5):466–7. [PubMed: 25212061]
4. Speroff L, Mishell DR. The postpartum visit: it's time for a change in order to optimally initiate contraception. *Contraception*. 2008; 78(2):90–98. [PubMed: 18672108]
5. Prevention. CfDCA. Medical Eligibility Criteria for Contraceptive Use, 2010. *MMWR Early Release*. 2010; 59:7–10.

6. Brito MB, Ferriani RA, Quintana SM, Yazlle ME, Silva de Sá MF, Vieira CS. Safety of the etonogestrel-releasing implant during the immediate postpartum period: a pilot study. *Contraception*. 2009; 80(6):519–526. [PubMed: 19913145]
7. Lewis LN, Doherty DA, Hickey M, Skinner SR. Implanon as a contraceptive choice for teenage mothers: a comparison of contraceptive choices, acceptability and repeat pregnancy. *Contraception*. 2010; 81(5):421–426. [PubMed: 20399949]
8. Winner B, Peipert JF, Zhao Q, et al. Effectiveness of long-acting reversible contraception. *N Engl J Med*. 2012; 366(21):1998–2007. [PubMed: 22621627]
9. Eisenberg D, McNicholas C, Peipert JF. Cost as a barrier to long-acting reversible contraceptive (LARC) use in adolescents. *J Adolesc Health*. 2013; 52(4 Suppl):S59–63. [PubMed: 23535059]
10. Ogburn JA, Espey E, Stonehocker J. Barriers to intrauterine device insertion in postpartum women. *Contraception*. 2005; 72(6):426–429. [PubMed: 16307964]
11. Washington CI, Jamshidi R, Thung SF, Nayeri UA, Caughey AB, Werner EF. Timing of postpartum intrauterine device placement: a cost-effectiveness analysis. *Fertil Steril*. 2015 Jan; 103(1):131–7. [PubMed: 25439838]
12. Jackson E, Glasier A. Return of ovulation and menses in postpartum nonlactating women: a systematic review. *Obstet Gynecol*. 2011; 117(3):657–662. [PubMed: 21343770]
13. Reeves MF, Smith KJ, Creinin MD. Contraceptive effectiveness of immediate compared with delayed insertion of intrauterine devices after abortion: a decision analysis. *Obstet Gynecol*. 2007; 109(6):1286–1294. [PubMed: 17540799]
14. Daniels, K.; Daugherty, J.; Jones, J. NCHS data brief. Hyattsville, MD: National Center for Health Statistics; 2014. Current contraceptive status among women aged 15–44: United States, 2011–2013.
15. CDC National Immunization Surveys 2011 and 2012, Provisional Data, 2010 births. Available at: http://www.cdc.gov/breastfeeding/data/NIS_data/index.htm
16. Chiou CF, Trussell J, Reyes E, et al. Economic analysis of contraceptives for women. *Contraception*. 2003; 68(1):3–10. [PubMed: 12878280]
17. Trussell J, Koenig J, Ellertson C, Stewart F. Preventing unintended pregnancy: the cost-effectiveness of three methods of emergency contraception. *Am J Public Health*. 1997; 87(6):932–937. [PubMed: 9224172]
18. Phemister DA, Laurent S, Harrison FN. Use of Norplant contraceptive implants in the immediate postpartum period: safety and tolerance. *Am J Obstet Gynecol*. 1995; 172(1 Pt 1):175–179. [PubMed: 7847530]
19. Levi, E.; Cantillo, E.; Ades, V.; Banks, E.; Murthy, A. *Contraception*. 2012. Immediate postplacental IUD insertion at cesarean delivery: a prospective cohort study.
20. (CDC) CfDcAP. Postpartum care visits--11 states and New York City, 2004. *MMWR Morb Mortal Wkly Rep*. 2007; 56(50):1312–1316. [PubMed: 18097343]
21. Ghilarducci E, McCool W. The influence of postpartum home visits on clinic attendance. *J Nurse Midwifery*. 1993; 38(3):152–158. [PubMed: 8331426]
22. Kogan MD, Leary M, Schaetzel TP. Factors associated with postpartum care among Massachusetts users of the Maternal and Infant Care Program. *Fam Plann Perspect*. 1990; 22(3):128–130. [PubMed: 2379570]
23. Landon BE, Schneider EC, Normand SL, Scholle SH, Pawlson LG, Epstein AM. Quality of care in Medicaid managed care and commercial health plans. *JAMA*. 2007; 298(14):1674–1681. [PubMed: 17925519]
24. Stevens-Simon C, O'Connor P, Bassford K. Incentives enhance postpartum compliance among adolescent prenatal patients. *J Adolesc Health*. 1994; 15(5):396–399. [PubMed: 7947854]
25. Weir S, Posner HE, Zhang J, Willis G, Baxter JD, Clark RE. Predictors of prenatal and postpartum care adequacy in a medicaid managed care population. *Womens Health Issues*. 2011; 21(4):277–285. [PubMed: 21565526]
26. Wilson S, Tennant C, Sammel MD, Schreiber C. Immediate postpartum etonogestrel implant: a contraception option with long-term continuation. *Contraception*. 2014

27. Tocce K, Sheeder J, Python J, Teal SB. Long acting reversible contraception in postpartum adolescents: early initiation of etonogestrel implant is superior to IUDs in the outpatient setting. *J Pediatr Adolesc Gynecol.* 2012; 25(1):59–63. [PubMed: 22051792]
28. Funk S, Miller MM, Mishell DR, et al. Safety and efficacy of Implanon, a single-rod implantable contraceptive containing etonogestrel. *Contraception.* 2005; 71(5):319–326. [PubMed: 15854630]
29. Croxatto HB, Urbancsek J, Massai R, Coelingh Bennink H, van Beek A. A multicentre efficacy and safety study of the single contraceptive implant Implanon. Implanon Study Group. *Hum Reprod.* 1999; 14(4):976–981. [PubMed: 10221230]
30. Lakha F, Glasier AF. Continuation rates of Implanon in the UK: data from an observational study in a clinical setting. *Contraception.* 2006; 74(4):287–289. [PubMed: 16982226]
31. Power J, French R, Cowan F. Subdermal implantable contraceptives versus other forms of reversible contraceptives or other implants as effective methods of preventing pregnancy. *Cochrane Database Syst Rev.* 2007; (3):CD001326. [PubMed: 17636668]
32. Lipetz C, Phillips CJ, Fleming CF. The cost-effectiveness of a long-acting reversible contraceptive (Implanon) relative to oral contraception in a community setting. *Contraception.* 2009; 79(4):304–309. [PubMed: 19272500]
33. Allsworth JE, Madden T, Mullersman JL, Peipert JF. The Contraceptive CHOICE Project: reducing barriers to long-acting reversible contraception. *Am J Obstet Gynecol.* 2010; 203(2): 115.e111–117. [PubMed: 20541171]
34. Trussell J. The cost of unintended pregnancy in the United States. *Contraception.* 2007; 75(3):168–170. [PubMed: 17303484]
35. Trussell J, Lalla AM, Doan QV, Reyes E, Pinto L, Gricar J. Cost effectiveness of contraceptives in the United States. *Contraception.* 2009; 79(1):5–14. [PubMed: 19041435]
36. Hatcher, R.; Trussell, J.; Nelson, A.; Cates, W.; Stewart, F.; Kowal, D. *Contraceptive Technology.* 19. Ardent Media; 2007. rev
37. Trussell J, Henry N, Hassan F, Prezioso A, Law A, Filonenko A. Burden of unintended pregnancy in the United States: potential savings with increased use of long-acting reversible contraception. *Contraception.* 2013; 87(2):154–161. [PubMed: 22959904]
38. Ventura SJ, Curtin SC, Abma JC, Henshaw SK. Estimated pregnancy rates and rates of pregnancy outcomes for the United States, 1990–2008. *Natl Vital Stat Rep.* 2012; 60(7):1–21. [PubMed: 22970648]
39. Foundation KF. The Role of Medicaid and Medicare in Women's Health Care. *JAMA.* 2013; 309:1984.
40. Centers for Medicare and Medicaid Services. Association AM; <http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/PhysicianFeeSched/PFS-Relative-Value-Files.html>
41. Trussell J. Update on and correction to the cost-effectiveness of contraceptives in the United States. *Contraception.* 2012; 85(6):611. [PubMed: 22459232]
42. Healthcare, T. *Drug topics Red Book.* Montvale (NJ): 2010.
43. Hall KS, Trussell J. Types of combined oral contraceptives used by US women. *Contraception.* 2012; 86(6):659–665. [PubMed: 22770787]
44. Statistics BoL. *Consumer Price Index.* 2012.
45. Xu X, Ivy JS, Patel DA, et al. Pelvic floor consequences of cesarean delivery on maternal request in women with a single birth: a cost-effectiveness analysis. *J Womens Health (Larchmt).* 2010; 19(1):147–160. [PubMed: 20088671]
46. Gynecologists ACoOa. ACOG Practice Bulletin No. 121: Long-acting reversible contraception: Implants and intrauterine devices. *Obstet Gynecol.* 2011; 118(1):184–196. [PubMed: 21691183]
47. Gariepy AM, Simon EJ, Patel DA, Creinin MD, Schwarz EB. The impact of out-of-pocket expense on IUD utilization among women with private insurance. *Contraception.* 2011; 84(6):e39–42. [PubMed: 22078204]
48. Gurtcheff SE, Turok DK, Stoddard G, Murphy PA, Gibson M, Jones KP. Lactogenesis after early postpartum use of the contraceptive implant: a randomized controlled trial. *Obstet Gynecol.* 2011; 117(5):1114–1121. [PubMed: 21508750]

49. Zhu BP, Rolfs RT, Nangle BE, Horan JM. Effect of the interval between pregnancies on perinatal outcomes. *N Engl J Med.* 1999; 340(8):589–594. [PubMed: 10029642]
50. Zhu BP. Effect of interpregnancy interval on birth outcomes: findings from three recent US studies. *Int J Gynaecol Obstet.* 2005; 89(Suppl 1):S25–33. [PubMed: 15820365]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1.

Model of immediate versus delayed implant insertion. The collapsed Markov subtree in the figure models repeated menstrual cycles resulting in pregnancy or non-pregnancy states within each cycle while accounting for women's use of contraceptives and status of exclusive breastfeeding.

Figure 2.

Tornado diagram reflecting results from one-way sensitivity analysis. This figure only reports the top 15 parameters with the most impact on the incremental cost-effectiveness ratio of immediate versus delayed postpartum insertion of implant. *Costs in US dollars.

Table 1

Estimates of probability parameters used in the model

Parameter	Base Case	Range	References
Postpartum visit (PPV) attendance	65%	48–89.9%	10,13,18–25
Pregnant at PPV	3.07%	0–6.14%	7,10
Implant not inserted at PPV	27% ^a	18.5–35.5%	10,18
Implant discontinuation during the first year postpartum	18%	8.4–31.5%	16,26–32
Contraceptive use rate^b			14
Combined hormonal pill		16.0%	
Male condom		9.4%	
Withdrawal		3.0%	
Periodic abstinence		0.8%	
Intrauterine device		6.4%	
Depot medroxyprogesterone acetate injection		2.8%	
Implant		0.8%	
Combined hormonal ring, patch		1.6%	
No contraception		6.9%	
Exclusive breastfeeding (Lactational amenorrhea)			
At 6 weeks postpartum	48.0%	46.5%–49.5%	15
At 6 months postpartum	18.8%	17.6%–20%	15
Annual contraceptive failure rate			34,35,36
Progestin intrauterine device	0.2%	0.15%–0.25%	
Copper intrauterine device	0.8%	0.6%–1%	
Implant	0.05%	0.0375%–0.0625%	
Depot medroxyprogesterone acetate injection	3%	2.25%–3.75%	
Combined hormonal pill, patch, ring	8%	6%–10%	
Male condom	15%	11.25%–18.75%	
Withdrawal/periodic abstinence	25%	18.75%–31.25%	
No method	85%	63.75%–100%	
Probability of pregnancy over first 6 months postpartum when exclusively breastfeeding	2%	1.5%–2.5%	15
Pregnancy outcome			37,38
Live birth		46.3%	
Miscarriage		17.4%	
Ectopic pregnancy		0.6%	
Induced abortion		35.7%	
Proportion of births covered by Medicaid		48.0%	39

^a Arithmetic mean of the minimum and maximum values^b Percentages do not add up to 100% because we did not list data for women who use non-reversible contraception or not at risk for pregnancy as they were not relevant to our study.

Table 2

Estimates of cost parameters used in the model

Parameter	CPT Code	Base Case	Range	References
Contraceptive Method Costs				
Progestin IUD (5 years)				40,41
<i>Device</i>	N/A	\$917.87	\$688.41 – \$1,147.34	
<i>Insertion</i>	58300	\$70.93	\$53.20 – \$88.66	
Copper IUD (10 years)				40,41
<i>Device</i>	N/A	\$780.85	\$585.63 – \$976.06	
<i>Insertion</i>	58300	\$70.93	\$53.20 – \$88.66	
Implant (3 years)				40,41
<i>Device</i>	N/A	\$860.24	\$645.18 – \$1,075.29	
<i>Insertion</i>	11981	\$138.63	\$103.98 – \$173.29	
<i>Removal</i>	11982	\$156.90	\$117.68 – \$196.13	
Depot medroxyprogesterone acetate (3 months)				40,41
<i>Drug</i>	N/A	\$110.93	\$83.20 – \$138.66	
<i>Injection</i>	96372	\$25.08	\$18.81 – \$31.34	
Combined hormonal pill (28 day supply)				40–43
<i>Drug</i>	N/A	\$55.18	\$41.38 – \$68.97	
Combined hormonal patch (28 day supply)				40,41
<i>Drug</i>	N/A	\$71.36	\$53.52 – \$89.20	
Combined hormonal ring (28 day supply)				40,41
<i>Drug</i>	N/A	\$74.95	\$56.21 – \$93.68	
Male condom (28 day supply)				35,41
Contraceptive counseling visit	99212	\$43.70	\$32.78 – \$54.63	
Contraceptive Failure Costs				
Pregnancy Outcome		Cost		
Live birth				39
Medicaid		\$11,871.42		
Commercial		\$24,045.45		
Miscarriage		\$973.34		37
Ectopic pregnancy		\$4,905.84		
Induced abortion		\$788.46		

Table 3

Cost-effectiveness of immediate versus delayed postpartum implant insertion

	Expected Pregnancy Rate	Expected Cost
Immediate Insertion	2.4%	\$1,091
Delayed Insertion	21.6%	\$650
Difference	–19.1%	\$441
Incremental Cost Effectiveness Ratio(ICER)	Additional \$2,304 per pregnancy prevented	
Expected Cost Avoided (i.e., Difference in Expected Pregnancy Rate × Cost Per Pregnancy)	\$1,704 avoided per patient	
Expected Net Benefit (i.e., Expected Cost Avoided – Expected Cost Difference between Immediate and Delayed Insertion)	\$1,704 – \$441 = \$1,263 saved per patient	