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Inpatient Postpartum Long-Acting Reversible Contraception and Sterilization in the United States, 2008–2013

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Abstract

Objective—To measure rates of long-acting reversible contraception (LARC), including intrauterine devices and contraceptive implants, and tubal sterilization during delivery hospitalizations, and correlates of their use.

Methods—This retrospective cohort study used the 2008–2013 National Inpatient Sample, a publicly-available all-payer database. We identified delivery hospitalizations with the *International Classification of Diseases, 9th Revision, Clinical Modification* codes for intrauterine device insertion, contraceptive implant insertion, and tubal sterilization. We used weighted multivariable logistic regression to examine associations between predictors, (age, delivery mode, medical comorbidity, payer, hospital type, geographic region, and year), and likelihood of LARC and sterilization, and to compare characteristics of LARC and sterilization users.

Results—Our sample included 4,691,683 discharges, representing 22,667,204 delivery hospitalizations. LARC insertion increased from 1.86 per 10,000 deliveries (2008–2009) to 13.5 per 10,000 deliveries (2012–2013; $p < 0.001$); tubal sterilization remained stable (711 to 683 per 10,000 deliveries; $p = 0.24$). In multivariable analysis adjusting for all predictors, compared to neither LARC nor sterilization, LARC use was highest among women with medical comorbidity

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(count per 10,000 deliveries: 15.04, standard error [SE]= 2.11; adjusted odds ratio [aOR]=1.92; 95% confidence interval 1.72–2.13), non-private payer (13.50, SE=2.14; aOR=5.23; 3.82–7.16), and at urban teaching hospitals (14.92, SE=2.25; aOR=20.85, 12.73–34.15). Sterilization was least likely among women age 24 years (251.04, SE=4.88; aOR=0.12, 0.12–0.13, versus 35 years) and most likely with cesarean delivery (1568.74, SE=20.81; aOR=6.25, 5.88–6.63). Comparing only LARC and sterilization users, LARC users tended to have non-private insurance (84.95% vs. 57.17%, aOR=1.90; 1.38–2.63) and deliver at urban teaching hospitals (94.65% vs. 45.47%, aOR=38.39; 23.52–62.64) in later study years (2012–2013; 55.72% vs. 32.18%, aOR=8.26; 4.42–15.44, versus 2008–2009).

Conclusion—LARC insertion increased from 1.86 to 13.5 per 10,000 deliveries but remained less than 2% of the sterilization rate. Inpatient postpartum LARC insertion is more likely among sicker, poorer women delivering at urban teaching hospitals.

Introduction

Inadequate birth spacing (<18 months between delivery and subsequent conception) is associated with low birth weight, preterm birth, and maternal complications.¹ Women using highly effective contraception have nearly four times the odds of achieving adequate birth spacing than women using a barrier or no method.² However, few U.S. women use long-acting reversible contraception (LARC; intrauterine devices [IUD] and implants; 6%) or tubal sterilization (11%) by three months postpartum, partly due to poor access.³

Recent changes in practice guidelines and LARC reimbursement policies have created new opportunities for inpatient postpartum LARC provision.^{4,5} It is important to understand which groups utilize LARC and sterilization and in what delivery settings, in order to ensure equitable access for women desiring these services.^{4,6} Moreover, reproductive justice advocates have highlighted the importance of avoiding coercion by balancing efforts to enhance access with efforts to prioritize patient autonomy.⁷ It is currently unknown whether inpatient postpartum LARC and sterilization use differ across patient groups or hospital types.

Our objective was to use the most recent nationally representative data to estimate changes in LARC insertion and tubal sterilization rates, identify correlates of their utilization during delivery hospitalizations, and compare characteristics across LARC and sterilization users. We hypothesized that LARC insertion would increase over time and be more likely among young women and those with medical comorbidities who might be particularly motivated to prevent recurrent pregnancy; those with non-private insurance who may have barriers to outpatient postpartum care; and those delivering at urban teaching hospitals where LARC expertise may concentrate.

Materials and Methods

This retrospective cohort study used data from the National Inpatient Sample, the largest publicly available, all-payer, inpatient care database in the United States. The National Inpatient Sample was developed as part of the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality. The National Inpatient Sample is a stratified

sample of twenty percent of hospital discharges from U.S. community hospitals (including academic medical centers and public hospitals) in 46 states. Using a self-weighting design, the National Inpatient Sample estimates over 36 million hospitalizations annually and represents over 95% of the U.S. population; full details about sampling and weighting procedures are available at the Healthcare Cost and Utilization website.⁸ The National Inpatient Sample has been used to generate national estimates of healthcare utilization since 1988 and specifically within the field of obstetrics has allowed for identification of delivery hospitalizations.^{9,10}

The National Inpatient Sample contains clinical and non-clinical data for each hospitalization, including diagnostic and procedure codes, patient demographic characteristics, expected payment source, total charges, length of stay, and comorbidity measures. The National Inpatient Sample also contains data on hospital characteristics from the American Hospital Association Annual Hospital Survey, including hospital geographic region (Northeast, Midwest, South, and West), location (urban or rural), and teaching status (teaching or non-teaching; only reported for urban sites).

We generated a sample of delivery-related discharge records by identifying records with at least one Diagnosis-Related Groups code for vaginal birth or cesarean delivery or *International Classification of Diseases, 9th revision, Clinical Modification* (ICD-9-CM) diagnosis or procedure code for delivery in all of the study years. Tubal sterilizations were identified by the presence of ICD-9-CM diagnosis code V25.2 in addition to ICD-9-CM procedure codes 65.6, 66.5, 66.63, or 66.97, or ICD-9-CM procedure code 66.2–66.3 alone. We excluded records if they contained codes for both IUD insertion and tubal sterilization or implant insertion and tubal sterilization (n=68). Although other investigators have also excluded cases with co-incident hysterectomy codes,⁹ we elected to retain these cases (n=398 tubal + hysterectomy; n=1 LARC + hysterectomy) given our focus on access to inpatient postpartum contraception.

Comorbidities were identified using the Healthcare Cost and Utilization Project's comorbidity flags, which use the Elixhauser comorbidity measures to identify anemia, cancer, chronic lung disease, coagulation disorders, diabetes mellitus, heart disease, Human Immunodeficiency Virus (HIV) or Acquired Immune Deficiency Syndrome (AIDS), hypertension, hypothyroidism, liver disorders, obesity, neurologic disorders, renal failure, and rheumatoid arthritis or collagen vascular diseases.¹¹ Teaching status is reported only for urban hospitals. We combined location and teaching status to create a hospital type variable (urban teaching, urban non-teaching, rural). The unit of analysis is the discharge record, as the National Inpatient Sample does not include any patient identifiers. While possible that some women underwent more than one inpatient postpartum contraceptive procedure during the five-year study period and are reflected in more than one record, we assume that this is exceedingly rare and that each case in the National Inpatient Sample therefore represents one unique woman.

Statistical analyses were performed using the survey analysis procedures in SAS software. All analyses were conducted using Agency for Healthcare Research and Quality-specified discharge weights to obtain nationally representative estimates. All reported estimates are

based on at least 35 unweighted cases and are weighted estimates, unless otherwise noted. The National Inpatient Sample sampling design changed in 2012; for many estimates, the confidence intervals are about half the length of confidence intervals under the previous design.⁸ We calculated a national estimate for total number of delivery hospitalizations. We calculated rates (count per 10,000 deliveries) of inpatient postpartum LARC insertion, IUD insertion, implant insertion, and tubal sterilization, using Wald Chi-square test. We performed simple logistic regression of each outcome with time as a predictor to assess for linear trends across the study period. To minimize imprecision due to small numbers of unweighted cases for LARC insertion, years for trend analyses were combined into two-year intervals. We calculated the rates $\pm$ standard error of inpatient postpartum LARC insertion and tubal sterilization across subgroups. We then built a multivariable logistic regression model, with a three-level nominal outcome (LARC, tubal sterilization, or neither) to estimate adjusted odds ratios (ORs) and 95% confidence intervals (CIs) using the “neither” group as the referent. We also used a separate multivariable logistic regression model to compare the characteristics of LARC and tubal sterilization users. Each multivariable model controlled for patient age, delivery mode, presence of any medical comorbidity, primary payer, hospital type, geographic region, and year. Statistical significance was defined as *p* less than 0.05. As this study involved only the analysis of de-identified national data, it was deemed not regulated for human subjects review by the University of Michigan Medical School Institutional Review Board.

Results

There were 4,691,683 unweighted delivery discharges in the 2008–2013 National Inpatient Sample, representing approximately 22,667,204 deliveries in the United States (compared to approximately 24 million total U.S. births during the study period). An estimated 1,613,340 women received either LARC (*n*=18,206) or tubal sterilization (*n*=1,595,134) during their delivery hospitalization. The LARC insertion rate increased from 1.86 per 10,000 deliveries in 2008–09 to 13.5 per 10,000 deliveries in 2012–2013 (*p*<0.001; Figure 1), driven by significant increases in both IUD and implant utilization. The tubal sterilization rate did not change significantly during the study period (711 per 10,000 deliveries, 2008–2009; 683 per 10,000 deliveries, 2012–2013; *p*=0.24). Variation in reported confidence intervals may be due to the dataset’s 2012 design change.⁸

LARC use was highest among woman with medical comorbidity, with non-private payer, in urban teaching sites, in the West, and in later study years (Table 1). Sterilization rates were highest among women ≥ 35 years and undergoing cesarean delivery. In a multivariable model controlling for patient demographics, hospital characteristics and year, and comparing to neither LARC nor sterilization, LARC insertion was significantly associated with all variables except patient age. Independent variables strongly associated with LARC use included payer, hospital type, and study year. Women with non-private payer were five times as likely as those with private payer to receive LARC (aOR=5.23; 95% CI 3.82–7.16). Women delivering at urban-teaching hospitals were twenty times as likely to receive these devices (aOR=20.85, 95% CI 12.73–34.15) as women delivering at rural hospitals. Compared to 2008–09, the odds of LARC insertion increased in later years of the study period (2010–11: aOR=3.93, 95% CI 1.72–9.00; 2012–13: aOR=6.49, 95% CI 3.53–11.94).

LARC use was also more likely with cesarean versus vaginal delivery (adjusted odds ratio [aOR]=1.36, 95% CI 1.11–1.68) and presence of any medical comorbidity versus none (aOR=1.92, 95% CI 1.72–2.13) and less likely among women receiving care in the Midwest (aOR=0.17, 95% CI 0.10–0.29) or the South (aOR=0.38, 95% CI 0.18–0.78) compared to the West.

Conversely, tubal sterilization was independently associated with patient age and delivery mode (Table 1). Younger women were less likely than those ≥35 years to undergo sterilization (aORs 0.12 to 0.61), while those with cesarean versus vaginal delivery were more likely (aOR=6.25, 95% CI 5.88–6.63). Medical comorbidity (aOR=1.17, 95% CI 1.14–1.20), non-private payer (aOR=2.20, 95% CI 2.10–2.30), and delivery in the South (aOR=1.39, 95% CI 1.27–1.52) also increased odds of tubal sterilization. Odds of tubal sterilization were significantly lower at urban versus rural hospitals (urban non-teaching: aOR 0.59, 95% CI 0.55–0.63; urban teaching: aOR 0.56, 95% CI 0.51–0.62), in the Northeast compared to the West (aOR=0.83, 95% CI 0.76–0.91), and in later years of the study period compared to 2008–09 (2010–11: aOR=0.93, 95% CI 0.88–0.99; 2012–13: aOR=0.88, 95% CI 0.83–0.95).

We observed significant differences in patient and hospital characteristics among women receiving LARC versus tubal sterilization (Table 2). Compared to sterilization users, greater proportions of LARC users were women <24 years (46.76% vs. 11.70%), delivering vaginally (64.15% vs. 25.30%), with non-private payer (84.95% vs. 57.17%). Urban-teaching hospitals inserted nearly all LARC devices (94.65%), while tubal sterilizations were more evenly distributed across hospital types. Proportionally more LARC devices were placed in later study years (2010–11, 36.08%; 2012–13, 55.72%), while sterilization was evenly distributed across the study period.

In a multivariable model adjusting for patient and hospital characteristics and year, LARC use continued to be associated with patient age, delivery mode, medical comorbidity, payer, hospital type, geographic region, and year. Women <24 years were twelve times more likely to receive LARC than tubal sterilization (aOR=12.62, 95% CI 9.59–16.61), although many more young women received tubal sterilization than LARC (186,633 vs. 8,513). Women with medical comorbidity (aOR 1.49 95% CI 1.31–1.70), non-private payer (aOR=1.90, 95% CI 1.38–2.63), delivery at urban teaching hospitals (aOR=38.39, 95% CI 23.52–62.64, compared to rural sites), and delivery later in the study period (2010–11: aOR=4.51, 95% CI 1.98–10.24; 2012–13: aOR=8.26, 95% CI 4.42–15.44, compared to 2008–09) were more likely to receive LARC than tubal sterilization. LARC insertion was significantly less likely with cesarean delivery (aOR=0.23, 95% CI 0.19–0.29) and delivery in the Midwest (aOR=0.15, 95% CI 0.09–0.26) and the South (aOR=0.25, 95% CI 0.12–0.52, compared to the West).

Discussion

This study had three principal findings. First, LARC insertion rates during U.S. delivery hospitalizations increased 7-fold from 2008- to 2013, while tubal sterilization rates remained stable. Second, LARC insertion occurred almost exclusively at urban teaching hospitals

(94.65%) and most commonly involved women with non-private payers (84.95%). Third, LARC uses and sterilization users were demographically distinct; LARC users tended to be younger, with medical comorbidity, delivering vaginally, and in the West.

Our findings build on prior work examining national inpatient postpartum IUD and sterilization rates from 2001 to 2008.⁹ We demonstrate continued increases in LARC utilization and stronger associations between LARC use and patient and hospital characteristics.

In our study, tubal sterilization occurred much more frequently than LARC placement during delivery hospitalizations. An estimated 1,595,134 women underwent sterilization, compared to only 18,206 receiving LARC. These estimates, observed variation across hospital type and geographic region, and prior work identifying unmet demand for LARC after childbirth together suggest access barriers to inpatient LARC.¹² Urban non-teaching and rural hospitals may face institutional barriers to providing inpatient LARC services, including challenges regarding provider training, device supply chain, and billing/reimbursement.^{13–15} Clinicians seeking to offer inpatient LARC may benefit from publicly available resources, including an implementation guide and provider training materials.^{16,17}

Primary payer may influence postpartum contraceptive use. Women with non-private insurance were much more likely to receive LARC or tubal sterilization compared to receiving neither. Other recent studies suggest that female sterilization varies by payer, but LARC utilization does not.^{9,18–20, 24} Our findings could represent patient preferences; many Medicaid beneficiaries lose coverage 60 days post-delivery and may be particularly motivated to initiate highly effective contraception before hospital discharge. Alternatively, findings could result from biased counseling and care, with clinicians disproportionately promoting LARC and sterilization to women with non-private insurance. Women with non-private insurance had 1.9 times the odds of LARC insertion versus sterilization. Medicaid policy requiring signed consent 30 days in advance may limit utilization of sterilization.^{21,22} Additionally, covered benefits and reimbursement rates may differ between private and non-private plans and drive differences in LARC availability and use. Findings predate recent changes in Medicaid reimbursement for inpatient postpartum LARC, but variation in coverage across states may impact future utilization trends.^{5,23}

Inpatient postpartum LARC use concentrated among certain demographic groups. A significantly higher proportion of LARC versus sterilization users were aged <30 years. This is reassuring, given the known association between age <30 years and risk of regret with sterilization.²⁵ However, the estimated number of women <30 years receiving tubal sterilization (n=616,781) still vastly outstripped those receiving LARC (n=12,969) during 2008–2013. Inpatient postpartum LARC insertion is safe and effective for adolescents and young women and is likely underutilized by this population.

Women with medical comorbidity were also more likely to use LARC or sterilization, possibly due to motivation to avoid high-risk pregnancy. These women accounted for higher proportions of LARC versus sterilization users. Women with medical comorbidities and their providers may perceive LARC as particularly advantageous, as it has few medical

contraindications and provides equivalent contraceptive effectiveness while avoiding potential risks of sterilization surgery.⁴

Our findings should be interpreted in light of limitations common to studies using nationally representative discharge data. These data rely on accurate coding, and errors of commission or omission may occur. Claims data may not accurately capture every LARC device inserted, especially because these claims have not traditionally generated a payment separate from bundled fees for delivery care. As a surgical procedure, tubal sterilization may be less likely to be under-captured. Our dataset is unable to ascertain whether increased LARC use results from decreased reliance on sterilization or other contraceptive methods, a shift in LARC insertion from the outpatient to the inpatient setting, or increased LARC uptake by prior non-users of contraception. The National Inpatient Sample is designed to permit analyses of a nationally representative sample of all hospitalization discharge records, not delivery hospitalization discharge records; however, prior work suggests full capture of hospital-based births.¹⁰ Finally, although race is a known predictor of our outcomes, we could not include it in our models due to incomplete data in the National Inpatient Sample.²⁶

Despite these limitations, our study provides the most recent national estimates of inpatient postpartum LARC insertion and tubal sterilization. Observed variation in these procedures across hospital type, region, and primary payer suggest possible access barriers to these services. Improving contraceptive access is the focus of ongoing national efforts to monitor LARC and sterilization use after childbirth.²⁷ Women who are unable to initiate their preferred contraceptive method after childbirth are at increased risk of unintended short-interval pregnancy.^{28, 29} Maternity clinicians and policymakers should strive to ensure that women have access to the full contraceptive method mix after childbirth and can make an informed, voluntary, personal choice about whether and when to have another child.

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References

1. Conde-Agudelo A, Rosas-Bermudez A, Kafury-Goeta AC. Birth spacing and risk of adverse perinatal outcomes: a meta-analysis. *JAMA*. 2006; 295:1809–23. [PubMed: 16622143]
2. Thiel de Bocanegra H, Chang R, Howell M, Darney P. Interpregnancy intervals: impact of postpartum contraceptive effectiveness and coverage. *Am J Obstet Gynecol*. 2014; 210:311.e1–8. [PubMed: 24334205]
3. White K, Teal SB, Potter JE. Contraception after delivery and short interpregnancy intervals among women in the United States. *Obstet Gynecol*. 2015; 125:1471–7. [PubMed: 26000519]
4. Curtis KM, Tepper NK, Jatlaoui TC, et al. U.S. Medical Eligibility Criteria for Contraceptive Use, 2016. *MMWR Recomm Rep*. 2016; 65(RR-3):1–104.
5. Moniz MH, Dalton VK, Davis MM, Forman J, Iott B, Landgraf J, et al. Characterization of Medicaid policy for immediate postpartum contraception. *Contraception*. 2015; 92:523–31. [PubMed: 26452327]
6. American College of Obstetricians and Gynecologists. Immediate postpartum long-acting reversible contraception. Committee Opinion No. 670. *Obstet Gynecol*. 2016; 128:e32–7. [PubMed: 27454734]

7. Gold RB. Guarding against coercion while ensuring access: a delicate balance. *Guttmacher Policy Rev.* 2014; 17(3):8–14.
8. Overview of the National (Nationwide) Inpatient Sample (NIS). Available at: <https://www.hcup-us.ahrq.gov/nisoverview.jsp>. Retrieved August 21, 2016
9. Whiteman MK, Cox S, Tepper NK, Curtis KM, Jamieson DJ, Penman-Aguilar A, et al. Postpartum intrauterine device insertion and postpartum tubal sterilization in the United States. *Am J Obstet Gynecol.* 2012; 206:127.e1–e7. [PubMed: 21963310]
10. Patrick SW, Schumacher RE, Benneyworth BD, Krans EE, McAllister JM, Davis MM. Neonatal abstinence syndrome and associated health care expenditures: United States, 2000–2009. *JAMA.* 2012; 307:1934–40. [PubMed: 22546608]
11. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. *Med Care.* 1998; 36:8–27. [PubMed: 9431328]
12. Potter JE, Hopkins K, Aiken AR, Hubert C, Stevenson AJ, White K, Frossman GD. Unmet demand for highly effective postpartum contraception in Texas. *Contraception.* 2014; 90(5):488–495. [PubMed: 25129329]
13. Holland E, Michelis LD, Sonalkar S, Curry CL. Barriers to Immediate Post-placental Intrauterine Devices among Attending Level Educators. *Womens Health Issues.* 2015; 25:355–8. [PubMed: 26048758]
14. Kroelinger CD, Waddell LF, Goodman DA, Pliska E, Rudolph C, Ahmed E, et al. Working with State Health Departments on Emerging Issues in Maternal and Child Health: Immediate Postpartum Long-Acting Reversible Contraceptives. *J Womens Health (Larchmt).* 2015; 24:693–701. [PubMed: 26390378]
15. Moniz MH, Chang T, Davis MM, Forman J, Landgraf J, Dalton VK. Medicaid Administrator Experiences with the Implementation of Immediate Postpartum Long-Acting Reversible Contraception. *Womens Health Issues.* 2016; 26(3):313–20. [PubMed: 26925700]
16. Moniz M, Chang T, Heisler M, Dalton VK. Immediate postpartum long-acting reversible contraception: the time is now. *Contraception.* 2016 Nov 29. pii: S0010-7824(16)30511-X. Epub ahead of print. doi: 10.1016/j.contraception.2016.11.007
17. Hofler LG, Cordes S, Cwiak CA, Goedken P, Jamieson DJ, Kottke M. Implementing Immediate Postpartum Long-Acting Reversible Contraception Programs. *Obstet Gynecol.* 2017 Jan; 129(1): 3–9. [PubMed: 27926643]
18. Borrero S, Schwarz EB, Reeves MF, Bost JE, Creinin MD, Ibrahim SA. Race, insurance status, and tubal sterilization. *Obstet Gynecol.* 2007; 109:94–100. [PubMed: 17197593]
19. White K, Potter JE. Reconsidering racial/ethnic differences in sterilization in the United States. *Contraception.* 2014; 89:550–6. [PubMed: 24439673]
20. Garcia G, Richardson DM, Gonzales KL, Cuevas AG. Trends and Disparities in Postpartum Sterilization after Cesarean Section, 2000 through 2008. *Womens Health Issues.* 2015; 25:634–40. [PubMed: 26329256]
21. Potter JE, White K, Hopkins K, McKinnon S, Shedlin MG, Amastae J, et al. Frustrated demand for sterilization among low-income Latinas in El Paso, Texas. *Perspect Sex Reprod Health.* 2012; 44:228–35. [PubMed: 23231330]
22. Gilliam M, Davis SD, Berlin A, Zite NB. A qualitative study of barriers to postpartum sterilization and women's attitudes toward unfulfilled sterilization requests. *Contraception.* 2008; 77:44–9. [PubMed: 18082666]
23. Medicaid reimbursement for postpartum LARC by state. Available at: <http://www.acog.org/About-ACOG/ACOG-Departments/Long-Acting-Reversible-Contraception/Coding-and-Reimbursement-for-LARC/Reimbursement-Resources-for-Postpartum-LARC-Initiation/Medicaid-Reimbursement-for-Postpartum-LARC-by-State>. Retrieved December 26, 2016
24. Kavanaugh ML, Jerman J, Finer LB. Changes in Use of Long-Acting Reversible Contraceptive Methods Among U.S. Women, 2009–2012. *Obstet Gynecol.* 2015; 126(5):917–27. [PubMed: 26444110]
25. Hillis SD, Marchbanks PA, Tylor LR, Peterson HB. Poststerilization regret: findings from the United States Collaborative Review of Sterilization. *Obstet Gynecol.* 1999; 93:889–95. [PubMed: 10362150]

26. Healthcare Cost and Utilization Project (HCUP). Agency for Healthcare Research and Quality; Rockville, MD: Oct. 2011 Race/Ethnicity Data. Available at: www.hcupus.ahrq.gov/reports/r_e_disparities.jsp. Retrieved December 26, 2016
27. Department of Health and Human Services. Office of Population Affairs. Contraceptive Care Measures. Available at: <https://www.hhs.gov/opa/performance-measures/index.html#>. Retrieved December 26, 2016
28. Thurman AR, Janecek T. One-year follow-up of women with unfulfilled postpartum sterilization requests. *Obstet Gynecol.* 2010; 116(5):1071–1077. [PubMed: 20966691]
29. Harney C, Dude A, Haider S. Factors associated with short interpregnancy interval in women who plan postpartum LARC: a retrospective study. *Contraception.* 2016 Aug 30. pii: S0010-7824(16)30386-9 Epub ahead of print.

Figure 1.

Trends in inpatient postpartum intrauterine device (IUD) insertion, implant insertion, long-acting reversible contraction (LARC) insertion, and tubal sterilization, National Inpatient Sample, 2008–2009 to 2012–2013. Error bars represent 95% confidence intervals. Wald Chi-square test assessed for a linear trend in rate of each outcome across the study period.

* $P=.24$; † $P<.001$; ‡ $P=.02$.

Table 1

Association of patient and hospital characteristics with inpatient postpartum LARC insertion and tubal sterilization rates per 10,000 deliveries

Variable	LARC insertion				Tubal sterilization			
	Rate [*]	±SE	aOR [†]	95% CI	Rate	±SE [*]	aOR [†]	95% CI
Age, years								
<24	11.45	1.86	1.29	0.98–1.68	251.04	4.88	0.12	0.12–0.13
24–29	6.87	1.01	0.95	0.79–1.16	663.44	12.77	0.40	0.39–0.41
30–34	5.64	0.76	0.91	0.79–1.06	885.15	19.30	0.61	0.60–0.62
35	6.13	0.91	1.00	Reference	1427.57	29.97	1.00	Reference
Delivery Mode								
Vaginal	7.62	1.24	1.00	Reference	263.34	9.56	1.00	Reference
Cesarean	8.59	1.14	1.36	1.11–1.68	1568.74	20.81	6.25	5.88–6.63
Any comorbidity [‡]								
No	5.86	0.89	1.00	Reference	621.93	10.35	1.00	Reference
Yes	15.04	2.11	1.92	1.72–2.13	948.65	17.54	1.17	1.14–1.20
Primary payer								
Private	2.39	0.32	1.00	Reference	596.17	9.83	1.00	Reference
Non-private [§]	13.50	2.14	5.23	3.82–7.16	795.54	16.55	2.20	2.10–2.30
Hospital location								
Rural	0.67	0.13	1.00	Reference	914.96	16.67	1.00	Reference
Urban non-teaching	0.80	0.28	1.06	0.49–2.27	674.38	11.78	0.59	0.55–0.63
Urban teaching	14.92	2.25	20.85	12.73–34.15	660.97	22.13	0.56	0.51–0.62
Geographic region								
Northeast	12.12	3.59	0.61	0.30–1.21	558.20	14.84	0.83	0.76–0.91
Midwest	2.56	0.43	0.17	0.10–0.29	603.78	22.15	1.04	0.93–1.16
South	6.07	1.91	0.38	0.18–0.78	855.33	24.12	1.39	1.27–1.52
West	12.78	2.79	1.00	Reference	620.25	16.49	1.00	Reference
Year								
2008–2009	1.86	0.52	1.00	Reference	710.97	19.52	1.00	Reference
2010–2011	8.88	2.94	3.93	1.72–9.00	692.87	19.79	0.93	0.88–0.99
2012–2013	13.50	1.82	6.49	3.53–11.94	682.97	6.97	0.88	0.83–0.95

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LARC, long-acting reversible contraception; SE, standard error; aOR, adjusted odds ratio; CI, confidence interval

* Per 10,000 deliveries

[†] Comparing odds of LARC insertion (or tubal sterilization) to odds of neither LARC nor tubal sterilization; adjusted for all other variables in the table

[‡] Includes anemia, cancer, chronic lung disease, coagulation disorders, diabetes mellitus, heart disease, Human Immunodeficiency Virus or Acquired Immune Deficiency Syndrome, hypertension, hypothyroidism, liver disorders, obesity, neurologic disorders, renal failure, and rheumatoid arthritis or collagen vascular diseases

[§] Includes Medicaid, Medicare, self-pay and no charge

Note: The Wald Chi-square test was used for overall effect of independent variables on the model. The t-test was used to determine significance of each parameter estimate in the regression model.

Comparison of characteristics among women undergoing inpatient postpartum LARC insertion versus tubal sterilization

Table 2

Variable	LARC insertion (weighted n=18,206) Weighted n (%)	Tubal sterilization (weighted n=1,595,134) Weighted n (%)	LARC insertion versus tubal sterilization Crude Odds Ratio (95% CI)	Adjusted Odds Ratio* (95% CI)
Age, years				
<24	8,513 (46.76)	186,633 (11.70)	10.35 (8.23–13.02)	12.62 (9.59–16.61)
24–29	4,456 (24.48)	430,148 (26.97)	2.34 (1.97–2.77)	2.38 (1.94–2.91)
30–34	3,174 (17.43)	498,020 (31.23)	1.47 (1.28–1.69)	1.44 (1.23–1.68)
35	2,063 (11.33)	480,019 (30.10)	1.00 (Reference)	1.00 (Reference)
Delivery mode				
Vaginal	11,679 (64.15)	403,566 (25.30)	1.00 (Reference)	1.00 (Reference)
Cesarean	6,527 (35.85)	1,191,569 (74.70)	0.20 (0.16–0.24)	0.23 (0.19–0.29)
Any comorbidity [‡]				
No	10,397 (57.11)	1,102,582 (69.12)	1.00 (Reference)	1.00 (Reference)
Yes	7,809 (42.89)	492,552 (30.88)	1.70 (1.53–1.89)	1.49 (1.31–1.70)
Primary payer				
Private	2,736 (15.05)	682,058 (42.83)	1.00 (Reference)	1.00 (Reference)
Non-Private [‡]	15,450 (84.95)	910,281 (57.17)	4.13 (3.01–5.66)	1.90 (1.38–2.63)
Hospital Type				
Rural	172 (1.01)	233,425 (14.78)	1.00 (Reference)	1.00 (Reference)
Urban non-teaching	744 (4.34)	627,472 (39.74)	1.60 (0.74–3.47)	2.18 (1.01–4.70)
Urban teaching	16,206 (94.65)	717,951 (45.47)	30.48 (18.94–49.06)	38.39 (23.52–62.64)
Geographic region				
Northeast	4,426 (24.31)	203,846 (12.78)	1.23 (0.62–2.45)	0.82 (0.42–1.57)
Midwest	1,257 (6.91)	296,203 (18.57)	0.25 (0.15–0.41)	0.15 (0.09–0.26)
South	5,273 (28.96)	743,097 (46.59)	0.40 (0.20–0.84)	0.25 (0.12–0.52)
West	7,250 (39.82)	351,988 (22.07)	1.00 (Reference)	1.00 (Reference)
Year				
2008–2009	1,492 (8.20)	569,167 (35.68)	1.00 (Reference)	1.00 (Reference)
2010–2011	6,569 (36.08)	512,647 (32.14)	4.10 (1.76–9.55)	4.51 (1.98–10.24)
2012–2013	10,145 (55.72)	513,320 (32.18)	7.44 (4.01–13.80)	8.26 (4.42–15.44)

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LARC, long-acting reversible contraception; CI, confidence interval

[†]Includes anemia, cancer, chronic lung disease, coagulation disorders, diabetes mellitus, heart disease, Human Immunodeficiency Virus or Acquired Immune Deficiency Syndrome, hypertension, hypothyroidism, liver disorders, obesity, neurologic disorders, renal failure, and rheumatoid arthritis or collagen vascular diseases

[‡]Includes Medicaid, Medicare, self-pay and no charge

Note: The Wald Chi-square test was used for overall effect of independent variables on the model. The t-test was used to determine significance of each parameter estimate in the regression model. Weighted estimates were calculated after applying standard National Inpatient Sample survey weights to account for the stratified sampling design.