Uptake of postplacental intrauterine device placement at cesarean delivery

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BACKGROUND: Several studies have investigated the effectiveness of intrauterine device placement at cesarean delivery as a contraceptive method. However, national-level use and outcomes of a postplacental intrauterine device at cesarean delivery are currently understudied in the United States.

OBJECTIVE: This study aimed to examine the trends, characteristics, and outcomes of patients who received a postplacental intrauterine device at cesarean delivery.

STUDY DESIGN: This retrospective cohort study used the National Inpatient Sample. The study cohort included patients who underwent cesarean delivery from October 2015 to December 2018. The exclusion criteria included hemorrhage, chorioamnionitis, uterine anomaly, hysterectomy, and permanent surgical sterilization. Eligible cases were grouped on the basis of the use of a postplacental intrauterine device at cesarean delivery. The primary outcome measures were temporal trends and characteristics associated with the use of a postplacental intrauterine device at cesarean delivery, assessed using the generalized estimating equation model in multivariable analysis. The secondary outcome measure was perioperative morbidity (leukocytosis, endometritis, myometritis, and sepsis). Propensity score matching was used to balance the baseline characteristics.

RESULTS: Among 2,983,978 patients who met the inclusion criteria, 10,145 patients (0.3%) received a postplacental intrauterine device at cesarean delivery. The use of a postplacental intrauterine device increased from 0.1% in the fourth quarter of 2015 to 0.6% in the fourth quarter of 2018 ($P<.001$). In a multivariable analysis, the use of a postplacental intrauterine device increased by 14% every quarter-year (adjusted odds ratio, 1.14; 95% confidence interval, 1.13–1.15). In addition, (1) patient characteristics of young age, non-White race, obesity, tobacco use, lowest quartile median household income, and insured with Medicaid; (2) hospital characteristics of large bed capacity and urban teaching setting in Northeast region; and (3) pregnancy characteristics of early gestational age at cesarean delivery, hypertensive disease, previous cesarean delivery, multifetal pregnancy, grand multiparity, placenta previa, and nonelective cesarean delivery represented the independent characteristics associated with the use of a postplacental intrauterine device (all $P<.05$). A regression tree model identified 35 discrete patterns of the use of a postplacental intrauterine device based on 8 factors (time, race or ethnicity, primary

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This study received institutional review board exemption from the University of Southern California (approval number HS-16-00481).

The data on which this study is based on are publicly available on request at https://www.hcup-us.ahrq.gov.

The manuscript's corresponding author (Ko.M.) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported, that no important aspects of the study have been omitted, and that any discrepancies from the study as planned (and, if relevant, registered) have been explained. The National Inpatient Sample is developed for the Healthcare Cost and Utilization Project that is sponsored by the Agency for Healthcare Research and Quality, and the program is the source of the deidentified data used; race or ethnicity was grouped by the program; and the program has not verified and is not responsible for the statistical validity of the data analysis or the conclusions derived by the study team.

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expected payer, obesity, hospital bed capacity, hospital teaching status, hospital region, and previous cesarean delivery). There were 9 patterns, representing 8.8% of the study population, exhibiting a use rate of ≥1.0%, whereas there were 7 patterns, representing 16.0% of the study population, exhibiting no use of a postplacental intrauterine device (absolute rate difference from the highest group to the lowest group, 4.7%). In a propensity score–matched model, postplacental intrauterine device placement at cesarean delivery was not associated with increased risk of measured morbidity (any, 1.8% vs 1.7%; odds ratio, 1.06; 95% confidence interval, 0.66–1.69; *P*=.812), including postpartum endometritis (1.2% vs 1.0%; odds ratio, 1.19; 95% confidence interval, 0.67–2.14; *P*=.554).

CONCLUSION: The use of a postplacental intrauterine device at cesarean delivery increased significantly in recent years in the United States.

Key words: cesarean delivery, characteristics, morbidity, postplacental intrauterine device, trends

Introduction

Immediate postpartum long-acting reversible contraception (LARC) has been underutilized in the United States despite evidence of its safety and efficacy.[1] A postplacental intrauterine device (PP-IUD), placed within 10 minutes of placenta delivery, is 1 type of immediate postpartum LARC. It has been shown to be cost-effective[2,3] and superior to an interval intrauterine device (IUD) placed at 6 weeks after delivery, especially in terms of reducing short-interval and unintended pregnancies.[4,5]

Short-interval pregnancies, defined as those with fewer than 18 months between delivery and subsequent conception, are often unintended[6] and are associated with significant adverse pregnancy outcomes.[7–10] One such outcome is the increased risk of uterine rupture in patients with short intervals between cesarean delivery (CD) and subsequent trial of labor, supporting the need for effective, immediate contraceptive options for patients undergoing CD.[11] PP-IUD placement at the time of CD leads to higher rates of use at 6 months after delivery than interval IUD placement.[12] Further uptake of PP-IUD placement could lead to a greater reduction in these adverse outcomes; however, immediate postpartum LARC provision has been hindered in many cases by inadequate insurance reimbursement as part of a hospital's global payment for delivery.[13]

In 2016, the American College of Obstetricians and Gynecologists (ACOG) recommended the implementation of programs to increase the use of immediate postpartum LARC.[14] In conjunction, 44 state Medicaid programs have begun reimbursing immediate postpartum LARC since 2011.[15] Single-institution and state-level studies have demonstrated an uptrend in the use of postpartum LARC after Medicaid policy changes in their states,[5,16–19] but recent national-level data are lacking. Furthermore, national-level trends and outcomes of the use of a PP-IUD in the United States are currently understudied. This study aimed to examine trends, characteristics, and outcomes of patients who received a PP-IUD at CD in the United States.

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Why was this study conducted?

The national-level use, characteristics, and outcomes of a postplacental intrauterine device (PP-IUD) at cesarean delivery (CD) are currently unknown in the United States.

Key findings

In an analysis of the National Inpatient Sample that included 3 million CDs from the fourth quarter of 2015 to the fourth quarter of 2018, the use of a PP-IUD increased by 14% every quarter-year (odds ratio, 1.14; 95% confidence interval, 1.13–1.15). This increase was parallel to the increase in the number of states approving the use of immediate postpartum long-acting reversible contraception (the first state in 2011, 10 states in 2015, 30 states in 2017, 40 states in 2019, and 44 states in June 2020). Patient characteristics, including young and underserved populations, hospital characteristics with large urban teaching settings, and pregnancy characteristics with previous CD, early delivery, and comorbidity, were associated with the use of a PP-IUD at CD. Morbidity related to the use of a PP-IUD varied depending on patient characteristics.

What does this add to what is known?

The use of a PP-IUD at CD is gradually increasing in recent years in the United States.

Materials and Methods

Data source

This study queried the National Inpatient Sample (NIS) that was developed for the Healthcare Cost and Utilization Project (HCUP), which was supported by the Agency for Healthcare Research and Quality.[20] The detail of the data source has been described in previous studies.[21,22] In brief, the NIS program is a population-based all-payer database for inpatient records selecting randomly 20% from all hospitals, and the weighted data for national estimates represent more than 90% of the US population.

Ethical statement

The University of Southern California Institutional Review Board exempted this study because of the use of publicly available deidentified data.

Study design

This was a retrospective cohort study examining the NIS program. The study

population was patients who underwent CD from October 2015 to December 2018. This study point was chosen because of the introduction of the World Health Organization's International Classification of Disease, Tenth Revision (ICD-10), codes in the NIS program in the last quarter of 2015, and the ICD-10 codes were consistent throughout the study period. Case identification for CD was per the HCUP definition (Statistical Brief #254).[23,24]

The exclusion criteria were similar to those used in previous studies and based on contraindications to the use of a PP-IUD, namely, hemorrhage, intrauterine infection or sepsis, and uterine anomalies.[14,25,26] Patients who underwent hysterectomy or permanent surgical sterilization (tubal ligation or salpingectomy) were also excluded, as there is typically no indication for additional contraceptive use with these procedures. The ICD-10 codes for these diagnoses and procedures followed previous studies.[23,24] Uterine anomaly was based on the ICD-10 code of Q51.

Exposure allocation

The study cohort was grouped according to the use of a PP-IUD at CD (yes vs no). Specifically, patients with the ICD-10 code for IUD placement (Z30.430) were allocated to the PP-IUD group, whereas those without the code were allocated to the non-IUD group.

Outcome measures

The primary outcome measures were temporal trends and characteristics associated with the use of a PP-IUD at CD. The secondary and exploratory outcome measure was the study-defined perioperative morbidities (leukocytosis, endometritis, myometritis, and sepsis) that were selected before the analysis. The rationale of this core selection was based on the assumption that the insertion of a foreign object may be associated with an increased risk of infectious morbidity. The ICD-10 codes were based on D72.82 for leukocytosis, O86.12 for endometritis, and N71 for myometritis. Sepsis was based on the Centers for Disease Control and Prevention (CDC) definition.[27]

IUD expulsion after placement was another outcome measure examined in previous studies,[28,29] but the ICD-10 code specific to this diagnosis was neither available nor accessible during the study period.

Clinical information

The study covariates examined in this study included (1) patient baseline demographics, (2) hospital information, and (3) pregnancy characteristics. The ICD-10 codes and grouping allocation for the clinical information followed the same trend in the previous analyses.[22,23]

Patient baseline demographics included age, year, admission type, race or ethnicity, primary expected payer, median household income, and obesity. Obesity was classified using the CDC classification system.[30] Hospital information included bed capacity, hospital location and teaching status, and hospital region. Pregnancy characteristics included gestational age at CD, diabetes mellitus, hypertensive disease, personal history of CD, multifetal pregnancy, grand multiparity, placenta previa, breech presentation, uterine myoma, and preterm premature rupture of membranes (PPROM).

Statistical analysis

The first step of the analytical plan was to examine the temporal trend of the use of a PP-IUD at CD. A linear segmented regression model with log transformation was fitted for the trend analysis using quarter-year time increments.[31]

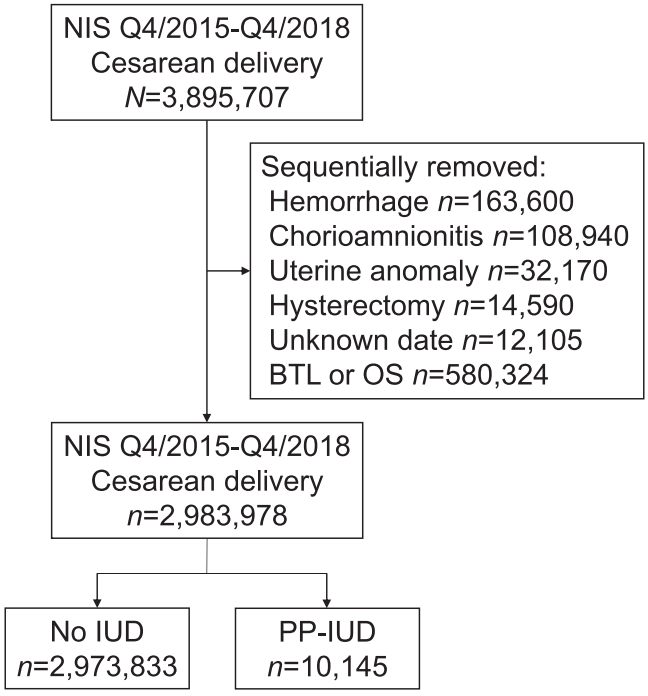
The second step of the analysis was to identify the independent characteristics associated with the use of a PP-IUD at CD. A generalized estimating equation model was used for multivariable analysis.[32] The initial selection criteria were $P<.05$ in the univariable analysis, and a conditional backward method was used with the stopping rule of $P<.05$ in the final model.[33] Multicollinearity was assessed with variance inflation factor among all the modeling covariates. The effect size was expressed with an adjusted odds ratio (aOR), corresponding to a 95% confidence interval (CI).

The last step of the analysis was to assess the exposure-outcome relationship, and the influence of the use of a PP-IUD on infectious morbidity (leukocytosis, endometritis, myometritis, and sepsis) was examined. A propensity score matching method was used to balance the differences in baseline characteristics between the 2 exposure groups.[34] A binary logistic regression model was used to compute the propensity score, and background characteristics were entered into the modeling. An automated algorithm was used for 1:1 propensity score matching between the 2 groups, and the optimal caliper width for estimating differences was equal to 0.2 of the standard deviation for the logit of the propensity score (difference cutoff, 0.0013).[35] Standardized difference was assessed in the matched model (the cutoff for the presence of clinical imbalance was >0.20),[36] and a generalized estimating equation model was used to estimate the effect size, expressed with an odd ratio (OR) and a corresponding 95% CI.

Several sensitivity analyses were undertaken to assess the robustness of the analytical findings. First, the trends of the use of a PP-IUD were assessed in subcohorts based on patient demographics, hospital characteristics, and pregnancy factors. Second, a recursive partitioning analysis was performed to construct a regression tree model for the use patterns of a PP-IUD at CD.[37] All independent characteristics of the use of a PP-IUD were entered in the modeling, and a chi-square automatic interaction detector method was used with the stopping rule of 3 layers. Last, the exposure-outcome association was tested in various subcohorts of interest. Propensity score matching was performed in each subcohort as above.

The weighted values for national estimates provided by the NIS program were used per their recommendation, and statistical interpretation was based on a 2-tailed hypothesis. A P value of $<.05$ was considered statistically significant. The National Cancer Institute's Joinpoint Regression Program (version 4.8.0.1), IBM SPSS Statistics (version 27.0; IBM Corporation, Armonk, NY),

FIGURE 1
Study selection schema



BTL, bilateral tubal ligation; *IUD*, intrauterine device; *NIS*, National Inpatient Sample; *OS*, opportunistic salpingectomy; *PP-IUD*, postplacental intrauterine device; *Q4*, fourth quarter.

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and R statistics (version 3.5.3; R Foundation for Statistical Computing, Vienna, Austria) were used for all analyses. The Strengthening the Reporting of Observational Studies in Epidemiology guidelines were followed to summarize the performance of the observational study.[38]

Results

Study cohort

The study selection schema is shown in Figure 1. Among 2,983,978 patients who met the inclusion criteria, 10,145 patients (0.3%) received a PP-IUD at CD. Across the study population, most patients underwent CD in an elective setting at large, urban-teaching centers (all, >50%) (Table 1).

Temporal trends of postplacental intrauterine device use at cesarean delivery

The use of a PP-IUD increased from 0.1% in the fourth quarter of 2015 to 0.6% in the fourth quarter of 2018 ($P<.001$) (Figure 2). Increasing use of a PP-IUD was observed in all the measured patient, hospital, and pregnancy characteristics (all, $P<.05$) (Supplemental Table S1), except for Native American individuals. The relative interval increase in the use of a PP-IUD seems to be the highest in patients who are older, have multifetal pregnancy, have Medicaid insurance, live in the Midwest region, and undergo CD at an earlier gestational age.

Characteristics associated with postplacental intrauterine device use

In univariable analysis (Table 1), all baseline characteristics, except for uterine myoma and breech presentation, were statistically significantly different between the 2 groups (all, $P<.05$). Specifically, patients in the PP-IUD group were more likely to have Medicaid insurance (71.5% vs 40.4%), median household income in the lowest quartile (45.1% vs 27.5%), obesity (30.2% vs 14.9%), previous CD (67.9% vs 43.8%), and CD at large (72.1% vs 50.7%) and urban-teaching (90.7% vs 68.5%) centers in the Northeast US region (30.9% vs 16.5%) but less likely to be White individuals (25.8% vs 49.7%) than those in the non-IUD group (all, $P<.05$).

In multivariable analysis (Table 2), the use of a PP-IUD increased by 14% every quarter-year (aOR, 1.14; 95% CI, 1.13−1.15). In addition, (1) patient characteristics of younger age, non-White race, obesity, tobacco use, lowest quartile median household income, and Medicaid insurance; (2) hospital characteristics of large bed capacity and urban-teaching setting in Northeast region; and (3) pregnancy characteristics of early gestational age at CD, hypertensive disease, previous CD, multifetal pregnancy, grand multiparity, placenta previa, and nonelective CD represented the independent characteristics associated with the use of a PP-IUD (all, $P<.05$). In contrast, patients who had a diagnosis of PPROM or underwent CD in the South region were less likely to receive a PP-IUD at CD (Table 2).

The use patterns of PP-IUD placement at CD were examined (Supplemental Table S2). A total of 35 discrete patterns were identified on the basis of the following 8 characteristics: time, race or ethnicity, obesity, primary expected payer, hospital bed capacity, teaching status, region, and previous CD (all, $P<.001$). The absolute rate difference of the use of a PP-IUD among the identified patterns was 4.7% [4.7% (the highest] vs 0% [the lowest]). There were 9 patterns, representing 8.8% of the study population, exhibiting a use rate of ≥1.0%. In contrast, there were 7 patterns, representing 16.0% of the study population, exhibiting no use of a PP-IUD at CD.

Perioperative morbidity

In a propensity score−matched model (Supplemental Figure S1), all the baseline characteristics were well balanced between the PP-IUD and non-IUD groups (all, standardized difference of

TABLE 1
Patient demographics (N=2,983,978)

Characteristic	No IUD	PP-IUD	*P* value
No. of patients	n=2,973,833	n=10,145	
Age	30 (25−34)	29 (25−33)	<.001
Study period			<.001
First to third	933,244 (31.4)	1475 (14.5)	
Middle to third	923,859 (31.1)	2755 (27.2)	
Last to third	1,116,730 (37.6)	5915 (58.3)	
Admission type			<.001
Nonelective	1,286,034 (43.2)	5215 (51.4)	
Elective	1,680,309 (56.5)	4915 (48.4)	
Unknown	7490 (0.3)	15 (0.1)	
Race or ethnicity			<.001
White	1,477,614 (49.7)	2620 (25.8)	
Black	477,025 (16.0)	2665 (26.3)	
Hispanic	556,450 (18.7)	3190 (31.4)	
Asian	178,845 (6.0)	445 (4.4)	
Native American	19,085 (0.6)	50 (0.5)	
Others	136,595 (4.6)	820 (8.1)	
Unknown	128,220 (4.3)	355 (3.5)	
Primary expected payer			<.001
Medicaid	1,201,734 (40.4)	7255 (71.5)	
Private, including Health Maintenance Organization	1,590,214 (53.5)	2285 (22.5)	
Medicare	25,180 (0.8)	245 (2.4)	
Self-pay	74,725 (2.5)	155 (1.5)	
No charge	1470 (0.0)	15 (0.1)	
Others	77,100 (2.6)	185 (1.8)	
Unknown	3410 (0.1)	—[a]	
Median household income			<.001
QT1 (the lowest)	819,004 (27.5)	4575 (45.1)	
QT2	730,980 (24.6)	2095 (20.7)	
QT3	721,130 (24.2)	2180 (21.5)	
QT4 (the highest)	672,750 (22.6)	1240 (12.2)	
Unknown	29,970 (1.0)	55 (0.5)	
Obesity			<.001
None	2,531,763 (85.1)	7080 (69.8)	
Class I-II	201,665 (6.8)	1470 (14.5)	
Class III	240,405 (8.1)	1595 (15.7)	
Diabetes mellitus			<.001
No	2,605,783 (87.6)	8485 (83.6)	
Yes	368,050 (12.4)	1660 (16.4)	
Hypertension			<.001
No	2,425,018 (81.5)	7630 (75.2)	
Yes	548,815 (18.5)	2515 (24.8)	
Tobacco use			<.001

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(continued)

≤0.065). In the prematching model, primary expected payer, hospital setting and teaching status, race or ethnicity, previous CD, hospital bed capacity, study period, median household income, hospital region, and obesity exhibited clinical imbalance between the 2 exposure groups (standardized difference of >0.20).

In the matched model, the perioperative morbidity of 10,145 women who received a PP-IUD was compared with 10,145 women who did not receive a PP-IUD (Table 3). PP-IUD placement at CD was not associated with an increased risk of measured morbidity (any, 1.8% vs 1.7%; OR, 1.06; 95% CI, 0.66−1.69; *P*=.812), including postpartum endometritis (1.2% vs 1.0%; OR, 1.19; 95% CI, 0.67−2.14; *P*=.554). In both groups, the median length of hospital stay for CD was 3 days (interquartile range, 3−4).

Sensitivity analysis

The exposure-outcome association was assessed in a total of 50 subcohorts based on patient, hospital, and pregnancy characteristics (Supplemental Table S3). Overall, a similar exposure-outcome association to the whole cohort was observed in most subcohorts, except for the Medicaid, lower median household income, and early gestational age groups.

In these 3 subcohorts, patients who received a PP-IUD were more likely to have measured morbidity than those without a PP-IUD: Medicaid (any measured morbidity, 2.2% vs 1.2%; OR, 1.90; 95% CI, 1.05−3.44), median household income of <50% (2.4% vs 1.0%; OR, 2.45; 95% CI, 1.72−3.50), and gestational age of <37 weeks (3.2% vs 1.5%; OR, 2.16; 95% CI, 1.18−3.96). A similar association was observed in patients who underwent nonelective CD, although statistically nonsignificant (2.6% vs 1.4%; OR, 1.82; 95% CI, 0.96−3.44) (Supplemental Table S3).

Comments

Principal findings

The key results of this study were 3-fold. First, there was a national-level increase

TABLE 1
Patient demographics (N=2,983,978) *(continued)*

Characteristic	No IUD	PP-IUD	*P* value
No	2,821,298 (94.9)	9330 (92.0)	
Yes	152,535 (5.1)	815 (8.0)	
Hospital bed capacity			<.001
Small	530,999 (17.9)	655 (6.5)	
Medium	935,889 (31.5)	2175 (21.4)	
Large	1,506,945 (50.7)	7315 (72.1)	
Hospital setting teaching			<.001
Rural	258,929 (8.7)	180 (1.8)	
Urban nonteaching	678,940 (22.8)	765 (7.5)	
Urban teaching	2,035,964 (68.5)	9200 (90.7)	
Hospital region			<.001
Northeast	491,695 (16.5)	3135 (30.9)	
Midwest	586,870 (19.7)	1910 (18.8)	
South	1,253,450 (42.1)	2730 (26.9)	
West	641,819 (21.6)	2370 (23.4)	
Gestational age at CD	39 (38–39)	38 (37–39)	<.001
Previous CD			<.001
No	1,672,774 (56.2)	3255 (32.1)	
Yes	1,301,059 (43.8)	6890 (67.9)	
Grand multiparity			<.001
No	2,966,798 (99.8)	10,085 (99.4)	
Yes	7035 (0.2)	60 (0.6)	
Multiple pregnancy			.017
No	2,855,738 (96.0)	9695 (95.6)	
Yes	118,095 (4.0)	450 (4.4)	
Breech presentation			.051
No	2,640,453 (88.8)	9070 (89.4)	
Yes	333,380 (11.2)	1075 (10.6)	
Placenta previa			<.001
No	2,948,918 (99.2)	10,025 (98.8)	
Yes	24,915 (0.8)	120 (1.2)	
PPROM			.034
No	2,893,328 (97.3)	9905 (97.6)	
Yes	80,505 (2.7)	240 (2.4)	
Uterine myoma			.585
No	2,898,003 (97.5)	9895 (97.5)	
Yes	75,830 (2.5)	250 (2.5)	

Data are presented as number (percentage) or median (interquartile range), unless otherwise indicated. A *P* value of <.001 was used for all variables in the univariable analysis. The total number may not be 2,983,978 because of the weighted value.

CD, cesarean delivery; *IUD*, intrauterine device; *PP-IUD*, postplacental intrauterine device; *QT*, quartile; *PPROM*, preterm premature rupture of membranes.

[a] Suppressed (number 1–10) per the Healthcare Cost and Utilization Project instruction.

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in the use of a PP-IUD at CD, particularly among historically underserved patients at academic centers. Second, there was large variability in the use of a PP-IUD at CD based on patient, hospital, and pregnancy factors. Third, measured morbidity related to the use of a PP-IUD seemed to be heterogenous, and the use of a PP-IUD was associated with an increased risk of infectious morbidity in certain patient groups.

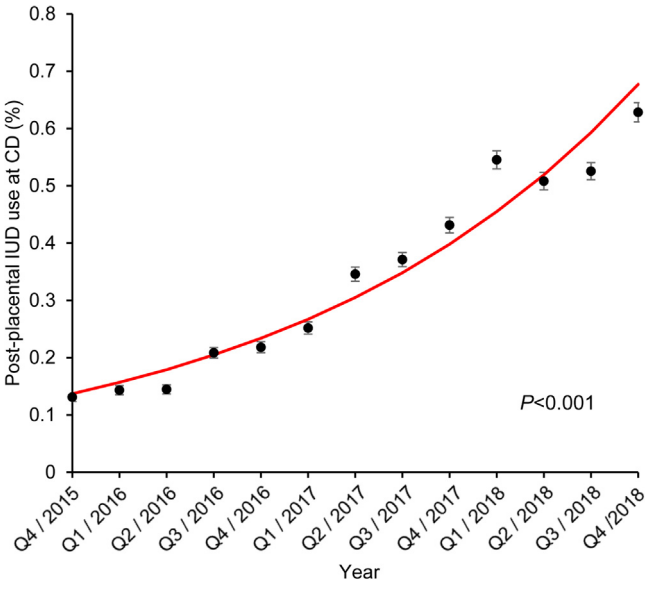
Results

The national-level increase in the use of a PP-IUD at CD observed in this study has added new information to the existing literature. The etiology of the increase is most likely multifactorial and, in part, a reflection of the overall increase in the use of a LARC nationally.[39] However, the increasing number of states approving Medicaid reimbursement of the use of immediate postpartum LARC over time seems to be the most compelling reason for the observed increase (Figure 3).

In the United States, the first state to approve immediate postpartum LARC reimbursement did so in January 2011. Furthermore, the cumulative number of states exceeded 10 in 2015, and in June 2020, 44 states had approved reimbursement for immediate postpartum LARC.[15] Data from institution- and state-level studies in Georgia, Texas, and Washington support the hypothesis that increased availability of a PP-IUD leads to increased use. Although our study could not ascertain causality between changes in Medicaid reimbursement policies and increased rates of the use of a PP-IUD at CD, the association suggests an increasing interest among postpartum patients and is a call to action for continued advocacy to expand access.

First, in our study, patients with pregnancy complications were more likely to have received PP-IUD placement, which supports existing data from a South Carolina study.[5] This may be due to heightened patient and provider concerns about complications of subsequent pregnancy, especially one that is short interval, and the relative safety and efficacy of the IUD compared with other contraceptive methods.[40] Conversely, there were decreased rates of PP-IUD placement for patients with PPROM in our study, possibly because of increased provider concern about infection.

FIGURE 2
Temporal trend of PP-IUD placement at CD



The use of a PP-IUD at CD was assessed with linear segmented regression with log transformation using 3-month time increments. In every 3-month period, the use of a PP-IUD at CD increased by 14.2% (95% confidence interval, 11.6–16.8; *P*<.001). The *dots* represent observed value, and the *bars* represent standard error. The *bold lines* indicate modeled value.

CD, cesarean delivery; *IUD*, intrauterine device; *PP-IUD*, postplacental intrauterine device; *Q1*, first quarter; *Q2*, second quarter; *Q3*, third quarter; *Q4*, fourth quarter.

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Second, patients with Medicaid were more likely to receive a PP-IUD, which is likely explained by policy changes as highlighted above. An additional contributing factor for patients with Medicaid may be the requirement for signing sterilization consent forms 30 days before the estimated due date. Although in place to protect populations that have historically been harmed by coercion and lack of informed consent, this requirement can pose as a barrier for some patients who desire sterilization, leading to the selection of LARC as the next most efficacious option.[1]

Third, the use of a PP-IUD was increased at large, urban-teaching hospitals. Uptake of PP-IUD placement was also high in these hospitals. This may reflect a tendency of academic centers to more rapidly adopt new research and recommendations, such as those from ACOG in 2016.[14] It is speculated that this increased use of a PP-IUD at large, urban-teaching hospitals may indirectly explain the increased likeliness of receiving a PP-IUD in underserved population because these patients are more likely to receive care at large, urban-teaching centers.

Last, increased rates among non-White patients corresponded with other data about recent trends in immediate postpartum LARC,[1] although the overall use of LARC has been shown to be similar across different races and ethnicities.[41] The combination of increased use at large teaching hospitals and in non-White patients has drawn considerable attention from reproductive justice advocates to express concern about LARC-related coercion and the long history of coercive sterilization and experimentation of non-White, low-income, and other marginalized people in the United States.[42] Although PP-IUD placement is an excellent option for many patients, especially those at disproportionate risk of short-interval pregnancy, pregnancy complications, and maternal mortality,[43] care must be taken to obtain patient-centered informed consent and avoid provider bias.[44,45]

In terms of infectious morbidity associated with the use of PP-IUD at CD, existing literature demonstrates no significant increase in postpartum infection.[46,47] Comparable infectious morbidity between the PP-IUD and non-IUD groups observed in our study supported the results from previous studies that, for most patients, PP-IUDs do not increase the rates of infection. However, as noted earlier, patients with PPROM were less likely to receive a PP-IUD, and patients with Medicaid, low income, and preterm delivery remained at increased risk of infection. This study was not able to assess the causality of this observation, and further research will need to be conducted to enumerate reasons for these differences, including the difference between elective and non-elective CDs.

Limitations

This study had several limitations. First, there was unmeasured bias inherent to a retrospective study. For instance, shared decision-making process for the use of a PP-IUD, patient's understanding and view of a PP-IUD, provider's knowledge and counseling strategy for the use of a PP-IUD, and indication and setting for CD (eg, emergency surgery) were important factors for exposure allocation but not available in the NIS program. Moreover, the severity and degree of outcome measures were not available in the database.

Second, the accuracy of the exposure assignment for IUD insertion and outcome measures for morbidity was not assessable as this study solely relied on ICD-10 codes without actual medical record review. Moreover, the study-defined morbidity indicators may be not due to the IUD insertion but from other causes. Third, long-term morbidity after discharge was unknown, as the NIS data only captured information for the index

TABLE 2
Independent characteristics associated with the use of PP-IUD at cesarean delivery

Characteristics	aOR (95% CI)	*P* value
Age (y)	0.99 (0.98–0.99)	.011
Year-quarter	1.14 (1.13–1.15)	<.001
Admission type		.024[a]
Nonelective	1.14 (1.04–1.24)	.006
Elective	1	—
Unknown	0.98 (0.31–3.06)	.967
Race or ethnicity		<.001[a]
White	1	—
Black	1.60 (1.40–1.83)	<.001
Hispanic	1.91 (1.68–2.18)	<.001
Asian	1.25 (0.99–1.57)	.060
Native American	0.92 (0.48–1.79)	.806
Others	2.33 (1.95–2.79)	<.001
Unknown	1.65 (1.28–2.12)	<.001
Primary expected payer		<.001[a]
Medicaid	2.79 (2.46–3.16)	<.001
Private, including Health Maintenance Organization	1	—
Medicare	4.44 (3.25–6.07)	<.001
Self-pay	1.34 (0.92–1.95)	.125
No charge	4.40 (1.40–13.81)	.011
Others	1.68 (1.19–2.37)	.003
Unknown	1.18 (0.17–8.39)	.870
Median household income		<.001[a]
QT1 (the lowest)	1.73 (1.48–2.03)	<.001
QT2	1.13 (0.96–1.33)	.156
QT3	1.33 (1.13–1.56)	.001
QT4 (the highest)	1	—
Unknown	0.91 (0.50–1.67)	.769
Obesity		<.001[a]
None	1	—
Class I–II	1.81 (1.59–2.07)	<.001
Class III	1.76 (1.54–2.00)	<.001
Hypertension		
No	1	—
Yes	1.26 (1.12–1.41)	<.001
Tobacco use		
No	1	—
Yes	1.30 (1.09–1.54)	.003
Hospital bed capacity		<.001[a]
Small	1	—

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(continued)

TABLE 2
Independent characteristics associated with the use of PP-IUD at cesarean delivery *(continued)*

Characteristics	aOR (95% CI)	*P* value
Medium	1.99 (1.64–2.43)	<.001
Large	4.27 (3.55–5.12)	<.001
Hospital setting teaching		<.001[a]
Rural	1	—
Urban nonteaching	1.81 (1.25–2.63)	.002
Urban teaching	6.15 (4.37–8.65)	<.001
Hospital region		<.001[a]
Northeast	1.87 (1.64–2.13)	<.001
Midwest	1.07 (0.92–1.24)	.402
South	0.64 (0.56–0.73)	<.001
West	1	—
Gestational age (wk)	0.98 (0.97–0.99)	.039
Previous CD		
No	1	—
Yes	2.65 (2.40–2.93)	<.001
Grand multiparity		
No	1	—
Yes	2.65 (2.40–2.93)	<.001
Multiple pregnancy		
No	1	—
Yes	1.81 (1.01–3.26)	.046
Placenta previa		
No	1	—
Yes	1.67 (1.10–2.52)	.015
PPROM		
No	1	—
Yes	0.72 (0.53–0.98)	.034

A generalized estimating equation model was used for the analysis. All the covariates with $P<.05$ in the univariable analysis were entered in the initial model, and a conditional backward method was used with the stopping rule of $P<.05$ in the final model.

aOR, adjusted-odds ratio; *CD*, cesarean delivery; *CI*, confidence interval; *PP-IUD*, postplacental intrauterine device; *PPROM*, preterm premature rupture of membrane; *QT*, quartile.

[a] Overall *P* value.

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admission of CD. Therefore, readmission, infectious morbidity after discharge, pregnancy outcome, quality of life, and patient satisfaction were not retrievable in this study; however, these factors are important outcome measures for healthcare service research. Fourth, ascertainment bias because of the data capturing schema limited the study quality. Last, the generalizability of the study results to other study populations was not assessed.

Conclusion

The increasing use of a PP-IUD is noteworthy and clinically important. In the second quarter of 2021, the trajectory of the recent increasing use of a PP-IUD on a national level has reached 1.0%. The association of this increase with policy changes across the country had implications for advocacy toward expanded access. There was substantial heterogeneity in the use of PP-IUD (Supplemental Table S2), which may imply the lack of a consistent or universal approach, suggesting the establishment of more concrete clinical practice guidelines. Finally, the overall use of a PP-IUD was not associated with increased infectious morbidity; however, validation and further studies are

TABLE 3
Comparison of outcome measures (propensity score–matched model)

Outcome	No IUD	PP-IUD	OR (95% CI)	*P* value
Leukocytosis	0.6 (0.5–0.8)	0.3 (0.2–0.5)	0.54 (0.21–1.35)	.186
Endometritis	1.0 (0.8–1.2)	1.2 (1.0–1.4)	1.19 (0.67–2.14)	.554
Myometritis	0.3 (0.2–0.5)	0.3 (0.2–0.4)	0.86 (0.29–2.55)	.781
Sepsis	—[a]	0.1 (0.1–0.2)	3.00 (0.31–28.9)	.341
Any[b]	1.7 (1.5–2.0)	1.8 (1.6–2.1)	1.06 (0.66–1.69)	.812

The incidence percentage rate with 95% CI is shown for each group. Overall, 10,145 patients were examined in each group in the matched model (Supplemental Figure S1 for balance statistics). A generalized estimating equation model was fitted to estimate the effect size (PP-IUD vs no IUD) for the measured outcomes.

CI, confidence interval; *IUD*, intrauterine device; *OR*, odds ratio; *PP-IUD*, postplacental intrauterine device.

[a] Suppressed per the Healthcare Cost and Utilization Project instruction (number 1–10); [b] Included any 1 of the 4 measured outcomes (leukocytosis, endometritis, myometritis, or sepsis).

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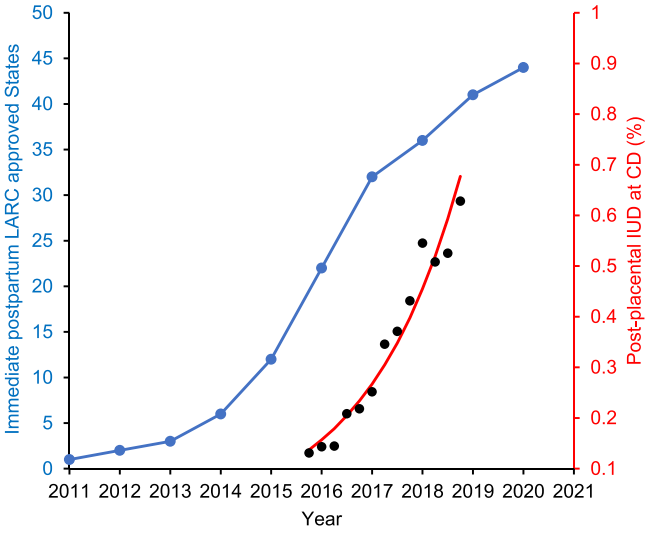
FIGURE 3
Number of states approving the use of immediate postpartum LARC



The *blue line* indicates the cumulative number of states that have approved Medicaid reimbursement for the use of immediate postpartum LARC. Public sites were searched to identify the approval date of the use of immediate postpartum LARC in the United States.[15] The search was conducted in June 2021, and the first approval was noted in January 2011. The cumulative number exceeded 10 states in 2015, 30 states in 2017, and 40 states in 2019. In June 2020, there were 44 states that approved the use of immediate postpartum LARC. The use of a PP-IUD at CD from the fourth quarter of 2015 to the fourth quarter of 2018 in the current study cohort is also shown in the second vertical axis scale (the *red line* indicates the modeled value, and the *dots* indicate the observed value).

CD, cesarean delivery; *IUD*, intrauterine device; *LARC*, long-acting reversible contraception; *PP-IUD*, postplacental intrauterine device.

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needed to better enumerate this relationship and the possible increased risk of certain subsets of the populations. ■

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.xagr.2022.100157.

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