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FAMILY PLANNING (A BURKE, SECTION EDITOR)

Intrauterine Devices and Contraceptive Implants: Overview of Options and Updates on Method Use

M. K. Findley[1] · **E. E. Levi**[1] · **M. V. Dragoman**[2]

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Abstract
Purpose of Review Intrauterine devices (IUDs) and contraceptive implants offer safe and highly effective long-acting reversible contraception (LARC) without requiring routine effort from users. A majority of women who choose these methods report high satisfaction; 12-month continuation rates typically exceed 80%. We summarize some of the latest research and recommendations for use of currently available LARC methods to promote high-quality service delivery.
Recent Findings New hormonal LARC methods are available, and research suggests that the duration of contraceptive protection for some existing methods extends beyond current manufacturer instructions. Updated evidence-based guidelines recommend that most women, including women with various medical conditions, can safely use IUDs and/or contraceptive implants. Initiation can be timed to whenever pregnancy is reasonably excluded, and few, if any, examinations or tests are required prior to insertion. We highlight some considerations for the use of these methods by adolescents and by women who are postpartum or breastfeeding and immediately following abortion.
Summary LARC methods offer many attractive features to women seeking contraception, and there are a growing number of options available for women to consider. Evidence-based recommendations should guide determinations of medical eligibility. Implementing best practices for safe and effective provision of LARC and optimizing opportunities for contraceptive initiation enables providers to better respond to women's needs. Access to contraception and family planning, including LARC, is critical to the health and well-being of women, families, and communities worldwide.

Keywords Contraception · Long-acting reversible contraception · LARC · Intrauterine device · IUD · Contraceptive implant

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✉ M. K. Findley
mfindley@montefiore.org

[1] Division of Family Planning, Department of Obstetrics and Gynecology and Women's Health, Albert Einstein College of Medicine–Montefiore Medical Center, 1695 Eastchester Rd, 5th floor, Bronx, NY 10461, USA

[2] Gynuity Health Projects, 15 East 26th Street, Suite 801, New York, NY 10009, USA

Introduction

Intrauterine devices (IUDs) and contraceptive implants offer highly effective, safe, and discreet long-acting reversible contraception (LARC) without requiring routine effort from users to maintain effectiveness. In addition, women gain various non-contraceptive benefits during use and experience a rapid return to fertility upon discontinuation. In 2015, over one in five married or in-union women aged 15–49 using contraception relied on IUDs or implants worldwide [1]. The proportion of United States (U.S.) women using either an IUD or implant increased from 2.4% in 2002 to 11.6% in 2012 (10.3% IUD and 1.3% implant) [2•].

The two types of IUDs available include levonorgestrel (LNG) and copper IUDs. There are etonogestrel (ETG) single-rod and LNG two-rod contraceptive implants available globally. All typical use 1-year failure rates for these methods are less than 1% (ETG implant, 0.05%; LNG implant, 0.08%; LNG IUD, 0.2%; and Cu IUD, 0.8%) [3]. The progestin-releasing methods share common mechanisms of action: thickening of the cervical mucus, endometrial thinning, and

ovulation inhibition, though their dominant effects vary [4–6]. While the mechanism of action for the copper IUD is not completely understood, it primarily appears to inhibit sperm viability and motility to prevent fertilization [5–7]. Serious complications associated with the use of IUDs and implants are very rare.

Compared to women using short-acting reversible contraception (e.g., oral contraceptive pills, injectables, patches, or rings), LARC users generally report much higher satisfaction and method continuation over time; 12-month continuation rates exceed 80% [8]. LARC methods are also more cost-effective options for women than short-acting methods, and increased uptake can offer cost savings to health systems [9]. The Contraceptive CHOICE project, a prospective cohort study that enrolled nearly 10,000 women seeking contraception in the St. Louis area of the U.S., demonstrated that when financial, logistic, provider, and knowledge barriers to access are eliminated, most women (67%) chose LARC [8]. In addition, increased contraceptive uptake in this cohort, predominantly LARC, contributed to significant reductions in unintended pregnancy and abortions at a population level [10]. We review currently available LARC methods and some of the latest recommendations and research to inform high-quality, evidence-based LARC provision.

LARC Methods

Levonorgestrel Intrauterine Devices

Available LNG IUDs commonly share T-shaped polyethylene frames with a steroid reservoir packaged in a user-friendly single-handed sterile inserter; however, total hormone dose, device dimensions, inserter characteristics, and duration of use vary (see Table 1). While hormonal IUDs were first developed in the 1970s, the first LNG IUD (52 mg LNG IUD; Mirena®) was introduced to Europe in the 1990s and approved in the U.S. in 2001. Until recently, it was the only LNG IUD available to women. Another LNG IUD fashioned of similar materials in the same size and shape with comparable levonorgestrel content became available in 2015. This new 52 mg LNG IUD (Liletta®, U.S. and Levosert®, UK) was developed by a non-profit pharmaceutical company dedicated to creating a more affordable product for women. It offers comparable efficacy through 5 years, though it is only approved for 3 years' use at this time. Slightly smaller devices with lower LNG doses (i.e., 19.5 mg LNG, 13.5 mg LNG) also emerged as new options (see Table 1). Theoretically, smaller devices and thinner intrauterine inserters might ease initiation and improve continuation among adolescent and/or nulliparous women choosing these methods, but research indicates that all available LNG IUDs are suitable for these populations [24–26].

Despite variations in total LNG dose, all of these IUDs offer similar contraceptive protection, and because of the progestin effects on the endometrium, users typically experience a decline in menstrual bleeding [27]. Users of the 52 mg LNG IUD can expect a 79–97% reduction in menstrual blood loss [28]. Rates of amenorrhea, oligomenorrhea, and episodes of unpredictable bleeding or spotting vary based on the LNG content of the device. The frequency of amenorrhea at 1 year decreases with decreasing LNG: 20%, 52 mg; 12%, 19.5 mg; and 6%, 13.5 mg; conversely, the likelihood of some bleeding or spotting increases. Overall, discontinuation rates for bleeding disturbances, including amenorrhea, are low among all users (52 mg, 1.5%; 19.5, 4.9%; 13.5, 4.7%) [11, 12].

Contraceptive Implants

Only one ETG single-rod subdermal contraceptive implant is currently FDA-approved in the U.S. Originally introduced in 2008 (Implanon®), the implant was replaced by an updated product in 2011 (Nexplanon®) with improvements to the inserter designed to ensure superficial placement and addition of radiopaque barium sulfate to the implant for easier localization using x-ray and CT scan, if needed. Worldwide, two-rod levonogestrel-releasing implants (Norplant II®, Jadelle®, Levoplant®, Sinoimplant II®) are also available (see Table 1) [29]. Originally developed by the Population Council [30], Norplant II® and Jadelle® are composed of two flexible silicone rods each containing 75 mg of LNG, approved for up to 5 years of use. The Sinoimplant II®, made and sold in China, shares the same manufacturing specifications as the other two-rod LNG implant, but it is only approved for 4 years' duration due to increased pregnancy rates in year 5 (2.1%) [13].

Most implant users experience reductions in menstrual blood loss, but new bleeding patterns may be unpredictable [31]. Unlike hormonal IUD users, unscheduled, unpredictable bleeding does not tend to improve over time [32, 33]. A large international randomized clinical trial (RCT) sponsored by the World Health Organization (WHO) comparing the clinical performance of ETG and LNG implants found no difference in 3-year cumulative pregnancy rates or continuation at 2.5 years; however, bleeding disturbances leading to discontinuation were more frequent among ETG implant users [16.7 per 100 woman-years (W-Y) vs. 12.5 per 100 W-Y] [14]. There is limited data regarding the management of unpredictable bleeding for women using the etonogestrel implant. Two small studies have shown that for most women, the use of combined hormonal contraceptive pills can arrest nuisance bleeding within 14 days; however, bleeding may resume within days of pill discontinuation [34, 35]. Despite challenges with unpredictable bleeding, the majority of women who choose this method are satisfied users.

Table 1 Characteristics of intrauterine devices and contraceptive implants[a]

	Cu T380A IUD	LNG IUD			ETG implant	LNG implant
Example trade names	Paragard®	Mirena® Liletta® Levosert®	Kyleena®	Skyla® Jaydess®	Nexplanon® Implanon NXT® Implanon®	Jadelle® Norplant-2® Sinoimplant II® Levoplant®
Total hormone/copper	Exposed copper surface area 380 ± 23 mm^2	52 mg	19.5 mg	13.5 mg	68 mg	150 mg total 75 mg each rod
Daily hormone release	N/A	1 month: 18–20 μg/day 1 year: 16.3–18 μg/day 3 years: 12.6 μg/day 5 years: 9.8–10 μg/day	1 month: 17.5 μg/day 1 year: 9.8 μg/day 3 years: 7.9 μg/day 5 years: 7.4 μg/day	1 month: 14 μg/day 1 year: not available 3 years: 5 μg/day	1 month: 60–70 μg/day 1 year: 35–45 μg/day 3 years: 25–30 μg/day	1 month: 100 μg/day 1 year: 40 μg/day 3 years: 30 μg/day 5 years: 25 μg/day
Device and inserter characteristics	T-shaped 36 mm length 32 mm width Inserter diameter 4.4 mm	T-shaped 32 mm length 32 mm width Inserter diameter 4.4 mm[b]	T-shaped 30 mm length 28 mm width Inserter diameter 3.8 mm	T-shaped 30 mm length 28 mm width Inserter diameter 3.8 mm	Single rod 2 mm diameter 40 mm length	Double rod 2.5 mm diameter 43 mm length
Radiopaque	Yes	Yes	Yes	Yes	Yes[c]	No
Typical use failure rate (12 m)	0.8%	0.2%	0.16%	0.4%	0.05%	0.1%
Continuation (12 m)	78–84%	80–87.5%	83%	81%	83–84%	87.9%
Duration of use per manufacturer	10 years	5 years[d]	5 years	3 years	3 years	5 years[e]
Evidence supports prolonged use	Yes	Yes	No	No	Yes	No

[a] [3, 8, 11–23]

[b] Liletta® inserter diameter 4.8 mm per Allergan Pharmaceuticals direct communication with corresponding author

[c] Excluding Implanon®

[d] Liletta® and Levosert® approved for 3 years' duration

[e] Sinoimplant II®, Levoplant® approved for 4 years' duration

Copper IUD

Copper-containing IUDs have been available since the 1960s. Currently, the copper T380A is the most widely used LARC method globally and the most effective copper IUD available [36, 37]. This IUD is a T-shaped polyethylene device with copper-sleeved arms and copper wire wrapped around the stem to create 380 mm^2 of exposed copper surface area. In addition to the many attractive features of LARC methods generally, some women prefer the copper IUD because it does not cause hormone-related side effects. It is also a safe option for women with any contraindications to estrogen- or progestogen-containing contraception. Unlike hormonal LARC methods, the copper IUD can increase the quantity and duration of menstrual bleeding as well as the likelihood of dysmenorrhea, the most common reasons for discontinuation [15].

Initiating LARC

Each woman's contraceptive choice depends on a constellation of factors reflecting unique personal circumstances and preferences. Thus, contraceptive counseling should be evidence-based and individualized to help a woman identify the method that best meets her needs. LARC offers many advantages compared to other forms of contraception, and the expanded number of available methods increases the likelihood that a woman may opt for highly effective contraception.

Both the WHO and the U.S. Centers for Disease Control and Prevention (CDC) recently released updated medical eligibility criteria (MEC) for contraceptive use [38, 39]. These evidence-based recommendations enable providers to counsel women on the full range of effective contraceptive options they may be eligible to safely use. Overall, the recommendations demonstrate IUDs and implants are remarkably safe for most people, and at least one highly effective LARC method is assigned a category "1" or "2" across the majority of medical conditions in the MEC, indicating no restrictions on use (category 1) or that the advantages of using a particular method generally outweigh any theoretical or proven risks (category 2).

The WHO and CDC also recently released updated editions of selected practice recommendations for contraceptive use, evidence-based guidelines informing how to use contraception safely and effectively [38, 40]. According to the guidance, LARC methods can be initiated at any point during a woman's menstrual cycle with reasonable exclusion of pregnancy. A provider can be reasonably certain that a woman is not pregnant (without routine pregnancy testing) if she meets specific criteria: if she is within 7 days since last menses; has not had sex since her last menstrual period; is consistently using a method of contraception; or she is within 4 weeks of delivery, 6 months of delivery with exclusive breastfeeding, or 7 days of an abortion or miscarriage [38, 40]. Provider insistence on LARC insertion with menses is an unnecessary barrier to timely initiation, resulting in increased cost and inconvenience to women presenting at other times in the cycle. In particular, some providers feel that IUD insertion is improved when timed with menses; however, no differences in short- or long-term outcomes have been observed relative to cycle day of insertion [41].

If a woman seeking LARC reports recent unprotected intercourse (≤120 h) and has a negative pregnancy test, consider offering emergency contraception and immediately initiating the LARC method of her choice. The copper IUD is the most effective method of emergency contraception available and has the added benefit of providing ongoing highly effective contraception [42, 43]. No evidence exists to support use of any LNG IUD as emergency contraception; however, research is ongoing to evaluate this application for the 52 mg LNG IUD (clinicaltrials.gov #NCT01539720). Administration of oral emergency contraceptive pills can be combined with immediate initiation of LNG IUDs or implants to avoid delay to the start of these methods; however, women should be advised of a small chance of pregnancy and the need for appropriate follow-up [44, 45].

Few, if any, examinations or tests are necessary prior to LARC initiation [38, 39]. While a bimanual examination and cervical inspection are necessary prior to IUD insertion, an advantage of the contraceptive implant is that it can be initiated without any gynecological examination. LARC initiation should not be delayed to obtain results from cervical cancer screening, STI testing, or other routine preventive tests in healthy, asymptomatic women [38, 40].

All LARC methods require a trained provider for insertion as well as removal, a potential barrier to both timely initiation and discontinuation. Options that decrease women's reliance on providers may increase uptake. More than half of over 300 women presenting for IUD removal at health centers across the U.S. were interested in attempting self-removal, and while only one in five of these women were successful with their attempt, a majority of women said they were more likely to recommend the method to a friend because of knowing about this option [46, 47].

LARC for Specific Populations

LARC and Adolescents

Adolescents bear a disproportionate burden of unintended pregnancy globally and are particularly vulnerable to a number of its serious downstream consequences. Complications of pregnancy and childbirth are the second leading cause of death in young women aged 15 to 19 years worldwide [48].

Numerous public health agencies and professional medical societies endorse LARC for use by adolescents, recognizing the significant advantages conferred to this population, and, according to medical eligibility criteria, age and nulliparity do not exclude initiation of any LARC method [49–52]. In the U.S., two thirds of the approximately 574,000 adolescent pregnancies each year are unintended, demonstrating significant unmet need for highly effective contraception [53]. Sexually active adolescents (ages 15 to 19 years) have the highest rates of unintended pregnancy compared to all other age groups [54]. LARC use among these at-risk adolescents remains low despite incremental increases observed in recent years (2006–2008, 1.1%; 2011–2013, 3.2%) [55].

Systematic reviews published in the last year demonstrate high continuation rates and favorable safety profiles when LARC is used by adolescent and young adult women [24–26]. Twelve-month continuation rates are high overall (all LARC = 84%, 95% CI 79.0–89.0) and are not significantly different among adolescent users of IUDs (74%, 95% CI 61.0–87.0) or implants (84%, 95% CI 77.0–91.0); this meta-analysis pooled results from a total of 4131 IUD (Cu and LNG) users and 755 ETG implant users, one third of whom were nulliparous [24]. Some providers express particular concern about the use of IUDs among adolescents; however, a large body of evidence shows that risks for various adverse outcomes (i.e., contraceptive failure, infection, uterine perforation) remains low and comparable to older IUD users [24–26, 56]. LARC methods should be offered to adolescents for consideration as first-line contraception.

Initiation of LARC in the Postpartum Period

Immediate postpartum initiation of LARC refers to the initiation of an IUD or implant within 48 h of giving birth. Public health authorities and medical professional societies agree that provision of immediate postpartum LARC has the potential to significantly decrease rates of unintended pregnancy and help women achieve healthy birth spacing [57, 58]. The timing is particularly advantageous since women are not currently pregnant, motivated to use contraception, and conveniently in contact with health providers. Access to postpartum LARC is associated with increased rates of initiation and continuation compared to initiation at the postpartum visit [59, 60]. Delaying LARC initiation until the postpartum visit, typically 4 to 6 weeks after delivery, places some women at risk for rapid, repeat unintended pregnancy [61]. This practice can impose a significant obstacle to contraceptive access for women unable to attend this visit, citing transportation and childcare issues as barriers [62–64].

Immediate postpartum IUD placement should ideally be completed within 10 min of placental delivery and can be achieved following either a vaginal or cesarean birth; the technique is rather straightforward but does differ from interval insertion [65]. Expulsion rates for immediate postpartum IUD insertion are higher than for interval insertion; however, this risk should be balanced against the benefit of timely initiation, especially for women unlikely or unable to return for interval placement. Following vaginal delivery, expulsion rates can be as high as 20–30% [60, 66], while IUDs placed at the time of cesarean delivery have an expulsion rate of 5–10% [59, 67]. A contraceptive implant can also be placed immediately during the postpartum period with no special considerations or change in insertion technique.

While studies are limited, immediate postpartum LARC initiation does not appear to affect successful breastfeeding initiation or continuation or infant growth and development [68, 69] and breastfeeding women are considered medically eligible to use all LARC methods [70]. Further research is needed to evaluate the impact of progestogen-containing contraceptives, including implants, on breastfeeding performance and infant outcomes, particularly among women with risk factors for low milk supply or difficulty breastfeeding [71]; several trials are currently ongoing to address these critical knowledge gaps (clinicaltrials.gov NCT01990703, NCT02866643, NCT02866279).

Initiation of LARC Following Abortion

There are a number of important reasons to address women's contraceptive needs at the time of treatment for abortion or miscarriage. Fertility can return as soon as 2 weeks after an induced or spontaneous abortion. Women with an unintended pregnancy resulting in an induced abortion have expressed both a desire to avoid childbearing and an unmet need for contraception, and uptake of LARC at the time of abortion can decrease the risk for a repeat abortion [72]. Following a miscarriage, women may want to delay a next pregnancy for health or personal reasons. Current recommendations note that all reversible methods of contraception, including LARC, can be initiated immediately following uncomplicated medical or surgical management of first and second trimester induced abortion or miscarriage [38, 39, 73].

Investigators have been evaluating the consequences of initiating contraceptive implants on the same day as ingestion of mifepristone for medical abortion through 63 days' gestation [74•, 75]. While there are theoretical concerns that the contraceptive implant could impair the abortifacient efficacy of mifepristone, an anti-progestin, two large, multi-center RCTs published in the last year demonstrate high efficacy of the regimen and no difference in medical abortion failure or ongoing pregnancies among women randomized to immediate versus interval initiation [74•, 75]. Reports of pain, bleeding, and rare additional clinical visits during the medical abortion process were also similar. Of note, immediate initiation was associated with substantially more satisfaction and higher proportions of LARC users at 6 months following abortion.

Providers should routinely offer women the option to initiate contraceptive implants concurrent with mifepristone administration at the time of early medical abortion.

Extending the Duration of Use for Select LARC Methods

Manufacturer-approved durations for LARC use vary according to method (see Table 1). All LARC is approved for a minimum of up to 3 years' use, and a single copper T380A confers the longest period of contraceptive protection. Available data demonstrate that select LARC methods may be used beyond manufacturer-approved limits (see Table 1). In addition to continued contraceptive efficacy, extended use may offer women convenience, cost savings, and ongoing non-contraceptive benefits.

Clinicians can recommend continued use of the copper T380A through 12 years; women initiating the device at age 35 or older can probably use the same IUD through menopause, understanding there may be a minimal risk for pregnancy [76]. As part of a large, multinational study sponsored by the WHO, the cumulative 12-year pregnancy rate observed among 172 parous women continuously using a copper T380A was 2.2% [77]. A Brazilian prospective cohort study followed parous copper T380A users for up to 16 years and noted no pregnancies during 366 W-Y of observation beyond 10 years; however, there were only 39 women using the device during years 12 to 16 [78]. A small prospective study by the Population Council suggests that contraceptive protection could even extend through 20 years of continuous use [79].

Evidence also supports prolonging use of the 52 mg LNG IUD (Mirena®) through 7 years. Results from a recently published RCT comparing contraceptive failures among parous users of either the 52 mg LNG IUD (n = 717) or copper T380A (n = 989) from nine countries demonstrated that the LNG IUD not only maintained efficacy but surpassed performance of the copper IUD at 7 years [59]. The reported cumulative pregnancy rate was 0.53 per 100 W-Y for the LNG IUD and 2.45 per 100 W-Y for the copper IUD in this WHO-sponsored investigation. A U.S. prospective cohort study including 496 LNG IUD users contributing 696.9 W-Y of follow-up showed consistent results; investigators observed cumulative failure rates of 0.25 (95% CI 0.04–1.42) per 100 W-Y during the sixth year and 0.43 (95% CI 0.08–2.39) per 100 W-Y during the seventh year of use [80•]. With extended use, women should be aware that they may be more likely to experience both predictable and unpredictable spotting or bleeding [81].

The new 52 mg LNG IUD (Liletta®) is currently only approved for 3 years' use. There is evidence for efficacy through 5 years and clinical trials are ongoing to determine safety and efficacy through 7 years [16•].

Convincing results from two recently published large studies endorse the use of the ETG single-rod implant through 5 years. A large international, multi-center RCT conducted by WHO directly compared outcomes during 2 years of extended ETG implant use to performance of the LNG implant during the same period [82]. Over 200 women completed 5 years of ETG implant use and contributed 588.3 W-Y of observation to analysis; no pregnancies were reported in years 4 or 5 in either group and cumulative pregnancy rates were comparable (ETG, 0.6 per 100 W-Y, 95% CI 0.2–1.8; LNG, 0.8 per 100 W-Y, 95% CI 0.2–2.3). Similarly, a U.S. cohort study including 291 ETG implant users contributing 444 W-Y of follow-up documented no pregnancies during extended use [80•]. These robust results confirm findings from smaller case series from Thailand and China [83, 84]. McNicholas et al. also demonstrated that median ETG levels at years 4 and 5 remain above the threshold for contraceptive protection among women of all BMI classes, including obese women [80•].

Conclusion

LARC methods offer many attractive features to women seeking contraception; there are a growing number of options available for women to consider. Evidence-based recommendations should guide determinations of medical eligibility and best practices for service delivery. Optimizing women's access to LARC and all forms of modern contraception is an important public health goal, critical to securing the well-being and autonomy of individuals while supporting the health and development of communities [1]. However, harmful U.S. foreign and domestic policies undermining access to family planning and contraception put women's lives at risk and are likely to result in increased numbers of unintended pregnancies, unsafe abortions, and maternal and newborn deaths at home and around the globe. Women's health providers have a vital role to play in defending reproductive rights and advocating for comprehensive sexual and reproductive health services, including access to LARC, for all.

Compliance with Ethical Standards

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