

10-24-2017

# An Introduction and High Yield Summary of Female Contraceptive Methods

Dharam Persaud

*Herbert Wertheim College of Medicine, Florida International University, Dpers001@fiu.edu*

J. Burns

*Herbert Wertheim College of Medicine, Florida International University*

J. Trangle

*Herbert Wertheim College of Medicine, Florida International University*

J. Agudelo

*Honors College, Florida International University*

J. A. Nunez

*Herbert Wertheim College of Medicine, Florida International University*

See next page for additional authors



This work is licensed under a [Creative Commons Attribution 4.0 License](https://creativecommons.org/licenses/by/4.0/).

Follow this and additional works at: [https://digitalcommons.fiu.edu/com\\_facpub](https://digitalcommons.fiu.edu/com_facpub)

 Part of the [Medicine and Health Sciences Commons](#)

## Recommended Citation

Persaud, Dharam; Burns, J.; Trangle, J.; Agudelo, J.; Gonzalez, JA; Nunez, D.; Perez, K.; Rasch, D.; Valencia, S.; and Rao, C. V., "An Introduction and High Yield Summary of Female Contraceptive Methods" (2017). *HWCOC Faculty Publications*. 117.  
[https://digitalcommons.fiu.edu/com\\_facpub/117](https://digitalcommons.fiu.edu/com_facpub/117)

This work is brought to you for free and open access by the Herbert Wertheim College of Medicine at FIU Digital Commons. It has been accepted for inclusion in HWCOC Faculty Publications by an authorized administrator of FIU Digital Commons. For more information, please contact [dcc@fiu.edu](mailto:dcc@fiu.edu).

---

**Authors**

Dharam Persaud, J. Burns, J. Trangle, J. Agudelo, JA Gonzalez, D. Nunez, K. Perez, D. Rasch, S. Valencia, and C. V. Rao

## Research Article

# An Introduction and High Yield Summary of Female Contraceptive Methods

Persaud-Sharma D<sup>1\*</sup>, Burns J<sup>1</sup>, Trangle J<sup>1</sup>, Agudelo J<sup>2</sup>, Gonzalez JA<sup>2</sup>, Nunez D<sup>2</sup>, Perez K<sup>2</sup>, Rasch D<sup>2</sup>, Valencia S<sup>2</sup> and Rao CV<sup>1,3</sup>

<sup>1</sup>Florida International University, Herbert Wertheim College of Medicine, USA

<sup>2</sup>Florida International University Honors College Bioethics, The Honors College, USA

<sup>3</sup>Department of Cellular Biology and Pharmacology, USA

\*Corresponding author: Dharam Persaud-Sharma, Florida International University, Herbert Wertheim College of Medicine, Miami, FL, USA

Received: August 06, 2017; Accepted: September 26, 2017; Published: October 24, 2017

## Abstract

Globally, contraceptive studies and their use are major challenges in the realm of public health. The ideal goal is to obtain a contraceptive method that is highly effective at minimizing unplanned pregnancies and nullifying the chance of contracting a sexually transmitted disease. Abstinence is currently the only way to attain such a dualistic goal, and while effective, it may not be suitable for sexually active individuals. While there is an abundance of method-specific information regarding the use of any one female contraceptive device, there is a paucity of resources that compare and contrast the advantages and disadvantages of such methods and enable an individual to optimize family planning. This paper attempts to address many of these topics by reviewing a multitude of U.S. Food and Drug Administration (FDA) approved contraceptive methods. This work is intentionally written towards educating medical students, educators and teachers at all levels of training with foundational knowledge regarding female contraception.

**Keywords:** Female contraceptive methods; Food and drug administration; Abstinence

## Introduction

In the United States, unplanned pregnancy continues to be a polarizing public health concern. Contraceptive methods remain a point of contention in American politics and public culture. At the same time, the United Nations Millennium Development Goals aim to increase access to reproductive health [1]. Between 2011 and 2013, approximately 62% of women between ages 15 and 44 in the United States used a contraceptive method. The groups least likely to utilize contraceptive methods included women ages 15 to 24, Latinas, and those with a high school diploma or less [2]. While a myriad of options exist for the prevention of pregnancy and sexually transmitted infections (STIs), the population most drastically affected by unplanned pregnancy is younger women [3]. This is further complicated across the globe by lack of awareness and access to contraceptive methods. It is suggested that at least 10% of married women have an unmet need for family planning. In certain regions, this number is even higher, especially in sub-Saharan Africa and Oceania [4]. It has been demonstrated that discussion of sexual and reproductive issues with both families and students improves awareness and may increase utilization of methods to prevent pregnancy and sexually transmitted diseases, even in populations in the developing world [5]. Data from Switzerland, where contraception is less taboo, suggest that condom use is the most common method utilized by adolescents, particularly at first intercourse [6]. In the United States, health beliefs and social discussions about contraception have a major influence on health practices rather than methods based on evidence. In urban populations, it has been demonstrated that misconceptions regarding emergency contraceptive methods are largely gleaned from the opinions of individuals close to them [7]. Importantly, the limited use of female contraception is an issue shared by both male and female sexual partners. Generally, men lack knowledge regarding

the available options for their female partners. Increased awareness and understanding of hormonal contraception by men can increase access to these methods and improve adherence [8]. Despite these issues, contraceptives are used by 64% of married or in-union women globally [4]. Though a divisive issue, for the improvement of women's health across the globe, it is imperative to improve understanding of the available methods. The proceeding discussion describes the use, risks, benefits, and costs of a number of female contraceptive methods. The aim of this review is to provide a comprehensive summary of these factors for each FDA approved contraceptive method as well as a discussion of the ethical implications of contraception visualized in the accompanying Quick Table.

## Contraceptive Methods

### Abstinence

Abstinence is a behavioral method of contraception in which individuals avoid engaging in any type of sexual activity altogether including but not limited to oral, anal, or vaginal intercourse. Abstinence is the only way a person can be completely certain of the prevention of pregnancy or infection with sexually transmitted diseases (STDs). Among older women, abstinence may reflect a genuine choice related to age. 10.4% of women between the ages of 35 and 49 were likely to use abstinence as a contraceptive choice, whereas 8.3% and 8.1% of women ages 25-34 and 15-24 respectively practiced abstinence [9].

Abstinence is a reversible, non-invasive, free of financial cost method of contraception. This practice does not have any risks or medical/hormonal side effects. Abstinence-related risks occur when women decide to no longer abstain from sex. One of the most common failures of abstinence is failure to avoid sexual activity, which can lead to a lack of planning for alternative forms of contraception.

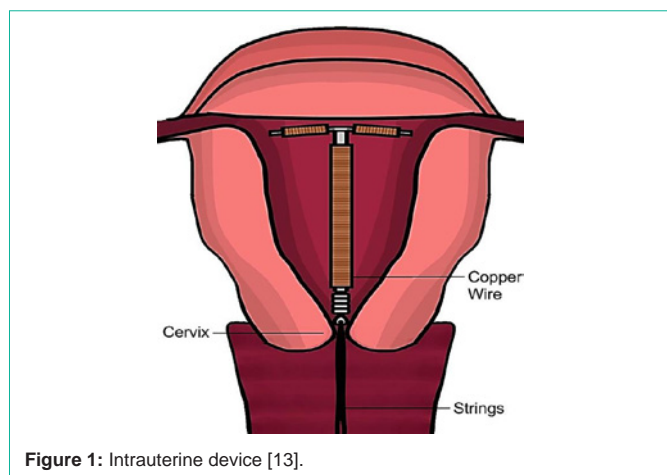


Figure 1: Intrauterine device [13].

This may cause some women to end periods of abstinence without having an alternative form of contraception [9]. There are no health contraindications associated with the use of abstinence as a form of contraception. If a woman believes that she will not be able to abstain from sex for extended periods of time, she should not consider abstinence as her primary form of birth control [10]. Consideration should also be given to psychological factors, such as confidentiality and cultural factors that may affect the choice of abstinence as a primary modality of contraception.

**Copper T intrauterine device**

The Copper T Intrauterine Device (IUD) is a reversible, non-hormone based method of female contraception with a unique ability to work in an efficient manner for a prolonged period of time [11]. As shown in Figure 1, the Copper T IUD is a T-shaped polyethylene flexible structure containing 380 mm of copper wire situated throughout its stem and arms [12].

The Copper T IUD is installed into the uterus [12]. The insertion process tends to be uncomplicated, with the most common complication from insertion being perforation. For the Copper T-380A IUD, perforation rates for insertion occur at a rate of 1.5 per 1,000 [14]. Once inserted, the Copper T IUD impedes fertilization through the virulent effects that copper has on the sperm and ovum, and by acting as a physical barrier to the sperm's voyage towards the egg [11]. In multiple trials, the Copper T IUD has proven to be an effective form of female contraception, revealing the risk of pregnancy while utilizing this device is 0.6% [15].

Though Copper IUDs have been in production for decades, in the 1980s, IUDs were criticized due to their inability to prevent sexually transmitted diseases, causing a decline in their utilization [16]. In the early history of the copper T IUD, liability claims negatively affected the use of the device and eventually manufacturers were forced to remove them off of the market. Eventually, one of the removed copper T IUDs was reinstated into the market [16]. Copper T IUDs are a very practical form of contraception. After the insertion of the Copper T there is no need for patient follow up with her healthcare professional for dosing administration as seen with most hormone based methods [11]. The Copper T IUD becomes effective immediately after insertion. More so, being hormone free makes this method safe for use for women with breast cancer, hypertension,

uncontrolled diabetes mellitus, and thromboembolic disease [11].

The uninterrupted use of the Copper T IUD has been approved for 10 years, meaning that a woman utilizing this Copper T IUD can keep it inserted for 10 years and it will work successfully for up to 12 years [11]. As previously mentioned, the Copper T IUD is reversible, which is made possible through the use of a string attached to the base of the T frame facilitates the process of removal and reversibility. After removal, the woman physiologically returns to fertility and the processes of ovulation typically occur anywhere from 10-14 days after removal. The use of Copper T IUD has possible side effects, including escalated bleeding during menstrual cycles, cramping and increased menstrual pains [11]. Although, in many patients these side effect diminish over time, they might vary in length depending on the age of the patient. The most profound reason for the removal of Copper IUDs is attributed to excessive vaginal bleeding which may result due to improper sizing of the device relative to the patient's uterine cavity [16]. There are several other contraindications and side effects summarized in Table 1. Studies have specifically shown that the Copper T 380A IUD is one of the most affordable methods of contraception with the 5-year cost of use estimated at \$1,678 USD without insurance [17].

**Levonorgestrel IUD**

Intrauterine devices containing Levonorgestrel are an effective and reversible form of long term contraception. Levonorgestrel is a synthetic form of progesterone used in many oral contraceptives and contraceptive implants. The Levonorgestrel intrauterine device, as shown in Figure 2, delivers a dose of Levonorgestrel daily for up to five years [18].

Levonorgestrel physiologically functions by restricting the growth

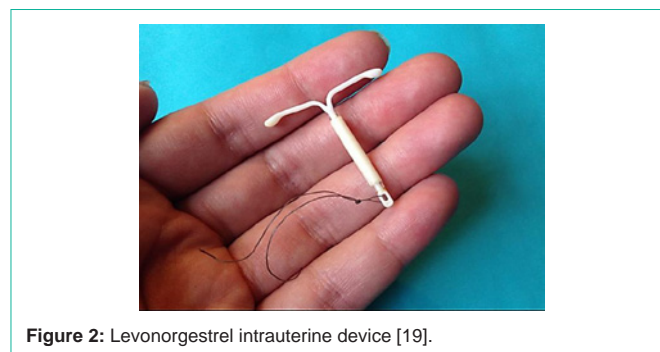


Figure 2: Levonorgestrel intrauterine device [19].

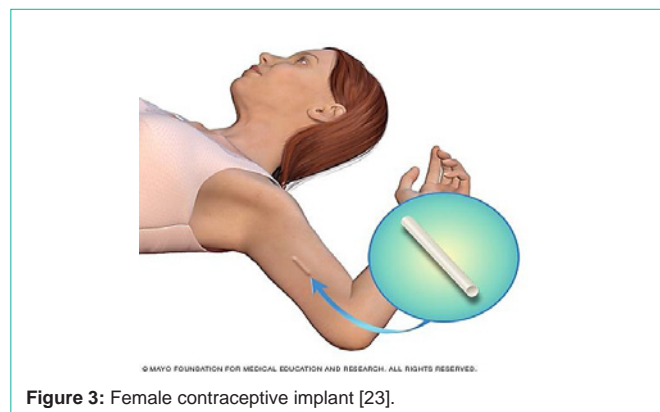


Figure 3: Female contraceptive implant [23].

**Table 1:** Female contraceptive – quick table guide.

Technique	Usage	Adverse reactions	Length of Action	Invasive-ness	Rever-sibility	Cost (\$ - \$\$\$)	Patient Considerations	Important Information
<b>Abstinence</b>	Non-participation of vaginal intercourse	No adverse reactions known.	Variable	Non-Invasive	Reversible	No cost.	This method has been proven to work best in young, single women and women reaching the end of their reproductive years. This method also works better among educated couples than less educated couples [9].	Anyone can practice abstinence. There is no link between religious affiliation and an individual's decision to remain abstinent [9].
<b>Copper T IUD</b>	Copper T IUD is installed into the uterus [12]. Once inserted, the Copper T IUD impedes fertilization through killing both sperm and egg cells while physically obstructing the sperm's voyage towards the egg [11].	Escalated bleeding during menstrual cycles and increased menstrual pains are common. Very rare reports including expulsion of the IUD, pelvic inflammatory disease, or ruptures during the insertion process [11]. Studies have identified a rare link between Copper T IUD and Human Papillomavirus (HPV) [113].	The uninterrupted use of the Copper T IUD has been approved for 10 years [11].	Invasive - requires a procedure conducted by a healthcare professional [11].	Reversible [11].	Estimated cost is \$1,678 without insurance [114]. \$\$\$	This method of contraception is non-hormone based. It is safe for women with breast cancer, hypertension, uncontrolled diabetes mellitus, and thromboembolic disease [11].	The probability of pregnancy while utilizing this device is 0.6% [15].
<b>Levonor-gestrel IUD</b>	The device is implanted every 5 years [17].	Miscarriage, preterm birth, possible infection, pelvic inflammatory disease, possible development of ovarian cysts [17]. Less serious but possible side effects include nausea, mood changes, weight gain and dizziness [17].	The contraceptive effect of the IUD lasts for up to 5 years after device placement [17].	Invasive as the device is inserted in the uterus [17].	Reversible [17].	Approximately \$1,646 every 5 years [20]. \$\$\$	This method is convenient for women seeking a long term contraceptive method. The levonorgestrel IUD should not be used by patients who experience unexplained vaginal bleeding or in patients who have been diagnosed with chlamydia or gonorrhoea [19].	This intrauterine device is 99% effective [17].
<b>Implant</b>	The implant can be inserted every 3-5 years [25].	Potential risk of bruising and infection at the site of injection. Abdominal, back, or breast pain, irregular vaginal bleeding, headaches, nausea, weight gain, ovarian cysts [27].	Depending on the model and dosage of progestin, the implant can be effective for 3-5 years [23].	Invasive as it is a small flexible rod that is inserted under the skin of the upper arm [21].	Reversible [21].	\$0-\$800, varies with insurance [21]. \$\$\$	Useful for patients desiring a long-lasting contraceptive method. The implant cannot be inserted in pregnant women and should not be used by women with a history of breast cancer, liver disease, blood clots, or irregular vaginal bleeding [23].	Successfully prevents more than 99% of pregnancies. It doesn't protect against STIs [25].
<b>Injection</b>	Injections are typically repeated every one to three months depending on the hormone being used [32].	Amenorrhoea, heavy bleeding, or frequent bleeding, weight gain, and decreased bone mineral density are among the most common side effects [32]. Many side effects are not harmful and are reduced 12 to 18 months after discontinued use [33].	Depending on the hormone being used, injections can be effective for one month (Lunelle), eight weeks (NET-EN), or three months (DMPA) [32].	Minimally invasive with slight discomfort at the site of injection [16].	Reversible with delay. Ovulation may take from 14 weeks to 18 months to resume [115].	\$50 - \$60 per injection, \$0 with insurance [36]. \$-\$\$	Injections are safe for most women and can be used by women of reproductive age. Women who are pregnant as well as those with severe hypertension or vascular disease, cancer, and liver disease should not use injectable contraceptives [30, 34].	

<p><b>Combined Oral Contraceptives</b></p>	<p>Taken at the same time daily [39].</p>	<p>Venous thromboembolism, hypertension, stroke, myocardial infarction [40].</p>	<p>Each pill lasts about 24 hours - taken continually oral contraceptives are effective until discontinued [40].</p>	<p>Non- invasive</p>	<p>Reversible with timedelay [39].</p>	<p>\$30-50 per monthly pack, \$0 with insurance [39]. \$\$</p>	<p>This method of contraception is usually prescribed to adolescent and young women. However, combined oral contraceptives can be used by any healthy reproductive aged female. Women who are heavy smokers, have sickle cell disease, previous cardiovascular illnesses and those who have gallbladder disease should avoid taking combined oral contraceptives due to increased risk of side effects [40].</p>	
<p><b>Progestin Only</b></p>	<p>Progestin only pills should be taken at the same time each day and have a three hour window for maximum effectiveness [34].</p>	<p>Irregular bleeding, headaches, nausea, breast tenderness, acne, weight gain to a lesser degree, formation of ovarian cysts, reduced efficacy from other medications processed by the liver, higher rates of ectopic pregnancies [30,42].</p>	<p>This contraceptive method is effective until discontinuation [30].</p>	<p>Non-invasive form of contraception [19].</p>	<p>Reversible with time delay [45]. After 24-hours without the pill, cervical mucus normalizes [37].</p>	<p>\$20 - \$50, varies with insurance [46]. \$\$</p>	<p>Women contraindicated with estrogen based contraceptives, those suffering with migraines or smokers over the age of 35, benefit from this method [42]. Women should not use if they have acute liver disease, breast cancer, pregnancy, genital bleeding, or cardiovascular disease [30].</p>	<p>Progestin-only contraceptive pills were developed as an alternative to estrogen in combination oral contraceptives which led to increased risk of venousthromboembolytic events [43].</p>
<p><b>Hormonal Vaginal Ring</b></p>	<p>The vaginal ring is manually inserted into the vagina and worn 3 weeks and then taken out for 7 days to allow endometrial shedding [30].</p>	<p>Vaginal secretion, breast tenderness, headache, nausea, vaginitis, coital issues, foreign body sensation, and ring expulsion [30, 34].</p>	<p>Effective until discontinuation. Efficacy is reduced if a new ring is not utilized within 24 hours after the 7-day shedding period [48].</p>	<p>Moderately invasive through insertion into the vagina [49].</p>	<p>Reversible with time delay post-discontinuation [49].</p>	<p>\$0 to \$80 [51]. \$-\$\$</p>	<p>Women should not use this method if they smoke over the age of 35 and have coronary artery disease, diabetes, Lupus, severe hypertension, thromboembolic disorders, known pregnancy, or localized migraines [30].</p>	
<p><b>Birth Control Sponge</b></p>	<p>Sponge placed before intercourse [53].</p>	<p>Toxic shock syndrome, vaginitis, irritation [57].</p>	<p>Can be used as a form of contraception for up to 24 hours after sponge is inserted [55].</p>	<p>Somewhat invasive form of contraception [53].</p>	<p>Reversible.</p>	<p>\$</p>	<p>This method of contraception can be used by all women. However it is not as effective as the other forms of contraception. For safety, it is advised that the sponge not be used during menses or puerperium [57].</p>	<p>Available over the counter [58].</p>



<b>Diaphragm or Cervical Cap</b>	Impedes the sperm from making its way into the cervix by being positioned in a manner that covers the cervix. This is considered an invasive method of contraception [57,60].	Applications of diaphragms with spermicides may increase the probability of urinary tract infections [57].	Advised time limit of usage of 1-year for a diaphragm. With regular maintenance, lifespan can be stretched to two years [57].	Invasive method of contraception [60].	Reversible [57].	\$	Indications for the use of diaphragms are made if the patient is unable to use hormonal contraceptives, if the patient is 6 weeks postpartum, and if the patient has rare sexual activity among other factors [57].	There are in fact allegations of a type of diaphragm made from silicone elastomer that has the unique ability to release an administered dose of spermicide, Nonoxynol-9 (N-9) [62].
<b>Female Condom</b>	Every time there is sexual intercourse [64]	Allergies, not always 100% effective	Whilst having sex	Not very invasive, easy to apply and remove [64]	Reversible [64].	\$6 for 3 condoms, [66]. \$	Good for both partners to avoid pregnancy and STDs [66]	Over-the-counter, more effective than male condoms [68]
<b>Spermicide</b>	Chemical agent that impair the sperm's mobility by disabling the sperm to move into the vagina or killing the sperm cell [59].	May cause a higher risk urinary tract infections (UTI) from women that use spermicides as a form of contraception vs. those that apply distinct contraception methods [70]. May cause irritations and allergic reactions to the woman or her counterpart [59].	Typically, spermicides should be left on for 6-8 hours after intercourse in order to work efficiently [69].	Somewhat invasive form of contraception [59].	Reversible [59].	Reasonably priced and affordable [70]. \$	Good for any woman who is unable to utilize hormonal forms of contraception [59].	The efficiency is increased when used with barrier devices like diaphragms or cervical caps [62].
<b>Natural Planning or Fertility Awareness</b>	Avoid sex during fertile days of the month.	No adverse reactions known.	Performed monthly during fertile days of the menstrual cycle [71].	Non-invasive form of contraception.	Reversible.	Around \$20 for thermometer and calendar/fertility awareness chart. \$	The method should work similarly for all women. In the US, it is more effective among white women between 19 and 29 years of age who are in long-term, stable relationships, and have high school education or higher [72].	This method is associated with a lower incidence of induced abortion in the US, and with a divorce rate lower than the general American population [72].
<b>Tubal Ligation</b>	Before or after a pregnancy.	Not 100% effective. Pregnancy remains a possibility in 5 out of 1000 women after a year, and in 13 out of 1000 women after 5 years [75].	Permanent length of action after contraceptive method is performed.	Invasive form of contraception. Surgery is performed, most of the time via laparoscopy [75].	Reversible with tubal anastomosis. May have therapeutic limitations. [77].	Costs range from \$0 to \$6,000, varies with insurance [79]. \$\$-\$\$\$\$	Best for older women and women who already have children.	Associated with a lower incidence, stage, and mortality of endometrial and ovarian carcinomas [80].
<b>Trans-cervical Sterilization</b>	Before or after a pregnancy. Method prevents pregnancy and doesn't protect against STIs.	Approximately 8% of first attempts at procedure are unsuccessful [89]. Procedure may cause pain, dizziness, nausea, or light bleeding. Potential risk of ectopic pregnancy or the insert moving out of place (can be removed if needed) [90].	After the occlusion is confirmed, length of action is permanent [83].	Invasive as the procedure is performed hysteroscopically [87].	Irreversible	\$0-\$6,000, varies with insurance [92]. \$\$-\$\$\$\$	Mostly a permanent method of contraceptive. Suggested for older women. Not recommended for women that are: - Currently pregnant, - Delivered or terminated pregnancy 6 weeks prior to insertion - Recent pelvic infection - Proximal tubal occlusion- Currently taking immunosuppressants - Have a unicornuate uterus [91].	Prior to the complete occlusion, it suggested to use another method of contraceptives to prevent pregnancy [87].

<b>Emergency Contraception</b>	1-5 days after sexual intercourse [96].	Headache, nausea, and low possibility of pelvic inflammatory disease [97,98].	Once after sexual intercourse [93].	Non invasive, just taking of a pill [93].	Irreversible	\$50 purchased over-the-counter, less if covered by insurance [97]. \$\$	Good for female trying to avoid pregnancy after having sexual interaction [94].	Some work better than others and are highly time dependant. Mechanism- Preventing sperm to fertilize an egg. Not equivalent to the "abortion pill" [96].
--------------------------------	---	---	-------------------------------------	---	--------------	---	---	--

Note: USD = U.S.  
\$: \$0 - 20; \$\$: \$20-100.  
Dollar \$\$\$: >\$100.



Figure 4: The Depo-Provera contraceptive injection [29].



Figure 5: Combined oral contraceptive pack [38].

of the endometrium. The thinning of the endometrium creates a harsh environment unsuitable for the blastocyst implantation [20]. Intrauterine device placement is a rather invasive procedure, as the device is inserted into the uterus through the vagina and cervix [18]. The levonorgestrel IUD is 99 % effective. The 5-year cost without insurance estimate of using the Levonorgestrel uterine device is about \$1,646 USD [21]. Some side effects associated with the implantation of the intrauterine device include nausea, mood changes, and changes in bleeding patterns, acne, dizziness, headaches, weight gain and the possible development of ovarian cysts. Other rare but possible complications related with the use intrauterine devices include the perforation of the wall of the uterus, miscarriage, preterm birth and possible infection [18]. The device should not be used by patients who exhibit unexplained vaginal bleeding and in patients who have been diagnosed with chlamydia or gonorrhea since IUD insertion can lead to the development of pelvic inflammatory disease (PID) [20].

**Hormone implant-extruterine**

A non-intrauterine female hormone based contraceptive implant consists of a small bendable rod approximately 4 cm in length that is inserted into a woman’s upper arm subdermally, just under the

skin, as seen in Figure 3. Similar to a levonorgestrel IUD, the implant releases progestin, a hormone that can be used to prevent pregnancy [22].

Physiologically, Progestin acts to thicken the mucus of the cervix which impedes cervical sperm transport. The implant differs from the levonorgestrel IUD in that high doses of synthetic progestin can prevent ovulation [22]. The implant is effective for 3-5 years, depending on the product and model used [24]. The implant can be used by women of all ages. Less than 1% of women with an implant become pregnant, rendering this a highly effective method [25]. It cannot prevent against sexually transmitted infections (STIs), so it is commonly used alongside methods that prevent STIs [26].

The implant is inserted by a trained health care provider as part of a routine in-office procedure [22]. The upper arm is cleaned and an anesthetic is used to numb the area, after which a needle applicator is used to insert the device(s). The site heals within 3-5 days. In order for the implant to be removed, a local anesthetic is used prior to making a small incision in the arm. The implant is then pulled out. If desired, a new implant can be placed in the same location [27]. The implant can be removed any time during the 3-5 year effective period. Once the implant is removed, the female hormone cycle resumes normality. If one does not desire pregnancy, a new birth control method should be used immediately [22].

Although uncommon, bruising or infection in the area of the injection can occur. The implant may cause irregular vaginal bleeding as well as abdominal, back, or breast pain. There is also a risk of headaches, nausea, weight gain, or developing ovarian cysts [27]. It should not be inserted during pregnancy. The implant also should not be used in women that have history of breast cancer, liver disease, blood clots, or irregular vaginal bleeding [24]. Depending on both the brand used and insurance, the implant can cost up to \$800 per insertion and up to \$300 for removal (USD) [22].

**Depot injection**

Injectable contraceptives are shots of the progestin hormone, specifically depot medroxyprogesterone acetate (DMPA), injected intramuscularly or subcutaneously in the arm or the buttocks [28]. Figure 4 illustrates the most widely used form of injectable contraceptives, Depo-Provera.

Medroxyprogesterone acetate (MPA or Lunelle), Norethisteroneenatate (NET-EN), and Mesygina are less commonly used injectables which are administered in a similar manner [29]. The main function of the injectable method is to prevent ovulation by altering the endometrial lining by blocking the action of luteinizing hormone [30]. It is important to note that this method does not protect against STDs.





**Figure 6:** Progestin birth control pills [41].

DMPA has been available in other countries like Indonesia, Mexico, and Thailand since the 1960s. Originally approved in the United States for the treatment of endometriosis and habitual abortion in 1960, DMPA was later approved for contraceptive use in 1992 after an extensive study published by the World Health Organization (WHO). This study revealed that DMPA led to no significant increases in breast or uterine cancers. The injection is composed of an aqueous solution containing suspended micro-crystals. Other injectables are widely used outside of the United States due to ease of continuity [31].

DMPA must be repeated every twelve weeks or three months at 150 mg/1 mL while NET-EN must be repeated every eight weeks at 200 mg/1 mL. Lunelle is repeated monthly [32]. The micro-crystals containing the hormones are in solution and slowly released into the blood over time. With every injection, there is an increase in progesterone levels during the first 24 to 48 hours followed by a steady decline in the following weeks [33]. After discontinuation, it may take up to 12 to 18 months for contraceptive effects to wane [34,35].

Injectable contraceptives are minimally invasive with slight discomfort at the site of injection [30]. DMPA is completely reversible and may be used by women of all ages. Injectable contraceptives are considered a method of long-acting reversible contraception. After discontinuing treatment, ovulation may take 14 weeks to 18 months to return [35]. Some common side effects include bleeding abnormalities such as amenorrhea (absence of menstrual periods), heavy bleeding, or frequent bleeding. Other effects include weight gain and decreased bone mineral density [32]. Many of these side effects are not harmful and are reduced 12 to 18 months after discontinuation [31, 33].

Injectable contraceptives are safe for most women. However, some contraindications exist among women who are pregnant and those with severe hypertension or vascular disease [30]. Women with diabetes can use injectable contraceptives, but this may lead to an adverse effect on glucose metabolism. Women with liver disease such as acute hepatitis, liver carcinoma, and liver cirrhosis generally should not use DMPA as it is metabolized in the liver. Women with breast cancer should also not use DMPA [34]. Injectable contraceptives are the most cost effective after one year of use [35]. Without insurance, the shot alone - excluding the cost of physician consultation charges ranges from \$50 - \$60 per injection. With insurance, the cost may be completely reduced to \$0 [36].

### Combined oral contraceptives

Combined oral contraceptives, more commonly known as birth control pills, contain a combination of two female hormones: estrogen and progestin [37]. Figure 5 illustrates a standard pill package for this method of contraception.

Progestin is associated with the majority of the contraceptive activity of the pill. The progestin component thickens the cervical mucus which makes it more difficult for sperm to enter the cervix leading to the uterus. It also suppresses the production of hormones that control ovulation. The estrogen component serves as a suppressor of hormones that cause ovulation [37]. If there is no ovulation, pregnancy cannot occur. Combined oral contraceptives should be taken at the same time daily. If taken exactly according to package directions only 3 out of 1000 women will become pregnant. Thus, combined oral contraceptives are 97% effective [39]. However, when used without complete adherence to instructions, there is a failure rate of 9%.

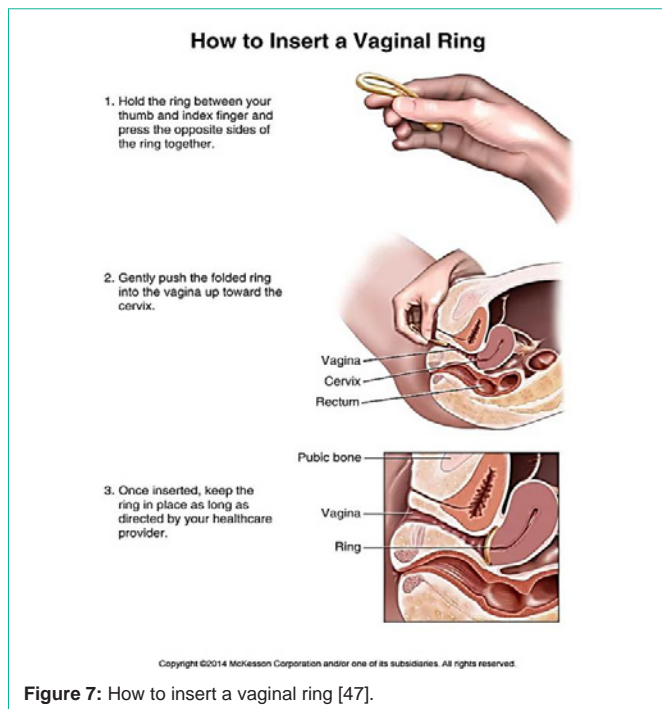
Potential side effects associated with combined oral contraceptives include an increased risk of cardiac problems such as venous thromboembolism, arterial thrombosis, myocardial infarction, hypertension and stroke. These risks are more likely to occur in women with a previous history of hypertension, heavy smoking, sickle cell disease, cardiovascular diseases, gallbladder disease, or have a pre-existing hypertension. Noncardiac associated side effects include migraines and esophageal reflux. Women who have a previous history of depression may experience worsening of their symptoms [40]. Combined oral contraceptives are a reversible and non-invasive form of contraception. Women who stop taking the oral contraceptive pill will have a two week delay in the resumption of ovulation. Brand named combined oral contraceptives usually cost around \$50 USD monthly. However, there are generic options available which sell for around \$30 per pack (USD). Many insurance providers do not cover the cost of combined oral contraceptives; however, some offer a co-pay option where the patient only pays a fraction of the cost [39].

### Progestin only oral contraceptive

Progestin-only contraceptive pills, also known as mini pills, contain 35%-75% of the progestin contained in combination pills and must be taken at the same time each day [30]. Figure 6 illustrates a standard 28-day progestin pill package.

Unlike combination pills, these do not contain estrogen. About 9 out of 100 women become pregnant when using the pill correctly during the first year [34]. They function by reducing the amount of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) while suppressing ovulation for about 50% of cycles [34]. In addition, they help to thicken cervical mucus which helps to prevent the penetration of sperm [30]. This method does not protect against STDs.

Progestin-only contraceptive pills have been available as a method of birth control since the 1960s [42]. They were initially developed to avoid the high dosage of estrogen in combination oral contraceptives which led to increased risk of venous thromboembolic events. Estrogen dosages have been significantly reduced over the past few decades, but the development of progestin-only pills was



**Figure 7:** How to insert a vaginal ring [47].

promoted to reduce such risks [43]. Women contraindicated with estrogen based contraceptives, such as those suffering with migraines or smokers over the age of 35, have been able to benefit from this method [42]. According to the National Survey of Family Growth, approximately 0.4% or 250,000 women between the ages of 15 and 44 currently use progestin-only pills [43].

Pills must be taken daily within the same 3-hour window for maximum effectiveness [34,44]. After 48 hours, full effects occur in the cervical mucus [44]. Progestin-only pills are non-invasive and taken orally [34]. This method of contraception is known as a short-acting hormonal method [45]. After a 24-hour period without the pill, cervical mucus normalizes. The normal ovulation cycle returns faster for these women than those on the combination pill [37].

Possible risks associated with progestin-only pills include formation of ovarian cysts and reduced efficacy from other medications processed by the liver. Common side effects include irregular bleeding, headaches, nausea, breast tenderness, acne, and weight gain to a lesser degree [30]. Women using this method also have a higher rate of ectopic pregnancies compared to women that use other methods [42]. Absolute contraindications for this contraceptive method include acute liver disease, breast cancer, pregnancy, or genital bleeding [30]. A relative contraindication is current cardiovascular disease such as venous thromboembolism [42,43]. The cost of progestin-only pills typically range from \$20-\$50 per month (USD) for those without insurance coverage. Those with insurance may have their prescription fully covered or may have a higher copay depending on the brand. Additional costs may include a visit to the physician and tests such as a pelvic exam which could range anywhere from \$35 to \$250 (USD) depending on insurance coverage. Some pharmacies and universities offer discounts on generic versions of these pills [46].

## Hormonal vaginal ring

The hormonal vaginal contraceptive ring is a flexible device placed inside the vagina that releases a combination of the hormones estrogen and progestin. The ring is worn for 21 days taken out during menstruation. After menstruation, a new ring is inserted to begin the following cycle [30]. Figure 7 illustrates the proper method of self-inserting the vaginal ring after consultation with a healthcare provider.

Approximately 9 out of 100 women using this method become pregnant during their first year of use [47]. This method inhibits ovulation and alters the composition of the cervical mucus. Contraceptive rings offer the lowest dose of estrogen out of all combined contraceptives. It does not protect against transmission of STDs [30]. The contraceptive ring was developed as a means of delivery of a constant small dosage (about 120 mcg of etonogestrel and 15 mcg of ethinyl estradiol per day) over a sustained period of time due to low rates of continuity with oral contraceptives. The first studies conducted on this novel idea were published in the 1960s, and with time, new components were added and altered [48]. The ring, measuring about 54 mm in diameter, is currently made of the polymer ethylene vinyl acetate. The outermost layer is the portion that releases hormones evenly over time [30]. The most commonly used brand, Nuva Ring, was approved for contraceptive use in 2001 by the FDA [48]. For the ring to be effective, the device does not require a specific positioning in the vagina. However, it will be less likely to fall out the further back it is placed. The hormonal vaginal ring secretes hormones continually and is used for three weeks followed by a week-long period where it is withdrawn [49]. Efficacy is reduced if a new ring is not put into place within 24 hours after the 7-day period [58]. The hormonal vaginal ring is moderately invasive through insertion into the vagina. This may cause some discomfort for some women, and the device may be easily dislodged [54]. After discontinuation of the vaginal ring, all effects are rapidly reversible with ovulation resuming in as little as a few days or as long as a few months [49].

Typical side effects of the vaginal ring include increased vaginal secretion, breast tenderness, headache, nausea, and vaginitis [30]. Many of these effects are similar to those of other combined contraceptives. Effects and risks specifically associated with this device include coital issues, foreign body sensation, and ring expulsion [30,34]. Vaginal rings are safe for most women of reproductive age. Absolute contraindications for this method are shared with all other forms of combination contraceptives including coronary artery disease, diabetes, Lupus, and severe hypertension. Relative contraindications include thromboembolic disorders, cigarette smoking in women over the age of 35, known pregnancy, and localized migraines [30]. Some studies reveal that this method may decrease total cholesterol [50]. The vaginal ring itself, available in one universal size, costs up to \$80 (USD) depending on insurance coverage. Additional costs associated with a physician visit and physical exams can range up to \$250 (USD). Some clinics and drugstores offer to charge based on an individual's income [51].

The birth control sponge, shown in Figure 8, is a type of contraception used in the birth canal. The sponge contains a spermicide to prevent fertilization. In addition to the spermicide, the sponge also has virucidal and bactericidal components that can



Figure 8: Birth control sponge [52].



Figure 9: Diaphragm [61].

potentially serve as protection from STDs [53]. Most birth control sponges contain Nonoxynol-9, which immobilizes sperm through the disruption of the sperm cell membrane. Findings show that this spermicide can impede diseases such as gonorrhea, chlamydial infection, candidiasis, genital herpes, syphilis, trichomoniasis and HIV [54]. However, it is highly advised that aside from the birth control sponge, other protection be used to prevent these diseases. The sponge can be used as a contraception method for up to 24 hours. The birth control sponge was developed as an alternative to the contraceptive diaphragm [65]. This method of contraception is among the least effective, failing approximately 10% percent of the time [56]. However, some studies show that the sponge is only 75% effective [57]. Possible risks that can occur when using the birth control sponge include pregnancy, irritation, discomfort and vaginitis. A rare side effect is toxic shock syndrome. It is advised that the sponge not be used during menses or during the six week period after childbirth [58]. The birth control sponge is available over the counter. This method of contraception is relatively inexpensive ranging from \$10 to \$15 (USD).

### Diaphragm or cervical cap

The diaphragm is a method of female contraception that impedes sperm from entering the cervix, as shown in Figure 9 [59]. There

are two kinds of contraceptive caps which are the diaphragm and the cervical cap [60]. Diaphragms tend to be larger in size than the cervical cap, about the size of the palm of the hand [60]. Cervical caps are much smaller, about the size of a small egg cup [60]. Use of the diaphragm is more common than that of the cervical cap. To use the diaphragm, a woman must situate the device in such a manner that it will barricade the sperm from reaching the cervix [60]. The majority of diaphragms are installed in a dome down method, but certain forms of diaphragms exist that can be placed in a dome up position [59]. The less common cervical cap has to be positioned directly on the cervix to detain the sperm from entering [60]. The preference between a cervical cap and the diaphragm are dependent on the woman, though typically women find it troublesome to keep the diaphragm in place due to their vaginal shape. For this reason, cervical cap use is more common in the United States [60].

Diaphragms are typified by their dome shape visualized in Figure 9. They are flexible and made of silicone with a spring activated rim which serves to obstruct sperm from reaching the cervix [59]. The diaphragm is kept in place by these rims which may be a flat- spring rim, coil-spring rim, or an arcing-spring rim generating a seal around the vaginal wall [59]. The diaphragm is a non-hormonal method of contraception. Diaphragms are frequently used alongside spermicides, utilizing chemical contraceptives such as Nonoxynol-9 to further facilitate and aid in the prevention of unwanted pregnancies [59]. When employing a diaphragm it is endorsed to apply two strips of spermicide on the superior surface of the diaphragm [59].

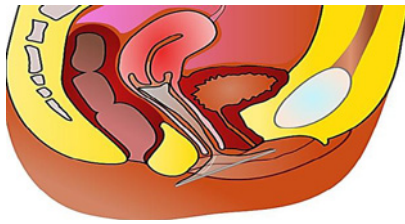
Current research and design initiatives are focused on a type of diaphragm made from silicone elastomer that has the unique ability to release an administered dose of spermicide, Nonoxynol-9 (N-9) [62]. For a patient to acquire a diaphragm, fitting must take place. The process of fitting is done through pelvic exam [59]. A diaphragm is a removable method of contraception [59]. Following the withdrawal of a diaphragm it must be rinsed in lukewarm water with soap and dried [59]. There is an advised time of use of one year for a diaphragm, but if properly maintained, this lifespan can be stretched to two years [59]. There may be a need to for a refitting postpartum, or if the patient has had a 15 pound change in weight, or following any gynecological procedures [59].

Indications for the use of diaphragms include inability to use hormonal contraceptives, postpartum status, and low frequency of sexual activity [59]. Contraindications for the use of a diaphragm include gynecological abnormalities, insufficient vaginal muscle-tone, wounds in vaginal wall, and critical cystocele or rectocele among other factors [59]. Possible side effects include the possibility of urinary tract infections (UTIs) [59]. Today, diaphragms and cervical caps have been overshadowed by oral contraceptives. They are only used by a small population of women, and currently are experiencing low approval among women [63].

### Female condom

The female condom is a barrier contraceptive that functions similarly to a male condom. However, it is worn by the female partner internally rather than the external covering of the male condom. The main function of this contraceptive method is to protect against pregnancy and sexually transmitted diseases. It creates a physical separation between the genitals using a polyurethane material,





**Figure 10:** Female condom [65].

visualized in Figure 10 [64].

The female condom has two flexible rings at the end, one which is used to insert the condom inside the vagina, and the other which covers the outer parts of the external genitalia [64]. This product was created to give women more control over the prevention of STDs [66]. A man might refuse to wear a condom but by using this, the female can protect herself accordingly. Moreover, this method of contraception allows for insertion prior to intercourse without disrupting sexual activity [67]. Even though this method of contraception is not used as commonly as the male condom, it is still just as available and offers the same or better protection than its male counterpart.

The female condom offers some benefits over the male condom. Providing women with a condom suited to their anatomy increases the control women have over their health [67]. The polyurethane material is thicker and is less susceptible to forming holes than latex [64]. It is also a great alternative for those who might have a latex allergy. In terms of protection provided, studies suggest that the female condom is just as protective as the male condom, if not more so. The female condom can reduce the risk of women getting HIV by 90% [68].

Female condoms are readily available to obtain for anyone of any age or gender. These condoms are found at local drugstores in the United States (US), without a prescription, for approximately \$6 (USD) for a box of eight depending geographic location in the US. No identification is required to buy this contraceptive method, thus age is not a restriction in obtaining them. Moreover, the female condom is provided via Medicare for beneficiaries in 32 states [66]. They are also available at some family planning centers or local health centers, such as a Planned Parenthood health center free of charge.

### Spermicide

Spermicides are chemical agents that disrupt the sperm cell membrane, decrease sperm motility and eventually destroys the sperm. The most commonly used spermicides include N-9 methoxy polyoxyethylene glycol 55 laurate, and p-methyl phenyl polyoxyethylene [59]. Spermicides come in various forms including cream, foam, soluble film, jelly, tablet, and suppositories. This method of contraception commonly supplements other methods such as diaphragms and cervical caps among others. Research shows that the resulting rate of pregnancy with spermicide use is 6 to 18% compared with 26 to 28% with just the conventional barrier method. However, the efficiency of spermicides is increased when used with barrier devices like diaphragms and cervical caps as previously discussed. Possible reasons for mechanism failure include reduced contact times between the semen and spermicide. Other reasons include the failure

of spermicide distribution [63].

Due to their availability, spermicides are a common method of contraception around the world. Typically, spermicides should be left on for 6 to 8 hours after intercourse in order to work efficiently [69]. The application of spermicides varies depending on the specific spermicide being utilized. If the spermicide is being used as a supplement contraceptive it is typically recommended to situate the barrier contraceptive with the spermicide in a way that it covers the cervix. In a scenario in which a woman is utilizing a spermicide delivered as foam, intercourse has to take place instantly after application. If a woman is utilizing jellies and creams the wait time for intercourse should be 2 to 3 minutes after application. In dealing with suppositories and foaming tablets the wait time for intercourse should be 3-15 minutes after the application of the spermicide. Finally, when dealing with soluble films the wait time for intercourse should be 30 minutes and these times should not be exceeded [59].

Studies show that women who utilize diaphragms supplemented by spermicides have a higher possibility of acquiring a urinary tract infection (UTI). Some of the adverse reactions include a higher risk UTIs in women that use spermicides as a form of contraception than women that apply distinct contraception methods. Patients that are pregnant or plan to get pregnant are advised against spermicides due to the unfavorable effects including spontaneous abortions and development of Down syndrome [70].

### Natural planning or fertility awareness

Contraceptive methods based on fertility awareness are those methods that involve the identification of monthly fertility patterns in women. Natural awareness methods predict women's fertility by identifying physical signs and symptoms, such as cervical secretions and basal body temperature, which change with hormonal fluctuations during the menstrual cycle [71]. Women who do not want a pregnancy practice sexual abstinence during the days of the month in which they are fertile. Usually, women who choose natural planning or fertility awareness as a contraceptive method fall between the ages of 19 and 29 years old.

Fertility awareness-based methods are performed monthly during the menstrual cycle. The method is highly effective as long as women avoid having sex during days of ovulation/fertile days [71]. These methods are noninvasive and do not require medical procedures performed by a physician. Fertility awareness-based methods of contraception are fully reversible. They can be conversely used as a pregnancy method by engaging in sexual activity during the fertile days of the menstrual cycle [72].

Contraindications include physical separation and lack of support from male partners that contribute to the failure or discontinuation of fertility awareness-based methods. Unless women have adequate communication, respect from their parents, deeper intimacy, and a working understanding of the reduced frequency of sexual intercourse involved with this method, then fertility awareness-based methods are contraindicated [72]. One of the benefits of this fertility awareness method is its low cost.

### Tubal ligation

Tubal ligation, a method of female sterilization, is a type of permanent birth control by which a woman has her fallopian tubestied,

closed, or cut to prevent a pregnancy. The procedure is intended to block the passage of eggs from the ovaries into the fallopian tubes, where they could be fertilized by sperm [73]. Though available since the early 1900s, it was not until the 1960s when cultural changes increased the popularity of female contraception and millions of women had more access to sterilization procedures, such as tubal ligation, when insurance companies decided to cover them [73].

Tubal ligation is more common among women who belong to minority groups, and those who have lower income and education levels [74]. Similar to other permanent methods of contraception, tubal ligation tends to be more common in older women and women who already have children. About 700,000 tubal ligations are performed in the United States each year, with approximately eleven million US women relying on it as their primary method of contraception [75]. This is a highly effective method of permanent contraception; however, it is not one hundred percent effective. One year after the procedure, five out of one thousand women (0.5%) have a risk of becoming pregnant. Five years after the procedure, around thirteen out of a thousand women (1.3%) may have become pregnant [75].

Tubal ligation is a surgical procedure which blocks, ties, or cuts the fallopian tubes. It can be done by laparoscopy in which a viewing and a surgical instrument are inserted through two small incisions in the abdomen. Tubal ligations performed after childbirth is performed via mini-laparotomy within 36 hours of the baby being delivered [75].

Ligation can also be accomplished with the use of tubal implants. These implants are small metal springs inserted in the fallopian tubes in a nonsurgical procedure that only requires local anesthesia or oral analgesics [76]. The cervix is first dilated and then a catheter that places the implant passes through the cervix into the uterus and into the fallopian tubes. An X-ray is taken after the procedure to assure that the implants were placed correctly and that the tubes are closed [76]. When tubal implants, such as Essure, are used, the sterilization is not immediately effective which forces women to use additional contraception for another three months until permanent tubal ligation occlusion is verified [76]. Both surgical and nonsurgical methods of tubal ligation are performed by a gynecologist or general surgeon.

Depending on the age of the patient, the method of tubal ligation, and the overall health of the reproductive organs, tubal ligation reversal- or tubal anastomosis- is possible. Tubal ligation reversal is done by laparoscopy in which the surgeon unties the tubes or removes any implants that block them [77]. The surgeon then proceeds to reconnect the ends of the tubes to the uterus. When compared to *in vitro* fertilization (IVF) procedures, tubal ligation reversal was the most cost-effective method for women less than 41 years of age who desired to become pregnant after a previous tubal ligation [77]. For women older than 41, the success rate of pregnancy after tubal ligation was higher with the use of IVF than by tubal ligation reversal.

Complications stemming from tubal ligation procedures are uncommon. However, of the minor complications possible, infection and separation of the wounds are the most likely. Major complications that could occur are severe blood loss, anesthesia-related problems, need for a larger incision during surgery, and perforation of organs

when the laparoscope is inserted into the abdominal cavity. Risks associated with the surgery tend to increase when women suffer from other conditions, such as diabetes, obesity, or cardiovascular problems.

In the event that tubal ligation is not effective, a pregnancy is likely to occur, with an increased risk of ectopic pregnancy [78]. Ectopic pregnancies happen when a fertilized egg implants in the fallopian tubes or other regions of the abdomen rather than in the uterus. This condition requires emergency treatment. Symptoms of ectopic pregnancies include nausea, vomiting, abdominal cramps, weakness, and pain on one side of the body. An ectopic pregnancy could lead to fallopian tube rupture and cause severe pain and bleeding.

The uncertainty of a patient in regards to tubal ligation is a contraindication for this type of birth control. The decision to perform a tubal ligation should be treated as a permanent, irreversible procedure, despite the possibility of a future tubal ligation reversal or a pregnancy through *in vitro* fertilization [78]. The patient should ask for the procedure herself, without external pressure, when she is in a competent state of mind to make such decisions. Tubal ligation performed via laparoscopy is contraindicated in patients suffering from diaphragmatic hernias and severe cardiopulmonary diseases [73]. Compression of the vena cava diminishes cardiac return, leading to cardiac decompensation. Splinting of the diaphragm by laparoscopic techniques may also reduce respiratory tidal flow [73]. Considerations needs to be given to obese patients in which the presence of morbid obesity take laparoscopy out of the list of low-risk surgeries when safer procedures are available. For gynecologic pathologies, such as ovarian tumors and pelvic relaxation, in which hysterectomies are suggested, the use of laparoscopic tubal ligation is obviated. The current costs of tubal ligation range from \$0 to \$6,000 (USD). The mean cost for the tubal ligation procedure was \$5,163 (USD) among commercially insured women in the United States. During a six-month follow-up of 7,286 women who had undergone laparoscopic bilateral ligation, the total medical and prescription costs were \$7,568 (USD) [79].

Tubal ligation has been associated with lower incidence, stage, and mortality among women with aggressive endometrial carcinomas. Tubal ligation prevents the passage of endometrial carcinoma cells from the fallopian tubes into the peritoneum, which seems to be a crucial step in the development of endometrial cancer [80]. Tubal ligation has also been associated with reduced risk of invasive ovarian cancer. The tubal ligation procedure has protective effects that are mediated by the ablation or prevention of ovarian seeding by precancerous cells from the uterus and fallopian tubes [80].

### Transcervical sterilization

Transcervical sterilization is a permanent method of birth control. As shown in Figure 11 & 12, a small metal coil is inserted into each of the two fallopian tubes [82]. Over the next 3 months, scar tissue forms around each of the metal coils and acts as a plug which prevents transport and fertilization of eggs [83].

Sterilization does not protect against sexually transmitted infections, so a method of STI prevention should be used in addition to this procedure. The first transcervical sterilization method was approved in the United States in 2002 [85]. It is the second most



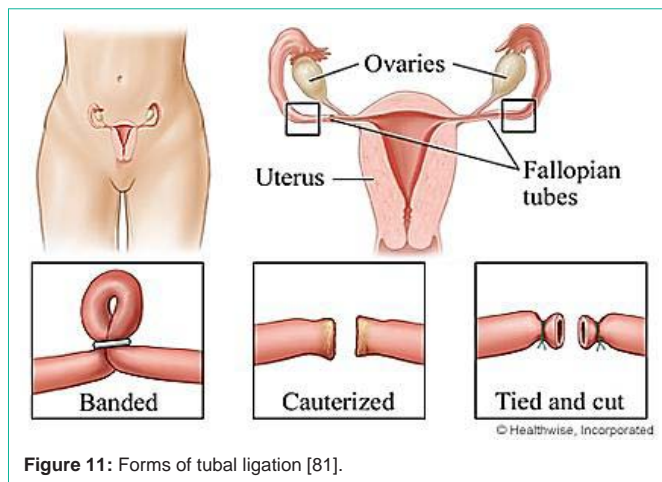


Figure 11: Forms of tubal ligation [81].

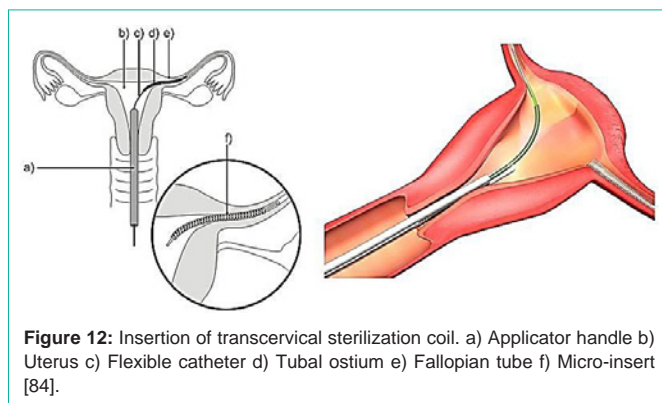


Figure 12: Insertion of transcervical sterilization coil. a) Applicator handle b) Uterus c) Flexible catheter d) Tubal ostium e) Fallopian tube f) Micro-insert [84].

commonly used contraceptive method for women between the ages of 15-44 and has been used by approximately 9.4 million women in the United States [86].

Sterilizations can be performed either laparoscopically through a small set of incisions made in the abdomen, or hysteroscopically through a tube that is inserted through the vagina that allows for visualization of the uterus [87]. Progress has been made to replace minimally invasive techniques with even less invasive techniques that can be performed using only anesthesia to numb the affected area and without the need for incision [88]. The hysteroscopic procedure is considered to be a one-day procedure in which the woman can return to her normal activities within the same day of treatment [82]. Sterilization is a permanent method of birth control and is not reversible. However, other methods of birth control should be used in the three months following application while the scar tissue takes its time to form and plug the fallopian tube [87]. Women may experience some discomfort during or after the procedure such as pain, dizziness, nausea, or light bleeding.

Approximately 8% of first attempts at placing the insert are unsuccessful [89]. If the fallopian tube is not completely blocked off, due to misplacement, additional birth control methods should be used to prevent pregnancy [90]. Once a healthcare provider confirms that the fallopian tube is completely occluded, transcervical sterilization is effective at preventing more than 99% of pregnancies [83]. If pregnancy does occur, there is an increased likelihood that the pregnancy is ectopic. In the case of injury or continuous pain, the

device can be removed by a follow-up surgical procedure [90].

Sterilization should not be performed for women that are currently pregnant, delivered or terminated pregnancy 6 weeks prior to insertion, had a recent pelvic infection, proximal tubal occlusion, are currently taking immunosuppressants, or have a malformed uterus known as unicornuate uterus [91]. Depending on the facility and insurance used, sterilization can cost between \$0 and \$6,000 (USD) [92].

### Emergency contraception

Emergency contraceptive is a broad, umbrella term for chemical contraceptives that can be taken or implanted after unprotected sexual intercourse [93]. The way an emergency contraceptive works is in prevention of the fertilization of an egg by a sperm even after sexual intercourse. It is used only as a method to prevent pregnancy, not to prevent the transmission of sexually transmitted diseases [94]. The benefit of this contraceptive method is to prevent pregnancy from outside sources such as the failure of another contraceptive method, partner refusal, or other sexual assault, among others. There are two main types of emergency contraceptives: the morning-after pill and copper IUD.

The morning-after pill lowers the chances of pregnancy but is less effective than OCPs. This pill estimates a range of effectiveness between 52% and 94% in reducing pregnancy risk [95]. Under this category there are two pills that are the most widely used- Ella and Plan B. The Ella pill is most effective and can be used up to 5 days after unprotected sex, but requires a prescription. It works by preventing ovulation, even during the time in your cycle when a woman is most fertile, for five full days following unprotected sex [96]. The Plan-B pill is not as effective and can be used up to 5 days after unprotected intercourse, but works better the earlier it is used. However, unlike Ella, no prescription is needed. Plan-B works by stopping the release of an egg from the ovary and by preventing fertilization of the egg [97]. For both pills, there are several side effects such as headaches and nausea, but few users have demonstrated serious adverse effects [97].

The copper IUD is a copper-releasing device that is placed in the uterus and is used to prevent a pregnancy. It can be placed up to five days after having unprotected sex. It has an effectiveness of 99% after placement for the next ten years [98]. Using a copper IUD, however, does have side effects, namely a longer and heavier period for several months and an increased possibility of pelvic inflammatory disease [98]. This method requires a prescription by a health care provider. Using a copper IUD requires removal prior to attempting becoming pregnant.

### Ethical Considerations

#### State laws

The Patient Protection and Affordable Care Act of 2010 commonly referred to as Obamacare or the ACA is a federal law that has set a standard of health care coverage for nationwide insurance companies. A key provision of this law pertaining to reproductive health requires that counseling or educational services and contraceptive methods including diaphragms, sponges, birth control pills, vaginal rings, IUDs, emergency contraception, and sterilization are covered at no additional cost, without a copayment or coinsurance [99].

Some state laws have been revised to match or expand the requirements outlined by the ACA. For instance, three states-California, Illinois, and Vermont-now mandate insurance coverage of over-the-counter contraceptive methods although they may require a valid prescription [100]. In addition, many states including California, District of Columbia, Hawaii, Illinois, Oregon, and Vermont have expanded the ACA requirements to cover an extended supply of contraceptive methods. An extended supply would mean that enough treatment for one year is provided during one visit [100]. Despite recent attempts to repeal the ACA, some states like Virginia have made strides towards protecting coverage of female contraceptives by introducing state laws that will explicitly continue coverage even without the ACA [101].

### Minors and consent laws

Consent laws outline the age and conditions at which one is able to agree to contraceptive treatments, testing and treatment for sexually transmitted infections, prenatal care, abortion services, adoption services, prenatal healthcare, and healthcare for the minor's child [102]. A majority of states, in addition to the District of Columbia, allow minors as young as 12 years old to consent to contraceptive treatments given that they meet the state's criteria as previously mentioned. However, Alabama, Hawaii and Pennsylvania only allow minors of 14 years of age or older to consent to such services [103]. All minors, women under the age of 17, are allowed access to testing and treatment for sexually transmitted infections [102]. Each state differs in their policies that explicitly allow for minors to consent to contraceptive services. Some states can allow for all minors to consent while other states require that other criteria be met including: minimum age, current parenthood, current pregnancy or previously pregnancy, high school graduation, maturity, or physician determination that the minor's health is at risk.

Currently, there are 25 states that require circumstances to be met in order for minors to be eligible to manage their use of contraceptive services without guardian involvement. For instance, restrictive state policies can be found in states like Connecticut, Indiana, Michigan, or Vermont in which minors can only consent if they are married [103]. A total of 21 states, in addition to the District of Columbia, allow all minors to consent. Of those 22 locations, states such as Kentucky, Maryland, Minnesota, Montana, and Oregon provide physicians the choice to inform the minor's parents. However states such as Massachusetts, New York, and Wyoming provide confidential services, meaning that the minor's health care decisions are kept private. There are 4 states - North Dakota, Ohio, Rhode Island, and Wisconsin - that currently do not have explicit policies about minor consent [103].

Contraceptive methods are typically equally effective for women of all ages. However, age, alongside potential desire of children in the future, is an important factor considered when determining an appropriate method, especially for irreversible contraceptive treatments.

### Rape/Incest

Rape is understood to be non-consensual sexual intercourse between two people. However, in the United States the age of sexual consent varies from 16-18 years old depending on the state [104].

Accordingly, it is illegal for anyone to have a sexual encounter with anyone under 16-18 years old depending on the state, though exceptions may apply when the person is married or if the other party is a minor and the sexual activity is consensual [105]. Studies have indicated that at least half of children born to female minors are fathered by adult men, also known as statutory rape [106]. One method to empower women to have more control in unequal sexual relationship is to increase their access to and the availability of emergency contraceptives. There have been some cases in which rape victims were not allowed to be prescribed emergency contraceptives [107]. However, now with the establishment of federal and state rape laws, all states provide necessary care for rape victims [108].

Incest is usually defined as sexual intercourse between members of an immediate family. This includes between a father and his child, a mother and her child, or siblings [109]. Different states, however, have different laws defining incest and how it is to be addressed in a court of law. These definitions of incest can include sexual intercourse between stepfamilies - such as a stepfather with his stepdaughter. Rape and incest can be closely affiliated and often co-occur if one party is a minor and cannot consent. Similar to rape laws, if a person experiences incest, all states provide emergency contraceptives or abortion methods in order to avoid unwanted pregnancy [108].

### Ethical case example

Contraception has been an area of discussion and debate in the world of ethics and medicine. Many religious backers do not find it moral for people to use contraceptive methods because it prohibits a life from forming that some higher power might have desired wanted that life to be born. Notably, in the *Zubik v. Burwell* case from 2016, some employer's insurance users are looking for an insurance company that will not provide contraceptive coverage because of their religious beliefs and ideologies [110]. Moreover, another big issue with the field of contraceptives is the ambiguity with how exactly these contraceptives work [111]. Push back from the FDA with approval of pills such as Ella or Plan B were once a very big issue for anyone who might be taking these emergency contraceptives but they have now been cleared and allowed to be used by the general public.

### Conclusion

Currently, the most common methods of contraception used in the United States are combined oral contraceptives, female sterilization, the male condom, and IUDs, respectively. In recent years, the use of IUDs has increased as the lack of evidence of association with their use and PID has been widely disseminated. However, despite the increase in utilization of female contraceptive methods, tremendous tumult exists surrounding the discussion of a woman's right to reproductive freedom. Though outside of the scope of this discussion, it remains of critical importance that women are able to obtain the information necessary to learn more about each method, its proper use and the statistics regarding its efficacy. The preceding discussion outlined the use of sixteen FDA approved contraceptive methods in addition to an ethical consideration of the issues of contraception in the United States. The provided Summary Table 1 is intended to be used as a quick reference tool for both students and those looking to compare methods for personal use. The information provided above does not substitute for the judgment of a trained medical professional.

## Acknowledgement

D.P.S., J.B., and J.T. would like to thank Dr. Marin Gillis, Dr. CV Rao and Dr. Elizabeth Gray for their reviews of this paper. We would further like to acknowledge Dr. Sabyasachi Moulik for his edits of the piece. We would also like thank the Florida International University Undergraduate Honors Bioethics students for their assistance, contributions and efforts in making this resource possible.

## Author Contributions

Dharam Persaud-Sharma conceived of the study, participated in its design and coordination and drafted the manuscript; Joseph Burns participated in its design and coordination and helped to draft the manuscript; Jeran Trangle participated in its design and coordination and helped to draft the manuscript; Jorge Agudelo helped to draft the manuscript; Joselyn Alvarez Gonzalez helped to draft the manuscript; Daniella Nunez helped to draft the manuscript; Katherine Perez helped to draft the manuscript; David Rasch helped to draft the manuscript; Samantha Valencia helped to draft the manuscript; CV Rao helped to draft the manuscript. All authors read and approved the final manuscript.

## References

- Bongaarts J. The Impact of Family Planning Programs on Unmet Need and Demand for Contraception. *Stud Fam Plann.* 2014; 45: 247-262.
- Daniels K, Daugherty J, Jones J. Current Contraceptive Status Among Women Aged 15-44: United States, 2011-2013. Washington, D.C: US Department of Health and Human Services. 2014; 173: 1-8.
- Finer L. Unintended Pregnancy Among U.S. Adolescents: Accounting for Sexual Activity. *J Adolesc Health.* 2010; 47: 312-314.
- United Nations, Department of Economic and Social Affairs, Population Division (2015). Trends in Contraceptive Use Worldwide 2015 (ST/ESA/SER.A/349).
- Melaku YA, Berhane Y, Kinsman J, Reda HL. Sexual and reproductive health communication and awareness of contraceptive methods among secondary school female students, northern Ethiopia: a cross-sectional study. *BMC Public Health.* 2014; 14.
- Narring E, Wylder H, Michaud P. First sexual intercourse and contraception: a cross-sectional survey on the sexuality of 16–20-year-olds in Switzerland. *Schweiz Med Wochenschr.* 2000; 130: 1389-1398.
- Mollen C, Barg F, Hayes K, Gotcsik M, Blades N, Schwarz D. Assessing Attitudes About Emergency Contraception Among Urban, Minority Adolescent Girls: An In-depth Interview Study. *Pediatrics.* 2008. 122: e395-e401.
- Merkh R, Whittaker P, Baker K, Hock-Long L, Armstrong K. Young unmarried men's understanding of female hormonal contraception. *Contraception.* 2009; 79: 228-235.
- Che Y, Cleland JG, Ali MM. Periodic abstinence in developing countries: an assessment of failure rates and consequences. *Contraception.* 2004; 69: 15-21.
- Abstinence. *Planned Parenthood.* 2016.
- Levine E, Ehrlich A. Intrauterine device. 2016.
- Patient Fact Sheet: Copper T IUD. ARHP org. 2017.
- "File:luddiagram.jpg". Commons.wikimedia.org. N.p., 2017. Web. 3 July. 2017.
- Chi I, Feldblum PJ, Rogers SM. IUD-Related Uterine Perforation: An Epidemiologic Analysis of a Rare Event Using an International Dataset. *Contracept Deliv Syst.* 1984; 5: 123-130.
- Brunsell S. CURRENT Diagnosis & Treatment in Family Medicine. 2017.
- Thiery M. Pioneers of the intrauterine device. *Eur J Contracept Reprod Health Care.* 1997; 2: 15-23.
- World Health Organization Department of Reproductive Health and Research (WHO/RHR) and Johns Hopkins Bloomberg School of Public Health/Center for Communication Programs (CCP). Family Planning: A Global Handbook for Providers. Baltimore and Geneva: CCP and WHO, 2007.
- Mirk S. Mirena IUD [Digital Image]. 2016
- Kailasam C, Cahill D. Review of the safety, efficacy and patient acceptability of the levonorgestrel-releasing intrauterine system. *Patient Prefer Adherence.* 2008; 2: 293-302.
- Mishell DR Jr. Intrauterine Contraception: Benefits to Patients. *J Fam Pract.* 2004; S9-14.
- Birth Control Implant (Implanon and Nexplanon). *Planned Parenthood.* 2017.
- Insertion of contraceptive implant-Mayo Clinic. 2017. Mayo Clinic.
- Contraceptive Implants-Product Brief. Caucus on New and Underused Reproductive Health Technologies. 2012.
- Winner B, Peipert JF, Zhao Q, Buckel C, Madden T, Allsworth JE, et al. Effectiveness of long-acting reversible contraception. *N Engl J Med.* 2012; 366: 1998-2007.
- Contraceptive Guidance for Health Care Providers - Implants. 2017. CDC.
- IMPLANON™ (etonogestrel implant) 68 mg. 2009.
- Contraceptive implant Risks-Mayo Clinic. 2015. Mayo Clinic.
- Kim CR, Fønhus MS, Ganatra B. Self-administration of injectable contraceptives: a systematic review. *BJOG.* 2017; 124: 200-208.
- Stacey D. Depo Provera and Weight Gain [Digital image]. 2015
- Shoupe D, Mishell DR. The handbook of contraception: a guide for practical management. Cham: Humana Press. 2016.
- Westhoff C. Depot-medroxyprogesterone acetate injection (Depo-Provera®): a highly effective contraceptive option with proven long-term safety. *Contraception.* 2003; 68: 75-87.
- Dhanjal MK. Contraception in women with medical problems. *Obstetric Medicine.* 2008; 1: 78-87.
- Long acting reversible contraception: the effective and appropriate use. London: RCOG Press. 2005.
- Curtis KM, Jatlaous TC, Tepper NK. U.S. Selected Practice Recommendations for Contraceptive Use, 2016. *MMWR Recomm Rep.* 2016; 65: 1-66.
- Trussell J, Leveque JA, Koenig JD, London R, Borden S, Henneberry J, et al. The economic value of contraception: a comparison of 15 methods. *Am J Public Health.* 1995; 85: 494-503.
- Planned Parenthood. Birth Control Shot (Depo-Provera). 2017.
- Winikoff B, Wymelenberg S. The whole truth about contraception: a guide to safe and effective choices. Washington, DC: Joseph Henry Press. 1997.
- Blaus B. Birth Control Pills [Digital Image]. 2016.
- Hatcher RA, Trussell J, Nelson AL, Cates W Jr, Stewart F, Kowal D. Contraceptive technology. New York, NY: Ardent Media. 2008.
- Sherif K. Benefits and risks of oral contraceptives. *Am J Obstet Gynecol.* 1999; 180: S343-348.
- Thought Catalog. Birth Control Pills [Digital image]. 2013.
- Freeman S, Shulman LP. Considerations for the use of progestin-only contraceptives. *J Am Acad Nurse Pract.* 2010; 22: 81-91.
- Hall KS, Trussell J, Schwarz EB. Progestin-only contraceptive pill use among women in the United States. *Contraception.* 2012; 86: 653-658.
- Melo NR. Estrogen-free oral hormonal contraception: benefits of the



- progestin-only pill. *Women's Health*. 2010; 6: 721-735.
45. What birth control method is right for you? 2017.
  46. Planned Parenthood. How Do I Get Birth Control Pills? 2016.
  47. McKesson Corporation. How to Insert a Vaginal Ring [Digital image]. 2014.
  48. Guazzelli CA, Barbieri M, Vieira CS, Torloni MR. New Developments in Vaginal Rings for Contraception. *Current Obstetrics and Gynecology Reports*. 2014; 3: 43-149.
  49. Roumen F, Apter D, Mulders T, Dieben T. Efficacy, tolerability and acceptability of a novel contraceptive vaginal ring releasing etonogestrel and ethinyloestradiol. *Human Reproduction*. 2011; 16: 469-475.
  50. Mishell DR. Vaginal Contraceptive Rings. *Annals of Medicine*. 1993; 25: 191-197.
  51. Planned Parenthood. Birth Control Vaginal Ring (NuvaRing). 2017.
  52. "Éponge spermicide.jpg". Commons.wikimedia.org. N.p., 2017. Web. Retrieved 3 July 2017.
  53. Ayotte N, Colin P. Spermicidal Activity of a New Contraceptive Sponge. *Adv Ther*. 2002; 19: 219-228.
  54. Hassan E, Creatsas G, Gravanis A, Georgoulas V, Psychoyos A. Anti-STD Vaginal Contraceptive Sponges. *Ann N Y Acad Sci*. 1997; 816: 451-456.
  55. Kuyoh M, Toroitich-Ruto C, Grimes D, Schulz K, Gallo M. Sponge versus diaphragm for contraception: a Cochrane review. *Cochrane Fertility Regulation Group*. 2003; 67: 15-18.
  56. Birth-control sponge near U.S. return. *Women's Health Weekly*, 57. 2004.
  57. Cunnigham GF, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, et al. *William Obstetrics* (24th ed.). McGraw - Hill Education. 2014.
  58. Edelman DA. The vaginal contraceptive sponge. 1984.
  59. Levine E, Ehrlich A. *Barrier Contraceptive Method*. 2016.
  60. Delvin D. Contraception – diaphragms and cervical caps. 2017.
  61. "Contraceptive diaphragm.jpg". Commons.wikimedia.org. N.p., 2017. Web. Retrieved 3 July 2017.
  62. Lee C, Bagdon R, Bhatt P, Chien Y. Development of silicone-based barrier devices for controlled delivery of spermicidal agents. *J Controlled Release*. 1997; 44, 43-53.
  63. Moench T, Chipato T, Padian N. Preventing disease by protecting the cervix: the unexplored promise of internal vaginal barrier devices. *AIDS*. 2001; 15: 1595-602.
  64. Farr GH, Gabelnick K, Sturgen L, Dorflinger. Contraceptive efficacy and acceptability of the female condom. *Am J Public Health*. 1994; 84:1960-964.
  65. "Contraception préservatif féminin.jpg". Commons.wikimedia.org. N.p., 2017. Web. Retrieved 3 July 2017.
  66. Witte Susan S, Kyle Stefano MSSW, Courtney Hawkins MSSW. "Can Medicaid Reimbursement Help Give Female Condoms a Second Chance in the United States?". *Am J Public Health*, 2010; 100, no. 10, pp. 1835-40, ABI/INFORM Collection; SciTech Premium Collection; Social Science Premium Collection.
  67. Gollub EL, ZA Stein. Commentary: The New Female Condom--Item 1 on a Women's AIDS Prevention Agenda. *Am J Public Health*. 1993; 83: 498-500.
  68. Trussell J, Sturgen K, Strickler J, Dominik R. Comparative Contraceptive Efficacy of The Female Condom and Other Barrier Methods. *Fam Plann Perspect*. 1994; 26: 66-72.
  69. Preventing Unintended Pregnancy during the Zika Virus Outbreak. Centers for Disease Control and Prevention.
  70. *Physical contraceptives-spermicides - Meyler's Side Effects of Drugs* (Sixteenth Edition). 2015.
  71. Frank-Herrmann P, Heil J, Gnoth C, Toledo E, Baur S, Pyper C, et al. (2007). The effectiveness of a fertility awareness based method to avoid pregnancy in relation to a couple's sexual behaviour during the fertile time: a prospective longitudinal study. *Hum Reprod*. 22: 1310-1319.
  72. Pallone S R, Bergus G R. Fertility Awareness-Based Methods: Another Option for Family Planning. *J Am Board Fam Med*. 2009; 22: 147-157.
  73. Tubal Sterilization. Retrieved May 02, 2017.
  74. Anderson JE, Jamieson DJ, Warner L, Kissin DM, Nangia AK, Macaluso M. Contraceptive sterilization among married adults: national data on who chooses vasectomy and tubal sterilization. *Contraception*. 2012; 85: 552-557.
  75. Tubal Ligation and Tubal Implants. (n.d.). Retrieved. 2017.
  76. Hurskainen R, Hovi S, Gissler M, Grahn R, Kukkonen-Harjula K, Nord-Saari M, et al. Hysteroscopic tubal sterilization: a systematic review of the Essure system. *Fertility and Sterility*. 2010; 9: 16-19.
  77. Messinger LB, Alford CE, Csokmay JM, Henne MB, Mumford SL, Segars JH, et al. Cost and efficacy comparison of in vitro fertilization and tubal anastomosis for women after tubal ligation. *Fertil Steril*. 2015; 104: 32-38.
  78. Peterson HB, Xia Z, Hughes JM, Wilcox LS, Tylor LR. The Risk of Ectopic Pregnancy after Tubal Sterilization. *Studies in Family Planning*. 1997; 28: 352.
  79. Carney PI, Yao J, Lin J, Law A. Comparison of Healthcare Costs Among Commercially Insured Women in the United States Who Underwent Hysteroscopic Sterilization Versus Laparoscopic Bilateral Tubal Ligation Sterilization. *J Womens Health (Larchmt)*. 2017; 26: 483-490.
  80. Felix AS, Brinton LA, Mcmeekin DS, Creasman WT, Mutch D, Cohn DE, et al. Relationships of Tubal Ligation to Endometrial Carcinoma Stage and Mortality in the NRG Oncology/ Gynecologic Oncology Group 210 Trial. *J Natl Cancer Inst*. 2015; 107.
  81. Marshall S, Olatunbosun F, FRCSC. (n.d.). Tubal Ligation Methods [Digital image].
  82. Transcervical tubal sterilization. (n.d.). Metroplex Health System.
  83. *Reproductive Health*. (2017, February 9). CDC.
  84. MU Dr. Havírov PK. ZavádeníspirályEssure - Wikimedia Commons [Placement of Essure Spiral]. 2015.
  85. Greenberg JA. Hysteroscopic Sterilization: History and Current Methods. *Reviews in Obstetrics and Gynecology*. *Rev Obstet Gynecol*. 2008; 1: 113-121.
  86. Daniels K, Daughert J, Jones J, Mosher W. Current Contraceptive Use and Variation by Selected Characteristics Among Women Aged 15-44: United States, 2011-2013. *Natl health stat reports*. 2015; 86: 1-14.
  87. *Contraceptive Guidance for Health Care Providers (US SPR)-Female Sterilization*. CDC. 2017.
  88. Palmer SN, Greenberg JA . Transcervical sterilization: a comparison of Essure® permanent birth control system and Adiana® permanent contraception system. *Rev Obstet Gynecol*. 2009; 2: 84-92.
  89. Garipey AM, Creinin MD, Smith KJ, Xu X. Probability of pregnancy after sterilization: a comparison of hysteroscopic versus laparoscopic sterilization. *Contraception*. 2014; 90: 174-181.
  90. *Hysteroscopic Sterilization. Women's Health Care Physicians - American College of Obstetricians and Gynecologists*. 2017.
  91. *Hysteroscopic Tubal Occlusion for Contraception (Essure® and Adiana® Systems)*. U Care Clinical and Quality Management. Minnesota. 2016.
  92. *Sterilization for Women (Tubal Sterilization)*. (2016, April 8). Planned Parenthood.
  93. Dunn S, Guilbert É. SOCIAL SEXUAL ISSUES COMMITTEE. Emergency contraception. *J Obstet Gynaecol Can*. 2012; 34: 870-878.
  94. Raine T, Harper C, Leon K, Darney P. "Emergency contraception: Advance provision in a young, high-risk clinic population". *Obstet Gynecol*. 2000; 96: 1-7.

95. Trussell, James. "Emergency Contraception." *Emergency Contraception* (March 2011):
96. ella® Prescribing Information, Charleston, South Carolina, Afaxys, Inc., March 2015.
97. Plan B One-Step® Prescribing Information, Pomona, New York, Barr Pharmaceuticals, Inc., July 2009.
98. ParaGard® T 380A Intrauterine Copper Contraceptive. Prescribing Information, North Wales, Pennsylvania, Teva Women's Health. 2014.
99. Birth Control Benefits and Reproductive Health Care Options in the Health Insurance Marketplace.
100. Insurance Coverage of Contraceptives. Guttmacher Institute. 2017.
101. Laws Affecting Reproductive Health and Rights: State Policy and Trends in the First Quarter of 2017. Guttmacher Institute. 2017.
102. An Overview of Minors' Consent Law. Guttmacher Institute. 2017.
103. Minors' Access to Contraceptive Services. Guttmacher Institute. 2017.
104. "Age Of Consent By State". [Age-of-consent.us](http://age-of-consent.us). 2017.
105. Attorney, Sandra Norman-Eady Chief. "STATUTORY RAPE LAWS BY STATE." *Statutory Rape Laws by State*. 2003.
106. Donovan Patricia. "Special Report: Can Statutory Rape Laws Be Effective in Preventing Adolescent Pregnancy?" *Can Statutory Rape Laws Be Effective In Preventing Adolescent Pregnancy?*. 1996.
107. Smugar, Steven S. "Informed consent for emergency contraception: variability in hospital care of rape victims." *Am J Public Health*. 2000; 90: 1372-1376.
108. "State Policy Updates." Guttmacher Institute. 2017.
109. Lester, David. "Incest." *The Journal of Sex Research*, vol. 8, no. 4, 1972, pp. 268-285.
110. *Zubik v. Burwell*. Supreme Court. Google Scholar. 2016.
111. "Contraception." *Bioethics and Culture*. Adelaide Centre for Bioethics and Culture. 2013.
112. Lekovich J, Amrane S, Pangasa M, Pereira N, Frey M, Varrey A, et al. Comparison of Human Papillomavirus Infection and Cervical Cytology in Women Using Copper-Containing and Levonorgestrel-Containing Intrauterine Devices. *Obstet Gynecol*. 2015; 125: 1101-1105.
113. Sawaya G, Chirenje M, Magure M, Tuveson J, Ma Y, Shiboski S, et al. Effect of Diaphragm and Lubricant Gel Provision on Human Papillomavirus Infection Among Women Provided With Condoms. *Obstet Gynecol*. 2008; 112: 990-997.
114. Chiou CF, Trussell J, Reyes E, Knight K, Wallace J, Udani J, et al. Economic analysis of contraceptives for women. *Contraception*. 2003; 68: 3-10.
115. Haider S, Darney PD. Injectable contraception. *Clin Obstet Gynecol*. 2007; 50: 898-906.