

# **Fertility and Women With Cancer**

Although not everyone ends up having children, most people want to at least have the option. Cancer – and treatment for cancer – can sometimes make this harder or even take this option away, or it can raise doubts about whether having children is even the right thing to do.

How cancer treatment will affect your fertility depends on the type of treatment you get. Effects also depend on other factors, such as the type of cancer, where it is, your age and overall health, and your response to treatment.

If you can, talk with your doctor, nurse, or another member of your health care team about fertility **before treatment**. There might be ways to save or protect your fertility before and maybe even during treatment. But after treatment, options are often more limited. (Parents of children with cancer should consider this, too. These special concerns are addressed in the section called "Preserving fertility in girls and teens with cancer.")

Women with cancer face some fertility challenges. Some of the things that must be considered when trying to preserve fertility are:

- Age
- Diagnosis
- Type of cancer treatment
- Whether the cancer has spread to the ovaries
- Time (some fertility procedures might take too much time when the cancer is fast-growing) Chances of success many of the fertility procedures available are still experimental
- Need for a male partner some of the most effective methods in use require a partner or a sperm donor

Studies have suggested that women with cancer are less likely to be given information about preserving their fertility than men. If you're interested in having children in the future, you might need to start this conversation with your cancer team or your doctor.

Most cancer survivors can still choose to become a parent if they wish. It might not happen the way it was expected to before cancer, but if you can be flexible, you'll find that there are options to help.

## What is infertility?

Infertility is not being able to start or maintain a pregnancy. For a woman, it means that she either can't become pregnant or that she can't carry a baby full-term.

Women are infertile if:

- Their ovaries don't make mature eggs.
- Damage to the reproductive system keeps eggs from being fertilized.
- A fertilized egg cannot implant and grow inside the uterus.

# Talking to your cancer care team about fertility before your treatment

Before you start cancer treatment, talk to your health care team about any concerns you have about your fertility. An open discussion with him or her will help you plan your cancer treatment and know what to expect.

Sometimes your cancer doctor (oncologist) may not be well-informed about fertility problems, or might seem to look at this issue as less important than saving your life with cancer treatment. But you have a right to get your questions answered, even if it means getting a second opinion or seeing a specialist. You can talk to an oncologist, surgeon, gynecologist (OB/GYN), nurse, reproductive endocrinologist, or fertility specialist.

This is not a complete list of questions, but it should give you a good starting point as you begin talking with your doctor or nurse about having children.

- Will this treatment have any short- or long-term effect on my reproductive system? If so, what kind of effect and how long is it likely to last?
- Can anything be done to prevent infertility before I start cancer treatment?
- Will any of the options to preserve my fertility interfere with my cancer treatment?
- If I become infertile, what are my options for having a family, such as adoption, using a donor egg, or having another woman carry a pregnancy for me?
- Should I speak with a fertility specialist before treatment?
- Once I finish treatment, how will I know if I am fertile or infertile?
- How long should I wait to try to get pregnant after cancer treatment?
- Can cancer treatment damage my ovaries so that I lose some or all of my eggs, or go into early menopause?
- Is my cancer treatment likely to damage my uterus, heart, or lungs in such a way that I could have trouble with a full-term pregnancy?

# How cancer treatments can affect fertility in women

A lot of things must take place for a couple to make a baby, and a "system malfunction" at any point can lead to infertility. Cancer, or more often cancer treatments, can interfere with some part of the process and affect your ability to have children. Different types of treatments can have different effects.

- Chemotherapy
- Targeted and biologic (immune) therapies
- Bone marrow or stem cell transplant
- Radiation therapy
- Surgery
- Other treatments

### Chemotherapy

Most chemotherapy (or chemo) drugs can damage a woman's eggs and/or affect fertility. (Remember a woman is born with all the eggs she will ever have and they're stored in her ovaries.) The effect will depend on the woman's age, the types of drugs she gets, and the drug doses. This makes it hard to predict if a woman is likely to be fertile after chemo.

The chemo drugs *most likely* to cause egg damage and infertility are:

- Busulfan
- Carboplatin
- Carmustine (BCNU)
- Chlorambucil
- Cisplatin
- Cyclophosphamide (Cytoxan®)
- Dacarbazine
- Doxorubicin (Adriamycin®)
- Ifosfamide
- Lomustine (CCNU)
- Mechlorethamine
- Melphalan
- Procarbazine

• Temozolomide

On the other hand, the chemo drugs that have a *low* risk of damaging the eggs include:

- 5-fluorouracil (5-FU)
- Bleomycin
- Cytarabine
- Dactinomycin
- Daunorubicin
- Fludarabine
- Gemcitabine
- Idarubicin
- Methotrexate
- Vinblastine
- Vincristine

Talk to your doctor about the chemo drugs you will get and the fertility risks that come with them. If you'd like more information on a drug used in your treatment or a specific drug mentioned in this section, see our *Guide to Cancer Drugs*, ask a member of your health care team, or call us with the names of the medicines you're taking.

#### Chemo and pregnancy

**Age makes a difference:** Women who are treated for cancer before they are 35 have the best chance of becoming pregnant after treatment. Young women who stop having menstrual periods during treatment often start having periods again after they are off chemo for a while.

After chemo, fertility may not last as long: Girls who had chemo before puberty (the time when periods begin) or young women whose menstrual periods start back after chemo are at risk for early (premature) menopause. When a woman stops having periods long before the average age (about 51), it's considered *premature menopause*. She becomes infertile because her ovaries stop releasing eggs. Early menopause also means that the ovaries stop making the female hormones estrogen and progesterone.

**Periods don't always mean fertility:** Even if a woman's periods start back after cancer treatment has stopped, her fertility is still uncertain. Usually some eggs are destroyed by cancer treatment. You may need a fertility expert to help you find out if you are fertile.

**Avoid getting pregnant during chemo:** Many chemo drugs can hurt a developing fetus, causing birth defects or other harm. You might be fertile during some types of chemo, so you'll need to use very effective birth control. Talk with your doctor about this.

It can harm the baby if you get pregnant too soon after chemo: Women are often advised not to get pregnant within the first 6 months after chemo because the medicine may have damaged the

eggs that were maturing during treatment. If a damaged egg is fertilized, the embryo could miscarry or develop into a baby with a genetic problem. Studies about this are hard to find. This is something you should talk to your doctor about before trying to become pregnant.

See A Guide to Chemotherapy for more information on chemotherapy.

### Targeted and biologic (immune) therapies

Targeted drugs attack cancer cells differently from standard chemo drugs. Use of these medicines has increased a lot in recent years, but little is known about their effects on fertility or problems during pregnancy.

Bevacizumab (Avastin<sup>®</sup>) is one exception – studies have found that this drug can cause ovarian failure, and some women's ovaries never recover.

Another group of drugs that are of concern are targeted drugs called *tyrosine kinase inhibitors* (TKIs) such as imatinib (Gleevec<sup>®</sup>), which cause birth defects in lab animals. At this time the recommendation is that women talk to their doctors before becoming pregnant while taking TKIs.

See Targeted Therapy and Immunotherapy to learn more about these cancer treatments.

#### Bone marrow or stem cell transplant

Bone marrow or stem cell transplant usually involves high doses of chemo and sometimes radiation to the whole body before the transplant. In most cases, this permanently stops a woman's ovaries from releasing eggs. Talk with your doctor or nurse about this risk before starting treatment. See the "Chemotherapy" (above) and "Radiation therapy" (below) sections for more on these parts of the transplant.

If you'd like to learn more about transplants, see *Stem Cell Transplant (Peripheral Blood, Bone Marrow, and Cord Blood Transplants)*.

## Radiation therapy

Radiation treatments use high-energy rays to kill cancer cells. These rays can also damage a woman's ovaries. For a woman getting radiation therapy to the abdomen (belly) or pelvis, the amount of radiation absorbed by the ovaries will determine if she becomes infertile. High doses can destroy some or all of the eggs in the ovaries and might cause infertility or early menopause.

Even if the radiation is not aimed right at the ovaries, the rays can bounce around inside the body and might still damage the ovaries.

When radiation is directed inside the vagina, the ovaries absorb a high dose of radiation.

Radiation to the uterus can cause scarring, which restricts flexibility and blood flow to the uterus. These problems can limit the growth and expansion of the uterus during pregnancy, and increase the risk of miscarriage, low-birth weight infants, and premature births.

Sometimes radiation to the brain affects the pituitary gland. The pituitary gland normally signals the ovaries to make hormones, so interfering with these signals can affect ovulation (the release of

eggs from the ovaries). This might or might not affect fertility depending on the focus and dose of the radiation.

You may be fertile when you start getting radiation treatments, but it's important not to become pregnant until treatment is completed because radiation can harm the fetus. Talk with your doctor about this.

You can get more details about this type of treatment in *Understanding Radiation Therapy: A Guide for Patients and Families*.

### Surgery

Surgery on certain parts of the reproductive system can cause infertility. For some cancers, a hysterectomy is part of the treatment. A hysterectomy is surgery to remove the uterus (womb) either through the vagina or through a cut made in the abdomen (belly). Once the uterus is removed, a woman cannot carry a child.

The ovaries might be removed (called an *oophorectomy*) at the same time the uterus is taken out. Without ovaries, a woman can't get pregnant because she no longer has any eggs. In some women with early stage ovarian or cervical cancer, the surgeon will try to save one ovary, if possible, to preserve eggs, which might still allow a woman to become pregnant. Keeping at least one ovary also preserves the hormones that prevent menopause symptoms like hot flashes and vaginal dryness.

Some women with small cervical cancers can have a surgery called a *trachelectomy*, which removes the cervix but leaves the uterus behind so a woman can carry a pregnancy. (See "Radical trachelectomy" in the section "Preserving fertility in women with cancer.")

Sometimes surgery can cause scarring in the fallopian tubes. These scars may block the tubes and prevent eggs from traveling to meet the sperm. This means they can't become fertilized and move on to the uterus to implant in the lining.

A Guide to Cancer Surgery gives you more information on surgery as a cancer treatment.

#### Other treatments

Hormone therapies used to treat breast cancer or other cancers can affect your ability to have a child. The effect of some other treatments on fertility and pregnancy is not yet known. It's always best to talk to your doctor, nurse, or other member of your health care team about your treatment and any possible effects on your sexual function and fertility.

## Preserving fertility in women with cancer

The following chart shows current options for preserving fertility before, during, and after cancer treatment. Ideally, fertility discussions should take place before treatment, but we know this is not always the case.

You can use this information to learn more and then discuss your fertility options with your doctor. In some cases, you and your doctor might decide to use more than one option to try to preserve your fertility, especially if one option has a low or unknown success rate. Be sure that you

understand the risks and chances of success of any fertility option you are interested in, and keep in mind that no method works 100% of the time. Married women and those with long-term partners might want to include them in these discussions and decisions.

This chart can help you learn more about your current options. After the chart we discuss the details of the listed options in alphabetical order.

## Fertility options for women with cancer

Before treatment	During treatment	After treatment
Egg (oocyte) freezing	Fertility-sparing surgical procedure (for certain women with ovarian cancer)	Adoption <sup>+</sup>
Embryo freezing	GnRH treatment*	Donor eggs
GnRH treatment*	Oral contraceptive (birth control pill) treatment*	Donor embryos
Oral contraceptive (birth control pill) treatment*	Ovarian shielding	Natural pregnancy
Ovarian tissue freezing*	Radical trachelectomy (for certain women with cervical cancer)	Surrogacy <sup>+</sup>
Ovarian transposition		Using your own frozen eggs – see Egg (oocyte) freezing
		Using your own frozen embryos – see Embryo freezing
		Using your own frozen ovarian tissue – see Ovarian tissue freezing*

<sup>\*</sup> Experimental

#### Adoption

Adoption is usually an option for anyone who wants to become a parent. Adoption can take place within your own country through a public agency or by a private arrangement, or internationally through private agencies. Some agencies specialize in placing children with special needs, older children, or siblings.

<sup>&</sup>lt;sup>+</sup> May be available at any point in time

Most adoption agencies state that they do not rule out cancer survivors as potential parents. But agencies often require a letter from your doctor stating that you are cancer-free and can expect a healthy lifespan and a good quality of life. Some agencies or countries require a period of being off treatment and cancer-free before a cancer survivor can apply for adoption. Five years seems to be an average length of time.

There's a lot of paperwork to complete during the adoption process, and at times it can seem overwhelming. Many couples find it helpful to attend adoption or parenting classes before adopting. These classes can help you understand the adoption process and give you a chance to meet other couples in similar situations. The process takes different lengths of time depending on the type of adoption you choose. Most adoptions can be completed in 1 to 2 years.

Costs of adopting vary greatly, from less than \$4,000 (for a public agency, foster care, or special needs adoption) up to \$50,000 (for some international adoptions, including travel costs).

You may be able to find an agency that has experience working with cancer survivors. Some discrimination clearly does occur both in domestic and international adoption. Yet, most cancer survivors who want to adopt can do so.

### Donor eggs

Any woman who has a healthy uterus and can maintain a pregnancy can have in vitro fertilization (IVF; mature eggs are removed from a woman's ovaries, joined with sperm in the lab, and then put in a woman's uterus to develop) with donor eggs and a partner's (or donor's) sperm.

Donated eggs come from women who have volunteered to go through a cycle of hormone stimulation and have their eggs collected. In the United States, donors can be known or anonymous. Some couples find their own donors through programs at infertility clinics or on the Internet. Some women have a sister, cousin, or close friend who is willing to donate her eggs without payment.

Egg donors should have been screened carefully for sexually transmitted diseases and genetic illnesses. Every egg donor should also be screened by a mental health professional familiar with the egg donation process. These screenings are just as important for donors who are friends or family members. Everyone also needs to agree on what the donor's relationship with the child will be, and be certain that the donor was not pressured emotionally or financially to donate her eggs. You want to be sure that everyone agrees about what the child will or will not be told in the future.

The success of the egg donation depends on carefully timing hormone treatment (to prepare the lining of the uterus) with the removal and fertilization of the donor's eggs. If the woman receiving the donor eggs has ovarian failure (she's in permanent menopause), she must take estrogen and progesterone to prepare her uterus for the embryo(s). The eggs are taken from the donor and fertilized with the sperm. Embryos are then transferred to the recipient to produce pregnancy. After the transfer, the woman will continue to need hormone support until the placenta develops and can produce its own hormones.

Egg donation is often a successful treatment for infertility in women who can no longer produce healthy eggs. The entire process of donating eggs, fertilizing them with sperm, and implanting them usually takes 6 to 8 weeks per cycle. The major health risk for cancer survivors and babies is the risk of having twins or triplets. Responsible programs may transfer only 1 or 2 embryos to reduce this risk, freezing extras for a future cycle. The price of a donor egg cycle should include

the price of IVF plus any payment to the egg donor, but it's good to find out all the costs beforehand (see "Insurance and financial concerns" in the section called "Other fertility-related issues to think about").

#### Donor embryos

Any woman who has a healthy uterus and can maintain a pregnancy can have in vitro fertilization (IVF) with donor embryos. (IVF; a fertilized egg, an embryo, is put in a woman's uterus to develop.) This approach lets a couple experience pregnancy and birth together, but neither parent will have a genetic relationship to the child. Embryo donations usually come from a couple who has used assisted reproductive technology and has extra frozen embryos. When that couple has conceived or for some other reason chooses not to use those frozen embryos, they might decide to donate them.

One problem with this option is that the couple donating the embryo may not agree to have the same types of genetic testing as is usually done for egg or sperm donors, and they may not want to supply a detailed health history. On the other hand, the embryos are free, so the cancer survivor only needs to pay the cost of getting her uterus ready and having the embryo placed.

Most women who use the donor embryo procedure must get hormone treatments to prepare the lining of the uterus and ensure the best timing of the embryo transfer. The embryo is thawed and transferred to the woman's uterus to develop and grow. After the embryo is transferred, the woman stays on hormone support until blood work shows that the placenta is making hormones on its own.

There's no published research on the success rates of embryo donation, so it's important that you research the IVF success rates of the centers you may use.

## Egg (oocyte) freezing

Egg freezing (or *oocyte cryopreservation*) is an established method of preserving fertility in women, although it has not been used as long as embryo freezing (described below). This may be a good choice for women who do not have a partner.

For egg freezing, mature eggs are removed and frozen before being fertilized with sperm. This process may also be called *egg banking*. When the woman is ready to become pregnant, the eggs can then be thawed, fertilized, and implanted in the uterus.

Collecting the eggs typically takes several weeks. Hormones can be used to ripen several eggs at once. In most women, this means starting a cycle of hormone shots 3 days before their menstrual cycle and continuing them for 2 to 3 weeks until many eggs are mature (often about 12 eggs in a woman under age 35). The eggs are then collected during outpatient surgery, usually with a light anesthetic (drugs are given to make you sleepy while it's done). An ultrasound is used to guide a needle through the upper part of the vagina and into the ovary to collect the eggs.

Some women might not be able to follow the schedule of hormone shots above. This could include women who have fast-growing cancers (who cannot wait 2 to 3 weeks to begin treatment) and women with breast cancer, who might be at risk of their tumors growing because of the high levels of estrogen caused by the hormone shots. One option for these women is to follow the natural cycle of the maturing egg. To do this, ultrasound is used to follow the progress of normal ovulation, and 1 or sometimes 2 eggs can be collected. Another option for women with breast

cancer is to use drugs such as aromatase inhibitors or tamoxifen during the hormone stimulation to keep the estrogen from helping cancer cells to grow. More studies are needed, but results so far do not show that this has any harmful effects on women's breast cancer treatment or survival.

Less is known about egg freezing than embryo freezing, but the methods and success rates have greatly improved in the past several years and it's being done more often in the US. Some fertility centers have reported success rates much the same as using unfrozen eggs, especially in younger women.

Some doctors freeze eggs at the same time they freeze embryos.

Because younger women have more eggs, and the eggs are likely to be healthier, some facilities cut off the age for egg freezing in the mid-thirties. This varies by facility.

If you are looking at egg freezing, ask how many live births the facility has had using frozen eggs. You might also want to ask how many eggs it takes, on average, to produce a single live birth. You will want to know the cost of the procedure (including all the medicines), annual storage costs of the frozen eggs, and the estimated costs of fertilizing and implanting later. Egg freezing usually costs less than embryo freezing.

#### An important note about freezing

If you have frozen eggs, it's important to stay in contact with the cryopreservation facility to be sure that any yearly storage fees are paid and your address is updated. Once a couple is ready to have a child, the frozen eggs are sent to their fertility specialist.

#### Cryopreservation of immature oocytes

It's thought that immature eggs might freeze better. Because they are less developed and less fragile, they might stand up to the freezing and thawing processes better than mature eggs. Immature oocytes can be collected at any time – no hormone stimulation is needed. Because of this, researchers are also looking at whether immature oocytes can be harvested, matured in the lab (instead of in the woman), and then frozen. This keeps the woman from having to get hormone stimulation and then wait for eggs to mature naturally in her body.

Immature oocytes are removed through a needle that's put through the vagina and into the ovary. Ultrasound is used to guide the needle. Immature eggs are sucked into the needle and then frozen or matured and frozen. When the woman is ready, her immature eggs are thawed, matured in the lab (if not done before freezing), fertilized, and then implanted in her uterus. Researchers are studying this, and at this time it's still considered to be experimental. Few reports have been published so far showing this method results in live births.

#### Embryo freezing

Embryo freezing, or *embryo cryopreservation*, is the most common and successful method of preserving a woman's fertility today. Mature eggs are removed from the woman's ovaries and fertilized in the lab. This is called *in vitro fertilization* (IVF). The embryos are then frozen to be used after cancer treatment. This option works well for women who already have a partner, though single women can still freeze embryos using donor sperm.

The process of collecting eggs for embryo freezing is much the same as for egg freezing (see above). Eggs are collected during outpatient surgery, usually with a light anesthetic (drugs are given to make you sleepy while it's done). An ultrasound is used to see the ovaries and the fluid sacs (follicles) that contain ripe eggs. A needle is guided through the upper vagina, into each follicle to collect the eggs. The eggs are fertilized, then frozen and stored.

Since each egg can most likely produce a single embryo at best, a woman will have a better chance of a successful pregnancy if several embryos are stored. Hormones can be used to ripen several eggs at once. In most women, this means starting a cycle of hormone shots within 3 days of starting their menstrual cycle and continuing them for 2 to 3 weeks until many eggs are mature (often about 12 eggs in a woman under age 35).

But some women who have fast-growing cancers cannot wait 2 to 3 weeks to begin treatment. And women with breast cancer may risk some growth of their tumors during IVF cycles because of the high levels of estrogen caused by the hormone shots. In cases like this, one option is "natural cycle IVF" in which ultrasounds are used to follow the progress of normal ovulation, and 1 or sometimes 2 eggs can be collected. Another option for women with breast cancer is to use drugs such as aromatase inhibitors or tamoxifen during the hormone stimulation to keep the estrogen from helping cancer cells to grow. More studies are needed, but results so far do not show that this has any harmful effects on women's breast cancer treatment or survival.

Successful pregnancy rates vary from center to center. Centers with the most experience usually have better success rates. Costs vary, too, see "Insurance and financial concerns" in the section called "Other fertility-related issues to think about" for more on this.

#### An important note about freezing

If you have frozen embryos, it's important to stay in contact with the cryopreservation facility to be sure that any yearly storage fees are paid and your address is updated. Once a couple is ready to have a child, the frozen embryos are sent to their fertility specialist.

## Fertility-sparing surgery (for ovarian cancer)

This type of surgery might be an option in young women with ovarian cancer in only one ovary. The cancer must be one of the types that's slow-growing and less likely to spread, like borderline, low malignant potential, germ cell tumors, or stromal cell tumors (typically grades 1 and some grade 2 epithelial ovarian cancers).

In this case, the surgeon can remove just the ovary with cancer, leaving the healthy ovary and the uterus (womb) in place. Studies have found that this does not affect long-term survival, and allows future fertility. If there's a risk of the cancer coming back, the remaining ovary may be removed later, after the woman has finished having children.

### GnRH agonist treatment (ovarian suppression)

The goal of this treatment is to shut down the ovaries during cancer treatment to help protect them from the damaging effects of treatment. The hope is that reducing activity in the ovaries during treatment will reduce the number of eggs that are damaged, so women will resume normal menstrual cycles after treatment.

Gonadotropin-releasing hormone (GnRH) agonists are long-acting hormone drugs that can be used to make a woman go into menopause for a short time. These hormones are usually given as a monthly shot starting a couple of weeks before chemo or pelvic radiation therapy begins. GnRH treatment is given each month the whole time a woman is getting the cancer treatment.

Studies suggest that this method might help prolong fertility in some women, especially those 35 and younger, but results are not clear and more research is needed to prove it works.

This treatment is experimental, and women who want to try it might want to look into a clinical trial that's testing GnRH treatment. If this treatment is used, it's best done with a back-up method of preserving fertility like embryo freezing.

This treatment costs a lot and the drugs can weaken a woman's bones if used for more than 6 months.

### Natural pregnancy

After cancer treatment, a woman's body may recover naturally and produce mature eggs that can be fertilized. The medical team may recommend waiting anywhere from 6 months to 5 years before trying to get pregnant. This is often based on the fact that the risk of the cancer coming back (recurring) is usually highest in the first 2 to 5 years after treatment. The length of time depends on the type of cancer and the treatment used.

But women who have had chemo or radiation to the pelvis are also at risk for sudden, early menopause even after they start having menstrual cycles again. Menopause may start 5 to 20 years earlier than expected. Because of this, women older than 35 might want to talk to their doctors about how long they should wait to try to conceive and why they should wait. It's best to have this discussion before going on with a pregnancy plan.

### Oral contraceptive (birth control pill) treatment

Some oncologists prescribe oral contraceptives (birth control pills) before and during cancer treatment, hoping they will reduce activity in the ovary and save eggs. The concept is similar to that for GnRH agonist treatment (described above), but there's little scientific evidence for this, and more research is needed. Some published studies suggest that it does not reduce infertility.

Still, oral contraceptives can sometimes be useful during chemo: They may help control menstrual bleeding when a woman's blood counts are low and help reduce the risk of accidental pregnancy during treatment.

Note that the hormones in birth control pills are not recommended for women with cancers that could be fueled by hormones, such as breast cancer. Oral contraceptives can also increase the risk of blood clots, which may already be high because of the cancer and its treatment effects.

### Ovarian shielding

This method of protecting the ovaries may be used during the total body radiation that's sometimes part of stem cell or bone marrow transplant. A lead barrier, or shield, is placed over the patient's lower abdomen (belly) to help keep radiation from directly affecting the ovaries.

A few small studies have found that ovarian shielding preserves ovarian function and does not appear to increase the risk of cancer relapse. But it does decrease the radiation dose to the pelvis, and it has been suggested that shielding not be done in women with active leukemia.

More studies are needed to know if ovarian shielding works and if it's safe.

## Ovarian tissue freezing

Ovarian tissue freezing is experimental and can be done in young girls who have not reached puberty. All or part of one ovary is removed by laparoscopy (a minor surgery where a thin, flexible tube is passed through a small cut near the navel to reach and look into the pelvis). The ovarian tissue is usually cut into small strips, frozen, and stored.

After cancer treatment, the ovarian tissue can be thawed and placed close to the fallopian tubes or in another part of the body, like the abdomen (belly) or forearm. Once the transplanted tissue starts to function again, the eggs can be collected and fertilized in the lab. In another approach, the whole ovary is frozen with the idea of putting it back in the woman's body after treatment, but this has not yet been done in humans.

Ovarian tissue removal does not usually require a hospital stay. It can be done either before or after puberty. Still, it's experimental and has produced only a small number of live births so far. Doctors are studying it now to learn the best methods for success. Faster freezing of the tissue (called *vitrification*) has greatly improved outcomes over the older, slow-freezing methods.

The ovarian tissue does grow a new blood supply and produces hormones after it's transplanted, but some of the tissue usually dies and it may only last for a few months to several years. Because they last such a short time, ovarian tissues are usually only transplanted when a woman is ready to try for a pregnancy.

At this time, ovarian tissue freezing and transplant is not recommended for women with blood cancers (such as leukemias or lymphomas) or ovarian cancer due to the risk of putting cancer cells back in the body with the frozen tissue.

Ovarian tissue freezing costs vary a lot, so you will want to ask about the freezing and annual storage costs as well as removal and transplant expenses. In some patients, ovarian tissue can be removed as part of another necessary surgery so that some of the cost is covered by insurance.

### Ovarian transposition

Ovarian transposition means moving the ovaries away from the target zone of radiation treatment. It's a standard option for girls or women who are going to get pelvic radiation. It can be used either before or after puberty.

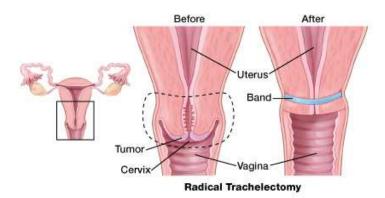
This procedure can often be done as outpatient surgery and does not require staying in the hospital (unless it is being done as part of a larger operation). Surgeons will usually move the ovaries above and to the side of the central pelvic area.

The success rates for this procedure have usually been measured by the percentage of women who regain their menstrual periods, not by being able to have a live birth. Typically, about half the women start menstruating again.

It's hard to estimate the costs of ovarian transposition, since this procedure may sometimes be done during another surgery that is covered by insurance. It's usually best to move the ovaries just before starting radiation therapy, since they tend to fall back into their old places over time.

#### Radical trachelectomy

Radical trachelectomy is an option for cervical cancer patients who have very small, localized tumors. The cervix is removed but the uterus and the ovaries are left, and the uterus is connected to the upper part of the vagina. A special band or stitch is wrapped around the bottom of the uterus to act as the cervix. A small opening allows blood from your period to flow out and sperm to enter the uterus to fertilize an egg. This is done during the surgery to treat cervical cancer, so insurance should cover some of the costs. Talk to your doctor about this.



Trachelectomy appears to be just as successful as radical hysterectomy (removal of the uterus and cervix) in treating cervical cancer in certain women. Women can become pregnant after the surgery, but are at risk for miscarriage and premature birth because the opening to the uterus may not close as strongly or tightly as before. These women will need specialized obstetrical care while they are pregnant, and the baby will need to be delivered by Cesarean section (C-section).

### Surrogacy

Surrogacy is an option for women who cannot carry a pregnancy, either because they no longer have a working uterus, or would be at high risk for a health problem if they got pregnant. There are 2 types of surrogate mothers:

A *gestational carrier* is a healthy female who receives the embryos created from the egg and sperm of the intended parents. The gestational carrier does not contribute her own egg to the embryo and has no genetic relationship to the baby.

A traditional *surrogate* is usually a woman who becomes pregnant through artificial insemination with the sperm of the man in the couple who will raise the child. She gives her egg (which is fertilized with his sperm in the lab), and carries the pregnancy. She is the genetic mother of the baby.

Surrogacy can be a legally complicated and expensive process. Surrogacy laws vary, so it's important to have an attorney help you make the legal arrangements with your surrogate. You should consider the laws of the state where the surrogate lives, the state where the child will be

born, and the state where you live. It's also very important that the surrogate mother be evaluated and supported by an expert mental health professional as part of the process. Very few surrogacy agreements go sour, but when they do, typically this step was left out.

## Preserving fertility in girls and teens with cancer

Parents of children diagnosed with cancer face many difficult issues in a time of severe emotional distress. They are often so focused on their child's treatment and survival that it's hard to think beyond the present. But about 4 out of 5 children treated for cancer live a long time, and infertility can become an issue for survivors when they reach young adulthood.

Talk with your daughter's doctor about the risk of infertility with the specific cancer treatment she will get. Sometimes, chemo and radiation can destroy or damage eggs and cause complete infertility.

## Talking to a child or teen about fertility

Not only should the oncology team discuss fertility with the parents, but it should also be mentioned to the child as soon as she is old enough to understand. If she is not old enough to discuss fertility while she's being treated for cancer, parents may need to tell her about it around the time that puberty begins. A follow-up visit at the oncology clinic is often a good time to bring up the topic.

Given the chance, many parents will want to save their child's fertility. If the child is old enough to understand fertility when she's being treated, she should be asked if she agrees to the treatment. Even though she's not able to give full legal consent because of her age, a child who can understand must generally agree (this is called *assent*) before a procedure can be done. The parents also must give consent before the procedure, after being told the risks, complications, and success and failure rates.

### Options before puberty

Although it's being studied, at this time there are no options that have been proven to preserve fertility in children who haven't gone through puberty. (Girls do not produce mature eggs until they go through puberty.)

One possible option before puberty is ovarian tissue freezing -- having ovarian tissue removed in an outpatient surgical procedure and frozen for the future. In fact, this is the only option at this time to spare a girl's eggs if she has not entered puberty, but this is experimental. Even in adult women, ovarian tissue grafted back into the woman's body after treatment has so far led to very few successful pregnancies. See "Ovarian tissue freezing" in the section "Preserving fertility in women with cancer" for more on this.

You might want to check into other experimental options to find out what may be available for your daughter. When you see a fertility doctor, ask about any clinical trials that are going on. Depending on where you are, you may have to travel to a larger city or a research center if you'd like to have the option of a research facility.

Even without special measures to preserve fertility, some girls will go through puberty and start having periods after cancer treatment, but they may still need to have hormone levels checked to find out if they are fertile. It's best to see a fertility specialist early in your daughter's reproductive years, soon after puberty. If available, mature eggs or embryos can be frozen at that time to preserve her fertility in case of early menopause. (See "Egg (oocyte) freezing" and "Embryo freezing" in the section "Preserving fertility in women with cancer" for more on these procedures.)

### Options after puberty

After puberty, a girl can have eggs or embryos frozen. Most girls begin puberty between ages 9 and 15.

If radiation is to be aimed at the abdomen (belly), sometimes the ovaries can be shielded (see "Ovarian shielding" in the section called "Preserving fertility in women with cancer"). In some cases, the ovaries may be surgically moved aside, out of the radiation area. They can be put back into the normal position (or might move back on their own) after treatment (see "Ovarian transposition" in the same section.

Some girls will have their periods return after cancer treatment, but they may still need to have hormone levels checked to find out if they are fertile. Some who are fertile in young adulthood may go through early menopause before they have time to have a family. It's important for your daughter to know that even if she has normal periods, she could still need to see a fertility specialist. It's best to see a specialist early in your daughter's reproductive years, soon after puberty. If available, mature eggs or embryos can be frozen at that time to preserve her fertility in case of early menopause. See "Egg (oocyte) freezing" and "Embryo freezing" in the section "Preserving fertility in women with cancer" for more on these procedures.

## Frequently asked questions

#### Should I have children after I've had cancer?

After a cancer diagnosis, many people wonder if they should even think about having children. They may question whether a genetic factor might have caused them to get cancer and if they might pass this cancer gene to their children. But only about 5% to 10% of cancers have a strong link to a gene that is passed on from parent to child. (See "Do children of cancer survivors have higher risks of getting cancer?" below.)

Survivors also may worry that treatment with chemo or radiation could cause birth defects or other health problems for future children. Many studies have found that babies conceived after cancer treatment don't have birth defects or health problems any more often than babies whose parent didn't have cancer. But problems are more likely if a baby is conceived during or too soon after cancer treatment, so it's important to know how long to wait before trying to have a baby.

People with cancer already have many worries from dealing with the disease and its treatment. Concerns about the cancer coming back, how long they can expect to live now that they've had cancer, and the costs of raising a child are other serious issues that people with cancer face when thinking about having children.

There are no simple answers to the question of whether to have children. Each person's cancer situation is unique. It helps to get as much information as you can before you make a decision that

will affect the rest of your life as much as this one will. You might want to discuss these concerns with a genetic counselor, geneticist, reproductive specialist, and/or a mental health professional.

Depression, anxiety, and stress may affect your ability to think as clearly as you would like about your reproductive choices. Talk about these issues and concerns with the people whose opinions you value and trust – your spouse or partner, health care team, family, close friends, clergy, etc. There are support groups as well as health professionals who deal with fertility issues for people with cancer. Ask your doctor to refer you to one of these specialists.

### Is pregnancy safe after cancer?

Despite concerns that pregnancy could cause cancer to return, studies to date have not shown this to be true for any type of cancer. Breast cancer is the type most people worry about because of the hormone changes that happen during pregnancy. So far, studies suggest that survival rates in women who become pregnant after breast cancer are as good as women who do not. But this issue is still being studied. Every cancer is different, so it's not possible to say for sure that it's safe for all cancer survivors to become pregnant.

You also need to know that pregnancy could be a problem if cancer treatment has damaged your heart, lungs, or other organs. When organs are damaged, the added physical stress of a pregnancy can lead to serious health problems for the mother and the growing fetus.

Radiation that reaches the uterus, especially if it was done when the woman was a child, can limit the ability of the uterus to stretch as the fetus grows. This creates an increased risk of a premature or low birth-weight baby, or even having a miscarriage.

If you are thinking about getting pregnant after cancer, it's a good idea to first see a specialist in high-risk obstetrics to find out if you have any health risks because of your cancer treatment. Your cancer doctor can also talk with you about how your health, your cancer and cancer treatment, and your risk of cancer coming back might affect pregnancy and parenthood.

# If I didn't act to preserve my fertility before cancer treatment, is it too late or do I still have options?

The answer to this question depends on your type of cancer and treatment. This is something you need to discuss with your oncologist. You may need to see a fertility specialist.

#### After cancer, how will I know if I need to see a fertility specialist?

It's best to discuss fertility with your oncologist first, because everyone's cancer diagnosis and treatment is different. But if you've had trouble conceiving for 6 to 12 months, despite having sex at the right times of the month, you may have a fertility problem and may need to see a specialist.

### After cancer treatment, how long should I wait to conceive?

There is no set time. It's very important to discuss this with your doctor to find out what's best for you.

## How long can embryos, eggs, and tissues be frozen?

Indefinitely. Samples have been stored for decades without damage. Most of the risk occurs in the freezing and thawing processes, so once they are frozen they can be stored for many years.

### What role does age play in fertility for women after cancer?

For women, getting older is a factor in fertility whether or not you have cancer. The older you are, the harder it is to get pregnant. Cancer treatments that cause premature menopause affect a woman's fertility.

Research suggests that the younger a woman is when she gets damaging cancer treatments, the less likely it is that she will become infertile. This may be because a younger woman has more eggs in reserve, so more eggs are likely to remain after treatment.

## Do fertility drugs cause cancer?

A few early studies suggested a link between some fertility drugs and cancer, but recent studies suggest there's no direct link between the use of fertility drugs and breast, uterine, ovarian, or any hormone-related cancer. If you are getting any of the drugs that stimulate eggs, talk with your doctor or nurse about their short- and long-term risks and side effects.

## Are the rates of birth defects higher in children born to cancer survivors who have had treatments like chemo and/or radiation therapy than in the general public?

So far studies strongly suggest that children born to cancer survivors are no more likely than others in the general public to have birth defects.

## Do children of cancer survivors have higher risks of getting cancer?

Research shows that no unusual cancer risk has been identified in the offspring of cancer survivors. The exception to this is in families who have true genetic cancer syndromes. If there's a lot of cancer in your family, you might want to check with a genetic counselor to see if any of your potential children would have a higher than usual chance of having cancer.

# If it looks like I am fertile after treatment, should I use the embryos or eggs I froze before treatment?

Make this decision with the help of a fertility specialist or a reproductive endocrinologist. Most fertility specialists would recommend that cancer survivors who recover fertility should try to conceive naturally with the eggs they are producing. There's no proof of an increased risk of birth defects in children born after cancer treatment. Fresh is usually preferred over frozen, but other factors could affect your individual situation, so be sure to discuss this with a specialist.

# Do cancer survivors have trouble adopting because of their medical history?

There's no published research on this subject. Most adoption agencies say they do not rule out cancer survivors as parents. But they often require medical exams and a letter from an oncologist saying that the cancer survivor has a good prognosis (outlook).

Some agencies or countries that offer international adoption may require a cancer survivor to be cancer- free for 5 years before applying for adoption.

Some discrimination clearly does occur both in domestic and international adoption. Yet, most cancer survivors who want to adopt can do so. You may be able to find an agency that has experience working with cancer survivors.

## Other fertility-related issues to think about

#### Insurance and financial concerns

After reviewing treatments to preserve fertility, most people wonder if they can ever afford any of these options. Many of the tests that diagnose fertility are covered by insurance, but treatment costs are often not covered. Some states have laws that require varying amounts of coverage for infertility and IVF treatments. But many patients are not covered by these laws and many more live in states with no or limited coverage.

To get your insurance plan to help pay for infertility treatments, you must first call them and ask about the steps you need to take to petition for coverage. Some patients have been able to get infertility treatment covered when they explained or had their doctor show that the infertility was a side effect of a necessary cancer treatment.

The costs of infertility treatments are a major barrier for most patients. Still, there are options available for some people, even if they cannot get insurance to cover it.

Figure out which treatment might be an option for you, where you can get it, and what the costs are. It helps to speak with a financial counselor in the fertility practice and ask for details about the treatment, its costs, and even specific insurance codes for the services you might need. One tip is to ask the financial counselor to get written confirmation by letter from your insurance company about which costs are covered and which are not. At that point, you might need to sit down and review your finances. Consider what you have in your bank and retirement accounts, any lines of credit you have (including credit cards), or even if you can get help from family members.

Some practices provide treatment packages at a single price and some offer financing options to make treatment more affordable by paying for it over time. Ask if these options are available. Some practices may take part in the Fertile Hope financial assistance program called "Sharing Hope," which reduces the costs of fertility preservation for qualifying patients. (Information about the Fertile Hope program can be found in the "To learn more" section.)

It's hard to think about spending money on fertility while you are dealing with other medical bills and cancer. Another barrier is that often you must act fairly quickly to preserve fertility before cancer treatment begins. Getting financial help and counseling is a start and will help you feel less

alone as you try to plan for a future after cancer. Most families would say it's worth the effort even though it can be hard in the beginning.

### Legal considerations

You might want to talk to an attorney (lawyer) about the fertility options you are considering and possible legal issues that may arise. An attorney can help you understand legal documents and your rights. Since you could be dealing with complex medical issues, find an attorney who's familiar with reproductive technology legalities.

For example, if a spouse or partner dies after embryos are fertilized, would he or she be willing for the surviving partner to use them anyway? If you do not use all your fertilized embryos, what will you do with them? Would you be willing to donate them to others who need them? These kinds of possibilities need to be understood and worked out in advance. An expert attorney can help you with the complicated issues of assisted reproduction, donation of sperm or eggs, and surrogacy.

There are also specialized lawyers who work with adoption services. They can help the birth parents give up (terminate) their legal rights to the child and handle the adoption process. This can help ensure a smoother adoption with less fear and anxiety.

#### Mental health services

Dealing with your cancer treatment and fertility issues may stir up strong emotions. You might feel overwhelmed, discouraged, or depressed. Some of the drugs women take for in vitro fertilization or to preserve fertility can have emotional side effects, too. These feelings are normal. A mental health professional can help you adjust to your cancer diagnosis and help you deal with your feelings about your fertility. This expert can also help you deal with feelings of guilt, anger, loss, and disability. Your therapist should understand the impact of cancer on fertility and help you sort through decisions about your parenting options. Having a third party who's not as emotionally involved as you and your partner are can be very helpful.

You may be able to find an infertility support group through your fertility specialist's office. Couples who share their unique experiences often find a special bond and strength. Infertility can be a roller coaster of highs and lows. It helps to go through that with others who understand.

#### Child-free living

Many couples consciously decide to not have children and focus on its advantages. Child-free living allows a couple to pursue other life goals, such as career, travel, or volunteering in ways that help others. If you are unsure about having children, talk with your spouse or partner. Reaching a decision together may become an exciting new investment in your future as partners. If you still feel unsure, talking with a mental health professional may help you both think more clearly about the issues and make the best decision.

### To learn more

## More information from your American Cancer Society

Here is more information you might find helpful. You also can order free copies of our documents from our toll-free number, 1-800-227-2345, or read them on our website, www.cancer.org.

#### **Coping with cancer**

After Diagnosis: A Guide for Patient and Families (also in Spanish)

How to Find a Financial Professional Sensitive to Cancer Issues: Financial Guidance for Cancer Survivors and Their Families

#### Sexual effects of cancer and cancer treatment

Sexuality for the Woman With Cancer (also in Spanish)

#### **Cancer treatment information**

A Guide to Cancer Surgery (also in Spanish)

A Guide to Chemotherapy (also in Spanish)

Understanding Radiation Therapy: A Guide for Patients and Families (also in Spanish)

Targeted Therapy

Immunotherapy

#### **Books**

Your American Cancer Society also has books that you might find helpful. Call us at 1-800-227-2345 or visit our bookstore online to find out about costs or to place an order.

#### National organizations and websites\*

Along with the American Cancer Society, other sources of information and support include:

#### Fertile Hope

Toll-free number: 1-855-220-7777 Website: www.fertilehope.org

Provides a list of fertility specialists and sperm banks, and information on fertility risks, options, and research studies. Financial help is available from Sharing Hope, a program for newly diagnosed cancer patients who wish to preserve fertility by egg freezing, embryo freezing, or sperm banking (must meet eligibility requirements).

#### **Oncofertility Consortium**

Toll-free number: 1-866-708-3378 Website: myoncofertility.org

Has a timeline for patients with information about fertility at all cancer stages, from diagnosis to after treatment; also offers assistance in finding a local fertility preservation specialist, as well as information for patients and their parents or partners whose fertility may have or will be impaired by cancer treatment.

#### **International Council on Infertility Information Dissemination (INCIID)**

Telephone: 703-379-9178 Website: www.inciid.org

Offers information on getting early care with qualified specialists and how to find them; fertility fact sheets; online support forums and weekly chat sessions; and "From INCIID the Heart," help for in vitro fertilization for those with financial and medical need, but without health insurance to cover it (Click "IVF Scholarships & Programs" on the left side of the INCIID home page.)

#### **RESOLVE: The National Infertility Association**

Telephone: 703-556-7172 Website: www.resolve.org

Provides information on the infertility journey, including treatment, coping, third party reproduction, adoption, child-free living, advocacy, and more. Also has fact sheets and personal stories. Local chapters/affiliates can be found on the website. Offers education and support groups; online community also available.

#### American Society for Reproductive Medicine (ASRM)

Telephone: 205-978-5000 Website: www.asrm.org

Offers infertility information, fact sheets, and booklets on adoption, genetic screening for birth defects, in vitro fertilization, sexual problems, reproduction information for cancer patients, and more; choose "Resources" tab on the home page. Also has a directory of ASRM member doctors.

#### **American Society of Clinical Oncology (ASCO)**

Toll-free number: 1-888-651-3038

Website: www.cancer.net

A comprehensive online resource providing oncologist-approved cancer information to help patients and families make informed health care decisions. Has "What to Know: ASCO's Guideline on Fertility Preservation" for patients available for free at www.cancer.net/patientguides.

#### **American Academy of Adoption Attorneys**

Telephone: 202-832-2222

Website: www.adoptionattorneys.org

Offers list of experienced member adoption attorneys and affiliated agencies.

<sup>\*</sup>Inclusion on this list does not imply endorsement by the American Cancer Society.

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at **1-800-227-2345** or visit www.cancer.org.

## References

Adoptive Families Magazine. *Building Your Family: 2013-'14 Donor, Surrogacy, and Adoption Guide*. Adoption Cost Breakdowns. Accessed at www.buildingyourfamily-digital.com/buildingyourfamily/building\_your\_family-2013\_2014\_donor\_surrogacy\_and\_adoption\_guide#pg46 on September 12, 2013.

American Society of Clinical Oncology. ASCO Recommendations on Fertility Preservation in Cancer Patients: Guideline Summary. *J Oncol Pract*. 2006;2(3):143-146.

American Society for Reproductive Medicine Ethics Committee. Fertility preservation and reproduction in cancer patients. *Fertil Steril*. 2005;83(6):1622-1628.

Ayensu-Coker L, Bauman D, Lindheim SR, Breech L. Fertility preservation in pediatric, adolescent and young adult female cancer patients. *Pediatr Endocrinol Rev.* 2012;10(1):174-187.

Blumenfeld Z. How to preserve fertility in young women exposed to chemotherapy? The role of GnRH agonist cotreatment in addition to cryopreservation of embrya, oocytes, or ovaries. *Oncologist*. 2007;12(9):1044-1054.

Blumenfeld Z, von Wolff M. GnRH-analogues and oral contraceptives for fertility preservation in women during chemotherapy. *Hum Reprod Update*. 2008;14(6):543-552.

Bouchlariotou S, Tsikouras P, Benjamin R, Neulen J. Fertility sparing in cancer patients. *Minim Invasive Ther Allied Technol*. 2012;21(4):282-292.

Brunk D. Fertility Preservation No Longer Experimental for Cancer Patients. *Family Practice News Digital Network*, 06/14/12. Accessed at www.familypracticenews.com/index.php?id=2659&tx\_ttnews%5Btt\_news%5D=134121&cHash=47e02be79468de56e43483da138cd478 on September 12, 2013.

Check JH, Katsoff B, Wilson C, Choe JK, Brasile D. Pregnancy outcome following fresh vs frozen embryo transfer into gestational carriers using a simplified slow freeze protocol. *Clin Exp Obstet Gynecol*. 2012;39(1):23-24.

Cheng X, Cheng B, Wan X, Lu W, Xie X. Outcomes of conservative surgery in early epithelial ovarian carcinoma. *Eur J Gynaecol Oncol*. 2012;33(1):93-95.

Clark NA, Swain JE. Oocyte cryopreservation: searching for novel improvement strategies. *J Assist Reprod Genet*. 2013;30(7):865-875.

Cobo A, Meseguer M, Remohí J, Pellicer A. Use of cryo-banked oocytes in an ovum donation programme: A prospective, randomized, controlled, clinical trial. *Hum Reprod*. 2010;25(9):2239-2246.

Combelles CMH, Chateau G. The use of immature oocytes in the fertility preservation of cancer patients: current promises and challenges. *Int J Dev Biol.* 2012;56:919-929.

Deepinder F, Agarwal A. Technical and ethical challenges of fertility preservation in young cancer patients. *Reproductive BioMedicine Online*. 2008;16(6):781-791.

Ernst E, Bergholdt S, Jørgensen JS, Andersen CY. The first woman to give birth to two children following transplantation of frozen/thawed ovarian tissue. *Hum Reprod.* 2010;25(5):1280-1281.

Fertile Hope. Pediatrics – Information for Parents. Accessed at www.fertilehope.org/learn-more/cancer-and-fertility-info/pediatrics.cfm on September 12, 2013.

Fertile Hope. Fertility Risks. Accessed at www.fertilehope.org/healthcare-professionals/clinical-tools/fertility-risks.cfm on September 12, 2013.

Fertile Hope. Parenthood Options. Accessed at www.fertilehope.org/learn-more/cancer-and-fertility-info/parenthood-options.cfm on September 12, 2013.

Fertile Hope. Pregnancy & Children After Cancer. Accessed at www.fertilehope.org/learn-more/cancer-and-fertility-info/pregnancy-and-children-after-cancer.cfm#q1 on September 12, 2013.

Fertile Hope. Questions to ask. Accessed at www.fertilehope.org/learn-more/cancer-and-fertility-info/questions-to-ask.cfm on September 12, 2013.

Kanda Y, Wada H, Yamasaki R, et al. Protection of ovarian function by two distinct methods of ovarian shielding for young female patients who receive total body irradiation. *Ann Hematol*. 2013 Jul 28 [Epub ahead of print].

Lee SJ, Schover LR, Partridge AH, et al. American Society of Clinical Oncology. Recommendations on Fertility Preservation in Cancer Patients. *J Clin Oncol*. 2006;24:2917-2931.

Lee S, Song JY, Ku SY, Kim SH, Kim T. Fertility preservation in women with cancer. *Clin Exp Reprod Med*. 2012;39(2):46-51.

Loren AW, Mangu PB, Beck LN, et al. Fertility Preservation for Patients With Cancer: American Society of Clinical Oncology Clinical Practice Guideline Update. *J Clin Oncol*. 2013;31(19):2500-2510.

Maltaris T, Beckmann MW, Dittrich R. Fertility Preservation for Young Female Cancer Patients. *In Vivo*. 2009;23(1):123-130.

Menczer J. Conservative fertility-sparing surgical treatment of invasive epithelial ovarian cancer: when is it acceptable? *Isr Med Assoc J.* 2013;15(2):116-120.

Metzger ML, Meacham LR, Patterson B, et al. Female reproductive health after childhood, adolescent, and young adult cancers: Guidelines for the assessment and management of female reproductive complications. *J Clin Oncol*. 2013;31(9):1239-1247.

Nakagawa N, Kanda Y, Yamashita H, et al. Ovarian shielding allows ovarian recovery and normal birth in female hematopoietic SCT recipients undergoing TBI. *Bone Marrow Transplantation*. 2008;42:697-699.

National Cancer Institute. Sexuality and Reproductive Issues (PDQ<sup>®</sup>), Fertility Issues. 06/14/2012. Accessed at www.cancer.gov/cancertopics/pdq/supportivecare/sexuality/HealthProfessional/page6 on August 30, 2013.

Norian JM, Feinberg EC, Decherney AH, Armstrong AY. Gonadal dysfunction. In DeVita VT Jr, Lawrence TS, Rosenberg SA, (eds). *DeVita, Hellman, and Rosenberg's Cancer: Principles and Practice of Oncology*, 9<sup>th</sup> ed. Philadelphia, Pa: Lippincott Williams & Wilkins; 2011:2372-2386.

Oktay K, Buyuk E, Libertella N, et al. Fertility preservation in breast cancer patients: a prospective controlled comparison of ovarian stimulation with tamoxifen and letrozole for embryo cryopreservation. J Clin Oncol. 2005;23(19):4347-4353.

Oktay K, Oktem O. Ovarian cryopreservation and transplantation for fertility preservation for medical indications: report of an ongoing experience. Fertil Steril. 2010;93(3):762-768.

Nieman CL, Kazer R, Brannigan RE, et al. Cancer Survivors and Infertility: A Review of a New Problem and Novel Answers. J Support Oncol. 2006;4:171-178.

Rienzi L, Romano S, Albricci L, et al. Embryo development of fresh 'versus' vitrified metaphase II oocytes after ICSI: a prospective randomized sibling-oocyte study. Hum Reprod. 2010;25(1):66-73.

Rizzuto I, Behrens RF, Smith LA. Risk of ovarian cancer in women treated with ovarian stimulating drugs for infertility. Cochrane Database Syst Rev. 2013 Aug 13.

Rodriguez-Wallberg KA, Oktay K. Fertility preservation in women with breast cancer. Clin Obstet Gynecol. 2010;53(4):753-762.

Rodriguez-Wallberg KA, Oktay K. Recent advances in oocyte and ovarian tissue cryopreservation and transplantation. Best Pract Res Clin Obstet Gynaecol. 2012;26(3):391-405.

Schover LR. Sexuality and Fertility After Cancer. New York, NY: John Wiley & Sons, Inc. 1997.

Schover LR. Reproductive complications and sexual dysfunction in the cancer patient. In: Chang AE, Ganz PA, Hayes DF, Kinsella T, Pass HI, Schiller JH, Stone R, Strecher V (eds). Oncology: An Evidence-Based Approach. Springer-Verlag, New York; 2005: 1580-1600.

Silber S, Kagawa N, Kuwayama M, Gosden R. Duration of fertility after fresh and frozen ovary transplantation. Fertil Steril. 2010;94(6):2191-2196.

Silva IS, Wark PA, McCormack VA, et al. Ovulation-stimulation drugs and cancer risks: A longterm follow-up of a British cohort. Br J Cancer. 2009;100(11):1824-1831.

Simon B, Lee SJ, Partridge AH, et al. Preserving fertility after cancer. CA Cancer J Clin. 2005;55:211-228.

Society for Assisted Reproductive Technologies. A Patient's Guide to Assisted Reproductive Technology. Accessed at www.sart.org/detail.aspx?id=4020 on September 12, 2013.

The University of Texas MD Anderson Cancer Center. Preserving Fertility Before Treatment. Accessed at www.mdanderson.org/patient-and-cancer-information/cancer-information/cancertopics/detection-and-diagnosis/preserving-fertility/index.html on September 12, 2013.

Wallace WH. Oncofertility and preservation of reproductive capacity in children and young adults. Cancer. 2011;117(10 Suppl):2301-2310.

Wallace WHB, Anderson RA, Irvine DS. Fertility preservation for young patients with cancer: who is at risk and what can be offered? Lancet Oncol. 2005;6:209-218.

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