

ARTIFICIAL INSEMINATION:

It is the deliberate introduction of sperm into a female's uterus for the purpose of achieving a pregnancy through in vivo fertilization. It is a fertility treatment for humans, as well as in animal breeding, including dairy cattle and pigs.

Artificial insemination may employ assisted reproductive technology. Artificial insemination techniques available include intracervical insemination and intrauterine insemination. Assisted reproductive technology (ART) is the technology used to achieve pregnancy in procedures such as fertility medication, artificial insemination, in vitro fertilization and surrogacy. It is reproductive technology used primarily for infertility treatments.

Assisted reproductive technology (ART) is the **technology** used to achieve pregnancy in procedures such as fertility medication, artificial insemination, in vitro fertilization and surrogacy. It is **reproductive technology** used primarily for infertility treatments, and is also known as fertility treatment.

PROCEDURES:General

With ART, the process of sexual intercourse is bypassed either by artificial insemination or fertilization of the oocytes in the laboratory environment (i.e., in vitro fertilization). In general, ART procedures involve surgically removing eggs from a woman's ovaries, combining them with sperm in the laboratory, and returning them to the woman's body or donating them to another woman." According to CDC, "they do not include treatments in which only sperm are handled (i.e., intrauterine—or artificial—insemination) or procedures in which a woman takes medicine only to stimulate egg production without the intention of having eggs retrieved."

Procedures are mainly fertility medication, as well as ART techniques that use more substantial and forceful interventions, of which in vitro fertilization (IVF) and expansions of it (e.g. OCR, AZH, ICSI, ZIFT) are the most prevalent. However, there are also other manual ART, not necessarily dependent on IVF (e.g. PGD, GIFT, SSR).

Fertility medication:

Most fertility medications are agents that stimulate the development of follicles in the ovary. Examples are gonadotropins and gonadotropin releasing hormone.

Artificial insemination:

Artificial insemination involves sperm being placed into a female's uterus (intrauterine) or cervix (intracervical) using artificial means rather than by sexual intercourse. This can be a very low-tech process, performed at home by the woman alone or with her partner.

In Vitro Fertilization:

In vitro fertilization is the technique of letting fertilization of the male and female gametes (sperm and egg) occur outside the female body.

Techniques usually used in in vitro fertilization include:

- Transvaginal ovum retrieval (OCR) is the process whereby a small needle is inserted through the back of the vagina and guided via ultrasound into the ovarian follicles to collect the fluid that contains the eggs.
- Embryo transfer is the step in the process whereby one or several embryos are placed into the uterus of the female with the intent to establish a pregnancy.

Less commonly used techniques in in vitro fertilization are:

- Assisted zona hatching (AZH) is performed shortly before the embryo is transferred to the uterus. A small opening is made in the outer layer surrounding the egg in order to help the embryo hatch out and aid in the implantation process of the growing embryo.



• Intracytoplasmic sperm injection (ICSI)

Intracytoplasmic sperm injection (ICSI) is beneficial in the case of male factor infertility where sperm counts are very low or failed fertilization occurred with previous IVF attempt(s). The ICSI procedure involves a single sperm carefully injected into the center of an egg using a microneedle. With ICSI, only one sperm per egg is needed. Without ICSI, you need between 50,000 and 100,000.^[2] This method is also sometimes employed when donor sperm is used.

- Autologous endometrial coculture is a possible treatment for patients who have failed previous IVF attempts or who have poor embryo quality. The patient's fertilized eggs are placed on top of a layer of cells from the patient's own uterine lining, creating a more natural environment for embryo development.
- In zygote intrafallopian transfer (ZIFT), egg cells are removed from the woman's ovaries and fertilized in the laboratory; the resulting zygote is then placed into the fallopian tube.
- Cytoplasmic transfer is the technique in which the contents of a fertile egg from a donor are injected into the infertile egg of the patient along with the sperm.
- Egg donors are resources for women with no eggs due to surgery, chemotherapy, or genetic causes; or with poor egg quality, previously unsuccessful IVF cycles or advanced maternal age. In the egg donor process, eggs are retrieved from a donor's ovaries, fertilized in the laboratory with the sperm from the recipient's partner, and the resulting healthy embryos are returned to the recipient's uterus.
- Sperm donation may provide the source for the sperm used in IVF procedures where the male partner produces no sperm or has an inheritable disease, or where the woman being treated has no male partner.
- Preimplantation genetic diagnosis (PGD) involves the use of genetic screening mechanisms such as fluorescent in-situ hybridization (FISH) or comparative genomic hybridization (CGH) to help identify genetically abnormal embryos and improve healthy outcomes.

- Embryo splitting can be used for twinning to increase the number of available embryos.

Surrogacy

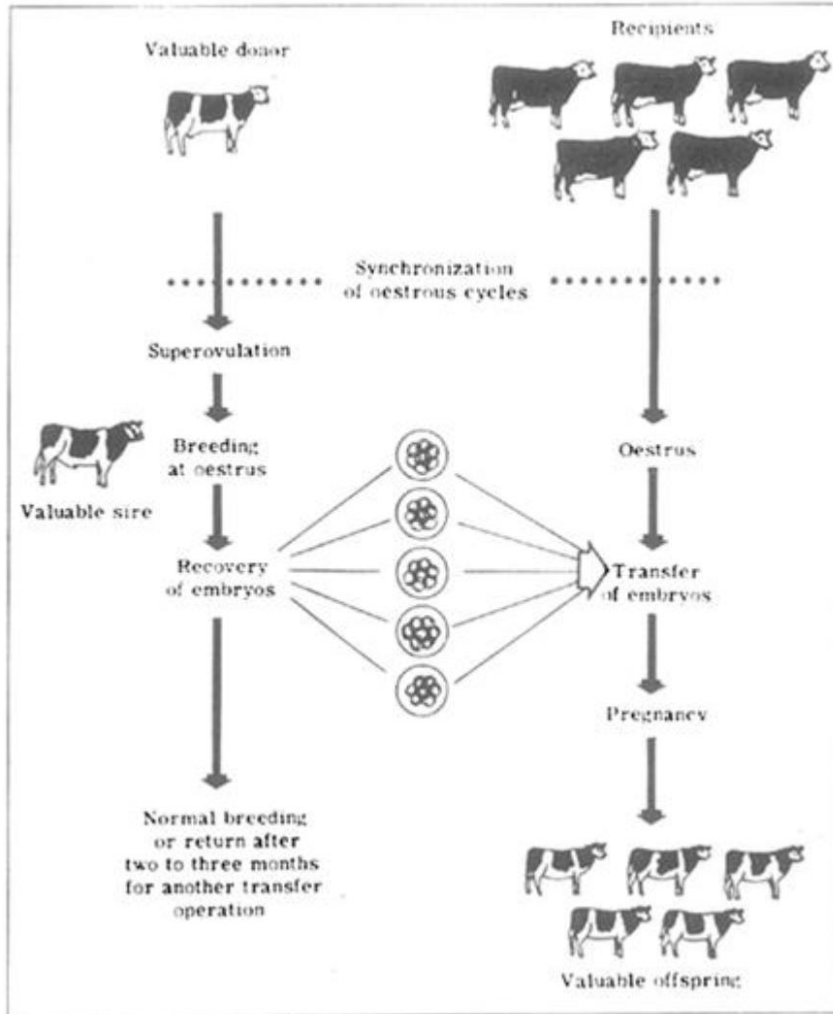
Surrogacy, where a woman agrees to become pregnant and deliver a child for a contracted party. It may be her own genetic child, or a child conceived through natural insemination, in vitro fertilization or embryo transfer using another woman's ova. Surrogacy via a gestational carrier is an option when a patient's medical condition prevents a safe pregnancy, when a patient has ovaries but no uterus due to congenital absence or previous surgical removal, and where a patient has no ovaries and is also unable to carry a pregnancy to full term.

EMBRYO TRANSFER

Embryo transfer refers to a step in the process of assisted reproduction in which embryos are placed into the uterus of a female with the intent to establish a pregnancy. This technique (which is often used in connection with in vitro fertilization (IVF)), may be used in humans or in animals, in which situations the goals may vary.

The donor cow is stimulated with a hormone (generally pregnant mare's serum gonadotrophin (PMSG) or follicle-stimulating hormone). Following such stimulation the animal comes on heat and she is bred or artificially inseminated with semen of the breeder's choice. In order to obtain maximum fertility two breedings are generally employed with a 12-hour interval, and a higher dose of semen is used the second time. It is expected that the donor will release a number of ova (10 to 15 or more) at this oestrus instead of the usual one. The ova are naturally fertilized within

the donor and proceed to develop. If these embryos are left to grow in the donor cow, resorption and or multiple pregnancies may result which are undesirable in cattle because of resulting complications and the possible occurrence of freemartins. About four to five days after breeding (when the embryos are freely "floating" within the uterus and are not yet implanted), the embryos are flushed out with a suitable biological medium.



Embryos are transferred within four to five hours of recovery; during this time they are stored with minimum changes of temperature and pH. It is important that the oestrous cycle of the recipient animal be synchronous with that of the donor (both donor and recipients should be in heat on the same day).

IN VITRO FERTILIZATION OR FERTILISATION (IVF)

In vitro fertilization or fertilisation (IVF) is a process by which an egg is fertilised by sperm outside the body: *in vitro* ("in glass"). The process involves monitoring and stimulating a woman's ovulatory process, removing an ovum or ova (egg or eggs) from the woman's ovaries and letting sperm fertilise them in a liquid in a laboratory. The fertilised egg (zygote) is cultured for 2–6 days in a growth medium and is then implanted in the same or another woman's uterus, with the intention of establishing a successful pregnancy.

IVF techniques can be used in different types of situations. It is a technique of assisted reproductive technology for treatment of infertility. IVF techniques are also employed in gestational surrogacy, in which case the fertilised egg is implanted into a surrogate's uterus, and the resulting child is genetically unrelated to the surrogate. In some situations, donated eggs or sperms may be used. Some countries ban or otherwise regulate the availability of IVF treatment, giving rise to fertility tourism. Restrictions on availability of IVF include to single females, to lesbians and to surrogacy arrangements. Due to the costs of the procedure, IVF is mostly attempted only after less expensive options have failed.

The first successful birth of a "test tube baby", Louise Brown, occurred in 1978. Louise Brown was born as a result of natural cycle IVF where no stimulation was made. Robert G. Edwards, the physiologist who developed the treatment, was awarded the Nobel Prize in Physiology or Medicine in 2010. With egg donation and IVF, women who are past their reproductive years or menopause can still become pregnant. Adriana Iliescu held the record as the oldest woman to give birth using IVF and donated egg, when she gave birth in 2004 at the age of 66, a record passed in 2006. After the IVF treatment many couples are able to get pregnant without any fertility treatments.

IVF is usually used for:

- Advanced age of the woman (advanced maternal age)
- Damaged or blocked fallopian tubes (can be caused by pelvic inflammatory disease or prior reproductive surgery)
- Endometriosis
- Male factor infertility, including decreased sperm count and blockage
- Unexplained infertility (An unexplained fertility problem)
- Low sperm counts
- Problems with ovulation
- Antibody problems that harm sperm or eggs
- The inability of sperm to penetrate or survive in the cervical mucus

This type of fertilization treatment presents some **advantages**. For instance, it reduces the numbers of surgery by half because women who resort to this technique don't have to undergo surgery on their fallopian tubes. It's also a great solution for women getting in age who really want to have a baby instead of their physical condition.

However, IVF is usually more reserved for women under 35 to eliminate a certain number of risks associate with advanced maternal age. In addition, this method is considered as safe as any other one. A recent study covered nearly 1,000 children conceived through these methods in 5 European countries and found that the children, monitored from birth to 5 years of age, were as healthy as children conceived naturally.

According to the Society of Assisted Reproductive Technologies (SART), **the approximate chance of giving birth to a live baby after IVF** is as follows:

- 41-43% for women under age 35
- 33-36% for women age 35 – 37
- 23-27% for women ages 38 – 40
- 13-18% for women over age 41

The in vitro fertilization generally goes through five (5) basics steps:

Step 1 : Stimulation or super ovulation

Fertility drugs are given to the woman in order to boost her egg production. Effectively, during an ordinary month, only a single egg might mature. With this type of hormone treatment, her ovaries are stimulated and produced a large number of mature eggs, sometimes more than 20.

Step 2 : Egg retrieval

This step starts with a minor surgery, sometimes substituted for laparoscopic surgery, called follicular aspiration. Taking place in the doctor's office without general anaesthesia, this technique allows doctors to remove eggs from the woman's ovary by inserting a thin needle through the vagina and into the ovary and sacs (follicles) containing the eggs. This needle is connected to a suction device, pulling the eggs out of the ovary one at the time.

Step 3 : Insemination and Fertilization

During this time, the man has to provide a semen sample. The sperm are separated from the semen in a laboratory procedure. Then, the man's sperms are placed with the best quality from the woman's eggs in an environmentally controlled chamber. This step is what we call insemination. Generally, the sperm fertilizes an egg a few hours after the insemination. However, if this step doesn't work, the sperm has to be injected directly into the egg, it's the intracytoplasmic sperm injection (ICSI).

Step 4 : Embryo culture

After the fertilization (about 18 hours later), the egg will divide to become an embryo (so we can determine if the last step worked or not). During this step, laboratory staff regularly check the embryo to make sure that it grows up properly. Within around five (5) days, a normal embryo has several cells that are actively dividing. These embryos are incubated and observed over 2-3 days or longer.

Step 5 : Embryo transfer

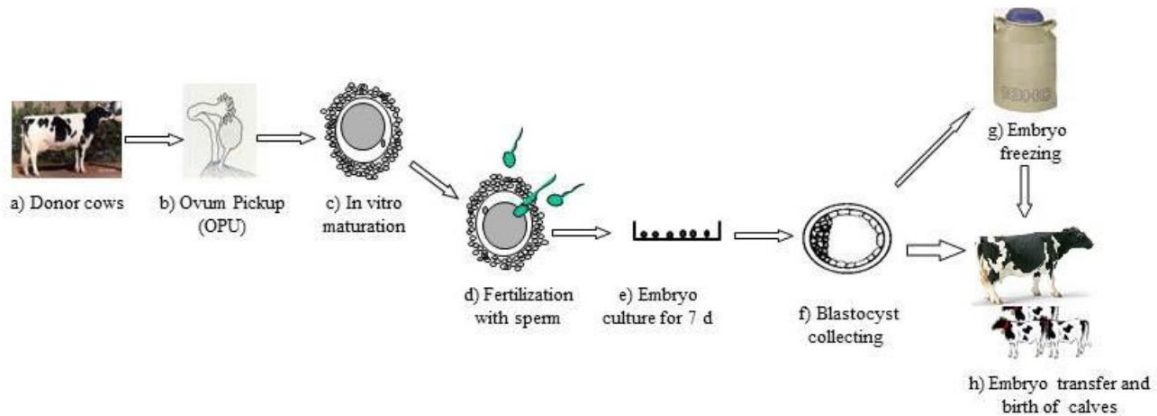
After these few days of embryos development observations, they are introduced into the woman's womb through the cervix with a catheter (a long slender tube) containing the precious embryos. If an embryo sticks to (implants) in the lining of the womb and grows, pregnancy

results. The number of embryos implanted depends on several factors such as the age of the mother or the country where the treatment is giving. However, North American Doctors agree to the fact that no more than two (2) embryos should be implanted at a time to eliminate multiple births which are more dangerous than beneficial. Also, unused embryos may be frozen and implanted or donated at a later date.

Main advantages of IVF in livestock market

- IVF makes it possible to rapidly multiply and breed genetically superior cattle within a short generation interval. Multiplying pre-selected females.
- Increasing efficiency of multiplication in breeding, permitting determination of sex of the offspring and pre-testing of actual fertility status of the bull.
- Genetics selection based on male and female.
- Productivity: Raise of average litre per cow.

- Improve pregnancy rates in lactating cows.
- We guarantee 100% pregnancy rate.
- Lower costs: Importation of live dairy cattle can cost P150,000 to P180,000 per animal initially.
- No quarantine needed: animals are born in the country.
- Potential to create a local raze and market it worldwide: beef and dairy cow.
- No need to super ovulate the cow, no need of hormones like with AI.
- Highly efficient use of semen in comparison with other repro tools (AI). One straw of conventional frozen semen can fertilized a high number of female donors (>25)..
- Genetic Jump: no need to wait too long to improve genetics.
- Rescue genetics: produce embryos from females in different physiologic conditions (terminal, disease, culled, accident, etc.)
- Proven Technology: All Latin America, USA, Europe, South Africa, Australia, China, Philippines will be the first one in South East Asia.
- Genetics generated in-house in the Philippines: money reinvested in the country.



References and further reading

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Animal Biotechnology (3rd Edition), by M.M. Ranga (Author)