



Technology Alternatives to Challenging Infertility Issues in Sub-Saharan Africa

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Authors' contributions

This work was carried out in collaboration between both authors. Author GA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author CTN managed the analyses of the study and managed the literature searches. Both authors read and approved the final manuscript.

Article Information

Editor(s):

(1) Dr. Sevgul Donmez, Gaziantep University, Turkey.

Reviewers:

(1) Ahlem Ben Slima, University of SFAX, Tunisia.

(2) Santosh Tanaji Kadam, Ayurved University, India.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/64401>

Review Article

Received 02 November 2020

Accepted 07 January 2021

Published 27 January 2021

ABSTRACT

Infertility has been a major reproductive issue worldwide causing instability in marriages. In the event of this, the society often views the woman as the cause of infertility and childlessness. Studies have proved that both males and females experience infertility issues. However, artificial reproductive technologies (ARTs) such as *In vitro* Fertilization and surrogacy have been used by couples in developed countries to produce offspring. This paper is thus a review on a public health issue which poses a grievous social problem in our society and brings about instability in relationships. This paper examines infertility and the use of technology alternatives in resolving the issue. Results from extensive review of literature shows that over 70 million couples have infertility issues worldwide amounting for 15% of reproductive aged couples globally. The prevalence in Nigeria is 30% as males contribute 40%, women 40% whilst the rest 20% are from a combination of other factors. Several measures are put in place to solve the problem of infertility including medical, surgical, artificial insemination or assisted reproductive technology (ART), which is one of the most successful, having a score of about 15 – 25% per cycle. There is limited knowledge and

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fund to utilize assisted reproductive technologies especially in Nigeria, which has limited its use. It is therefore, recommended that the Ministry of Health carries out public enlightenment to educate the masses on ART to boost their fertility and subsidy should be put on the prices of ART services so as to make them affordable by infertile couples and aid childbearing.

Keywords: Infertility; technology alternatives; IVF; Nigeria; Sub-Saharan Africa.

1. INTRODUCTION

Infertility is seen as the inability of a mature female and male to achieve pregnancy after unprotected coitus for one year. It could be primary or secondary [1,2,3,4]. The problem affects both males and females hence, should not be viewed as a female problem only. A report by the World Health Organization has it that, one out of four (1:4) married women of reproductive age in most developing countries are childless [3]. Nathan and Chikondi [5], observed that the male and female contribute 40% each to infertility problems, whilst the remaining 20% is contributed by a combination of other factors. Over 70 million couples have infertility issues amounting to 15% of reproductive age couples globally [6]. Also, in Sub-Saharan African region, the prevalence of infertility varies from 9% in Gambia, 21.2% in North-Western Ethiopia, between 20% and 30% in Nigeria and 11.8% among women and 15.8% among men in Ghana [7,8,9,10]. Infertility is thus a public health problem [4].

Infertility leads to gross dissatisfaction and blame game in marriages and is seen as a reason for infidelity and eventual divorce. Women who found themselves in this scenario are stigmatized, brutalized, deprived of many marriage rites, suffer lots of violence and are not seen as real women according [11]. The aforementioned reasons were the brains behind the introduction of technology alternatives to challenging infertility issues known as Assisted Reproductive Technology (ART) by medical experts, to enable infertile couples coast to victory in child bearing through *In vitro* Fertilization (IVF).

In vitro Fertilization is an assisted reproductive technology. It involves the process of fertilization by bringing out eggs, getting sperm and mixing them together in a laboratory glass; which is why it is called *In vitro*, meaning "in glass". It makes pregnancy more likely and the embryo(s) is thereafter transferred into the uterus [12,13]. Approximately 1.7% of all infants born in the

United States annually are products of ART; this figure has however been doubled in the past decade [14]. Although, few years ago the programme was called test-tube babies because they were fertilized outside their mother's womb, it is a household name in the US. The first baby delivered through this technology was in England in 1978 and was named Louise Brown [15]. In Nigeria, the first test tube baby delivery was at the Lagos State Teaching hospital in 1989 [16,17].

In vitro Fertilization (IVF) is not the first line of intervention for infertility as there are so many avenues that need to be explored, as such, this should be a last resort. According to the American Society for Reproductive Medicine [18], ART is for couples who have tried every other fertility method and failed. Our continent (Africa) has however not experienced much of IVF technology as seen by other continents [19]. According to Horbst [20], it cannot be carried out in Africa as it is done in Europe, largely because of the awareness. This is the observation of many gynecologists and embryologists resulting from several empirical data derived from anthropological fieldwork. This paper is thus aimed at reviewing the use of ARTs in Sub-Saharan Africa.

1.1 Objectives of the Review

The objectives of this review were to examine:

1. The types of ARTs;
2. Risks associated with carrying out ARTs;
3. Causes of IVF failure and success;
4. Ethical considerations in carrying out ARTs and
5. Barriers to the widespread use of ARTs.

2. METHODOLOGY OF THE REVIEW

The information used in this review were acquired from articles and previous studies published in the reputable journals on the internet such as PubMed. The articles were critically reviewed to obtain relevant information.

3. TYPES OF ART

There are different types of ART to resolve the problem of infertility which include:

- *In vitro* Fertilization (IVF)
- Gamete Intrafallopian Transfer (GIFT)
- Zygote Intrafallopian Transfer (ZIFT)
- Intra Cytoplasmic Sperm Injection (ICSI)
- Intra Uterine Insemination (IUI)
- Donor Eggs
- Surrogacy (Surrogate Mother)
- Ovulation Induction (OI)
- Artificial Insemination (AI)
- Pre-implantation Genetic Diagnosis (PGD) [21].

4. ALTERNATIVE METHODS FOR SOLVING INFERTILITY

The following are a few procedures that help in solving the problem of infertility:

4.1 Fertility Preservation

This is done to protect the eggs, sperm or reproductive tissue with the aim of using them to obtain biological children [22].

4.2 Surrogacy (Surrogate Mother)

It is a type of ART where a woman – the surrogate, accepts to carry and bear a child for another woman or partner known as the commissioning parent(s) or intended parent(s). The womb is also referred to as “borrowed womb”. There are two types of surrogates known as– Traditional surrogate and Gestational surrogate. There must however be a legal write up before this method is embarked upon [23]. This method is best when there are problems with the uterus, hysterectomy and severe heart diseases making pregnancy impossible.

4.3 *In vitro* Fertilization (IVF)

It seems to be the most known type of ART and one of the most successful, having a score of about 15 – 25% per cycle.

4.3.1 Tips in preparing for IVF

There is much a lady can do to increase the success of her IVF and these include avoiding smoking and drinking, taking vitamins and consuming a lot of fertility foods. About two weeks to the time, the lady needs to have enough rest/sleep, minimize stress and engage in breathing exercises.

4.3.2 Risks associated with IVF

The risks associated with IVF include nausea or vomiting, decreased breath, faintness, severe abdominal colic and bloating, excess weight gain for just a short period of time (3-5days), hyper – stimulation, ovarian torsion, failure to get pregnant, multiple pregnancies, premature and small-for-date babies, birth defects, risks from handling of gametes and embryos, risks of culture and risks associated with cryopreservation, gamete and embryo “mix ups” [24].

5. ASSISTED REPRODUCTIVE TECHNOLOGY AND MATERNAL RISKS

ART leads to fulfilment of heart desire to many couples who were infertile. This procedure has its risks, both during the treatment process and even when conception is present, which includes early and late abortion, ectopic gestation happens to about 2% - 5% of IVF women, and multiple gestation [25]. Also, cancer and stress (psychological, physical, financial and emotional) could result from the procedure [26]. IVF is however like a money-making industry [27].

6. WAYS TO MAXIMIZE THE SUCCESS OF IVF

The following are ways to maximize the success of IVF as buttressed by Shiffer [14] and these are:

6.1 Maintain a Heal the Weight

This is very vital to the success of an IVF. Owing to the fact that obesity (BMI >35) and underweight (BMI <19) can prolong conception time by 2 and 4 respectively, they both adversely affect IVF success rates. According to Aculife [28], BMI should oscillate between 20 and 25. The excess weight makes maturity of ovaries very difficult and enhances complications during egg retrievals. Programs that can lead to cardio-metabolic weight loss are encouraged.

6.2 Optimized Sperm Health

Multivitamins utilization and moderate body weight can enhance sperm quality. Consulting a sperm analyst for any abnormalities is the best action to be taken. Also, medications assist immensely in boosting sperm numbers and quality and it has multiplier effect on IVF success.

6.3 Partner with an Excellent Doctor and Embryology Laboratory

Liaising with an expatriate in reproductive endocrinologist will be very helpful in this journey. The lady needs to be comfortable with the entire process, feeling that someone cares, she is heard and is receiving emotional support.

6.4 Reduce Stress

Minimizing stress during IVF stimulation cycle leads to great success. Therefore, people can go into acupuncture, stress relieving activities and different training workshops to reduce stress.

6.5 Quit Smoking

Smoking affects the quality of egg and sperm negatively. Family, friends, structured programs and pharmacological aids can help in smoking cessation for best IVF outcome.

6.6 Looking Into Taking Supplements

The doctor prescribes supplements which can enhance the quality and quantity of eggs.

6.7 Ensure You Have Adequate Levels of Vitamin D

At least 40% of humans are suffering from vitamin D deficiency. This has affected fertility and hinders IVF success. For this reason, every infertile couple need to check and treat for this condition.

6.8 Focus on Persistence and Patience

Lots of clients do not succeed with only one cycle. If the first circle fails, the doctor adjusts things for you to go in for the second, third and fourth time. Do not blame yourself for not doing one thing or the other right as you may not be the cause.

7. CAUSES OF IVF FAILURE

Certain factors have been identified to be reasons for IVF failure and these include:

7.1 Embryo Quality

When there is an anomaly found in the embryo, there will be difficulty in embedding in the uterus because, the embryo is not healthy to thrive.

7.2 Age of the Eggs

In this procedure, the age of the egg is even more vital than that of the mother. It affects the success rate of IVF. Only about 25% of transferred embryos develop to babies.

7.3 Ovarian Response

In a situation where the ovaries respond poorly to the fertility medications, it will be difficult for the desired number of eggs to be retrieved; this will in turn affect the number of embryos for screening and possibly implantation.

7.4 Chromosomal Issues

This is one of the most striking reasons for IVF failures. If the woman is 35 years and above, the incidence of anomalies begins to set in and increases faster; however, a man's sperm develops abnormality slowly.

7.5 Lifestyle Factors

Those smoking and drinking have to desist from it 3 months before the commencement of lifecycle, to avoid miscarriages [29].

8. ESSENTIAL TIPS FOR EMBRYO TRANSFER

8.1 Request for an Experienced Doctor

Patients should insist that the most experienced doctor or consultant should carry out the embryo transfer as their hands will be steady.

8.2 Absence of Hydrosalpinx

Hydrosalpinx is the presence of fluid in one or the two fallopian tubes due to untreated STIs or endometriosis. It hinders implantation in IVF and natural pregnancies too.

8.3 Take Folic Acid—Ideally Within a Multivitamin

It assists in reducing birth defects, in both natural and IVF cases. The patient should be on daily folic acid for three months before the embryo transfer.

8.4 If you are over 40 Years, Consider Transferring Two Embryos

Even though, single embryo transfer is better, for age's sake, two is best for older clients if medical conditions are alright.

8.5 Do Not Head for the Bed after the Embryo Transfer

It is false to say the patient must be on bed rest. Go out for a nice lunch with your partner but do not consume alcohol or smoke; no strong activity should be carried out.

8.6 Avoid Coughing or Sneezing

Coughing while the catheter is inside is wrong, therefore, get some cough tincture to wall off such situations [30].

9. WHEN IS EMBRYO TRANSFER NEEDED?

Embryo transfer is done when it has become impossible for conception to be achieved naturally. The under listed are some of the reasons for ART, as observed by Jon [31].

- i. Ovulation Disorders: When a woman produces fewer eggs and has irregular ovulation.
- ii. Damage to Fallopian Tube: If this occurs, it is almost impossible for fertilization to take place, thereby rendering the woman childless.
- iii. Premature Ovarian Failure: This leads to subnormal secretion of oestrogen thereby making the release of eggs difficult.
- iv. Genetic Disorders: This sometimes gives rise to inability to conceive.
- v. Uterine Fibroid: Most times they hinder the implantation of embryo in the uterus, thereby making pregnancy impossible. These are tumours found at different parts of the uterus.
- vi. Impaired Sperm Production: If a man has problem with his testes or there are abnormalities in the semen, low sperm count or abnormal sperm morphology, it becomes humanly impossible for him to be able to impregnate a woman.

10. ETHICAL ASPECT OF ART

Assisted Reproductive Technologies (ARTs) for handling childless issues has been on for some years now in Nigeria, however, it lacks formal framework regulating it as buttressed by Zakariya [32]. According to Obos [33], ARTs have the capacity of leading to complicated ethical challenges for individuals, health care professionals and the society in general. An ethical dilemma that is tagged with ARTs is the politics of how an embryo that was not used

should be managed. If a couple fertilized more than one embryo, the unused one will be preserved till another use. Whatever maybe the outcome at last, even if the family fails to pay the preservation bill any further, the clinic has no right to dispose the preserved embryo without the consent of the family. Therefore, families should take a stand on what should be done to their preserved embryo if any before they go into the process of fertilization. The unused embryo could be given to another infertile couple, the clinic can also destroy it based on the instruction from the couple, it is compulsory that the couples reach a consensus on what should be done to the embryo before the clinic acts. Some of the ethical and moral issues involved in embryo include:

- i. Preservation has four possible outcomes and those involved are to consider and implement any of them depending on their choice;
- ii. Thawing and throwing away;
- iii. Giving them free of charge for research;
- iv. Storing them forever and
- v. Forfeiting the embryo to another infertile couple [34]. This is based on the fact that buying or selling of Oocyte is regarded as an unethical practice hence, the donor(s) could be given compensation; though it varies from country to country, this ought to be regulated so as to avoid exploitation of the donor and the donor doing it against her wish [35].

Another ethical and legal debate associated with donated gametes is whether the identity of the donor should be made known to the offspring. In most cases, humans want to know the root of their genetics. However, some egg donors and sperm donors may or may not consent to revealing their identities [36]. Some individuals are in support of revealing the identities as it is vital in the event of medical investigations in the future [37,38]. It is of utmost importance that the offspring and the donor know themselves and establish a relationship [39].

11. SOME COMMON IVF MYTHS AND FACTS

1. IVF can certainly deal with all infertility problems: This is not true. There are different types of assisted reproduction technologies. IVF is just one out of the lots, so others are also very effective [40].

2. It is a treatment for the rich and famous: IVF is costly but not so expensive if a survey is carried out to see what happens when other surgical remedies are embarked upon.
3. Only young couples benefit from this treatment: All age groups (except those below reproductive age) benefit, even the post-menopausal. The only caution is that the eggs of a younger lady must be used for better result.
4. IVF possesses a 100% achievement: This is wrong as the achievement rate is about 40% for couples less than 35 years. The success rate is determined by various factors such as age, hormonal issues and the cause of infertility.
5. IVF children are born with birth problems as well as malformations: The possibility of any defects is not predictable, just as it is with normal conception. These are not peculiar to IVF babies alone [41].

12. BARRIERS TO THE USE OF ART IN SUB-SAHARAN AFRICA

The following are barriers to the use of ART in Nigeria:

- There is an obvious disparity and inequality in getting services of ART within and between countries not minding the fact that childless couples are desperately in need of ART (Human Resource Planning and World Health Organization, 2016).
- According to Mehta, Nangia and Dupre [42], infertility care should not be viewed as a Human rights issue.
- In Sub-Saharan Africa, there is no accurate statistics to show the actual number of people affected and the much trauma they are subjected to, in order to enable the public know and appreciate their sufferings and see the need to assist. Only 6 countries (Cameroon, Kenya, Mali, Nigeria, South Africa and Senegal) were included in the data analysis by International Federation of Fertility Societies (IFFS) [43].
- There is huge gap between the rich and poor as well as urban and rural dwellers in the use of ART services. The services are not really available and affordable to all classes of people [44].
- Finance is a huge obstacle in the use of ART. Most African countries are too poor to establish ART in the public hospitals hence, it is left in the hands of private hospitals who

- do it at a “cut throat price”. It becomes impossible for some couples to start; more than half of those that start are even not able to complete the course of treatment. The worst is that when it fails as only a selected few can go for the 2nd and 3rd cycles [45,46]. According to Agholor, [47], one cycle of IVF in Nigeria costs an average of 3,289 USD.
- Many people are not knowledgeable about ART despite the fact that the programme has positively impacted over 50% of infertile couples. There is also lack of awareness on prevention of the causes of infertility in Africa [48]. It was observed that some other countries also experience this setback due to improper health education. African countries need to step up actions to improve awareness of ARTs [49].
 - Many countries in sub-Saharan Africa do not view infertility as an ailment and so do not give a helping hand to infertile couples, not even insurance policy to subsidize the cost of treatment, hence, it becomes a barrier [50]. Infertility is however known as an ailment that affects reproductive health of millions of people worldwide.

13. CONCLUSION

Infertility is a global problem. Several methods of Artificial Reproductive Technologies however exists to help persons with infertility issues have offspring. The success of any of the procedures involves both the male and female adhering to the doctor's instructions to ensure it is successful. Cost of carrying out the procedure, especially in Nigeria is a major hindrance to the widespread use of these technologies. Regardless of the setbacks, these technologies have been helpful in taking away the shame of childlessness most couples experience. There is limited knowledge of these, as such a huge awareness is needed both in the rural and urban areas and fund to utilize assisted reproductive technologies (ART) should be made available for willing but poor families.

14. RECOMMENDATIONS

14.1 Public Enlightenment Campaign

This should be done by the government and leaders at different spheres to educate the masses on infertility and availability of ART. This will make them knowledgeable and enable them seek appropriate medical attention to solve the

problem of infertility forever and run a stable home and invariably, live a happy life.

14.2 Availability and Accessibility

The hospitals where ART services are rendered should be available and accessible to the people to avoid travelling to far places and giving up. Proximity will enable persons with infertility issues to solve the problem with ease.

14.3 Affordability

The government should subsidize the prices of ART services to enable infertile couples afford it. This will enable them share of the joy of biological parenthood.

14.4 Professionalism

The government should put policies in place to make sure only qualified personnel are allowed to function in such facilities to avoid much failures and other complications recorded in the past.

Finally, infertility should not be seen as a woman's problem alone, so that the couple can collectively tackle it and profer lasting solutions to it.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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