

UNIVERSITY OF PORT HARCOURT
SEARCHING FOR THE ‘FRUIT OF THE
WOMB’: SCIENCE AND TECHNOLOGY
BRIDGING THE GAP

AN INAUGURAL LECTURE

By

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DEDICATION

This lecture is dedicated to God for His kindness and mercy upon my life.

To my late father, Vincent Damodu Ikimalo who died while I was in medical school.

To all couples seeking the 'fruit of the womb', may your joy be complete with the birth of a healthy baby, as science and technology bridge the gap.

ACKNOWLEDGMENTS

I am most grateful to the Almighty God who has never departed from my side. I give him all the praise, glory and honour for making it possible for me to meet with all the people that have impacted my life.

I lack the appropriate words to adequately express my gratitude to my academic mentors who have now become family. Professor Linus Ajabor who took me as his adopted son right after my housemanship training under his unit at the University of Benin Teaching Hospital. He stimulated my interest and guided me into residency in Obstetrics and Gynaecology. He has followed up on my progress in my career and family life to date.

Also Emeritus Professor Nimi Briggs, another father who recruited me into residency training and into his research group. He stimulated my interest and taught me diligence and intuition in clinical research and he remains my master, motivator and role model. Thank you Sir. My other colleagues in the research group, Professor OK Obunge, Professor Ngozi Odu, Dr. Seye Babatunde and Dr. Chizoba Wonodu are highly appreciated.

Professor Celestine John is another mentor of mine who strengthened my hands and confidence in Clinical and Surgical skills as a resident. He exposed me to many opportunities within and outside the country to grow in my career. Professor Kelsey Harrison's belief in my capabilities pushed me further to be diligent and to pay attention to details in patient centered management. I appreciate his love and concern for me and my family.

My gratitude also goes to Professors Diejomaoh, Ezimokhai, Okpere; Chief Dr. CIT Wokoma, Late Chief Dr. MT Member and Late Dr. Duncan Lolomari for their teaching and inspiration during my undergraduate and residency training.

I wish to thank my colleagues, Professor Anthony Okpani, Professor Chris Akani, Dr. Nestor Iminigba, Professor Samuel Uzoigwe, all other consultants, residents, nurses and staff of the Department of Obstetrics and Gynaecology. They have all provided a conducive and convivial work environment for my academic growth.

I am immensely grateful to the University of Port Harcourt for sponsoring my training in In-vitro Fertilization (IVF) at the IVF unit of Groote Schuur Hospital, Cape Town, South Africa. I deeply appreciate the contributions of Professor Stephane van der Spuy, Professor Silky Dyer, Dr. Femi Olarogun and members of the unit who impacted their knowledge, skills in IVF and their friendship.

I appreciate the efforts of the former Chief Medical Directors of UPTH, Dr. U.S. Etawo, Professor Aaron Ojule and the support of the present CMD, Professor Henry Ugboma in the establishment and maintenance of the IVF unit in UPTH. Their efforts combined with the technical and financial support of my friend and brother, Dr. Ibrahim Wada and Mr. Gab Odoma made the dream of setting up an IVF unit in UPTH a reality.

I recognize the members of the IVF units in UPTH and NisaPrime, Drs. Fiebai, Orijji, Orazulike, Green, Nyeche and Jude Okohue, the embryologists, nurses and administrative staff of these units who are working tirelessly to achieve pregnancies in patients who come into the units for treatment.

I am eternally indebted to my late resourceful parents, Vincent and Regina Ikimalo who brought me up and molded me to be the best that I can be.

My heart is full of gratitude to my siblings, Mrs. Comfort Inobeme, Mrs. Maria Mogba (of blessed memory) and Victoria Ikimalo who made sure I never lacked anything since my father passed on. Also Angela, George, Benson, Caroline Christopher, their spouses and children. Mr. Augustine Ikimalo my uncle and Mr. Tony Aikpoghome have stood by me all the time.

I appreciate my mother-in-law Chief Mrs. Veronica Obozuwa, my late father-in-law Chief Francis Obozuwa and my wife's siblings, Joseph, Elizabeth, Carol, Patricia, Felicia, Francis, their spouses and children for their support for me and my children.

To my dear wife Franky, thanks for the sparkle and spice you have always added to my life. This journey would not have been possible without your love, patience, calmness, tolerance, sacrifice and entrepreneurship. Above all you have helped to raise our four beautiful children, Osilama, Emike, Anosi and Okiaofe. Together, you have all been my greatest support.

ORDER OF PROCEEDINGS

2.45P.M. GUESTS ARE SEATED

3.00P.M. ACADEMIC PROCESSION BEGINS

The procession shall enter the Ebitimi Banigo Auditorium, University Park, and the Congregation shall stand as the procession enters the hall in the following order:

ACADEMIC OFFICER
PROFESSORS
DEANS OF FACULTIES/SCHOOLS
DEAN, SCHOOL OF GRADUATE STUDIES
PROVOST, COLLEGE OF HEALTH SCIENCES
LECTURER
REGISTRAR
DEPUTY VICE-CHANCELLOR [ACADEMIC]
DEPUTY VICE-CHANCELLOR [ADMINISTRATION]
VICE CHANCELLOR

After the Vice-Chancellor has ascended the dais, the congregation shall remain standing for the University of Port Harcourt Anthem. The congregation shall thereafter resume their seats.

THE VICE-CHANCELLOR'S OPENING REMARKS.

The Registrar shall rise, cap and invite the Vice-Chancellor to make the opening Remarks.

THE VICE-CHANCELLOR SHALL THEN RISE, CAP AND MAKE HIS OPENING REMARKS AND RESUME HIS SEAT.

THE INAUGURAL LECTURE

The Registrar shall rise, cap, invite the Vice-Chancellor to make his opening remarks and introduce the Lecturer.

The Lecturer shall remain standing during the Introduction. The Lecturer shall step on the rostrum, cap and deliver his Inaugural Lecture. After the lectures, he shall step towards the Vice-Chancellor, cap and deliver a copy of the Inaugural Lecture to the Vice-Chancellor and resume his seat. The Vice-Chancellor shall present the document to the Registrar.

CLOSING

The Registrar shall rise, cap and invite the Vice-Chancellor to make his Closing Remarks.

THE VICE-CHANCELLOR'S CLOSING REMARKS.

The Vice-Chancellor shall then rise, cap and make his Closing Remarks. The Congregation shall rise for the University of Port Harcourt Anthem and remain standing as the Academic [Honour] Procession retreats in the following order:

VICE CHANCELLOR

DEPUTY VICE-CHANCELLOR [ADMINISTRATION]

DEPUTY VICE-CHANCELLOR [ACADEMIC]

REGISTRAR

LECTURER

PROVOST, COLLEGE OF HEALTH SCIENCES

DEAN, SCHOOL OF GRADUATE STUDIES

DEANS OF FACULTIES/SCHOOLS

PROFESSORS

ACADEMIC OFFICER

PROTOCOLS

- ❖ The Vice-Chancellor
- ❖ Previous Vice-Chancellors
- ❖ Deputy Vice-Chancellors (Admin and Academic)
- ❖ Previous Deputy Vice-Chancellors
- ❖ Members of the Governing Council
- ❖ Principal Officers of the University
- ❖ Provost, College of Health Sciences
- ❖ Dean, Graduate School
- ❖ Deans of Faculties
- ❖ Heads of Departments
- ❖ Distinguished Professors
- ❖ Directors of Institutes and Units
- ❖ Visiting Academics and Colleagues
- ❖ Esteemed Administrative Staff
- ❖ Captains of Industries
- ❖ Cherished Friends and Guests
- ❖ Unique Students of UNIPORT
- ❖ Members of the Press
- ❖ Distinguished Ladies and Gentlemen.

PREAMBLE

Mr. Vice-Chancellor Sir, with great humility, I want to thank you and the entire administration for giving me this opportunity to stand before this unique University community and the public to give the 161st inaugural lecture of the University of Port Harcourt. This is the fifth inaugural lecture from the Department of Obstetrics and Gynaecology of the University.

My final gratitude goes to all of you in this hall for coming to listen to my inaugural lecture on the topic **Searching for the 'fruit of the womb': Science and Technology bridging the gap.**

1. INTRODUCTION

The Almighty God gave the first commandment to Adam saying ‘Be fruitful and increase in number, fill the earth and subdue it. Rule over the fish in the sea and the birds in the sky and over every living creature that moves on the ground.’¹ (Genesis 1: 28, NIV).

Interest in the fertility process of man has been expressed in various passages of the Holy Bible (Genesis 16:1-2, 25:21, 1 Timothy 5:14, NIV)¹. The ancient Hebrews thought that conception was possible 7 days after menstruation stops. However, human external and internal features were first described by the Greeks in the form of sculptures and paintings.

Hippocrates and Aristotle were aware of the internal and external reproductive organs. Hippocrates (460-377 BC) believed that seeds came from all parts of the body of man and woman, flowed together forming the fruit that then develops. Aristotle (AD 384-322) was the first to record that intercourse was necessary for semen and menstrual blood to mix in the uterus to form the *fruit of the womb*. He did not believe that the ovary played any role^{2,3}.

The Middle Ages, a span of about 1000 years, was really a dark era in medical knowledge and learning. Human dissection was not allowed, so little advancement was made in understanding the anatomy of the human body. The Renaissance that followed witnessed a return to scientific investigation and a lot of the manuscripts of the ancient authors were found to be inaccurate and refuted.



Figure 1. Leonardo da Vinci (1452-1519)



Figure 2. ‘de coitus’

Leonardo da Vinci (1452-1519) was the first to detail the male and female reproductive anatomy in art and he pictorially represented the act of intercourse. (Figure 1 and 2). The work was called 'de coitus'.

Many other theories developed as to how conception proper took place especially after Andreas Vesalius (1514-1564) published the detailed anatomy of the human body^{4,5}.

The Union of sperm and egg was first observed by Oscar Hertwig and also by Beneden in 1875. Since then what we understand today as normal conception began to take shape⁶. It is this conception which leads on to the development of a fetus in the womb and the emergence of a baby at birth. That is the 'fruit of the womb' that we are talking about in today's lecture (figure 3).



Figure 3. The Fruit of the Womb

1.1. Measuring the Gap: Definitions

In the world today, 10 – 15% of the population in the reproductive age group are unable to achieve this natural process for the *fruit of the womb*.⁷ Again it is this incapacity to obtain the fruit of the womb that is referred to as 'the gap' in this lecture.

This gap, which in reality is known as **Infertility**, is the inability of a couple to achieve pregnancy within 12 months of regular and unprotected sexual intercourse.

It is called **primary infertility** if a woman has never been pregnant and **secondary infertility** if she has been pregnant, irrespective of the pregnancy outcome.

1.2. Demography

There are more than 186 million people worldwide looking for the *fruit of the womb*.⁸

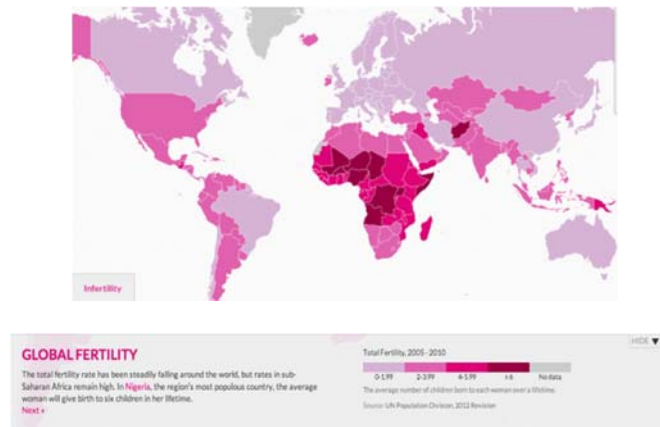


Figure 4. Map Showing Global Fertility

Majority of these people live in Central and Eastern Europe, South and Eastern Asia, the Pacific and Sub-Saharan Africa (figure 4).

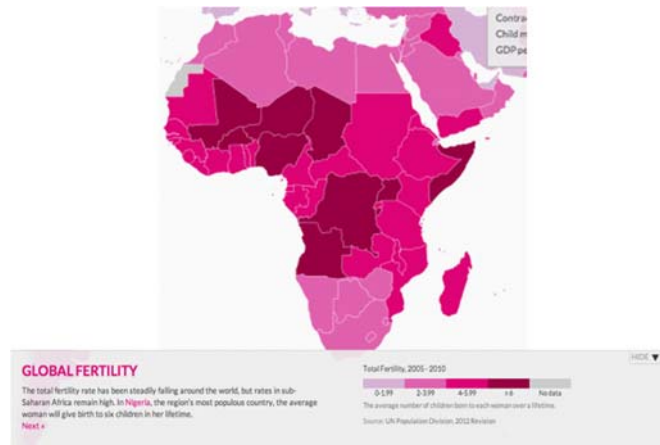


Figure 5. Map Showing Africa Infertility Belt

A survey of infertility in Sub-Saharan Africa in 2002 showed that over 60% of the countries had infertility rates above 75%. Zimbabwe for instance had rates as high as 62%, nearly 2/3 of the population of reproductive age.^{9,10} The high rate of infertility across West, Central and Southern African countries, in contrast to the countries of North Africa, caused demographers to describe these areas as an infertility belt.^{11,12} (figure 5) Liberia, Sierra Leone, Nigeria, Cameroon, Equatorial Guinea, Gabon, Mozambique and Central African Republic all have high rates of infertility. Paradoxically, these same areas have high fertility rates.¹³

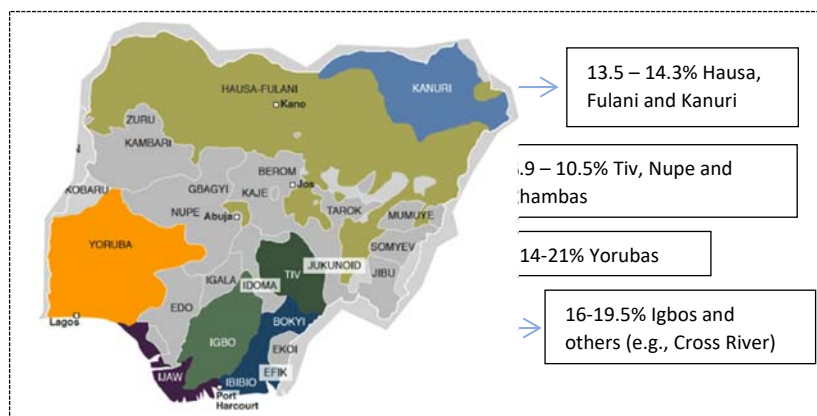


Figure 6. Regional Infertility prevalence in Nigeria (source – Dr. Wada)

In Nigeria, rates of infertility range from 15.4% in Abakaliki¹⁴ to 26.8% in Lagos.¹⁵ The rates are about 15.7% in Sokoto¹⁶ and 23.9% in Bauchi.¹⁷ In all of these studies, secondary infertility was above 60% whereas in the western world, the prevalence of infertility is much lower and more of primary infertility.¹⁸ Figure 6 shows the regional variations in the prevalence of infertility in Nigeria. In our gynecology clinics, up to 60% of the patient present with infertility. For all of us seated here, we must know one or two families waiting for the *fruit of the womb* and so this is often a prayer point for most of us individually and in our religious congregations and worship. The consequences of not bearing the fruit of the womb are enormous for the couple, but are borne more by the woman than the man

especially in our environment. These include depression, low self-esteem, sexual dysfunction, violence, abandonment, separation, threats by husband's relatives, divorce, polygamy, ridicule, stigma, poverty, suicidal tendencies and death.^{19,20} Infertility is strongly stigmatized in Nigeria and mother-in-laws have been shown to be the greatest tormentors of the infertile woman.²¹ It has been shown that women who did not have a child after an initial fertility evaluation and treatment are more than twice at risk of committing suicide than women who have at least one child.²²

1.3. Case Studies

When I came into Port Harcourt for the National Youth Service Corps (NYSC) in 1981, I visited a senior colleague who had just divorced his wife after 4 years of marriage. Their main problem was infertility and he related to me the extent they had gone in their efforts to achieve a pregnancy. His story included how he slept overnight in a cemetery on two occasions. You can imagine an educated individual going through all of this, just because of a desire to have the *fruit of the womb*.

The second incident happened shortly after I was employed in a private hospital upon completion of my NYSC. A young lady of about 30 years consulted me with a 3 year history of inability to get pregnant and not being able to sleep for 2 days. She narrated how 2 days prior to presentation, her husband had taken her to consult an Alhaji in the old Port Harcourt Town. Her husband stayed in the reception while she was taken into an inner room where she was made to lie naked on a high slab covered with mat. The Alhaji massaged her body with different substances until she slept off. On waking up, she realized that she had been sexually assaulted. She could not tell her husband because he had taken her to different cities in Rivers, Akwa Ibom and Abia States with weird experiences that caused quarrels between them anytime she complained about them. However, she had been unable to sleep following this recent event as she wondered whether she should tell her husband. She was managed as a rape case and as part of counselling, I encouraged her to tell her husband all that had happened. She got better after she did and slept well.

2. 'THE FRUIT OF THE WOMB'

2.1. How Pregnancies Take Place.

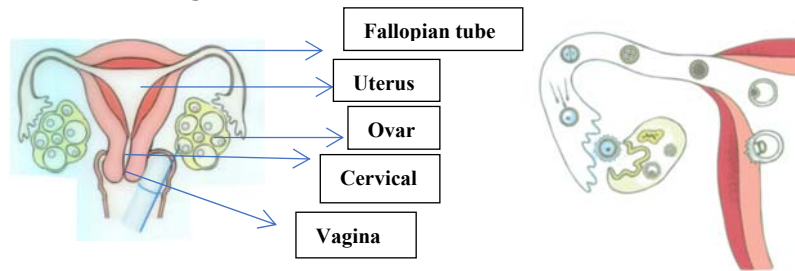


Figure 7. Female Genital Tract

Figure 8. How pregnancies take place

In natural circumstances, pregnancy takes place after coitus when a man deposits spermatozoa into a woman's vagina (Figure 7). The spermatozoa (sperm) swim up into the cervical canal where acrosome reaction described as capacitation (head shaving) takes place. The spermatozoa then swim upwards through the uterus to the fallopian tubes where they stay, waiting for the arrival of the ovum (egg from women). A woman's egg is normally released from either ovary (occasionally both) at about the middle of the menstrual cycle every month. Ovulation and the menstrual cycle are regulated by a cascade of hormonal interplay between the hypothalamus, pituitary, ovary and the uterus.

The egg when released is grasped by the fimbriae and moved into the Fallopian tube where a single sperm fertilizes (penetrates) the egg. An embryo is formed in the Fallopian tube and the embryo moves into the uterine cavity within 5 days (Figure 8). Implantation takes place and the *fruit of the womb* begins the process of growth and development. The baby develops in the womb for about 40 weeks after which it is delivered to the joy of the parents, the family and society.

2.2. Causes of "The Gap"

The causes of infertility are thought to be found in the following proportions: -

- 30% in the female
- 30% in the male

- 30% in both of them
- 10% as unexplained.

2.2.1. Female Factors

More than 85% of female factor infertility in Africa is caused by tubal damage arising from pelvic infections compared to 33% of women worldwide.¹³ Seventy percent (70%) of these pelvic infections are mainly due to sexually transmitted infections (STI) by *Chlamydia trachomatis* and *Neisseria gonorrhoea*.⁶ Puerperal and post- abortal infections account for the rest. These infections damage the fallopian tube causing blockage of the sperm from meeting the egg for fertilization to take place.

New growth, such as endometriosis,²³ and previous pelvic or abdominal surgeries like caesarean sections, appendicectomies or ovarian cystectomies can also cause tubal blockage.²⁴

Absence of ovulation in a woman is another major cause of infertility and this arises from inappropriate hormonal secretions from the brain to the ovaries and then to the uterus (hypothalamo-pituitary-ovarian axis). Polycystic ovarian disease and increased prolactin secretion are few examples.

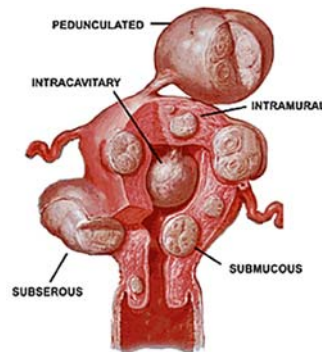


Figure 9. Locations of Uterine Fibroid

Uterine fibroids (Figure 9) are common in women of African descent, including Nigerians.²⁵ Although quite a good number of women get pregnant with fibroids, they can cause infertility depending on their size and position in the uterus. They can cause

displacement of the cervix, obstruction of the proximal fallopian tubes, alteration of the tubo-ovarian anatomy or interference with uterine function during implantation.²⁶

Age is another important factor in the fertility of the woman. Above the age of 35 years, fertility declines rapidly until 40 – 42 years. This is mainly due to natural reduction in the number and quality of the eggs produced by the ovaries.²⁷

Other causes of infertility in the female are congenital anomalies of the various parts of the female reproductive tract, from the vulva up to the ovaries, and diseases of other endocrine organs like the thyroid, pancreas, adrenals and the pituitary.

2.2.2. Male Factors

Men may present with either low sperm count or total absence of spermatozoa from the semen.

In more than 50% of male infertility, the cause is unknown or classified as idiopathic. The known causes of male infertility can be classified as pre-testicular (1-2%), testicular (30-40%) and post testicular (10-20%).²⁸

The pre-testicular causes are due to inadequate hormonal support to the testis from the hypothalamo-pituitary-testicular axis and poor general health resulting from systemic illness and drug use. Examples are Kallman's Syndrome, pituitary adenoma, obesity, hyperprolactinaemia, anabolic steroids, cimetidine, nitrofurantoin, spironolactone, GnRH agonists and antagonists.

Testicular causes are either congenital, developmental or acquired diseases. The congenital disorders include Klinefelter's syndrome and Y-chromosome microdeletions. Acquired disorders of the testes include exposure to high temperature (like in blast furnace workers, use of tight underwear and persistent use of sauna's) and damage to the testes from environmental toxins like lead, cadmium, mercury and hydrocarbons. Mump viral infection could result in epididymoorchitis and testicular atrophy. Radiotherapy, surgery and chemotherapy are other causes.

Post-testicular causes affect the outflow of the genital tract despite the production of spermatozoa. Congenital bilateral absence of the vas deferens or obstructions of the vas are the main

manifestations. Sexually transmitted infection by Chlamydia and Gonorrhoea are the leading causes of obstruction, followed by surgical and spinal injuries.

Although a man can still father a child at any age, recent evidence shows that seminal fluid quantity, motility of sperm and morphologically normal sperm all decline with advancing age.²⁹

2.2.3. Factors affecting both sexes.

Occupational and environmental factors like excessive radiation, heat, heavy metals, hydrocarbons, microwave radiation, smoking, alcohol, tobacco, hard drugs (cocaine, marijuana) affect fertility.

Excessive weight gain leading to obesity and excessive weight loss like in strenuous exercise in both male and female can lead to infertility.

2.2.4. Unexplained Infertility

In about 10% of infertile couples, the cause of infertility is not easily identifiable and so they are classified as unexplained or idiopathic. However, as technology and new procedures emerge for the evaluation of infertile couples, some of those who fell into this category in the past have had the cause of their infertility identified.

3. SEARCHING FOR THE FRUIT – TREATMENT OF INFERTILITY

3.1. Traditional and Unorthodox Treatment

The history of traditional and unorthodox ways of looking for the *fruit of the womb* abound in various communities. The use of charms, sacrifices to the deities, gods and goddesses, oral and vaginal concoctions which may further damage the reproductive tract are common.^{30,31,32} Religious groups and churches also manage infertility with special prayer sessions and services including fasting.

A relatively new concept of growing concern in Port Harcourt and environ is 'Crypto-pregnancy'. Here the woman searching for the *fruit of the womb* suddenly 'delivers' a baby in a facility without an obvious pregnancy. These facility providers when consulted tell the clients that they are already pregnant. Hormonal

drugs or steroids are sometimes given to induce amenorrhoea (stop menses) and generalized oedema (body swelling). They are warned that the pregnancy is undetectable by ultrasound and by the doctors because it is at the back of the abdomen. Eventually the client is called up (apparently when the desired baby is available) for a phantom labour and delivery. A higher fee is charged for male babies.

3.2. The Science and Technology

Science is a systematic process to gain knowledge through observations and experimentation. The practical application of science gives rise to technology. Technologically designed products are in turn used to further develop science. Ultimately, the quality of human life is improved through science and technology.

Following the scientific understanding of conception, drugs were developed to make women who did not ovulate to do so. Artificial insemination of donor or husband's semen was developed and used for a long time, since the 1940s.³³

In the period between 1950 and the 1970s, tubal surgeries were carried out to repair the damaged tubes³⁴. Even with the application of microsurgical techniques to tubal repair,³⁵ little success was achieved generally, yet these were the best that could be offered as treatment for infertility then.³⁶

3.2.1. In-Vitro Fertilization and Embryo Transfer (IVF-ET)



Robert Edwards and Richard Steptoe

Figure 10. Edwards and Steptoe and Birth of Louise Brown

On the 25th July 1978, exactly 41 years today, Robert Edwards and Richard Steptoe, made history with the delivery of the first IVF baby called Louise Brown in the UK (figure 10). This was done by the

technique known as In-Vitro Fertilization and Embryo Transfer (IVF-ET).³⁷ This technological advancement of IVF has been described to rival the first man walking on the moon 9 years earlier.³⁸



Figure 11. IVF Procedure

Without intercourse, the woman's egg is retrieved from her ovary, and the spermatozoa is taken from the man. They are both put together in a petri dish for fertilization to take place. The embryo so formed is then transferred through the woman's vagina and cervical canal into her uterus (womb) to develop normally for about 40 weeks and thereafter be born live (figure 11).

This technological revolution changed the entire treatment for most of the hopeless cases of infertility and gave joy to many families.

The practice of IVF immediately spread all over the Western world with the refinement of the original procedure and development of newer procedures. This is the treatment now collectively referred to as Assisted Reproductive Technology (ART).

Assisted Reproductive Technology is defined as all treatments and procedures that include the in-vitro handling of the human sperm or egg or embryo for the purpose of establishing a pregnancy. These include In-Vitro Fertilization and Embryo Transfer (IVF-ET), Gamete Intrafallopian Transfer (GIFT), Zygote Intrafallopian Transfer (ZIFT), gamete/embryo donation, cryopreservation, Intracytoplasmic Sperm Injection (ICSI), Intracytoplasmic Morphologically Selected Sperm Injection (IMSI),

surgically retrieved sperm and Surrogacy. To date, over 8 million children have been born by IVF since the birth of the first baby.³⁹



Figure 12. Em. Prof. Osato Giwa Osagie and Prof. O. Ashiru

In Nigeria IVF-ET was introduced by Professors Giwa Osagie and Ashiru in Lagos in 1987 (Figure 12) and they have remained at the centre of the development of this Sciences in Africa.



Figure 13. Dr. Ibrahim Wada and Baby Hannatu

In 1998, Dr. Ibrahim Wada reported the first baby delivered in Nigeria – Baby Hannatu. (Figure 13). Since then he and the other pioneers in the field have assisted in the spread of the Technology to other parts of the country.

3.2.2. Highlights of the steps and some major developments in ART

Since the birth of Louise Brown, the first IVF baby, there is arguably no other branch of medicine that has witnessed the speed of development observed with ART.

The steps and processes deployed are constantly changing from year to year, with the goals of improving the take-home-baby rate, reducing complications and mitigating ethical dilemmas that trail each new development in ART.

3.2.3. Ovarian stimulation

When Edward and Steptoe started, they used the natural cycle, that is, they waited for the single egg to develop to maturity every month in the woman before they retrieved it. Soon after, hormonal drugs were given to stimulate the ovaries of women to generate more eggs for retrieval.⁴⁰ Occasionally, too many eggs, 20-30 were retrieved and one of the major complications was Ovarian Hyper Stimulation Syndrome (OHSS).⁴¹ In this condition, the ovaries are enlarged, fluid is redistributed and gets accumulated in the abdomen and thorax with difficulty in breathing. This could be life-threatening when severe.

Improvements have occurred in the dose, quality and purity of the hormonal drugs used nowadays⁴² hence, a moderate number of eggs are harvested without causing this complication to the woman. We now talk about 'patient-centred controlled ovarian hyper-stimulation'. Here, stimulation protocols are tailored to the individual patients' need.

3.2.4. To collect eggs from the woman (Oocyte retrieval)

Laparoscopic surgery with general anaesthesia was used initially to collect eggs from the woman but now, transvaginal ultrasound scan with needle guide through the vagina is used.⁴³ General anaesthesia is no longer needed for egg retrieval.

3.2.5. To collect the sperm from the man

The traditional method of collecting semen by masturbation may not be feasible in some men. Assistance with the use of drugs,⁴⁴ non-spermicidal condom and post ejaculatory urine sample can be used to retrieve the sperms.⁴⁵ There are now various surgical retrieval methods for collecting sperm where there is obstruction,

azoospermia or oligozoospermia (figure 14).⁴⁶ Electro ejaculation can also be done where there is no erection.⁴⁷

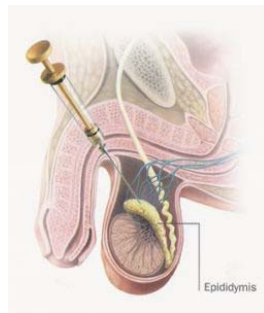


Figure 14. Testicular Sperm Injection

Chinese company creates automatic sperm extractor

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Figure 15. Sperm Extractor

Most recently, the Chinese have developed a sperm extractor machine⁴⁸ shown in figure 15. Sperm banks exist where sperm donated or for self-use are frozen and stored.

3.2.6. Fertilization and Embryo development

One of the greatest advancement in the ART is the ability to inject one sperm into the egg to achieve fertilization.

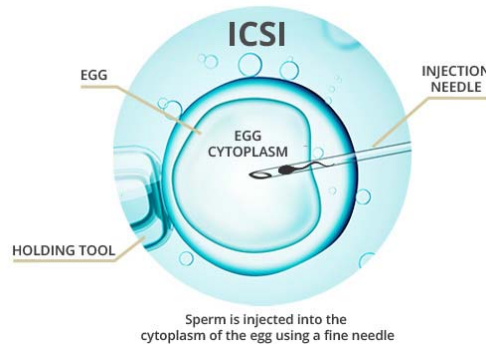


Figure 16. Intracytoplasmic Sperm Injection

The procedure is called Intra cytoplasmic sperm injection (ICSI)⁴⁹ (figure 16). It is now followed by intracytoplasmic injection of morphologically selected sperm (IMSI), using sperms that are processed and known to be normal and viable.⁵⁰

3.2.7. Embryo Transfer

The transfer of the embryo so formed is done 2-3 days (cleavages stage) after fertilization, but now with improvement in the culture media they can be cultured further to five days (blastocyst stage) before transfer to the uterus for better result.⁵¹

In order to improve the chances of pregnancy, several embryos up to 4 or 8 used to be transferred, which resulted in increased multiple pregnancy rates and associated complications, including maternal mortality. Presently, single embryo transfer (SET) is being advocated and legislated upon in the Western world.^{52,53} Technological advancements in freezing by vitrification for storage of embryos have now made it possible to store the extra embryos and implant one embryo at a time for a woman without having to stimulate ovulation in her again.

The receptivity of the endometrium of the womb has been and is still undergoing a lot of research to improve implantation. The thickness of the endometrium (like the fertile soil) has been studied.⁵⁴ The distance where the embryo should be dropped in the uterus, catheter type and the window of implantation (WOI) are all associated with improved pregnancy rates.^{55,56,57}

3.2.8. Pre Implantation Genetic Testing / Diagnosis (PGT)



Figure 17. Pre Implantation Genetic Biopsy

Prior to the transfer of embryo, a sample of cell can now be taken from the embryo (biopsy) for genetic testing⁵⁸ (figure 17). This can be done for:

1. Disease detection e.g sickle cell
2. Sex determination
3. Research / genetic engineering

Miscarriages are common in natural pregnancies as well as ART. Genetic abnormalities cause over 50% of first trimester miscarriage. Pre-Implantation Genetic Testing (PGT) can now identify normal embryos for implantation.⁵⁹ This has increased pregnancy rates by 20% and reduced the rate of miscarriages.⁶⁰ All the 24 chromosomes have been assessed and with DNA gene-sequencing, human gene editing technologies now exist with the potential for therapeutic application. The sex of the baby can be determined by this method and so the desired sex can be implanted for sex balancing. Genetic engineering has made it possible for genes to be manipulated to change specific characteristics in the babies like intelligence, length of nose etc., the so called – ‘designer babies’ but these are fraught with serious ethical issues.

3.2.9. Vitrification - Freezing



Figure 18. Vitrification and Cryopreservation

Before now, sperm was the only gamete that was frozen. Vitrification (figure 18) is a new method of very rapid freezing of tissues without ice formation.⁶¹ This method preserves the component of the cells in a way that the cells can resume biological activity after thawing, even after many years of storage. Eggs and embryos can now be vitrified and stored for future use.⁶²

3.2.10. Fertility Preservation

The development of the technology of vitrification and cryopreservation opened another important vista in ART. Sperm and eggs can be stored for further use in cases prior to cancer treatment,

benign diseases like premature ovarian failure, diminished ovarian reserve and delayed fertility because of career.^{63,64}

3.3. Third Party ART - Surrogacy

Surrogacy is when a woman carries and delivers a baby on behalf of another woman. It is sometimes described as ‘womb renting’. It has become one of the greatest bioethical issues of the 21st century. The first birth from surrogacy occurred in April 1986 for a woman who had lost her womb from ruptured uterus. She was married to a cardiologist from New Jersey.⁶⁵ The indications for surrogacy include absence of uterus (hysterectomy, congenital absence), diseased uterus like huge and multiple fibroids, severe intrauterine adhesion (Asherman’s syndrome), recurrent miscarriages, anomalies of the uterus (rudimentary or hypoplastic uterus) and medical conditions precluding pregnancy like severe cardiac or renal diseases. Newer or more recent indications include single men or women, same-sex couples’ and women who do not just want to carry pregnancy like celebrities, models and athletes.

There are 2 types of surrogacy

1. Traditional or genetic surrogacy - where the egg used is from the surrogate mother
2. Gestational surrogacy - where the egg is not from the surrogate mother

Surrogacy can be commercial, where monetary compensation is given, or altruistic, where monetary compensation is not made. In the latter, the surrogate is just happy helping someone. Reimbursement of medical expenses can be given in both cases.

Due to the complicated ethical, legal, religious and traditional ramifications of surrogacy, some countries have banned surrogacy (France, Italy, Germany and UAE). Others allow altruistic surrogacy (Australia, Canada, South Africa and Brazil).

The countries that allow all sorts of surrogacy include India, Russia, Ukraine and Nigeria where there is no regulation of ART right now. Surrogacy is available in all the ART centres in Nigeria and an agency for recruitment exists in Nigeria at <http://nigeriansurrogates.com/>

Surrogacy has made medical tourism and cross-border gamete/embryo and surrogate transfer popular. This has brought us to the concept of social parenting and ‘Google baby’.⁶⁶ The social parent is where the couple raises and provides for the child to adulthood. The Google baby is the one sought from the internet and facilitated by the courier services like FedEx. Some of the serious bioethical issues raised by surrogacy and third-party ART are – Who is the mother of the baby? A child born by surrogacy can have 3 mothers or 5 parents. The contracting father, the contracting mother, the genetic father, the genetic mother and the surrogate mother.

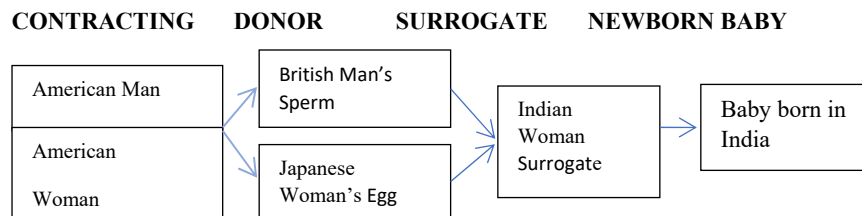


Figure 19. Google Baby

A couple living in America can decide to source for the spermatozoa of a British man and the egg of a Japanese lady, can ship these gametes by FedEx to India for ART and gets an Indian lady to carry the pregnancy for 40 weeks and deliver the baby (figure 19). The baby can then be taken to them in America where necessary adoption laws may apply. In this regard, single men or women and same sex couples can source for a baby through this means.

I identify myself with the original indications for surrogacy as outlined earlier and I worry about the consequences of the availability of human gametes and embryo through the internet like on a supermarket shelves and the ordering of surrogate babies like ordering for Chihuahua dogs in modern day.

3.4. Uterine transplantation

Gestational surrogacy may soon become a thing of the past as there are recently evolving success with transplantation of the uterus in Sweden as demonstrated by the birth of a baby from a transplanted uterus on September 4th 2014.⁶⁷ To date over 13 human uterine transplantations have been conducted in 3 different countries.^{68,69}

Scientific research is currently looking at the creation of bio-engineered uterus for development just as for the heart through multidimensional printing in 3D, 4D and so on.⁷⁰

The possibility of implanting the uterus into males in transsexuals cannot be ruled out in the near future.

3.5. Transplantation of the Fallopian Tubes and Ovary

Where the fallopian tubes have been extensively damaged, attempts had been made to transfer another healthy fallopian tube from a live donor but immunological rejection is still a major obstacle.⁷¹

The successful transplantation of the ovary leading to healthy pregnancy has also been reported.⁷² By 2017, over 130 cases of ovarian tissue transplantations have been carried out.⁷³

3.6. Human Reproductive Inefficiency

The process of reproduction in humans is very inefficient compared to other mammalian species. The probability of achieving pregnancy during a menstrual cycle is approximately 30%,⁷⁴ compared to 96% in rabbits. In humans, only 60% of all conceptions advance beyond 20 weeks and 75% of most fertilized eggs fail to implant and are not recognized as pregnancies.⁷⁵ Even after pregnancy has occurred miscarriage may occur in 10-20% of pregnancies for various reasons including cervical incompetence.⁷⁶ As pregnancy advances, other complications in pregnancy^{77,78} and labour^{79,80} may further reduce the take home baby rate.

3.7. Complications of ART

Assisted Reproductive Technology is not without complications even though the babies are normal. Some of these include;

1. Haemorrhage, injury to pelvic structures and infection may occur during the surgical procedures.
2. Ovarian Hyperstimulation Syndrome (OHSS).
3. Multiple pregnancies with increased pregnancy complications.
4. Psychological complications from the intense stress that follows the process.

3.8. ART Ethical Issues in Nigeria

Every step in the development and progress of ART has met with multiple ethical issues. Some of the major ethical challenges in Nigeria include:

1. Lack of regulation and accreditation of clinics. A bill before the National Assembly on the setting up of a regulatory body called The Nigeria Fertility Regulatory Authority has not been debated since 2012.
2. Absence of serious national dialogue on the ethics of ART.
3. Poor access – urban / rural centres
4. Embryo management – we still practice multiple embryo transfer and what happens to the excess embryos is not publicly discussed.
5. Poor documentation – when disclosure issues will arise, there may be problems with documentation, use of fake names etc.
6. Authentic declaration of results / standard of clinics. Some clinics are now operated by non-doctors and others publicize fake results to attract patients.

I am happy to say that Lagos State Government, in collaboration with the Association for Fertility and Reproductive Health of Nigeria (AFRH), has had series of ART stakeholders fora and finally launched the State guidelines for the practice of ART in Lagos on Monday 6th May 2019.

3.9. Adoption

I want to emphasize that not every couple can have a child. Even with all the technological advancements in infertility management to date, a few couples desiring the *fruit of the womb* may not be able to have this. Adoption remains the last call to fill the gap between the desire and actually having a child of their own. The adoptive parents accept all the parental rights (care, nurturing, training, physical, emotional and financial support) relinquished by the biological parents through a 'legal system'.⁸¹

At the United Nations Convention on the rights of the child in 1986, the legal framework for child adoption was constituted.⁸² Acceptable reasons for adoption include management of infertility, replacement of a dead child, protecting marriages, providing

company for an only child, legitimize an illegitimate child, salvaging an abandoned child or taking over the burden of child care from indigent parents.

In Nigeria, the National Child Right Act passed in 2003 included legally recognized adoption practices.⁸³ However, several social and cultural taboos and misconceptions have weakened its acceptability by infertile couples, despite widespread knowledge about it. Adoption can close the gap for every couple to have a child.

4. MY CONTRIBUTION TO THIS SCIENCE, TECHNOLOGY AND THE COMMUNITY

My modest contributions to science and technology in the area of searching for the *fruit of the womb* started with a survey of the reproductive health of adolescent girls in a rural community in Ogoni land. In this multi-disciplinary, international collaborative study, we were interested in adolescent girls who are in the dawn of their reproductive lives. I then worked with similar adolescent girls in communities in urban Port Harcourt City. The prevalence of infertility in Rivers State and perception of infertility in Port Harcourt were studied before I finally concentrated my research efforts inside the hospital, on contemporary treatment of infertility in the field of Assisted Reproductive Technology.

In 1993, we carried out an extensive study, in collaboration with The Liverpool School of Tropical Medicine and the Overseas Development Administration (ODA) of Britain (now DFID), on the reproductive health of women, with particular interest in adolescent girls (12-19 years of age) in K-Dere, Ogoni land.



Figure 20. House to House Survey

We did a house to house survey and interviewed all the women in the village numbering 868 (figure 20). These were made up of 410 (93.4% of all female adolescents in the village) adolescents less than 20 years and 458, (88% of all adult female in the village) of women 20 year old and above, in the community. These women had clinical examination and laboratory testing in the health centre which we had to upgrade (figure 21).



Figure 21. K-Dere Health Centre Upgrade

Our findings showed that:

- Sexual activities had commenced in 43.6% of adolescent before the age of 17 years and 80.1% of 17 – 19 year old were sexually active.
- Only 5.2% had ever used any form of contraception and they did not use them regularly.
- The partners of these adolescent girls were at least 5 years older in majority of cases.
- 40.4% of the adolescent girls had Reproductive tract infections, and 19.4% had sexually transmitted infections.
- 10.5% of adolescents between 17 – 19 years had chlamydia trachomatis infection.
- 24.11% had already induced abortions for unwanted pregnancies.
- 42.1% had either undergone an abortion or had an STI, or both.

These findings were disseminated to the community and the Ministry of Health in Rivers State. These findings served as a lead paper from original research published in the *Lancet* journal in 1995.⁸⁴ It was

also recognized as one of the largest population studies on the reproductive tract infection amongst adolescent girls in a rural setting, particular coming from sub-Saharan Africa. Furthermore, it should be noted that most of the positive findings in this study are the commonest causes of tubal damage that can lead to infertility.

4.1. Studies in Port Harcourt City

As a follow up to the rural study, we carried out a similar study on prevalence and risk factors for STI among adolescent school girls in Port Harcourt City. A total of 1066 unmarried adolescent girls were recruited. Five hundred and forty-five (51.1%) of them were already sexually experienced. Fewer numbers 2.1% had chlamydia and 2.1% had Gonococcal infections unlike in the rural study. In all, 13.8% of the girls had a sexually transmitted infection. We found that having a partner 25 years and above and doing business were increased risk factors for STI, remaining in school reduced the risk for STI and that vaginal discharge was not pathognomonic of STI. We opined that the STI rate was reduced in these urban girls because of their better knowledge, access to antibiotics, condom use and gate-keeper effects of parents and guardians.⁸⁵

Our findings and the dissemination of the results helped in the advocacy for the establishment of adolescent-friendly centres in Diobu and introduction of school health programs including family life education curriculum in some secondary schools. I introduced the school health program at our University Demonstration Secondary School as Chairman of the board in 2013. We also established a youth friendly centre called 'Youth Profile' in Diobu, Port Harcourt. Our findings on the efficacy of drugs used for the treatment of the uncomplicated STI found in these studies were also incorporated into the National Guideline for the treatment of sexually transmitted infections in Nigeria and the algorithm for the syndromic management of STI worldwide.

To investigate the effect of chronic under-nutrition and abnormal sex hormone secretion on infertility, we carried out two separate studies; One on the nutritional status of adolescent girls in both rural and urban settings. We found that 10.4% of our rural girls and 4.7% of our urban girls were stunted compared to British girls.⁸⁶

This was a reflection of our socio economic condition. It was also noted that girls with low blood levels, anaemia (Hb < 10g/dl), were likely to be stunted. This study is one of the first in the world to describe under-nutrition in adolescents living in developing countries and to explore International cut off values for low body mass for age. We concluded though that more studies were needed to define and interpret low Body Mass Index (BMI) in the adolescent. Body Mass Index is an important tool used in the management of infertility.

The other study was on the levels of sex hormone and serum retinol concentration in adolescent girls. We found that adolescent girls with vitamin A deficiency had derailed pattern of estrogen, progesterone, luteinizing hormone and follicle stimulating hormone interaction.⁸⁷ These are all necessary hormones for reproductive function⁸⁸.

In 2001, we carried out a survey of the health status of women in the entire Niger Delta region. In that survey, we found the prevalence of infertility to be 17% and that primary infertility was uncommon.⁸⁹ There was also a poor general knowledge about the causes and treatment of infertility.

This background information led to a study on the perception of infertility among urban residents in Port Harcourt. A cross-sectional household survey of infertility was carried out in Borokiri area because of the poor knowledge of the causes, treatment and the societal attitude to infertility. Our findings showed that out of the 150 adults interviewed, only 32% could correctly identify what infertility really means. Most people knew that risk factors like promiscuity and venereal disease (STI) could cause infertility but did not know how. Table 1 shows the respondents perception of the risk factors for infertility.

Table 1: Respondents' perceptions of Risk factors of Infertility (n=150)

Cause of Infertility	YES n (%)	NO n(%)
Unknown	110 (73.3)	40 (26.7)
Venereal Disease	133 (88.7)	17 (11.3)
Promiscuity (risky sexual behavior)	150 (100.0)	0 (0.0)
Men using tight underwear	8 (5.3)	142 (94.7)
Previous abortion	133 (88.7)	17 (11.3)
Abnormalities of reproductive organ	140 (93.3)	10 (6.7)
Medical disease/operation	140 (93.3)	10 (6.7)
Excessive drinking	135 (90.0)	15 (10.0)
Excessive smoking	135 (90.0)	15 (10.0)
Punishment from God	3 (1.4)	147 (98.6)
Curse from witches/enemies	7 (4.7)	143 (95.3)
Getting married to a relative	0 (0.0)	150 (100.0)

Sixty three percent (2/3) believed that the woman is responsible for infertility. Though 70.7% knew about IVF, 68% opposed adoption and not even one person supported surrogacy. This also shows that we are still far behind in the knowledge and attitude towards embracing modern treatment methods for infertility.⁹⁰

4.2. Hospital Research / ART

Collaborating with the pioneers of Assisted Reproductive Technology in Nigeria, and Niger Delta in particular we documented our first 18 months' experience in the field of ART in 2004 at a time when kidnapping was going on in this region.

Our findings showed an initial low turnout of patients because of poor knowledge and so patients had to be batched for treatment. 147 patients were treated, 92.6% responded to treatment and we had a clinical pregnancy rate of 32.6% per embryo transfer.⁹¹

More importantly were the peculiar challenges we encountered which we highlighted as: power surge which blew incubators, epileptic power supply, difficulty with getting consumables like embryo catheters media and needles, reliance on endometrial thickness alone without doing hormone assays like estradiol, manipulation treatment to suit the schedule of visiting embryologist, kidnapping and late night consultations for vulnerable clients. Despite all these, we learnt to surmount these unforeseen challenges and our results became comparable to others in the world.

The entire process of going through IVF treatment can be physically, emotionally and financially stressful for the couple. On the day of collection of eggs from the woman, semen is also collected from the man. Unfortunately, some men have ejaculatory failure at that moment. In 2010, we reported 5 cases of ejaculatory failure out of 301 egg retrievals over a 3 year period giving an incidence of 1.66%. These were men who had no problems with sexuality. We gave them 50mg sildenafil citrate (Viagra) and the couple watched a sex video, still they could not produce semen after 12 hours. We surgically retrieved sperm in one of them, 3 of them had repeat IVF with semen collected easily a day before egg retrieval but the men were not told about the day of retrieval. One of them eventually had a set of twins. The last man ended up quarrelling with his wife seriously, almost went physical. We settled their quarrel but they never came back. At this time liquid nitrogen was not readily available in the country for semen storage. This paper demonstrated the psychogenic effect of infertility management on sexuality.⁹²

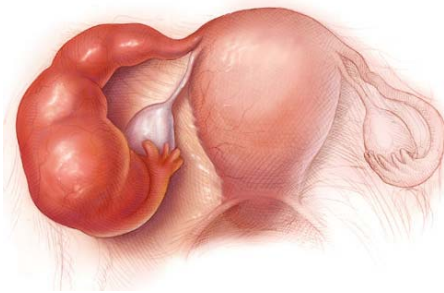


Figure 22. Right Hydrosalpinx

Hydrosalpinx (figure 22) is the presence of fluid accumulated in a damaged Fallopian tube. It can negatively affect IVF success rate and so it is advocated that a prior surgery is done before IVF. This adds additional cost and surgical operation for the patient. We recorded a case of successful pregnancy from IVF with simple aspiration of the cyst through the vagina at the time of collecting the egg without abdominal surgery or general anaesthesia.⁹³ It is now a practical option sometimes used in low-resource countries where cost and aversion to surgery is a major problem.

After fertilization, implantation is the most crucial stage in the establishment of pregnancy in natural conception and in ART. Here, the embryo attaches itself to the endometrium, penetrates and forms the placenta. This is like lying on a soft and succulent bed. The thickness of the endometrium contributes to the success of implantation. We studied 298 patients between the ages of 20 – 35years undergoing ART treatment to find the most appropriate thickness of the endometrium for implantation. No pregnancy occurred when the endometrium was thin, <7mm. 3.2% of pregnancy occurred when the endometrium was too thick, >14mm and 50% of pregnancy occurred with endometrial thickness of 7-14mm.⁵⁴

Our finding is still very important and useful to know when to stop treatment and cryopreserve the embryos for better preparation of the endometrium. The embryos can then be transferred into the womb later.

Another problem we commonly have in the endometrium includes already existing pathologies that cannot be established without looking at the endometrium directly.



Figure 23. Hysteroscopic Surgery

The hysteroscope, a fibre-optically lighted endoscopic instrument is used to see the inside of the uterus (womb) and the picture is projected on a screen (television) in real time (figure 23). Intrauterine pathologies can be visualised.

Knowing that damage to the endometrium from induced abortion is prevalent, we used this instrument to look at the womb of 87 women undergoing ART in a 3year period. We found out that only 23% had normal findings, 48.30% (44) had one pathology and 26.4% (23) had multiple pathologies. Amongst those who had pathologies, intrauterine adhesions occurred in 64.2%, retained fetal bone from previous termination of pregnancy in 3.5%, endometrial polyp in 11.5% (10) and silk was found in one patient's endometrium. She had a previous myomectomy (Fibroid operation).⁹⁴ All of the patients were treated with the hysteroscope and one of the 3 patients that had fetal bones removed got pregnant immediately after the procedure. Some authors now advocate hysteroscopy for all patients undergoing ART in our region because of the high prevalence of endometrial pathologies.⁹⁵ At the University of Port Harcourt Teaching Hospital we have introduced hysteroscopy as part of infertility evaluation when necessary.

In 2013, we compared IVF/ICSI outcome in patients who had Polycystic Ovarian Syndrome (PCOS) and those with tubal factor infertility between 2004 and 2008.

Our findings showed that there was no significant difference in the endometrial thickness, clinical pregnancy rate and miscarriage rate

between the two groups provided metformin treatment was given to those with PCOS before stimulation.

In this study, we affirmed the need to treat those with PCOS with metformin before IVF treatment.⁹⁶

In most developed countries where ART is deeply rooted, advances made and regulatory bodies established, single embryo transfer (SET) is now the norm because of the complications following multiple pregnancies. However, in Nigeria, considering the cost of IVF, late presentation of our patients and the fact that we have the highest twinning rate in the world⁹⁷, we carried out a study on women undergoing ART in Nigeria between May 2006 and April 2007. We found that 94.4% of our women prefer to have 2-3 embryos to be transferred compared to 5.6% who wanted single embryo. Cost and long period of infertility were the reasons cited by 39.2% and 29.4% of the women respectively.⁹⁸

Ectopic pregnancy is when a pregnancy develops and grows outside the womb. Most commonly, this occurs in the Fallopian tube. One of the life threatening complications is rupture of the tube and haemorrhage. One of the complications of IVF is the likelihood of ectopic pregnancy. We reported 5 cases of ectopic pregnancies that occurred out of 64 clinical pregnancies following IVF in a 3 year period (2005-2008). Between 2-4 embryos were transferred easily without difficulties. Two (40%) of the women had a history of previous ruptured ectopic pregnancies for which they had surgeries (salpingectomy). One of the patients had heterotrophic pregnancy (one pregnancy in the tube and another one in the uterus). This is a rare occurrence. Another rare occurrence was in one of the patients who had an ectopic pregnancy despite the fact that both of her fallopian tubes had been removed previously from ruptured ectopic pregnancies. Four of the patients were treated successfully by surgery and the other one by using medical drugs only.⁹⁹

We advocated that doctors looking after IVF pregnancies should have a high index of suspicion when these patients present with minimal symptoms of ectopic pregnancy.

Fluid accumulation in the abdomen is one of the symptoms of OHSS, a complication of hyperstimulation of the ovaries. When it is severe, breathing can be affected. Continuous drainage of the

abdominal fluid is required in moderate to severe cases. The special catheter used for this drainage is not only expensive, it is also not readily available, making doctors to sometime resort to repeated drainage which can lead to peritonitis (infection of the peritoneum in the abdomen). We improvised with the use of another cheaper and more readily available catheter, the Bonanno Catheter commonly used for suprapubic drainage of urine in cases of urinary retention due to prostate enlargement in men. The catheter was used in 14 patients successfully, 8 were pregnant and the catheter got blocked and was changed in only 3 patients. There was no injury to abdominal organs or cases of broken catheter. We concluded that this catheter is safe and can be used for continuous closed abdominal drainage in OHSS.¹⁰⁰

In 2018, we looked at the Reproductive outcome following abdominal myomectomy (fibroid operation) in UPTH over a 10 year period. We found that 32.78% of the women who had fibroids and infertility got pregnant within 2 years of carrying out the operation. This study showed that operating on fibroid in patients with infertility improves their chances of spontaneous pregnancy.¹⁰¹

Dr. Ibrahim Wada and I established the first ART centre in the South South and South East in 2003 and our first delivery was a set of triplets in 2005.

When I was Head of Department of Obstetrics and Gynaecology in UPTH in 2005, I recognized the asset of having 3 other colleagues in my department who were pioneer practitioners in IVF in the South South and South East of Nigeria (figure 24).



Figure 24. Pioneer IVF Practitioners in the South South, Nigeria.

I approached Dr. Ibrahim Wada for support in establishing the first public sector IVF centre in Nigeria at UPTH, but this could not materialize because of lack of funds. Dr. Wada thereafter directed his energy to the National Hospital Abuja where Emeritus Professor Nimi Briggs was Chairman of the Governing board and they successfully established the first ART centre in a Nigerian public sector hospital in 2006.

Hope was not lost as we persevered until we finally established a centre in UPTH in 2017. The unit recorded its first delivery of a 4.5kg baby boy on the 7th of January 2019 to a couple who have been searching for the fruit of the womb for over 10 years (figure 25).



**Dr. Oriji, Prof. Ikimalo, Nurse Opusulaga with baby, Dr. Fiebai , L-R sitting
Dr. Oporum, Mr. Showers, Dr. Orazulike, Mr. Agih, Mrs Ekee, Miss Ezeogu,
Miss Ogidiagba, Miss. Egba, Dr. Nyeche and Dr. Green.**

Figure 25. UPTH IVF Staff with the first baby

To date, there are over 70 ART centres across the country, distributed mainly in the private hospitals of the major cities – Abuja, Lagos and Port Harcourt. Only 7 centres (Table 2) are now successfully established in the public hospitals like the Teaching Hospitals mainly through Public – Private Partnership (PPP).

Table. 2. Public Hospitals with ART centres

Hospital	Year
National Hospital Abuja	2006
University of Benin Teaching Hospital	2007
University of Ilorin Teaching Hospital	2012
Lagos State University Teaching Hospital	2013
University of Lagos Teaching Hospital	2016
University of Port Harcourt Teaching Hospital	2017
Federal Medical Centre Umuahia	2018

5. FUTURE PLANS

The establishment of an ART centre in UPTH is not just for service but also for research and training. As a unit, we are now embarking on operational research into the knowledge and attitude towards ART in various urban, rural communities and professional groups in Rivers State. This will eventually help to plan awareness and intervention strategies towards the utilization of ART services.

Another area of interest to the unit is in the contribution of male factor infertility in our environment and to find out the extent to which our local environmental factors affect fertility. This will be a multidisciplinary research in collaboration with the departments of community health and environmental sciences.

The third area we are working on is with uterine fibroids as it affects fertility and ART, management. We will look at treatment outcome with the position, size, weight, age of patient, whether or not myomectomy was done, method of myomectomy etc. We hope to find the critical point at which surrogacy (or uterine transplant when available) will be advised.

6. RECOMMENDATIONS

The major cause of infertility in both women and men in our environment is damage to the reproductive tract caused by sexually transmitted infections. It is therefore important to take public health measures to preserve the reproductive tract of adolescent girls from the damage caused by sexually transmitted infections and abortion. The following recommendations will help to achieve this goal.

- Family life education should be integrated into school health programs.
- Abstinence / use of condom which give double protection should be emphasized.
- Establishment of youth-friendly centres to include out-of-school children
- Improvement in family planning uptake which will reduce the number of unwanted pregnancies.
- Improve access to skilled delivery attendants to reduce incidence of puerperal sepsis
- Government should devote resources into identifying and removing environmental and physical causes of infertility.
- As ART centres proliferate and ethical challenges multiply, there is an urgent need for government to engage all principal stakeholders, (religious, legal, community, scientific leaders, bioethicists and ordinary citizens) in order to regulate and establish minimum standards with quality assurance in ART. Lagos State Government has set the pace. Other states should follow urgently.
- The Nigerian Fertility Regulatory Authority Bill of 2012 should be passed urgently after review with all stakeholders.
- Improve awareness in infertility management through print, electronic and social media. Introduction of infertility management into primary health care in order to achieve universal health care coverage.

- Address the infrastructural problems like power, road, security and health care facilities.
- Include infertility management in the National Health Insurance Scheme (NHIS) to improve access. Encourage partnership between health insurance and financial institutions like Hygeia HMO/Access Bank Partnership on IVF treatment launched in Feb. 2019.
- Enlist more private sector support through Public Private Partnership (PPP) with public health institution and protect the PPP by law from incessant industrial strikes and disruption of services.

7. CONCLUSION

Mr. Vice-Chancellor Sir, the biblical injunction which God gave to man to go and increase in number had been fraught with various impediments created by man. Infertility has been a worldwide problem of public health concern. Disproportionately affected is the sub Saharan Africa which includes Nigeria. Reproductive tract infection from sexually transmitted infections, puerperal and post abortal infection are major reasons for the disparity and all of these can be prevented.

The introduction of ART in the management of infertility 41 years ago became a game changer as many more women can now get pregnant. Assisted Reproductive Technology is developing very fast with the ultimate aim of improving pregnancy rate and reducing complications. ART millennial development race comes with different bioethical issues which are tackled by further scientific and technological development.

One area which is witnessing more rapid development is in genetic engineering where new tissues can be created or generated and transplanted. Damaged, nonfunctional or congenitally absent organs can then be replaced with functional bio-engineered ones.

The proliferation of ART centres in this country is a welcome development because it will create awareness, improve access to care and follow up with the technological advancement in other parts of the world even though slowly.

It is high time the government step in to encourage, regulate and control the practice of ART in line with our local sociocultural norms. It is my hope that the establishment of an ART centre at the University of Port Harcourt Teaching Hospital will help us to catch up with the modern technological advancement in order to further close the gap for couples searching for the 'fruit of the womb'.

The rapid development in the Science and Technology for those searching for the '*fruit of the womb*' will, in the not too distant future fill the gap. Sooner rather than later, every couple will be able to have the fruit of the womb.

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PROFESSOR JOHN IGEMO IKIMALO

MB,BS (BENIN), DRH (Liverpool), FMAS (INDIA) FWACS, FICS.

Professor John Ikimalo was born in Lagos on 20th July 1954 to Mr. Vincent Damodu Ikimalo and Mrs. Regina Inebode Ikimalo both from Agenebode in Etsako East Local Government Area of Edo State.

He began his educational pursuit at the age of 5 by attending the St. Paul's Primary School, Ebute-Metta, Lagos from 1959 to 1967. He started his secondary education at St. Peter's College, Abeokuta and transferred to Loyola College Ibadan where he obtained the West African School Certificate in 1972. He attended Edo College Benin City for 'A' levels before proceeding to the University of Benin for his Bachelor of Medicine and Bachelor of Surgery degree from 1974 to 1980.

Following his Housemanship at the University of Benin Teaching Hospital in 1981, the National Youth Service Corp at the Military Hospital Port Harcourt in 1982 and residency training at the University of Port Harcourt Teaching Hospital, Port Harcourt (UPTH) from 1984 to 1991, he gained employment as a consultant Obstetrician and Gynaecologist at the University of Port Harcourt Teaching Hospital and as lecturer 1 at the University of Port Harcourt in 1991. He rose through the academic ladder to be promoted senior lecturer in 2003 and to the rank of Professor in 2010.

Professor John Ikimalo won many scholarships, distinctions and is a recipient of several awards. These started as early as 1972 when he won the Etsako Local Government award for School Certificate distinction and from then on, the Federal Government scholarship award to study Medicine, British Council scholarship to study Reproductive Health in Liverpool, Gunter Charitable Trust (London) award for Reproductive Health at the Liverpool School of Tropical Medicine, MacArthur Foundation grant to study Infertility Management at the University of Cape Town, South Africa and Excellence award in Medical Science by the JAYCEES. He is a distinguished Alumnus Awardee of the University of Benin Alumni Association and admitted into the Distinguished Roll of Honour of the Nigerian Medical Association, Rivers State branch in 2012.

Professor John Ikimalo also holds a Fellowship in Minimal Access Surgery from India, a diploma in Reproductive Health from the Liverpool School of Tropical Medicine / Royal College of Obstetrician and Gynaecologists and a certificate in Public Enterprises and Management of the Administrative Staff College of Nigeria (ASCON), Badagry. All these prepared our distinguished speaker for the enviable positions he has occupied so far.

He was Chairman, Professor T.I Francis Memorial lecture committee, 2002-2004, Chairman, Faculty of Clinical Science Development Committee (2005), Member planning Committee for All University Vice-Chancellor's meeting in Port Harcourt 2001, Member Audit Committee and Editorial Board of UPTH news from 2006 to 2009. He was Chairman of various disciplinary and investigative panels at the UPTH.

He was Head of Department of Obstetrics and Gynaecology from 2006 to 2009. In his tenure, he completed the successful movement of the department from the teaching hospital temporary site to the present permanent site. He introduced ultrasonography, hysteroscopy and therapeutic laparoscopic surgeries in the department. He also introduced the daily early morning clinical and academic review of all new patients managed in the department. These management strategies improved patient care and the post graduate examination pass rate by 70%. He has also trained and supervised over 50 fellows for the West African College of Surgeons

and the National Post Graduate College. He commenced the Assisted Reproductive Technology (ART) unit in the department. Between 2011 and 2013, Professor John Ikimalo served as Dean, Faculty of Clinical Sciences, College of Health Sciences of our University, a period that had many dramatic positive changes in human and capital development including student mentorship programme.

Professor John Ikimalo represented the senate in the University of Port Harcourt Governing Council from 2013 to 2015. He was a member and later chairman, University Demonstration Secondary School from 2013 to 2016. Presently, he is a member of the University of Port Harcourt Teaching Hospital Board, where he represents the Vice-Chancellor.

In the academics, our distinguished lecturer today has been a co-investigator in many international collaborative research studies and ground breaking regional surveys like the Women's Health Programme with the Liverpool School of Tropical Medicine funded by the British Government from 1992 to 1999, the Youth Health and Development programme funded by John D and Catherine T. MacArthur Foundation from 1997 to 2000 and the Niger Delta Environmental Survey on baseline status of biophysical, social and health ecosystems in the Niger Delta Region funded by Shell Development Oil Company from 1998 to 1999.

He has served as external examiner in 7 medical schools in Nigeria and also in the Gambia. He is an external examiner to the West African College of Surgeons. He has published over 60 articles in local and international journals, written 7 chapters in various text books and co-edited 4 books. He has presented many papers in Conferences and presented many public lectures on women's health. Professor John Ikimalo is a member of the Nigeria Medical Association, Society of Gynaecology and Obstetrics of Nigeria (SOGON), Association for Reproductive Health of Nigeria (AFRH), Association of Reproductive Medicine, USA and Association of Gynaecological Endoscopic Surgeons of Nigeria. He is also a Fellow of the West African College of Surgeons, Fellow of Minimal Access Surgery and a Fellow of the International College of Surgeons.

Professor John Ikimalo is not 'all work and no play'. He is a very sociable person and a philanthropist at heart. He belongs to a number of socialphilanthropic groups where he served as either Chairman or President. He is a Paul Harris Fellow of Rotary International. He is member of the Council of Chiefs in Rumuogba, Port Harcourt where he lives and a High Chief in Agenebode, Edo State where he hails from.

Professor John Ikimalo is a devout Catholic who has received various awards from his church and other denominations for his services to humanity. He is a caring husband to Dr. Francisca Ikimalo, a Consultant Paediatrician and a loving father to four delightful children: Osilama (M), Emike (F), Anosi (M) and Okiaofe (F).

Colleagues, distinguished Ladies and Gentlemen, let me present to you, a meticulous and humane Obstetrician and Gynaecologist, a dedicated and disciplined workaholic, a forthright, hardworking entrepreneur, a dependable team player; a jovial and loyal friend, a socialite; an amiable and consummate teacher and mentor, Professor John Igemo Ikimalo to deliver the 161st Inaugural Lecture.

Professor Ndowa S. E. Lale
Vice Chancellor