UNIVERSITY OF PORT HARCOURT

BLOOD: THE ESSENCE OF LIFE

"The life of the flesh is in the blood"

An Inaugural Lecture

By

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DEDICATION

This inaugural lecture is dedicated to my five angels: Ifeyinwa, my best friend, lover, wife and mother of all our four children-Amaka, Zommii, Ozi and Ruby. May the Lord God of Israel bless you and keep you: The Lord make his face shine upon you, and be gracious unto you: The lord lift up his countenance upon you, and give you peace, Amen.

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Being a member of the pioneer medical class of 1979 of the College of Health sciences of this unique University was both challenging yet exciting. We were indeed a small family and I wish to appreciate every one of you for your friendship and encouragement to reach for the skies.

By the act of God's wisdom, I was born into a family of teachers, each of whom have inspired and supported me all the way: My dad, late Eze Israel Okere Nwauche, foremost educationist, administrator, Statesman, former principal of some of the premier secondary schools East of the Niger: Government College, Umuahia, Abia State; St. John's College, Diobu, Port Harcourt, Methodist Boys High School, Uzuakoli, Abia State; County Grammar School, Ikwerre Etche, Baptist High school, Port Harcourt,

Bishop Dimeari Grammar school, Yenagoa, Okrika Grammar School, Okrika, etc; Mum-Jemimah Ibiene Nwauche (nee Cookey)-was an accomplished teacher as was her younger and only brother, Professor Sylvanus J.S. Cookey, who excelled to become the 2nd Vice Chancellor and father of this University (Uncle was the one who purchased some of my first set of Anatomy and Physiology textbooks including the famous "Gray's Anatomy"), my younger brother Enyinna who is an Associate Professor of law; and my cousins- Professors Winston and Henry Leopold Bellgam. I also appreciate the love and support of my two sisters: Mrs Ngozi Pearse and Mrs Uloma Unonu, and their husbands- Dr. Justus Donye Pearse and Mr. Sam Unonu.

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I want to put on record the unequalled emotional support, encouragement and comfort of my family: my wife Ifeyinwa, our children Amaka, Zomii, Ozi and Ruby; and other members of my household: Happiness and Ezra.

Finally, I acknowledge the providence, election, grace, blessing, wisdom and guidance from the Lord God of Israel, whose I am and whom I serve in the spirit of His Son Jesus Christ, the firstborn of the new creation man in God that have gained the victory over death and darkness.

Legend of Tables and Figures

Lecture Outline

Preamble

Vice Chancellor Sir, May I crave your indulgence to begin this inaugural lecture by drawing inspiration from some portions of the Holy writ "The bible" (King James Version):
Genesis 2:7 "*And the LORD God formed man of the dust of the ground, and breathed into his nostrils the breath of* ***life****; and man became a* ***living soul****."*

Leviticus 17:11 "*For the* ***life of the flesh is in the blood****: and I have given it to you upon the altar to make an atonement for your souls: for it is the* ***blood*** *that maketh an* ***atonement for the soul****."*

I have always been captivated by the life sciences. As I reflect on the evolvement of this interest, it is quite evident that this romance was incrementally invigorated on each occasion when my young inquisitive mind lighted upon various shades of ideas, thoughts, theories and philosophies; schools of thought, doctrines and dogmas all through my odyssey through the various Centres of learning that I was privileged to attend. These include my membership of the pioneer set of 1973, Federal Government College Enugu and then my secondary school and sixth form years in Government College, Umuahia and Federal Government College, Port Harcourt respectively during which I fell in love with the subject of Biology.

My subsequent choice of Medicine as a career was an appropriate platform to continue this academic inquest hence my enrollment into the pioneer 1979 medical class of the College of Health Sciences, University of Port Harcourt. Here, my imaginations were fired up by the amazing architecture and splendor of the human body through the lectures, tutorials and practical sessions in the various disciplines of Physiology, Anatomy and Biochemistry. The seed of my endearment to the "*life sciences"* was effectively sown as I sat at the feet of my Physiology lecturers (including the legendary late Professor Kenneth Diete-Koki) and drank deeply from the fountain of their wisdom in the quest to bag my bachelor's degree with honours in Physiology.

This seed of my love for the "*life sciences*" eventually blossomed into an endearment with the ***"blood sciences"*** and was watered and nurtured to fruition in the hallowed chambers of the Imperial College School of Medicine (Hammersmith Hospital) of the University of London. The faculty then was staffed by such globally acclaimed academic luminaries in the haematology world as Professor John M. Goldman, Professor of leukaemia biology and leading global authority on chronic myeloid leukaemia (in whose Adult Leukaemia Laboratory I wrote my Masters in Haematology thesis on "*the detection 0f BCR-ABL fusion gene in peripheral blood neutrophils of Chronic Myeloid Leukaemia patients on interferon-alpha treatment by the fluorescence in situ hybridization {FISH} method*") and Professor A. Victor Hoffbrand (lead editor of the must-read premier reference text in haematology titled "*Postgraduate Haematology*").

Others members of staff included Professor Edward C. Gordon-Smith (global opinion leader on anaemias and bone marrow failure syndromes); Professor Daniel Catovsky (a global authority on Chronic Lymphoid Leukaemia and Lymphomas), Professor Marcella Contreras, Professor of Transfusion Medicine and the then Executive Director for London and the South East, National Blood Service, United kingdom; and Professor Edward G.D. Tuddenham, Professor of Haemostasis and one of the global leading lights in the unravelling of the molecular and biochemical profile of the factor VIII/ Haemophilia gene and other coagulation proteins involved in the blood clotting pathway.

The peak of this experience of the ruminations of my mind on the various dimensions of the study of the principles and practice of the "*blood sciences*" was during my residency training in haematology (Laboratory Medicine) and when I was writing my thesis for the fellowship of the West African College of Physicians on the subject of *"Rhesus negative blood group status of women of reproductive age in Port Harcourt"* under the mentorship of Professor Wuraola A. Shokunbi of the Department of Haematology, University College Hospital, Ibadan and Professor Osekhuemen A. Ejele of the Department of Haematology, University of Port Harcourt Teaching Hospital, Port Harcourt.

2. The philosophy of blood as the essence of life

Life is a gift or bestowment upon the soul of man from the Almighty God. It is that energy, vitality or quickening force that was ***"transfused"*** out of the being of the Almighty God into the dust of the earth which subsequently brought forth the living soul nature of the first man Adam. Thus, we can safely adduce that the very first **"*medical procedure*"** to be carried out upon the earthly body of man was that of transfusing the very divine life and energy of God into Adam. *This underlines the centrality of the invigorating nature of divine life in the constitution and existence of every man.* One can then clearly appreciate the well assured place of **Blood Transfusion Medicine** and practice as being not only the preserve and art of the Eternal Heavenly One but also that essential human service which every sane community and polity must bequeath to its citizenry.

Furthermore, man in his constitution has a tripartite nature of spirit, soul and body, hence the concept of the TOTAL MAN. This basic structure of man is a true reflection of the triune image of the Almighty creator, Jehovah the great I AM and El-Shaddai (the double breasted one and Lord of the Heavens and the earth) who has manifested Himself to man as Father, Son and Holy Ghost. We therefore see that this divine life as breathed ***(transfused)*** of God into man is designed and segregated into two main realms of spiritual and biologic/natural life in order to serve and minister the essence of the life force, vitality, being and energy of the Eternal Immortal Almighty creator to mortal man in his dual basic natures of the ***inner spiritual man*** (consisting of the human spirit and soul) and the ***outer natural/Physical bodily man***. It is incontrovertible then to surmise that man in his dual inner spiritual and outer physical natures need both spiritual and physical nourishment and life.

In this regard therefore, it is very clear to all that the Almighty God has elected ***to use blood as the vessel to transmit His life to meet the need of the TOTAL MAN***. Admittedly, we then see that blood provides the platform or instrument through which the divine reality of life is transmitted to the body. Thus, we can rightly affirm that blood is the essence, bridge or altar of life in that both the spiritual and physical essence of life are both united and expressed through the instrumentality

of blood. Therefore, we can safely adduce and conclude that **Blood is the vessel of life**, designed of God to ***"transfuse***" life, energy and vitality to man.

2.1. Definitions of Life and essence.

Life being a universal reality means several things to various people. Among the old English gentry, the word ***"life (lif)"*** *means:*

*"**the life force or energy in all things**…the sequence of physical and mental experiences that make up the existence of an individual….the principle or force that is considered to underlie the distinctive quality of animate beings…an animating and shaping force, principle or energy…the ability to grow or change that distinguishes living from non-living things.."*(Merriam-Webster Dictionary, 2015).

The word ***"essence"*** on the other hand is taken from the old English word **"esse (is)"**meaning: *"to be".*

The Merriam-Webster Dictionary, 2015 defines the word *"essence"* as **...**"*the basic nature of a thing: the quality or qualities that make a thing what it is…**the most significant element, quality, or aspect of a thing or person**…"*

2.2. Blood: the essence of life.

The essence of the spiritual life of man therefore centers on the worship of an Almighty supreme deity or giver of life **based essentially on the efficacious and substitutionary atonement through a blood sacrifice** as the basis to obtain a resurrection and salvation for the fallen soul of man due to original sin and the consequent moral depravity of the elementary natures of the soul of man.

This universal fellowship, communion and partaking of the spiritual life of God by the soul of the believer also entails sacred offerings and sacrifices in a sanctuary or temple; and offers the promise of salvation, resurrection of the soul, peace and vitality both now in time and forever in eternity.

The essential role of blood in the communion and sacred offerings of the spiritual life of man is universal in every faith, community and fraternal fellowship. The most significant benefit to the worshipper, adherent, disciple and fraternal devotee in this **blood sacrifice** is not only the impartation of life, spiritual union, reconciliation, nourishment and bliss for the inner man; but also physical comfort, prosperity, blessings and perpetual benefits that accrue from this **blood covenant** with the Almighty God.

We then see that the veracity and essence of this blood covenant between man and God on earth ceases and comes to an end in death when the life-force, power and vitality of the essence of the life of God exits or departs from the red fluid flowing within the veins and arteries of man in death. At this juncture, it can then be said that the blood in man would have served its essential calling as the altar, bridge and the vessel of the life of God to man.

2.3. The Blood covenant between God and man

The essence of blood to the spiritual life of man is the benefit and blessing made available to every soul to experience and partake of the life of God upon the basis of a blood covenant with the Almighty God. The evidence of this blood covenant between man and his creator is the living vitality of the "***red fluid***" that daily continues to refresh and nourish both the inner and outer realms of the life of man. Blood therefore speaks of this covenant of life between man and God whom he has created in his image and likeness **(*Genesis 1 vs 26***).

This blood covenant between man and God forms the basis and driving force of the unrelenting and inexhaustible quest of the human soul for fellowship with the Almighty creator. Thus, the human soul is ever caught up with the pursuit of being united with his creator in fellowship and blissful communion; hence the plethora of offerings, sacrifices, faiths, creeds and religions all in search for peace with God.

The offerings and speakings of a blood covenant may be of animal or human nature and may include: religious renewals and rebirth in a sanctuary or temple. It may also entail cultural oaths, covenants and

ritual practices in cults, gangs, fraternities; or in village and local communal settings; and even in the marriage covenant, etc.

Indeed, this principle of the exchange, impartation and infusion of the essential properties, force, energy, vitality of life in the act of a blood sacrifice and covenant forms the basic tenets and is accepted as the fore-runner of **Modern Blood Transfusion** practice.

2.4. The impact of blood in the life and culture of man.

Based on the foregoing, the essence of blood as the vessel of life is amply demonstrated and illustrated within the following context of the relationships, livelihood and culture of man:

2.4.1. The vitality of blood in ancient times.

From the earliest times, blood has always been viewed as being sacred hence the Holy Bible emphasizes several strict injunctions as regards its sanctity such *as "Ye shall eat no manner of blood"* (Lev. 7:26). Death by exsanguination as practiced by the Romans gave their physicians the insight that *"life"* was *"let out"* in the process. ***"Blood-letting"*** was also commonly used to achieve cure by letting out ***"bad blood".*** Thus, it was then reasoned that by infusing "***good blood****"* into a patient he could be healed and thus saved. This was the probable reason for the Roman practice of drinking the blood of dying gladiators. Furthermore, the Egyptian Pharaohs were also known to bathe with blood as a way of rejuvenating themselves or to receive cure from Leprosy (Miale, 1977).

2.4.2. Blood as the universal vernacular and language of life and death

Furthermore, we see that blood serves as a universal vehicle and carrier of life in all cultures, languages and peoples. Thus, the act of blood being the vessel which gives life to all flesh irrespective of their tribe, sex, and skin colour, social and educational status underlies and verifies the fact that it serves and is regarded as a universal language, vernacular and a unifier of all men in our communion with blood and life.

Admittedly, we also see that it is globally recognized that there is an identical worldview of the symbolism of blood amongst the different

peoples of the world-Assyrians, Egyptians, Chaldeans, Medes, Persian, Greeks, Romans, Africans, Indians, Europeans, etc. Furthermore, it is a commonly held mores in our communal relationships that bloodshed defiles the land and "*calls or speaks*" of revenge, etc. This universal language or vernacular of blood may speak of life, death, curse, blessing, revenge and defilement, etc:

- **Life**: The red colour of blood is representative of life and among the Egyptians, red was seen to represent and speak of power because of its association with blood; in particular, the protective power of the blood of Isis, wife of Osiris (who was revered as the god of the afterlife; and of death, life and resurrection) and mother of Horus. They also regarded red as the colour of victory hence during celebrations, they would paint their bodies with red ochre which was also a representation of other deities that represent victory (egyptmyths; ancientegyptonline).

  Conversely, we also see that the blood of Jesus speaks of forgiveness, love, redemption, Light and hope (Hebrews 12:24, John 1:1-12; 29). Interestingly, the blood of Ebola virus survivors contained antibodies that offered a ray of hope being that they were efficacious to offer protection and life to several victims of the current Ebola epidemic in West Africa.

- **Death, Revenge and Curse:** Blood also speaks of death. This phenomenon is aptly exemplified by the Egyptian plague of the river Nile turning to blood and bringing death to the people of Egypt (Exod.7:16-21.) In Spielvogel and Redles' "*Hitler's Racial Ideology: Content and Occult sources"* Adolf Hitler's warped ideology during World War II was based on what he called "*the principle of blood*" in which he viewed his "***Aryan blood***" to be pure and that of the Jews to be evil making him embark on a pogrom and mass killing of Jews in order to achieve ethnic cleansing and purity. This ideology of blood meant and brought death to millions of Jews.

  It is also common knowledge that blood shed places a curse upon the perpetrator(s) while it often evokes the passion of violent revenge amongst the relatives and within the community of the victim(s). In the biblical story of Cain and Abel, we are told that the

blood of Abel cries from the ground (Gen 6.10; Heb. 12: 24) calling for revenge and evoked a curse upon the first murderer Cain his brother, for killing his brother and spilling the first blood of mankind.

Thus, we see that bloodshed begets more bloodshed, hence blood defiles the land and requires atonement for complete reconciliation and appeasement.

2.4.3. Blood sacrifice and faith

The centrality of blood in the spiritual communion and life of man is also universal and irreplaceable. Thus, blood is the essential cardinal tenet of Christianity being that it is essentially based on the narrative that Jesus Christ is the manifest Son of God, and that his blood is that of the substitutionary Lamb of God that takes away the sin of the world. Hence, the testimony of the host of believers worldwide and through the ages, is that the popular Christian gospel story anchored essentially on this atoning blood of our Lord Jesus Christ (the precious Lamb of God who shed his soul-cleansing blood on the cross of Calvary), has brought boundless joy and comfort to their hearts.

Admittedly, blood sacrifice also plays a pivotal role in the rites, offerings, initiations, worship and veneration festivities and celebrations of fraternities, cults, secret societies and brotherhoods on a universal proportion. It is to blood sacrifice that communities resort to whenever it is deemed that an act(s) of defilement and sacrilege have been perpetrated hence the need for propitiation and redemption, especially as regards violent and unexplained death.

Furthermore, blood also serves as a crucial and veritable sacred instrument and token that is regularly utilized for blood oaths, ritual cleansing during very important and epochal communal events such as the initiation and installation of traditional stools and titles; initiation into womanhood and manhood and also in certain traditional marriage and burial rites and rituals.

In certain communities, the new yam and New Year festivities are accompanied by blood sacrifices (both human and animal in nature) as a

token of the celebration and renewal of life. During times of war and conflict, blood sacrifices are also employed both to initiate and strengthen the tribal militias and also as acts of punishment amongst the warring communities through rape and human sacrifices, etc.

Furthermore, the power and veracity of blood in its applications, import and usage in the cultural settings of man is such that it has no restrictions as regards geography and time; for example it is written in the Holy Bible (Revelations 13: 8) that the blood of Jesus was shed from the foundation of the world, hence it is supposedly not just a red liquid but an ancestral spirit whose roots, foundations and priesthood eloquently speaks and reverberates through time and eternity.

2.4.4. Blood, womanhood and life

The act and state of womanhood is probably one of the best demonstrations of the essence of blood to the life and existence of man. The act of the monthly cycle which alights upon every young maiden upon attaining the age of puberty is a universal and inevitable experience that essentially entails a periodic "***blood offering*"** to womanhood for the sustainability of the posterity of humankind upon the earth. This is more so as the *monthly cycle* signifies the *"bringing forth and* flow *of life"* as manifested in the birth of a newborn child.

This cyclic blood offering is also repeated at the time of parturition to not only bring forth a newborn into this world but to also celebrate and re-enact the eternal blood covenant between God and man. It also speaks to the necessity of a much-needed spiritual rebirth of the inward man from the clutches of original sin unto an assured bliss and communion with God Almighty.

2.4.5. The role of blood in scientific investigation and Hospital practice.

One of the bedrocks of academic pursuits in the universities, and also in the Colleges of Medicine is hinged on studies that are blood-based. In the same vein, investigative and therapeutic hospital practice is dependent on the analysis and use of blood and blood-products in the

blood bank, haematology and other Laboratory tests; and Surgery and Obstetric practice, etc.

In forensic science and in the resolution of parental (paternity and maternity) disputes, analysis of blood specimens yield protean and definitive data which contribute to confer and restore proud parentage and heritage. They also serve to empower the criminal justice system to apprehend deviant and diabolic characters and to bring them to book thereby ensuring the enthronement of sanity, law and order in our communities.

The same can also be said of the role of investigative scientific research and the pure sciences and even the social sciences and the humanities which rely much on the genetics of the blood groups in Anthropological and Archeological studies. Admittedly, blood plays a pivotal role in the generational transmission of familial traits and diseases (sickle cell disease, HIV, haemophilia, etc) that are associated with population dynamics and socio-cultural factors.

Furthermore, doping amongst sports men and women is a major threat to the concept of "*clean sports*". However, giant strides have been made in recent times with the increased sophistication of blood based assessments of sportsmen and women. Thus, these regular checks and evaluations have contributed in no small way in restoring credibility to the modern sports industry.

3. The Life of the flesh is in the Blood

In general, the main function of all living cells and tissues of the body is to move, breathe, to have adequate nutrition, exhibit irritability and response to external stimuli; to grow, excrete waste substances and to reproduce. These basic metabolic processes of all living tissue require basic metabolic raw materials in the form of carbohydrates, fats and oils, proteins, vitamins, minerals and trace elements to be accessible to the cellular end-users on a constant and sustainable basis. This essentially requires a platform that can directly supply these much-needed metabolic nutrients directly to each cell on a sustainable basis. In the wisdom of the Almighty God and creator of all flesh, blood

possesses all the qualities and capacities that are necessary to achieve this gigantean task.

Thus, Blood contains the requisite life, vitality and energy needed by the human body. Blood is therefore the "***breadbasket and source of life"*** of the cells and tissues of the body. Blood can also be described as the ***"land of promise flowing with milk and honey"*** that all cells, tissues and organs of the body must access for their vitality, sustenance and life. Thus, the sticky red-coloured fluid called blood that flows within the circulatory system composed of the heart, arteries and veins is a storehouse of metabolic nutrients for the use of the cells, tissues, organs and systems of the body to carry out their various functions of delivering vitality and life to the body.

3.1. The capacity of blood to give life to the body.

The capacity of blood to give life to the human body can be broken down to the following main areas:

3.1.1. Transportation

This entails the supply of metabolites and nutrients to the body tissues such as carbohydrates, proteins, fats, vitamins, trace elements, etc; and the evacuation and excretion of waste metabolic substances from the body. The cellular tissues of the body require oxygen to enable them access the energy locked up within the metabolic break down products; from their original forms in the raw food materials that have been ingested and digested by the gastro-intestinal system. Blood also evacuates metabolic waste and carbon dioxide from the body through the excretory systems of the body especially the kidneys, gastrointestinal tract, skin, etc. Chemicals and drugs utilize the platform offered by blood to access the cells and tissues of the body in order to exact their various prescribed functions.

3.1.2. Mother and Child in the womb and in the postnatal period.

Blood functions as the first important link and bond between the mother and child in which nutrients from mother's blood both nourish and protect the baby in the womb. Furthermore, the health of the newborn is

ensured through the antibodies that are produced by the blood, once the baby is outside the womb.

3.1.3. Immunity and defense of the body from infections.

The body also has the capacity to empower the body tissues and to protect them from infection by micro-organism and other toxic and noxious substances. It does this by providing the platform for the immune system to provide primary and secondary protection and security from invasion and attack by foreign bodies, toxins and micro-organisms, etc. Blood also provides the body with the function of immune surveillance in which it watches and scans the body cells and tissues for any abnormal properties and tendencies that may arise from within them that may be untoward and dangerous to the body.

3.1.4. Inter and Intra-cellular signaling and communication

The control and regulation of the vast array of metabolic processes and activities taking place in the body requires monitoring, co-ordination and regulation in order to ensure the well-being and livelihood of the body. This function is provided by the gamut of pro-inflammatory proteins, cytokines and hormones which are transported and distributed throughout the body from their sites of production in the liver, kidney, cells of the reticulo-endothelial system and endocrine organs to modulate metabolic processes often in far flung and remote tissues and locations of the body.

This control is achieved through the highly coordinated functioning of various mechanisms, such as cell to cell messaging that may involve cell surface receptors on specific target cells and adhesion molecules; haemopoietic growth factors such as erythropoietin, thrombopoietin and the various colony stimulating factors(Granulocyte-Colony Stimulating Factor, G-CSF and Granulocyte Macrophage-Colony Stimulating Factor, GM-CSF); and intra-cellular signal transduction pathways such as the JAK/STAT, the mitogen-activated protein(MAP) kinase and the phosphatidylinositol 3 (PI3) kinase pathways.

3.1.5. Haemostatis and blood clotting

The fluid based system of blood requires a provision for the establishment of a haemostatic plug to arrest the loss of blood if and whenever the walls of the blood vessels are breached. Blood again contains coagulation proteins, platelets and other pro-coagulants and possesses the capacity to deliver these essential haemostatic components to the any site in the body in order to achieve blood clotting and the prevention of excessive blood loss.

3.1.6. The health status and identity of an individual

Blood contains several factors such as blood group antigens and antibodies that serve as individual signatures that confer specific identity and characterization of a person. These factors may be modified depending on genetic, environmental and population dynamics and also reflect the health status of an individual. This then forms the basis for their employment as diagnostic stool in Investigative Medicine and Forensic Haematology.

3.2. Blood Formation

Blood formation is a process referred to as erythropoiesis and occurs in several sites in the body including:

The yolk sac in the embryo: 0-2 weeks of life; Foetus: 2-7 months in the spleen and liver, and 5-9 months in the bone marrow; Infants: Bone marrow; Adults: In the axial skeleton. In blood disorders that compromise the normal functioning of the bone marrow, extra-medullary blood formation reverts to the primordial sites of the spleen and liver.

3.3. Composition of blood

Blood is composed of both cellular elements and a sticky fluid called plasma. These blood elements include the following: Red blood cells (RBCs) or Erythrocytes; White blood cells (WBCs) or Leucocytes, which have several subtypes as follows: Granulocytes (composed of neutrophils, basophils and eosinophils)**,** Agranulocytes (composed of lymphocytes and plasma cells) and Platelets.

On the other hand, plasma is composed of the following: Water, dissolved proteins, glucose, amino acids, vitamins, minerals-mainly sodium chloride, urea, $C0_2$; hormones, antibodies, etc.

3.4. Adaptations in the constitution of blood to give life to the body

One of the most significant adaptations that we find in the design and functioning of the human body is that all essential and vital tissues, organs and systems are very strongly related to blood for their optimal functioning, for example: Heart-pumps blood to the cells and tissues; Lungs-adds value to blood (inputs oxygen into blood and uptakes Carbon dioxide from blood); liver-detoxifies and replenishes the proteins in the blood; Bone Marrow-forms blood; Kidney-filters metabolic waste from blood; Spleen-removes cellular inclusions, old and abnormal or deformed red cells from blood.

The spleen also controls and regulates the blood volume to suit the various and prevailing states or conditions of the body and the brain which depends strongly on blood for its energy and vitality.

Life-giving characteristics of the morphology of blood elements: Secondly, the blood components enumerated above possess specific features in their *"Cell Morphology"* or shape, size, characteristics of the cytoplasm and its membrane, and nuclear characterizations, etc, that enable them to carry out their various functions of giving life to the body:

3.4.1. Red Blood Cells (Erythrocytes):

i. Shape: Bi-concave and discoid thus enabling it to meander through tiny vasculatures of the end arterioles-sinusoids and venules to supply blood nutrients and metabolites to hard-to-reach end-cells.

ii. Anucleate empty cytoplasm: The huge space created by the absence of a cell nucleus creates a greatly enhanced capacity for the red cell to uptake haemoglobin in order to bind and deliver to and from the tissues as much Oxygen and carbon dioxide as is possible. The Red blood cell is in actual fact a huge bag packed full of life-giving haemoglobin in that it binds and transports both Oxygen and Carbon dioxide. It would

not therefore be out of place to say that the red blood cell aptly exhibits the essential element of ***"selflessness and self-denial"*** in that it has chosen to become a super-specialized end cell by foregoing the luxury of a nucleus so that it can give as much life, energy and vitality to the body-the phrase below captures this exceptional quality that reflects the self-less and loving attitude of the giver of Life and the Almighty creator himself:

"For the red blood cell so loved man, that he gave up the luxury of enjoying the metabolic benefits of a nucleus that it might deliver to man abundant oxygen, energy, life and vitality"

This self-less nature of the RBC is a daily ministration to man to also assume a selfless attitude in all our dealings and social relationships.

iii. Erythrocyte cell membrane: This cellular component acts as the burden bearer of the cells. It functions much like the *proverbial "Atlas-the burden bearer of the world"* in that it ever so faithfully anchors both the internal cyto-skeleton, and all the proteins, glyco-proteins, receptors, blood groups, antigens, antibodies, etc; on its external surface to enable them and the cell communicate with other cells and the extra-cellular milieu.

3.4.2. White Blood Cells: The unique morphology of these cells equip them to provide the immune function and defense of the body from foreign invasion by micro-organisms, toxins, etc:

i. Granulocytes/ Macrophage-Phagocyte system: The multi-lobed cytoplasmic formations that characterize the different cell constituents of the granulocyte/ macrophage phagocyte system enables them to engulf, internalize, digest and neutralize unwanted foreign bodies with the aid of several granules and lysosomes containing active enzymes: primary granules (contains acid phosphatase, myeloperoxidase, esterase) and specific or secondary granules (lysozyme, elastase, collagenase, lactoferrin). In this way, these cells function as the body scavenging system that that keeps the body free of toxins and noxious substances, etc.

ii. Lymphocytes: These cells (also referred to as immune competent cells) which serve to initiate and regulate immune responses in the body, are masters of multi-tasking; and graciously bear the brunt of the assault from the continuous barrage of ceaseless waves of immune challenge mounted by foreign antigens against the body. Their role it is to mount an appropriate immune response (antigen- antibody reactions) against the legion of invading foreign organisms including viruses, bacteria, parasites, etc. They release specialized substances called "*cytokines*" through which they modulate immune response in the body.

iii. Cytokines: These substances are pro-inflammatory in nature, and include the subgroups that are engaged in cell signaling; and function to equip the various subsets of lymphocytes with the requisite immune armamentarium that are necessary to co-ordinate and effect the multi-dimensional complexity of immune responses against the foreign invasion of antigens.

3.4.3. Platelets: These are broken-off components of the cytoplasm of the megakaryocytes, one of the largest cells in the body. They are richly-laden with several granules, lysosomes, inclusions and metabolites including: glycogen, specific α-granules (which contain fibrinogen, factor V, von Willebrand factor, fibronectin, heparin antagonist, other proteins) and electron dense granules (ADP, calcium, serotonin), etc. Their membranous surface provides the template or platform upon which the process of blood coagulation takes place, thereby limiting and localizing the action of clot formation to the immediate vicinity of the injury to the blood vessel wall. Platelets are extremely small in size and discoid to enable them permeate and plug the breaches of the vessel wall whenever an injury occurs.

3.4.4. Plasma proteins-The sticky pale-coloured plasma contains a rich mixture of proteins such as coagulation proteins, immunoglobulins, albumin and others. This sticky substance acts as a type of ***"blood-cement"*** that forms a rich matrix, paste or gum with which and/or upon which the cellular blood elements utilize or adhere to in their quest to perform their various life giving duties in the blood.

3.5. The Disorders of blood

The disorders of the blood system in man arises when there is a malfunctioning, breakdown or, compromise of any of the processes involved in the various life-giving activities of blood. This abnormal functioning of blood results in several diseases which are encapsulated in the field of the Pathology of blood disorders or more specifically the discipline of **Haematology.**

The Basis of the disorders of blood

These may be classified into two broad fields:

3.5.1. Invasion of Microbes *("foreign interests")* and agents into the *("domestic affairs")* of human blood: Human blood is obviously richly endowed with nutrients necessary for the metabolic needs of its cellular/ tissue constituents and also for the life and survival of its progeny. This metabolic "*breadbasket*" is full of "*milk and honey*" as was the proverbial land of promise. However, it is also ***needed and considered to be very vital to the existence and sustenance of other interests and life forms in the ecosystem of man especially micro-organisms which include viruses, bacteria, blood parasites such as Plasmodium Falciparum spp, etc***.

In the same vein, many foreign agents may be introduced into the blood system such as chemicals, drugs, poisons, toxins, alcohol. All these invaders ultimately cause harm, danger or disease to man within or even beyond the blood system of man (Nwauche and Arokoyu, 2003), hence requiring the services of a Haematologist, who is a specialist Physician trained in the very sublime art of restoring the ability and capacity of blood to give life to man and not pain, sorrow, suffering and death.

3.5.2. Abnormality of any of the components of the blood system:

i. Genetic sabotage-Genetic disorders of any of the cellular elements of blood may cause disease such as the case with blood cancers e.g. Leukaemia; sickle cell disease, haemophilia, etc.

ii. Incompatibility and immunologic clash of interests-This occurs when there is an incompatibility between the blood groups of either a blood donor and recipient leading to a incompatibility that leads to a

haemolytic transfusion reaction, which could be life-threatening. This setting may also arise between the fetus and mother in which the maternal system does not recognize the paternally –derived antigens in the blood of the fetus if and when the fetal blood system mixes or flows into the maternal blood system and results in the life-threatening and often fatal Haemolytic disease of the newborn.

iii. Dynamics of disordered production and loss of blood- In these situations, there is either an absence or much reduced production of any of the components of blood on the one hand; or a premature destruction, loss or waste of any or all the cell lines and components of the blood system.

3.6. Basics of Haematology or Blood disorders.

Thus, the malfunctioning of blood can be best summarized into two broad groups: "***external aggression*"** and "***internal chaos*".** External aggression refers to the "*microbe invasion*" of blood that has been previously discussed while internal chaos encapsulates all the mechanisms such as *"genetic sabotage"*, through which blood disorders occur in blood and blood forming tissues especially the proteins and metabolites involved in cell transduction and signaling, which may undergo genetic change such as mutations, deletions and translations, etc.

Haematology therefore, is the branch of Pathology and Medicine that studies and cares for people who suffer from blood diseases or the abnormal functioning or disorders of blood.

The blood disorders are summarized as follows:

3.6.1. Red Blood Cell (RBC): The disorders of the RBC may be broken up into two groups-Qualitative and Quantitative as follows:

3.6.1.1. Qualitative disorders: These are the structurally-related abnormalities of the RBC described as follows:

i. Red cell membrane abnormalities:

- Blood groups and antibodies (Immuno-Haematology).

- Congenital/ inborn errors of the erythrocyte membrane (Hereditary Spherocytosis and Elliptocytosis).
- Acquired abnormalities of the erythrocyte (Paroxysmal Haemoglobinuria)

ii. Cytoplasm:
- Haemoglobin-These abnormalities may be a structural disorder (Sickle cell disease (SCD) and Anaemia (SCA) or they may be due to abnormal quantities of defective haemoglobins (Thalasseamias).

iii. Enzymopathies: These are due to deficiencies of the RBC enzymes such as:
- Glucose-6-phosphate dehydrogenase and
- Pyruvate kinase deficiency, etc.

b. Quantitative:
- Polycythaemias-Excessive quantity of RBCs.
- Anaemia: Reduced amounts of RBCs in the blood.

II. White Blood Cells: The abnormalities of the WBC may also be classified into the two broad groups of quantitative and qualitative type disorders:

a. Quantitative:
Excessive production of Leucocytes or WBC:
- Leukaemia (acute- Myeloid and Lymphoid; and chronic-Myeloid and Lymphoid).
- Plasma cell neoplasm (Multiple Myeloma, plasma cell leukaemia, etc).

Reduced amounts of leucocytes –Neutropenia.
Excessive amounts of lymphocytes-Lymphoma.
Reduced amounts of lymphocytes-lymphopenia.

b. Qualitative: These are mainly due to reduced amounts of Leucocytes due to several types of congenital abnormalities of the various structural defects: May-Heglin anomaly,

3.6.3. Platelets: The Quantitative defects are characterized by excessive amounts in the peripheral blood (Thombocytosis) or reduced amounts (thrombocytopenia). The qualitative defects may be due to several congenital and acquired causes.

3.6.4. Serology:

- **Plasma proteins**: These may be reduced (Hypoproteinaemia) or excessively increased (Hyperproteinaemia due to infections and proliferative disorders).
- **Haemo-parasites:** This is the presence of several types of parasites in the blood such as Malaria (*Plasmodium spp*; viruses (HIV, Hepatitis), Bacteria (syphilis), etc.

4. My Romance with Haematology

Mr. Vice Chancellor Sir, may I now seek your permission to turn my attention to the studies that I have undertaken in the field of Haematology over the past 26 years.

The blood system in man is a minister of life both to man and to other life forms such as micro-organisms. This is due to the fact that blood is richly endowed with basic and essential metabolic nutrients that are crucial to the livelihood, growth and sustenance of life.

However, this essential life-giving quality of blood may be perverted and turned around to become a conveyor of pain, sorrow, disease and death. This unfortunately is the very sad story when any of the constituents of blood becomes defective or when the microbes that invade blood in search of life-giving and sustaining nutrients also bring about disease and death as a direct consequence of their unwanted interference in the normal constitution and operations of the human blood system.

The role of the Haematologist.

It can then rightly be said that the Haematologist has his job well cut out for him in that it is then his primary responsibility to care for the segment of the general population who may fall victim to any of the

disorders of the blood system which we have very briefly reviewed in the preceding section of this lecture.

Upon my employment into the Department of Haematology, Blood Transfusion and Immunology of the Faculty of Basic Medical Sciences of the College of Health Sciences, University of Port Harcourt on 04 April, 1989, I embarked upon a review of the existing work environment for the research and practice of Hematology.

My observations then were as follows:

i. The absence or paucity of baseline epidemiologic information and data necessary for the management of the plethora of challenges confronting the health care delivery system at that time such as:

- The anaemias especially among pregnant women and under-five children,
- A non-existent National Blood Transfusion service for the provision of safe blood for the teeming population that require such services,
- The burgeoning HIV/AIDS and Hepatitis pandemic,
- Brain drain of highly trained specialist manpower coupled with medical tourism especially as regards care of patients requiring medical attention for Haematological cancers such as Leukaemias and Lymphomas, etc.

ii. Low awareness of the need and role of the Haematologist in the health care delivery system in Nigeria.

iii. The entrenched poor research infra-structure evidenced by ill-equipped medical library, limited access to global intellectual research facilities, grants/fellowships and scholarships, and non-existent/ill-equipped research laboratories and teams.

iv. Abysmal funding for staff training, equipment of laboratories with basic equipment and acquisition of reagents for special tests and procedures.

v. An over-burdened public service groaning under the crushing load of blood cancers and HIV/TB/Malaria.

vi. The skewed health seeking behavior/health service characterized by collapse of the referral system and weak primary health care services with the attendant over-patronage of tertiary health

facilities such as the University of Port Harcourt Teaching Hospital, Port Harcourt.

It is for these reasons that our research and practice of Haematology in the Niger Delta of Nigeria have been focused on generating data and advancing knowledge. It is also geared towards the enhancement of our capacity to offer the victims of these disordered functioning of blood evidence- based care in line with global best-practices as much as was practicable within this environment.

Highlights of my research and practice of Haematology in Nigeria and especially in the Niger Delta.
My specific contributions in proffering solutions to the above-mentioned challenges are in the following areas:

4. 1. Blood Cancers: This refers to the **"15-20 year roadmap"** that I envisaged for the establishment of a functional stem cell transplant programme in this centre for the management of blood cancers in the Niger Delta of Nigeria. This entails extensive public enlightenment on the subject of blood cancers, capacity building in the technology and expertise of haemato-oncology and stem cell technology; continuous manpower training and retraining, and the enhancement of individual patient's awareness and capacity to positively undergo treatment for blood cancer afflictions of the body.

4. 2. Blood Transfusion and HIV/AIDS Medicine: This consists of studies on blood groups and blood transmissible diseases such as HIV/AIDS and hepatitis viruses, syphilis and malaria; and the reproductive health and sexual orientation in the Niger Delta.

4. 3. Sickle Cell disease and blood coagulation disorders: The other areas of my specific contributions were in the studies of sickle cell disease and bleeding disorders.

4.1. Blood Cancers
Mr. Vice Chancellor Sir, the subject of blood cancers or haematological malignancies (HM) is of interest to me for the following reasons:

- My Master of Science degree in Haematology of the Imperial College school of Medicine (Hammersmith Hospital of the University of London -1996-97) thesis was on chronic myeoid leukaemia during which I worked under one of the global authorities on leukaemia biology-Professor John M. Goldman.
- I was a MacArthur scholar on "*Advanced Oncology"* for three months in 2005 at the University of the Wittswatersrand, Johannesburg, South Africa.

This is even more so, as the subject increasingly dominates the center stage of public discourse in view of its public health importance in National development especially as blood cancers represent one of the major reasons for medical tourism in this country today.

May I now seek your permission to turn my attention to the discussion of some basic salient issues regarding blood cancers and their impact upon the life of the residents of the Niger Delta.

The term Cancer means abnormal and unregulated cell growth or new growth otherwise known as ***"neoplasm"*** that can arise from any part of the body and invade neighbouring tissues. Blood cancers on the other hand are cancers that affect blood and blood forming tissues such as the cellular elements of blood (red and white blood cells, and platelets).

The time line and natural history of every cell in the body is controlled by certain growth regulators that ensure genetically programmed death of each cell when they grow old or become damaged through a process known as "***apoptosis"*** which means programmed cell death. Therefore, cancer develops when a cell becomes unresponsive to these programmed regulatory signals and subsequently exhibits uncontrollable growth or proliferative potential. The end result is the accumulation of abnormal and unwanted cells which tend to invade and destroy the host and adjoining tissues.

Another characteristic of cancer cells is known as ***"clonality"*** which means that the cancer cells all originated from a parent abnormal or neoplastic cell. These cells or clone of cells collectively exhibit the

same physical, microscopic, biochemical, immunologic and genetic properties.

In summary*,"blood cancers can then be defined as an abnormal, neoplastic and clonal proliferation of blood and blood forming tissues of the body which brings about the accumulation of cancerous cells in both the bone marrow and peripheral circulation*". The accumulation of these abnormal immature cells in the blood forming tissues of the *"bone marrow"* often results in the failure of the bone marrow to repopulate the cellular blood elements with normal functioning red blood and white blood cells, and platelets.

In some other cases, the sanctity of blood itself becomes breached and becomes a minister of pain, disease and death instead of its God-ordained function of being a vessel of life and vitality. This happens when cancerous cells and their by-products utilize the capacity of blood to perfuse and nourish the body tissues to ***"metastasize"*** or disseminate and become seeded into secondary locations in various parts of the body from their primary sites of origin in the body which could be Breast, Prostrate, Brain or Lungs, etc.

This phenomenon of ***"bone marrow failure"*** leads to the subsequent failure of the functioning of its end-products consisting essentially of the cellular blood elements. The result is that the body transits into the state in which there is a reduction in the quantity of normal red blood cells with the resultant reduction in its oxygen carrying capacity or ***"anaemia"***.

On the other hand, we also have the failure of normal white blood cells to provide the body with immunity, and to defend it from external "*microbe invasion*" and the resultant frequent and sometimes, life-threatening "***infections"***; and also the cessation or reduction of the critical function of "***immune surveillance"*** that ensures that no cell from the blood or body becomes "*aberrant*" or unresponsive to immune regulation.

In this setting of a compromised or damaged bone marrow, it becomes easy for an aberrant clone of abnormal or ***"malignant"*** cell or cells to thrive and "*gain a growth advantage"* over the normal tissues of the bone marrow that may result in the occurrence or development of a second cancer or malignancy.

We can also say the same for the platelets when there is the reduction in their quantity otherwise referred to as ***"thrombocytopenia"*** due to the phenomenon of a failed bone marrow. Thus, their normal functioning to effect blood clotting and excessive loss of blood whenever there is injury and a breach in the integrity of the blood vessel walls fails and leads to excessive bleeding or ***"haemorrhage".***

4.1.1. Types of Blood Cancers

The different types of blood cancers arise commonly from the cellular elements of blood as follows:

4.1.1.1. Cancers involving the Red Blood Cells (RBCs) or Erythrocytes:

The cancers of the RBCs include Erythro-Leukaemias and Polycythaemias, etc. The word ***"Polycythaemia***" means ***"poly"***-many or excess and ***"cythaemia"*** meaning-blood cells. It is said to be **"*primary*"** if its origin is from the immature, early bone marrow progenitor or precursor cells in which case they are called ***"primary polycythaemia",*** "***Polycythaemia vera (PV)****"*or "***Polycythaemia rubra vera (PRV)"***. It essentially means that there is an abnormal increase of red cells by the early immature blood forming erythrocyte progenitors (stem cells) in the bone marrow. The consequence of this unregulated growth is an increase in the bulk of these cells in the bone marrow which eventually spills into the general peripheral blood circulation.

It is common for the white blood cells and platelets to also show a corresponding increase in their quantities being that their parent stem cells are not exclusively restricted or programmed to make only erythrocytes but also have the capacity of making both WBCs and platelets. Hence, an abnormal clone of RBC progenitors bringing about an excess erythrocyte cell mass would also cause a proliferation of both

the WBCs and platelets with the attendant abnormalities that are associated with them.

Conversely, the term ***"Secondary Polycythaemia***" is used to describe the group of polycythaemias that are caused by artificial or natural increase in the erythropoietin such as is the case with altitude. Erythropoietin is the hormone that stimulates the blood forming early erythrocyte stem cells (***Erythroblasts***) to produce RBCs. This differentiates them from primary polycythaemia in which the abnormality is restricted to the red blood cell precursors themselves.

4.1.1.2. Cancers involving the White Blood Cells: The white blood cells essentially consist of the myeloid and lymphoid tissue. The myeloid cells consist of neutrophils, eosinophils, monocytes/ macrophages and Basophils while lymphoid cells are made up of Lymphocytes and Plasma cells. There are different types of blood cancers that involve the white blood cells and they be grouped as follows:

- Cancers arising from Myeloid cells-Myeloid Leukaemias-acute/chronic, Myeloproliferative disorders, etc.
- Cancers arising from Lymphoid cells-Lymphoid Leukaemias-acute/chronic, Multiple Myeloma, Lymphomas, Lymphoproliferative disorders, etc.

i. Leukaemia: The term "***Leukaemia***" is taken from the word "***leuko***" (Greek for white), thus leukaemia means excessive amounts of white blood cells in the blood. In effect, this type of blood cancer may be further classified into "*acute or chronic Leukaemia*" depending on a number of factors such as the course of the illness and the predominant cell type. The acute Leukaemias generally run a very short and aggressive course sometimes lasting only hours and days from the time of diagnosis, to the demise of the patient.

The cell type is usually predominated by the immature cells or "*blasts"* known as "*Myeloblasts*" or "*Lymphoblasts*" depending on whether they have the characteristics and morphology of granulocytes or Lymphocytes. Thus, the acute leukaemias are divided into two groups-

the acute myeloid leukaemias and the acute lymphoid leukaemias. Each of these consist of several subtypes.

In the same vein, the chronic leukaemias are also of two broad groups- the chronic myeloid and chronic lymphoid leukaemias and are characterized by the predominance of mature cell types and a less aggressive course of illness. Chronic myeloid leukaemia is association with the genetic abnormality of the reciprocal translocation between two chromosomes (9 and 21) to form the famous ***"Philadelphia chromosome"*** described by Howell and Hungerford, 1960. This discovery generated enormous global interest and has been one of the major catalyst to the present day revolution in genetic engineering based on novel DNA- based technologies.

ii. Lymphomas: The lymphocytes are a very heterogenous and diverse collection of cell types which are widely distributed in the body. They are usually located within the reticulo-endothelial system which consist of the primary lymphoid organs of bone marrow and Thymus; and the secondary lymphoid organs-Lymph nodes, Spleen, lymphoid tissues of the gastro-intestinal, genito-urinary and the respiratory system, etc.

The lymphocytes consist of three types of cells: The B and T lymphocytes and the natural killer cells. Abnormal cancerous clone of cells can also arise from any of the cells located in any part of the body and are known as ***"Lymphomas"*** which are broadly classified into two: the Hodgkin's and Non-Hodgkin's lymphomas. One of the most common type in this locality is called Burkitt 's lymphoma which has an established link to Malaria and the Epstein-Barr virus.

In our study, Omunakwe, Madubuike, Nwosu, Pughikumo, Nwauche (2011), we have made a report of a lymphoma involving the gastric mucosa (Mucosa-associated lymphoid tissue lymphoma (MALT) in a middle aged man. He presented with a two-year history of dyspepsia, gradual weight loss and an epigastric mass but could not be salvaged due to delayed diagnosis and commencement of appropriate treatment. We observed the need for prompt endoscopy with biopsy and histologic

diagnosis of specimens to shorten delays in diagnosis and improve patient outcome.

iii. Multiple Myeloma: The plasma cells are memory B-lymphocytes that function to produce antibodies through which the body combats unwanted foreign bodies and infections. When they become neoplastic and malignant they cause a type of blood cancer known as ***"Multiple Myeloma"*** which is characterized by excess production of abnormal proteins that deposit in various parts of the body to cause damage, disease and several life-threatening complications.

4.1.2. What are the causes of blood cancer?

The causes of blood cancers are unknown, however it has been demonstrated that there are several factors that work together to predispose an individual to be affected by blood cancer:

- Familial/inheritance factors.
- Chromosomal abnormalities and Genetic damage.
- Environmental Factors-Infections, Drugs, Chemicals and Radiation

i. Familial/inheritance factors: There have been several reports in the literature demonstrating a possible link between blood cancers and familial and inheritance factors. In a case report on Familial Acute Lymphoblastic Leukaemia (ALL) of 2 siblings, Nwauche et al, (2009) have highlighted the interplay of the associated risk factors of genetic, parental, socio-economic and environmental influences on the incidence of familial leukaemia. There have also been other reports that have demonstrated its association with Acute myeloid leukaemia (AML), Chronic lymphoid leukaemia (CLL), Hodgkins Lymphoma, etc.

ii. Chromosomal abnormalities and Genetic damage: Incidence of Leukaemias is increased in some genetic diseases. In another case report (Nwauche and Ikimalo, 2004) we demonstrated that Acute lymphoblastic Leukaemia co-existed with sickle cell anaemia in a Nigerian child. This finding is consistent with other studies showing the association of blood cancers and other genetic abnormalities such as: Down's syndrome (**20-30 fold increase of acute Leukaemia**),

Fanconi's anaemia, Neurofibromatois, Bloom's syndrome, Ataxia Telangectasia, klinefelter's syndrome, etc.

iii. Environmental Factors: These include Infections, Drugs, Chemicals and Radiation. There is a very strong association that has been demonstrated between various types of viruses and blood cancers: Human T-Lymphotropic Virus Type 1 & Adult T-cell Leukaemia/Lymphoma; Epstein-Barr virus (EBV) & Burkitts Lymphoma; Human Herpes Virus 8 & Karposi's Sarcoma; and HIV & Lymphomas arising from the Central nervous system.

The same association has been also made between blood cancers and certain bacteria and parasitic infestations: Bacteria-*Helicobacter pylorii* has been implicated in the pathogenesis of Gastric mucosa B-cell (*MALT*) lymphoma; and Parasitic infestations: *Burkitt's Lyphoma* occurs in areas with high malaria infections associated with altered host Immunity predisposing different individuals to tumour formation.

The other Environmental factors that have also been implicated are:
Chemicals especially Benzene has been associated with Myelodysplasia and Leukaemia (AML).

Drugs-Alkylating agents e.g. Chlorambucil (AML) and Etoposide (secondary Leukaemias).

Radiation-Leukaemogenic potential of radioactive rays (exposure to radiation through the atom bomb explosions in Hiroshima, Japan during World War II).

4.1.3. How common are these blood cancers? The incidence has been shown to vary according to gender, age, geographic region and type. Several published reports show that they are not uncommon in Nigeria:

- **In the North:** In Maiduguri, Kagu et al, (2013) have reported blood cancers of contributing **6.05%** of all malignancies and 0.31% of hospital admissions; and the Lymphomas were most frequent.
- **In the South:** In Benin, Nwannadi et al, (2010) have reported haematological malignancies (blood cancers) as **17.4%** of

malignancies of adult and children. Here, more adults than children were affected and more males that females were affected too.

- **In the West:** A study from Ilorin by Babatunde et al, (2008) reported blood cancers to be **18.05%** of all malignancies in 10 years and 0.41% of hospital admission. More males were also affected.
- Another report from **Lagos** by Akinde et al, (2015) put haematological malignancies (blood cancers) as the second leading cause (**9%)** of cancer mortality (deaths) after breast cancer.
- Most of the common ones reported have been **Lymphomas, leukaemias**, **myeloma;** and myelodysplastic syndromes have been considered to be rare.
- From Port Harcourt (Unpublished data-**UPTH Cancer Registry, 2013**): In a six year 2007-2013 review. Haematological malignancy (Blood cancers) was the **3rd** commonest cancer after Urogenital (Prostrate, Ovaries) and Breast cancers. In another review chronic myeloid leukaemia (CML) accounted for **34** out of 105 **(32.4%)** haematological cancers seen in the 8 year period (January 2004 to December 2012). The median age at presentation was **36.5** years with 18 males and 16 females: This CML data shows a presentation at a **lower median age** compared to Caucasian median age of **>50** years.

4.1.4. How does blood cancer manifest in the body? The clinical presentation and the manner in which the individuals who have blood cancers present themselves to the medical doctor and the other health care givers is varied and depends on the type and severity of the blood cancer that may be afflicting them.

However, the general signs and symptoms may be those of **bone marrow suppression or failure** in which case they will have features consistent with:

- Reduced quantity of normal RBCs and their oxygen carrying capacity (**anaemia**) which is demonstrated in the affected individuals by getting easily tired, inability to climb stairs or being exhausted upon minor exertion or physical stress, irritability, etc.
- Reduced quantity of the normal types of the different kinds of WBCs **(Leucopenia/Neutropenia**) and their inability to protect the

individual from being repeatedly infected (**recurrent infections and sepsis**).

- Reduced quantity of platelets or thrombocytes (**Thrombocytopenia**) which leads to that may present as bleeding gums, prolonged monthly menstrual bleeding episodes in females, etc.

Secondly, the individuals that are suffering from blood cancer may show features that are due to organ infiltration by the abnormal ***"leukaemic, lymphoma or myeloma"*** cells:

- Lymphadenopathy: Swelling of lymph nodes in different sites in the body is referred to as (**Lymphadenopathy)**.
- Hepatomegaly and splenomegaly: Abnormal enlargement of the liver (**Hepatomegaly**) and of the spleen (**Splenomegaly**).
- CNS symptoms (rarely): Sometimes, the tissues of the central nervous system especially the cerebrospinal fluid may be infiltrated and cause features of severe headaches, dizziness, confusion, altered personality, priapism, visual defects, etc.

Mr. Vice Chancellor Sir, in our research on blood cancers here in Port Harcourt, we have published four studies on the pattern of presentations of these blood cancers in this environment. The first two studies were on the features of chronic myeloid leukaemia in Port Harcourt (Korubo, Omunakwe, Nwauche, 2013; Ekeke, Omunakwe, Nwauche, 2012) while the third study (Korubo, Nwauche, Ejele, 2013) was on anemia in cancer patients. These reports show that the patients here present at a lower age (<50 years) as against the case among caucasians who tend to present >50 years of age. Secondly, we showed the disparity of our patients being seen at our health facilities with various complications such as massively enlarged spleen and liver (splenomegaly and hepatomegaly), priapism and severe anaemia while the presentation in developed countries is either incidental or at the early stages of the disease.

Further we have reported on our analysis of plasma cell neoplasia within a 10 year period at the University of Port Harcourt Teaching Hospital (Omunakwe, Korubo, Onodingene, Nwauche, 2013). A total of

20 patients were diagnosed with multiple myeloma, 70% were male, the mean age was 61.30 ± 8.8 years, 50 % of them had pathological fractures. The mean duration before presentation was 11.89 ± 11. 7 months (Median = 7 months) and was associated with poorer outcome. . The most common method of treatment was chemotherapy with Melphalan and Prednisolone. Madu et al (2014) have also made a similar report in this regard.

In view of the fact that this is a disease of the elderly that can negatively impact on the quality of life due to the complications associated with it, we have observed that long duration of symptoms before presentation is a common problem and has been associated with substantial morbidity and mortality in this study.

4.1.5. How can someone know that he has blood cancer (Diagnosis)?
The diagnosis of blood cancer may be made by the medical doctor or any other member of the health care team on recognition of any evidence of illness in an individual that is similar to the well-established features of blood cancer. These features may be excessive loss of weight and weakness, repeated blood transfusions especially within a short space of time, fever, repeated infections, bleeding gums and swelling of lymph nodes, spleen or liver, etc.

Sometimes, it may be the individual or family members, friends or neighbours that may notice any of the above-mentioned features of blood cancer that may then prompt a decision to seek expert medical attention. On other occasions, especially in chronic Leukaemias, it may be an incidental finding during routine medical checkup, etc.

An integrated array of investigations may then need to be carried out to determine specific diagnosis, the severity and life expectancy or prognosis and monitoring of response to treatment.

The specific methods of diagnosis usually employed by the specialist physician in the treatment of blood cancers (Haematologist) includes:

- **Full Blood Count (FBC)-T**his is used to assess evidence of the following features of blood cancer in a suspected patient- anaemia, presence of infections, bleeding gums, organ infiltrations, etc.
- **Peripheral Blood Film (PBF) examination or Morphology-** In this test method, changes in the various characteristics of individual blood cells in terms of the shape, size and photo-chromatic properties of the nucleus, cytoplasmic organelles and cell membrane, etc, are evaluated. The presence of foreign substances, forms or micro-organisms are noted and contribute to the identification of blood cells.
- **Bone Marrow Aspirate (BMA)-**This is the examination of the blood forming precursor cells for evidence of infiltration by the blood cancer cells such as leukaemic blast cells or the seeding of the bone marrow by the secondary deposits of a cancer in another location in the body such as the breast, prostate or lungs.
- **Bone Marrow Biopsy (BMB):** This is similar to the above but focuses more on the examination of the basic architecture of the bone marrow.
- Further tests with blood samples or bone marrow samples:
    - **Immuno-phenotyping:** This employs the principles of antigen-antibody reactions to detect the presence of the features of blood cancer in a test sample.
    - **Immuno-cytochemistry:** This is the manipulation of the cellular contents such as enzymes, using bioactive dyes like Periodic-acid Schiff (PAS) and Sudan black B to profile specific characteristics that are exhibited and diagnostic of blood cancer cells.
    - **Chromosomal analysis or Cytogenetics:** This is the examination of the chromosomal tissues that have been extracted from the nucleus of the cells of the test samples (usually the bone marrow) for the evidence of blood cancer; e.g., the presence of the *"Philadelphia chromosome"* that involves the reciprocal translation between chromosomes 9 and 21 is diagnostic of chronic myeloid leukaemia.
    - **Molecular methods such as Polymerase chain reaction (PCR), Fluorescent in-situ hybridization (FISH), etc:** These are test methods that are based on the laboratory analysis of

DNA (genes) tissue obtained from the patient's blood or bone marrow samples. They are more specific in the identification of the evidence of blood cancer-leukaemia, lymphoma or multiple myeloma.

The use of FISH test analysis in the diagnosis of chronic myeloid leukaemia was the subject of my 1997 Master of Science in Haematology (*M.Sc. in Haematology*) dissertation of the Imperial College School of Medicine of the University of London. It was titled ***"Detection of BCR-ABL fusion gene in Peripheral blood neutrophils in chronic myeloid leukaemia patients on Interferon-α treatment by the fluorescence in-situ hybridization (FISH) method"***.

The aim of the study was to evaluate a new method of utilizing FISH analysis to detect the presence of the ***"BCR-ABL fusion gene"*** in peripheral blood neutrophils. This fusion gene is the resultant genetic product of the Philadelphia chromosome that causes the production of an abnormal tyrosine kinase protein. This protein possesses an excessive capacity for cell proliferation that results in the accumulation of leukaemic cells characteristic of chronic myeloid leukaemia and is usually detected in a time-consuming standard procedure of normal chromosomal analysis.

The results obtained showed that this method compares favourably with the standard cytogenetic analytic method. In recent times, the result of this study has been incorporated into the routine DNA-based test cocktail of tests employed in making a diagnosis of chronic myeloid leukaemia.

4.1.6. How are Blood Cancers treated?

Treatment of blood cancers is often challenging and the burden of care is usually enormous on all stakeholders consisting of patients, their families, the medical doctors and other care givers. Thus, the basic supportive care consisting of nursing and counseling care with blood transfusion support is very essential.

The definitive treatment could include:

- "**Watchful waiting"** - in some early stages of lymphomas.

- **Periodic phlebotomy –** In this conservative procedure, units of blood are removed periodically in order to temporarily ameliorate the effect of the excessive quantities of RBCs that characteristic Polycythemia Rubra Vera (PRV).
- **Therapeutic apheresis** – In certain blood cancers such as chronic myeloid leukaemia (CML), Essential Thrombocythaemia (ET), PRV, Monoclonal gammopathies, etc., there is the accompanying phenomenon of the presence of excessive amounts of unwanted *"non-sense proteins, cells and tissues"* that are filtered out of blood through the use of the apheresis equipment.
- **More toxic therapeutic options:**
- **Use of various chemotherapeutic agents:** These are usually very strong drugs capable of killing off the unwanted cancer cells. However, they also affect the normal cells which incidentally possess a growth advantage over the cancer cells in their capacity to repopulate the normal cells in the various cycles of treatment. This associated high cell turn over and the side effects of the drugs, together with the primary effect of the blood cancer itself all come together to bring about several complications which pose huge challenges for appropriate patient management.
- **Use of radiotherapy:** This treatment option employs the principles of radioactivity to control the proliferative activities of the cancerous cells and tissues.
- **Use of immunotherapy:** This treatment modality is based on the capacity of the immune system to mount immunological cytotoxicity activity against the tumour cells. This essentially entails the stimulation of the patient's own immune system to fight against the cancer or the use of man-made or foreign immune system to work with the patient's immune system to achieve the same goal. It is commonly used to treat the lymphoid malignancies, e.g. the monoclonal antibody called Rituximab used to treat B-cell lymphomas.
- **Use of Targeted therapy against tyrosine kinase enzymes:**
  Recent data regarding the enzyme receptor tyrosine kinase (RTK) have demonstrated that its activation regulates many key processes including cell growth and survival. Therefore, RTK has become an attractive therapeutic target. One way to effectively block signaling

from RTK is inhibition of its catalytic activity with small-molecule inhibitors. Low-molecular-weight TK inhibitors (TKIs), such as Imatinib (Glivec®) are currently being used as the treatment of choice in the management of chronic myeloid leukaemia in Nigeria (Durosinmi, Faluyi,.. Nwauche**,** et al, 2008).

4.1.7. How can blood cancer be prevented?

A review of the natural history, management challenges, morbidities and mortality associated with blood cancers all point to the fact that the only viable option of overcoming blood cancer is prevention.

A good starting point in the journey of cancer prevention is to review the lessons learnt from the presentation of blood cancer patients:

- Poor health seeking behavior.
- Inadequate personal health care plan.
- Need for regular periodic health check-once or twice a year.
- Late presentation to health care personnel or facility.

Diet and nutrition have also been reported to play a huge positive role in boosting the immune system to help the body fight the cancer cells. Block, Patterson and Subar (2009) have reported that statistically significant protective effect of **fruit and vegetable** consumption was found in 128 of 156 dietary studies in which results were expressed in terms of relative cancer risk.

In their review of approximately 200 studies that examined the relationship between fruit and vegetable intake and different types of cancer, they found that for most cancer sites, persons with low fruit and vegetable intake (at least the lower one-fourth of the population) experience about twice the risk of cancer compared with those with high intake, even after control for potentially confounding factors. In the same vein, there are reports in the literature that point to the link between processed food and increased risk of cancer (Santarelli, Pierre, and Corpet, 2008).

4. 1. 8. Can blood cancer be cured??

Mr. Vice chancellor Sir, I wish to bring to your attention that significant progress have been made in recent times in the quest to achieve a ***"cure"*** in the treatment of blood cancers. In this regard, the advent of

Stem Cell Transplantation (SCT) has revolutionized the practice of cancer treatment globally.

4.1.8.1. Haemopoietic Stem Cell Transplantation: This latest treatment modality of blood cancers is the use of the very immature blood- forming precursor or progenitor cells (also called ***"Stem cells"***) found mostly in the bone marrow, but also exist in small numbers in the peripheral or general blood circulation. They possess the capacity to multiply and produce any of the three main blood cellular elements: RBCs, WBCs and Platelets.

The procedure of stem cell transplantation is usually a two-step process that involves two individuals, the recipient and the donor. This procedure entails the elimination of the immune system and the haemopoietic stem cells using chemotherapy / and or radiotherapy in an individual who is afflicted with a blood cancer who is called the ***"recipient"*** while the ***"donor"*** is the individual from whom viable stem cells have been harvested, for the purpose of transplanting them into the recipient to replace the eliminated immune and haemopoietic cells.

Thus, stem cell transplantation begins with the initial step of eliminating the stem cells and the immune system of the recipient while the second step is that of replacing them with the previously harvested stem cells and immune cells from the donor. In certain circumstances, the stem cells of the patient is processed and given back to the same patient.

4.1.8.2. What are the types of stem cells used for this procedure?
The various types of stem cells used and the blood-forming sites they are harvested from are as follows:

- **Bone marrow:** Marrow pluripotent (multi-cell lineage) stem cells.
- **Peripheral blood:** Peripheral blood stem cells.
- **Umbilical cord:** The stem cells sourced from this site are usually harvested at birth. In this regard, Nwauche *et al* (2008) established baseline haematological data in maternal and cord blood pairs in Port Harcourt.
- **Amniotic fluid:** The stem cells here are derived from the mesenchyme- collection of loosely knit cells that give rise to cells

that make up the lymphatic and circulatory systems, in addition to the connective tissues throughout the body (from which the skeletal system develops).

- **Embryo:** The inner cell mass (ICM) of a blastocyst or post-fertilization early-stage embryo also serves as a veritable source of stem cells, although it is associated with abortion and ethical issues.

What are the various types of Stem cell transplantations (SCT):

- **Syngeneic transplant:** SCT involving identical twins.
- **Allogeneic transplant:** SCT involving another person.
- **HLA-matching sibling allogeneic transplant:** SCT involving two siblings whose immune system are similar hence the critical Human leucocyte antigens (HLA) matching testing show a high compatibility result.
- **HLA-matching unrelated volunteer allogeneic transplant:** The SCT here involves an unrelated volunteer donor who is chosen from the global stem cell register of prospective donors.
- **Autologous transplant:** This novel approach essentially entails using patient's own stem cells that have been previously "***processed"*** or *"**purged"*** of cancer cells for the transplant procedure. This processing involves the use of several techniques and manipulations of the donor tissue to remove the cancer cells. This is commonly done by using chemotherapy and monoclonal antibodies that target specific antigens on the cancer cells while another method employs running the *"donor harvest"* through a mechanical filtering machine that removes the cancer cells.
- **Bone marrow stem cell transplantation (BMSCT):** The stem cells here are sourced from the bone marrow.
- **Peripheral blood stem cell transplantation (PBSCT):** The stem cells here sometimes need to be mobilized to give a high cell yield by administering certain drugs.
- **Umbilical cord stem cell transplantation (UCSCT):** This a new approach that employs umbilical cord-derived stem cells for the transplant procedure.
- **Amniotic Fluid stem cell transplant (AFSCT):** Autologous cells could be obtained during gestation or pregnancy from the amniotic fluid with minimal risk for the fetus and the mother, (Shaw et al,

2011). These harvested cells then are employed for the transplant process.

- **Embryonic stem cell transplant:** The inner cell mass (ICM) that is attached to the trophoblast of the very early stage post-fertilization embryo serves as the template that eventually gives rise to the complex tissues and organs of the fetus. The stem cells derived from here could also be utilized for a transplant (Marikawa and Alarcón, 2009).

4.1.8.3. What are the types of blood cancers that can be treated by SCT: These may be:

Blood cancers and disorders of the bone marrow:

- Acute Leukaemia-Acute Lymphocytic Leukaemia (ALL) and Acute Myeloid Leukaemia (AML).
- Chronic Leukaemia-Chronic Myeloid leukaemai (CML), Chronic Lymphocytic Leukaemia (CLL).
- Lymphomas.
- Multiple myeloma.
- Myelofibrosis.
- Myelodysplasia.
- Severe acquired aplastic anaemia.
- Paroxysmal nocturnal haemoglobinuria.
- Red cell aplasia.

SCT have also been utilized to treat some inherited blood disorders:

- Sickle cell anaemia-The very first SCT in Nigeria took place at the University of Benin Teaching Hospital (UBTH) in 2012!!!
- Thalassaemia major.
- Immune deficiencies.
- Inborn errors of metabolism –Osteopetrosis.

4.1.8.4. How do we source or harvest the Stem cells:

The stem cells are commonly harvested from either the peripheral blood or the bone marrow:

i. Harvesting of Stem cells from the PBSCT:

- The donor/patient is connected to the cell-seperator or apheresis machine to enable the harvest of the appropriate cells as the blood runs through the machine and back to the donor/patient.
- The Harvest of the mononuclear (stem cells) cells is done by centrifugation.
- Return of the supernatant (Red cells and others) to donor circulation is the next step.
- This procedure is a continuous process that goes on for hours to achieve the required set yield of stem cells.
- The yield is sometimes increased through the use of chemotherapy and growth factors.
- The assessment of the adequacy of yield is carried out by utilizing the characteristic prescence of the CD34+ antigen on the cell membrane of stem cells to do a CD 34+ cell count.

ii. Harvesting of Stem cells from the BMSCT:

- The Stem cell harvest is usually done under general anaesthesia.
- Here, multiple bone marrow punctures from pelvis are carried out.
- The target here is to harvest between 500-1200mls of bone marrow.
- Steps are usually taken to avoid clotting of the marrow harvest during the procedure.
- Steps to ensure the adequacy of yield are included in the harvest protocol.

4.1.8.5. How is the Stem Cell transplant procedure carried out?

The procedure of SCT is quite a complex undertaking however, a huge amount of effort is being invested in research to simplify these processes so that it would become a routine out-patient walk-in walk-out experience for the individual who is challenged with blood cancer. These complex processes can be simplified into the following steps:

- **Patient selection:** the whole process of SCT begins with making sure that the right patient is selected for the procedure because the transplant itself can lead to the death of the patient or cause very serious complications.
- **Donor selection:** a suitable donor is selected based on a series of tests that include basic laboratory workup to assess the following profiles: haematological (blood groups, full blood count, etc),

clinical chemistry including the liver and kidney function tests, and microbiological tests (bacteriological, virology profiling especially cytomegalovirus, hepatitis B & C, and HIV screening, etc). One of the most important pre-transplant tests is the HLA-matching of the immune cells of both the donor and recipient that determines the suitability of the donor.

- **Harvest of stem cells:** The stem cells are commonly harvested from the peripheral blood, bone marrow and umbilical cord as previously discussed.
- **Conditioning of patient (recipient**): The activities and manipulations the recipient undergoes before the actual infusion of the harvested stem cells is known as **"*conditioning*".** This conditioning is achieved by the use of chemotherapeutic agents alone or sometimes in combination with radiotherapy to initiate the first step of the transplant procedure which is the eradication of the immune and haemopoetic cells of the recipient.

Any cancer cells present are also eliminated in this process that paves the way for the second step of the SCT. The chemotherapeutic agents used commonly include busulphan, melphalan and cytosine arabinoside. The associated complication of this conditioning procedure is chiefly that of mucositis or the inflammation of the mucous membranes of the body especially the mouth that may require the bypassing of the mouth and other gastro-intestinal areas in the feeding of the patient (parenteral nutrition).

In recent times, the strength of the conditioning process or regimen has been reduced to give two types of conditioning regimens: The "***myeloablative***" and the "***non-myeloablative"*** regimens. In the former, very high doses of chemotherapeutic agents and or radiotherapy are used to irreversibly destroy the haemopoetic function of the bone marrow. Conversely, the latter spares the marrow from complete destruction with a resultant reduction in the associated morbidities and mortality of the transplant procedure. These reduced-intensity or mini transplants are designed to employ reduced immunosppression to allow donor stem cells to engraft without completely eradicating host marrow stem cells.

The drugs commonly used here are: Fludarabine, anti-lymphocyte globulin, low-dose busulphan and cyclophosphamide while the radiotherapy is low-dose irradiation. Sometimes, small-portions of the donor lymphocytes (Donor Lymphocyte Infusions, DLI,) are also given continuously or serially to encourage engraftment of the transfused immune and stem cells.

- **Infusion of stem cells (SCT):** This crucial activity is actually the second stage of the SCT procedure SCT in which the harvested stem cells are infused or given to the recipient after 36 hours after the conditioning process. Here, the infusion of the harvested stem cells is designed to effect the reconstitution and repopulation of the bone marrow (which has been purged of ***"cancer-contaminated"*** immune and stem cells) with the normal immune and haemopoetic cells from the infused donor harvest.

The process of conditioning also works on the principle of being able to also suppress the immune system of the recipient to tolerate the "***foreign cells***" (antigens) of the donor cells. If a rejection of the transplanted foreign cells by the recipient occurs, a **"*graft failure*"** is said to have occurred.

- **Support of the recipient after conditioning and infusion of harvested stem cells:** The immediate post-transplant period is characterized by profound immunosuppression that can be likened to an ***"induced bone marrow failure"*** in the recipient with the resultant effect of the absence of the blood cellular elements in the circulatory system, otherwise known as "***pancytopenia***" which lasts about 21 days.

The recipient therefore requires total support of the immune and haemopoietic function through the continuous transfusion of blood and blood products in view of the induced anaemia and thrombocytopenic bleeding. We also use very strong antibiotics to prevent infections and sepsis in the recipient at this time.

- **How do we know that the infused stem cells have been accepted by the recipient?**

The first evidence that the stem cell graft has been accepted or ***"taken***" by the recipient is the presence of newly formed monocytes and neutrophils in the peripheral blood. This serves as a concrete evidence of engraftment in the recipient. The period of neutropenia is reduced by the use of growth factors such G-CSF.

This initial response is then followed by the raised cell counts of platelets, reticulocytes and lymphocyte counts. The recovery time for the marrow is 1-2 years, and 12 months for the CD4 count while the blood group changes to that of the donor.

4.1.8.6 Are there any complications associated with Stem Cell Transplantation:

As it is to be expected from such complex procedure that is designed to deal with an intractable and life-threatening disease as blood cancer, there are huge problems associated with SCT. These complications are either due to the disease itself or are associated with the SCT procedure. These complications are generally divided into two broad groups with those occurring before 100 days being classified as early complications while those that occur after 100 days are grouped as late complications.

a. Early complications:

- One of the most important early complications of SCT is known as **Graft versus host disease.** Here, the immune competent cells derived from the donor especially T-lymphocytes mount an immunological reaction against the host or recipient resulting in tissue destruction and disease. Attempts to prevent this often life-threatening complication is to give immune boosting drugs to the recipient such as cyclosporine and methotrexate or to remove T-cells from the donor graft stem cell infusion.
- **Acute graft versus host disease** occurs within 100 days of the infusion of stem cells while it becomes chronic graft versus host disease after the 100 days mark. The former is characterized by diarhhoea, skin rashes and liver complications while treatment is with corticosteroids. The latter chronic Graft versus host disease

is commonly associated with worsening of the effects upon the skin, gastrointestinal system and liver, in addition to the involvement of the joints and impairment of the immune system leading to life-threatening infections, malabsorption, etc.

- **Infections** also constitute a major source of problems here with varying types of micro-organisms leading to fungal infections (Candidiasis, Aspergillosis), viral infections (CMV, varicella zoster virus, Epstein barr virus, etc). The other complications include graft failure, haemorrhagic cystitis, veno-occlusive disorder of the Liver, cardiac failure and haemolysis.

b. Late Complications: The late complications that are often encountered include relapse of the original disease, infections, delayed pulmonary complications, endocrine complications, autoimmune disorders, second malignancies and central nervous system complications.

4. 2. Blood Transfusion and HIV/AIDS Medicine.

Mr. Vice Chancellor Sir, the next major area of my research and professional work was in the field of blood transfusion and HIV/AIDS medicine and they are presented as follows:

1. Provision of safe blood in the Niger Delta.
2. Rhesus D protein and Haemolytic Disease of the Newborn (HDN).

4. 2.1. Provision of Safe blood in the Niger Delta Area of Nigeria.

One of the major challenges that I encountered upon the commencement of my research and professional practice in haematology here in the Niger Delta of Nigeria was the non-existence of a viable, efficient and functional National Blood transfusion service in Nigeria whose task will include the provision of safe blood to the ever increasing clientele of clinicians and patients requiring this service.

This is more so, when viewed upon the background of the sharp increase in the demand for safe blood at the Local, State and National levels especially within the context of the current pandemic of HIV/AIDS and Hepatitis. In addition, there are increases in surgical emergencies due to road traffic accidents and obstetrics care of pregnant

mothers that have put a strain upon the provision of safe blood for routine hospital use and to meet the increased demand of the pandemic.

Based on the foregoing, one of the main thrusts of my contributions to the knowledge and professional practice of haematology in this locality was to address the following:

1. The generation of requisite epidemiologic information and baseline data that would advise policy on the firm establishment of the long-overdue National Blood Transfusion service that has been in the pipeline for several decades.
2. The provision of safe blood on an efficient platform to meet the increasing demand for blood/blood products for emergency /routine hospital use and also to alleviate the strain being piled upon the weak blood supply chain by the needs of the ongoing HIV/AIDS and Hepatitis pandemic.
3. To contribute to the establishment of a viable Blood Transfusion system in the University of Port Harcourt Teaching Hospital that would support the proposed commencement of Stem Cell Transplantation programme which would go a long way to address the challenge of medical tourism in this environment as regards blood cancers.

Blood is essential for the optimum functioning of the tissues and organs of the body, especially when any part becomes diseased or any of the blood components assumes an abnormal and disordered function.

However, blood can also transmit harmful effects to an individual particularly through the following:

a. The transmission of blood-borne viruses (Human Immune deficiency virus, HIV; Hepatitis B, and C and Cytomegalovirus, CMV), bacterial infections (Syphilis), and parasitic infestations (Malaria, Filariasis, African sleeping sickness, Leshmaniasis and Dengue fever).
b. Transfusion of "*unsafe blood*" containing red cells that are genetically damaged such as Haemoglobin AS (Hb AS) or have an enzyme deficiency e.g. Glucose-6- phosphate dehydrogenase (G6PD); or white blood cells that have a genetic mutation that has

conferred upon it the property of a clonal neoplastic cells (Leukaemic, Lymphoma or Myeloma cells). These individuals could have a high haemoglobin concentration and thus pass the specific gravity screening test for donors but their blood would be inadequate and unhealthy for transfusion purposes. It is therefore very important that only safe blood is made available for transfusion to patients in need of blood products (Akinsete, 1998).

c. Transfusion of blood that has been contaminated by drugs, alcohol, and harmful chemical substances.

Safe blood is therefore blood that does not contain viruses, parasites, damaged blood cells and proteins, drugs, chemical substances or other extraneous factors that might cause harm, danger or disease to the recipient(Esan, 2002). The need thereby arises for the procurement, processing and distribution of safe blood on a regular, efficient and sustainable basis which has been encapsulated in the concept of a National Blood Transfusion Service.

This is even more so in our resource-limited setting such as the Niger Delta of Nigeria, where Blood Transfusion services have not been a priority even though blood is obviously the most commonly given tissue and its use has become an integral part of modern clinical practice. This importance is reflected by the increase in road traffic accidents (RTA), the HIV/AIDS and Hepatitis epidemics, complications of pregnancy and childbirth, various anaemias especially Sickle Cell anaemia and surgical emergencies; all of which require safe blood. The challenge of the provision of safe blood in the Niger Delta is also compounded by the paucity and non-existence of the requisite data and epidemiological information that would ensure the running of an efficient blood transfusion service.

It was therefore my determined objective to embark upon research that would adequately address the obvious lack of informative data that would advise policy and aid the effective functioning of the then newly established National Blood Transfusion service with a headquarters in Abuja and several Zonal/regional centers. These data would facilitate the provision of safe blood and blood products to meet the ever

increasing demand by both the private and Government health institutions at the primary, secondary and tertiary levels of health care delivery nationwide and especially in the Niger Delta.

Specific review of studies on the provision of safe blood in the Niger Delta of Nigeria

This review shall be in three sections:
4.2.1.1. Studies on reference values of the common blood parameters.
4.2.1.2. Studies on Transfusion Transmissible Infections (TTIs).
4.2.1.3. Study on safe blood services in Rivers State.

4.2.1.1. Studies on reference values of common blood parameters.

These common reference values include such parameters as Haemoglobin values, blood counts, etc. since the caucasian values in present use may not be fully applicable to the clinical situations confronting the laboratory medicine physician and other clinicians in their practice in the Niger Delta.

The normal functioning of a blood transfusion service and indeed the day to day clinical practice depends heavily on a proper knowledge of the blood counts and parameters of both the donors and recipients of blood and blood products in the locality. It has been shown severally by investigators that the reference values of these parameters in Africans and Nigerians show significant variations, however, there was a paucity of data as regards the Niger Delta in this regard.

Our studies on reference values were classified into two broad groups:
4.2.1.1.1. Reference values of general haematological parameters.
4.2.I.1:2. Reference values of the clinically significant blood groups.

4.2.1.1.1. Reference values for general haematological parameters

The main objective of blood transfusion is not only to give life but to use the rich resource base of the blood nutrients to restore the ailing functioning of the body parts. Hence, the need to select only the most viable, healthy and resource assured blood units from the general population in order to achieve this goal.

The basic blood parameters are generally employed as health and nutrition status indicators to screen the general population from which potential donors are selected. More specifically, the reference values are used routinely in the medical laboratories including the blood bank, to assess blood donors for anaemia, prescence of infections (such as viral, bacterial or parasitic infestations including malaria) and other blood disorders. These parameters include haemoglobin, packed cell volume/ haematocrit, white blood cell (total and differential counts), platelet counts, erythrocyte sedimentation rate, etc.

We carried out three studies amongst different segments of the population to determine the status of these reference values in this locality. The parameters studied included: haemoglobin, packed cell volume/ haematocrit, white blood cell (total and differential counts), platelet counts, erythrocyte sedimentation rate, etc:

1. Haematological reference values of healthy adults in Port Harcourt (Dapper, Nwauche and Didia, 2006).
2. Haematological values in pregnant women in Port Harcourt (Dapper, Ibe and Nwauche, 2006).
3. Some haematological reference values for pre-primary and primary school aged children in Port Harcourt, Nigeria (Dapper, Nwauche and Siminialayi, 2001). The study on reference values for healthy adults measured eight basic haematological parameters in Port Harcourt. These included Haematocrit (Hct), Haemoglobin concentration (Hb) , Red blood cell (Rbc) count , White blood cell (Wbc) count, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular concentration(MCHC) and Erythrocyte sedimentation rate (ESR).

The results show that significant gender variations were found in the values of all parameters under assessment as shown by our report that there were significant higher haematocrit, Haemoglobin concentration and red and white blood cell counts in males compared to female subjects. We also showed that the mean corpuscular haemoglobin concentration and Erythrocyte sedimentation rate were significantly higher in females than in male subjects. This variation could be

attributable mainly to the combined effects of testosterone in males and menstruation and pregnancy in females.

The second study on the haematological values in pregnant women in Port Harcourt showed that out of the eight parameters that were previously evaluated in the first study on healthy adults, only haematocrit values showed significant differences in all the three trimesters, while it showed an initial reduction amongst subjects in the second trimester and later a rise amongst subjects in the third trimester of pregnancy. Thus, our results show that except for haematocrit, most haematologic parameters do not show significant differences in the three trimesters of pregnancy. The initial reduction may be due to the effects of haemodilution resulting from the increase in blood volume usually occurring from the twentieth week of pregnancy while the rise in the last trimester has been said to be due to the effects of supplementary haematinics.

Finally, our last study under this category of our research was on the reference values for pre-primary and primary school aged children in Port Harcourt, Nigeria in which we report essentially normal values except for the finding of no gender-based differences between the two age groups. This is in contrast to the findings in the adult age group in our previous study which is attributable to hormonal factors between the two groups.

4.2.1.1b Reference values of the clinically significant blood groups

The establishment of the local database and epidemiologic information of the blood groups in this environment is very pertinent for the provision of safe blood on an efficient basis while the prevalence and frequencies of the present day blood group antigens and antibodies are dependent on the principles of Paleo-Immunohaematolgy.

Paleo-immunohaematology and reference values of blood groups

The genetics, inheritance pattern, and population dynamics of these present day blood group systems are said to have evolved over time according to the concept of Paleo-Immunohaematology which is the study of the ancient blood group inheritance patterns hinged on the twin

processes of phylogenetic evolution and population migration. However, the phenomenon that is basic to these two theories is the concept of local mutations followed by migrations as is the case with the present day distribution of the haemoglobinopathies where migration caused a mixture of the original population through wars, slave trade and intertribal marriages.

Thus, it has been postulated that once upon a time there evolved a primitive blood group substance of H specificity from which there developed blood group substances A & B and supposedly other groups and subgroups. In the same vein, the other blood groups were developed such that certain blood group systems were more common in certain races, tribes and geographical location such as the Indians of Latin America who are almost always Rhesus positive (Miale, 1977). We therefore see that the prevalence of the various blood group frequencies would be subject to such population dynamic factors as inter-tribal marriages, urban-rural movements and other socio-cultural factors.

The schematic diagram below encapsulates this concept of the provision of safe blood:
The concept and practice of the provision of safe blood is essentially directed at eliminating whatever immunological and extraneous factors that might be at play to introduce substances especially antigens and antibodies into the blood system that might endanger and render both the donor and recipient liable to not only haemolytic transfusion reactions but other complications of blood transfusion.

In this regard, the most potent transfusion factors in view are the antigens and antibodies of the clinically significant blood group systems. This safety check procedure that ensures that safe blood is made available for the recipient involves the process of determining the blood group of the antigens on the red cell membrane of both the donor and recipient while the second crossmatch procedure screens the serum of the recipient with known blood group antigens common and indigenous to the local population composed into a panel of "*known screening cells*".

It is instructive that several studies carried out in the other parts of Nigeria and elsewhere have yielded data that could be utilized to generate the relevant panels of known cells and requisite antisera for the above very intricate and complicated procedure. However, the paucity and scarcity of these data in the Niger Delta implies that the Blood Transfusion services here would be hampered from effectively carrying out this service with the ideal attendant minimal consequence of haemolytic transfusion reactions.

Our research on reference values of clinically significant blood groups in the Niger Delta. The most clinically significant blood group is the ABO blood group system, followed by the Rh blood group system. The other blood groups that are also important are the Kell, Duffy, MNSs, Lutheran, P, etc.

Previous workers have reported the findings about some of the clinically significant blood groups in various part of Nigeria especially in Western Nigeria while there has been a paucity of data as regards the Niger Delta. Hence, we set out to correct this imbalance by conducting four studies involving three of the most clinically significant blood group systems that are relevant to our practice here in the Niger Delta:

i. ABO and Rhesus antigens in a cosmopolitan Nigerian population (Nwauche and Ejele, 2004).

This study was carried out in Port Harcourt, capital of Rivers State of Nigeria, a cosmopolitan city consisting of several ethnic groupings such as the Ikwerre, Ijaw, Ibo, Ogoni, Efik-Ibibio, Edo, Yoruba, Hausa and foreign nationals. However, there was neither a functional nor organized State Blood Transfusion service, coupled with the availability of little or no relevant data that would assist the efficient running of an efficient blood transfusion service for the cosmopolitan city of Port Harcourt and the entire state.

A total 936 blood donors from three health facilities within the city were randomly screened for ABO and Rh D antigens and reveal that blood group O was the highest with 527 (56.30%) followed by blood

groups A, B and lastly AB with 212 (22. 65%), 178 (19.02%) and 18 (2.10%) respectively.

Furthermore, the highest contribution to blood group O was from the Ibos with 220 (23.50%) while the Ijaws gave the highest contribution of Rh D antigen with 370 (39.53%). Rh D negativity values in this study was 7.26% with the highest contributors being the Ijaws with 33(3.53%) and the Ibos with 27 (2.89%) while the Rh D positive value being 92.74%.

Thus, blood group O was the commonest ABO blood group antigen while the Rh D antigen was absent or present in a low percentage among the ethnic groupings studied within Port Harcourt metropolis. This data was consistent with the figures obtained elsewhere in Nigeria in which Worlledge et al (1974) reported blood group O to be 51.5% among the Yoruba.

ii. A survey of the status of common Rhesus phenotypes in Port Harcourt (Nwauche and Ejele, 2004).

The Rh proteins carry the Rh antigens but are only expressed on the erythrocyte surface if (RHAG a glycosylated homolog) is also present. Thus, the RH D protein expresses the D antigen, while the RHCcEe protein carries either the C or c antigens together with E or e antigens on the same protein and are both located on the chromosome 1 with 30-32 and 32-34 Kd respectively. The most frequently occurring forms of RHD and RHCE encode several haplotypes designated as: Dce, dCe, DcE, dCE, DCE, dcE and dce.

In Nigeria and most developing countries that are characterized by rudimentary blood transfusion service, routine Rh antigen typing is restricted to only Rh D phenotype screening for several reasons which include the unavailability of the relevant Rh antisera: anti-C, anti-c, anti-E and ant-e. The obvious consequence of this practice is increased risk of the occurrence of the grave life-threatening and sometimes fatal cases of HDN and HTR.

In this environment, most studies have been concentrated on the ABO and Rh D antigens hence this pilot screening of the common Rhesus phenotypes in Port Harcourt amongst 65 subjects consisting of pregnant women and blood donors. The results confirmed the already established trend of Low Rh D negativity and the corresponding high Rh D positivity. However, the most common Rh phenotype in these samples was the Rh C antigen which is not consistent with previous reported data both in Port Harcourt (Nwauche and Ejele, 2004) and elsewhere in the country and could be due to the small sample size and thus requires validation by a larger study.

iii. Nwauche and Ejele (2003): Red cell antigens and the practice of transfusion medicine in Nigeria. In this research work, we reviewed all published data on ABO and Rh antigens and blood groups in Nigeria. The results are highlighted as follows:

TABLE 1: ABO blood group studies in Nigerians.

Study	O Blood	Group	A Blood	Group	B Blood	Group	AB Blood	Group
	Range%	Average	Range%	Average	Range%	Average	Range%	Average
Worlledge et al	45.9-64-5	53.5	12-30	21.9	11.9-30	21.5	0-4.9	2.9
Falusi et al	41.5-56.9	50.12	22-25.3	23.24	15.3-30.6	22.9	2.5-4.9	3.8
Udeozo K	56-58	57.14	25-28	26.64	12-15.57	14.14	2-2.29	2.1
Odaibo, Omada and Fleming	36.5-54.8	47.01	18.7-26.1	21.60	20.6-38.5	27.72	2.5-6.4	3.7
Onwukeme KEO	31-47.4	42.85	20.7-28.2	24.48	24.6-40.1	29.8	2.2-7.5	4.84
Ahmed and Obi	52	52	27.1	17.73	17.73	17.73	3.16	3.16
Odunaiya OA	55.3	55.3	22.3	22.3	19.5	19.5	2.9	2.9
Nwauche and Ejele	56.30	56.30	22.65	22.65	19.02	2.10	2.10	2.10

The data above shows that the frequency of ABO blood group in Nigeria is as follows: group 0.31-64.5%, group A: 12-30%, group B: 11.9-40.1% and group AB: 0-75%.

Table 2: Rhesus D Blood group studies in Nigerians.

Study	**Rh D Positive%**	***Rh D Negative***
Worlledge etal	91.7-100	0-8.3
Falusi etal	94.11-98.45	1.55-5.89
Udeozo K	95.4	4.6
Odaibo, Omada and Fleming	94.1-97.8	2.2-5.9
Onwukeme	94-97	2.9-6.0
Ahmed and Obi	98.56	1.44
Odunaiya	94.8	5.2
Nwauche, Ejele and Okpani	90.5	9.5
Nwauche and Ejele	92.74	7.26

Thus the figures above shown in this table depict the finding that the prevalence of Rhesus D positive and negative in Nigeria based on the studies under review is of the value of 90.5-100% and 0-9.5% respectively.

iv. Kell blood group antigens in Port Harcourt, Nigeria-a pilot study (Ugboma and Nwauche, 2010).

The Kell blood group system is important in transfusion medicine, and the kell (k) is probably second in importance to Rhesus D as an immunogen in alloimmunized pregnancies which cause haemolytic diseases of the newborn. Available data in this environment indicate that apart from the classic studies of Worlledge et al in Western Nigeria, there have been very few studies on this important blood group system, even here in the Niger Delta.

The Kell blood group is composed of 22 blood group antigens and like the ABO and Rhesus blood group system, it is determined by three closely linked loci, each of which can be occupied by one of a pair of allelic genes: K and k, Kpa and Kpb, and Jsa and Jsb.

The Kell antigens are peptides located within the kell protein which have been reported to have racial prevalence as shown by the preponderance of K among the Northern Europeans, the Jsa in people of African descent and the Kpa antigen has been more frequently found in

the Japanese. Worlledge et al, 1974 reported a 100% kell negativity.as confirmed by other studies in Nigeria which confirmed a low or rare kell positivity.

The importance of relevant baseline data about the prevalence of the Kell antigens in the Niger Delta coupled with its high immunogenic potential in causing life-threatening HTR and HDN prompted us to initiate this pilot study among 200 adult Nigerians including pregnant women.

The findings from this study shows that the prevalence of K in this environment is 2.0% and was recorded amongst the Ijaw and Edo ethnic groupings(1% each) which is in keeping with the low figures obtained elsewhere such as the UK where it was reported in 0.2% of the English population and is deemed to be the next most immunogenic antigen after the Rh D antigen, and is clinically significant being able to induce anti-kell antibodies in about 10% of Kell negative individuals who are given one unit of kell positive blood (Hoffbrand, Lewis, Tuddenham, 2000).

In the light of the above capacity of Kell positive blood units to induce anti-kell antibodies, the reported 2% Kell negativity in this environment stand the grave risk of both HTR and HDN and the data thrown up by this study should hopefully assist the National blood transfusion and transfusion medicine practitioners and clinicians to adequately provide safe blood to the target population in need.

4.2.1.2. Studies on Transfusion Transmissible Infections

These include viral infections (HIV, Hepatitis B and C), Bacterial infections (Syphilis) and other blood parasites (*e.g.* Malaria).

Microbe invasion of blood is one of the most eloquent demonstrations of the fact that blood is rich in metabolic nutrients that are basic to the livelihood and survival of all living tissue, including both human cellular tissues and micro-organisms hence the "*competition*" to access the *"goodies of this promise land flowing with milk and honey".*

We have also seen that this microbe invasion causes pain, suffering, disease and death to man. This therefore brings to focus the need to restore life and vitality to the body by the provision of safe blood by both the transfusion medicine practitioners and the Blood transfusion service. This quest to provide safe blood through an efficiently run blood transfusion service is therefore burdened with the responsibility to provide blood that is free of transfusion-transmissible infections (TTIs).

Specific contributions to the management of TTIs in the context of the provision of safe blood in the Niger Delta.

The TTIs that we investigated included viral infections (HIV, Hepatitis B and C), Bacterial infections (Syphilis) and other blood parasites (*Plasmodium spp*).

The focus of our studies in this field was to generate data that would enhance the capacity of the blood transfusion service to provide safe blood devoid of TTIs and also to support the various measures outlined above designed to control their transmission in the general population.

These research studies are classified as follows:

4.2.1.2.1. Transfusion -Transmitted Infections (TTIs) involving HIV.

4.2.1.2.2. Transfusion- Transmitted Infections (TTIs) with Hepatitis B and C.

4.2.1.2.3. Transfusion -Transmitted Infections (TTIs) with mixed organisms involving HIV, Hepatitis B and C, syphilis and Malaria.

4.2.1.2.4. Studies on the Laboratory management of highly active antiretroviral therapy (HAART).

4.2.1.2.5. Studies on the reproductive health and sexual orientation of the population of the Niger Delta of Nigeria.

4.2.1.2.6. Epidemiology and management of occupational exposure to blood borne viral infections in the Niger Delta.

4.2.1.2.1. Transfusion Transmitted Infections (TTIs) involving HIV.

In this regard, we carried out three studies: Sero-prevalence of HIV among unemployed individuals undergoing pre-employment medical examination in Port Harcourt, Nigeria (Ejele, Nwauche and Erhabor,

2005); Seroprevalence of HIV among blood donors in Port Harcourt, Nigeria (Ejele, Nwauche and Erhabor, 2005) and Prevalence of HIV among secondary schools students in two cities in south-south Nigeria (Koofreh, Nwauche and Ugboma, 2008).

These three studies enabled us to profile the status and related issues of HIV in the general population of Port Harcourt especially among the vulnerable groups of unemployed youths, blood donors and secondary school students.

In the first study among unemployed individuals, the prevalence of HIV was 3.1% against a National prevalence rates of 5% in 2003, 5.8% in 2001, 5.4% in 1991, 4.5% in 1996; 3.8% in 1993 and 1.8% in 1991. HIV-1 was 25 (92.6%) while HIV-2 was 2 (7.4%). There were more affected females (3.6%) than males (2.4%) while the highest prevalence was found among <19 years age group(5.1%) with the lowest prevalence was in the 40-49 years age group (2.3%). However, the profile of the marital status showed that the highest HIV prevalence occurred among the individuals who were separated 7.7% when compared with the single 3.9% and married 1.8%.

These findings of the increased vulnerability of teenagers and those who are separated emphasized the influence of socio-cultural factors such as poverty, alcoholism, smoking of marijuana/hard drugs, promiscuity on the transmission of HIV. We also demonstrated a higher female vulnerability which may be due to the fact that women are more likely to be infected with HIV during unprotected sexual intercourse; they have lower social status and to be in sexual relationships. This gender vulnerability is particularly acute for young women, who are more likely to be coerced, raped, and enticed into unprotected sexual intercourse by someone older, stronger or richer.

Women are disempowered in the society and are at a poor position to question their husbands or lovers about extramarital affairs and infidelity; negotiate condom use or refuse to have sex. Furthermore, an increasing number of unemployed females are involved in women trafficking abroad only to return home voluntarily or repatriated with

HIV infection. Finally, the practice of pre-employment HIV screening is highlighted by this study as an important ongoing issue of social and workplace stigmatization of HIV infected individuals and underlines the need to institute policies and programmes that would adequately manage the impact of HIV in the workplace to ensure that the manpower and human resources base of the nation is not eroded by the current HIV/AIDS pandemic.

The second study was the determination of the prevalence of HIV among blood donors in Port Harcourt which was found to be 1% of which 0.8% was due to HIV-1 and 0.2% was attributable to HIV-2. An important highlight of this study was that the prevalence of HIV was significantly higher in commercially remunerated donors than among the family replacement donors.

Again, the higher prevalence observed among commercial donors especially those within the age bracket of 20-29 years compared to family replacement donors of the same age bracket in this study may be attributed to the fact that paid donors often come from the poorest sectors of the society and may also be poor in health. They may also be more likely to give blood more often than recommended, be undernourished and be more at risk of having a TTI from high risk behaviours; intravenous drug use, involving sharing of needles, promiscuity, and unprotected sex. On the other hand, family replacement donors may feel obliged to donate blood even if they know that they have some health condition which prohibits blood donation.

Finally, the 1% prevalence reported in this study is a confirmation of the risk of transfusing unscreened blood in the Niger Delta of Nigeria. This is moreso, when it is considered that health facilities here especially in the remote fishing ports and settlements may not have HIV screening facilities, coupled with the fact that electric power supply in most cases is not available and when available may not be adequate.

This scenario therefore translates to an overall shortage of safe blood and blood products in this locality which invariably puts most transfusion centers under pressure of collecting blood from

commercially remunerated and family replacement donors. Hence, the urgent need for the functioning of an efficient blood transfusion service to bridge this gap.

The third study was a prevalence of HIV infection among secondary schools in two south-south cities of Port Harcourt and Calabar. In sub-Saharan Africa, Nigeria inclusive, young women are most affected due to biological, health-related and socioeconomic reasons. Furthermore, youths are among the most vulnerable groups to HIV because they begin sexual activity at an increasingly tender age, tend to have multiple sex partners and have restricted access to information on safer sexual practices.

Table 3: Seroprevalence among Secondary School Adolescents in Port Harcourt and Calabar.

Sex	City	Positives	Negatives	Total	Percentage Positives
Male	Port Harcourt	3	107	110	2.7%
Male	Calabar	2	117	119	1.7%
Female	Port Harcourt	3	139	142	2.1%
Female	Calabar	5	115	120	4.1%

A total of 491 students were entered into the study and yielded 13 positives with 8 females out of 254 (3.1%) and 5 males out of 224 (2.2 %).

The South-South geopolitical region of Nigeria is one of the areas with a high sero-prevalence in the country and adolescents in this age group are vulnerable to HIV infection especially through heterosexual relationships which is the commonest route of transmission in Nigeria. They are also the most promising candidates for behaviour change and could be utilized to change the course of the HIV pandemic being that their live-in environments includes adults whose responsible behavior could serve as role models. Thus, more effort should be focused on information, health education and counselling (IEC) as strategies to achieve control of the spread of the virus.

The other big challenge as shown in this study is the need to engage the majority of secondary school students who tested negative to continue to be negative through the effective deployment of IEC tools. Social mobilization including the faith-based and community groups should be brought on board in this crusade.

4.2.1.2.2. Transfusion Transmitted Infections (TTIs) with Hepatitis B and C.

Here, we carried out two studies to determine the prevalence of both Hepatitis B and C in the Niger Delta: Sero-epidemiology of Hepatitis B surface antigenaemia among blood donors in the Niger delta (Nwauche, Ejele and Erhabor, 2005) and seroprevalence of Hepatitis C virus in the Niger delta of Nigeria (Ejele, Nwauche and Erhabor, 2006).

The discovery of the Australia antigen, now known to be the genetic marker of Hepatitis B virus (HBV) infection heralded a new era in blood transfusion practice worldwide, affecting about 350 million globally as chronic carriers of which a significant proportion would die of Liver Cirrhosis and Hepatocellular Carcinoma.

Conversely, Hepatitis C virus (HCV) is the major cause of parenteral (blood-borne) non-A, non-B Hepatitis in the world infecting about 3% or 170 million people.

In our study of the prevalence of hepatitis B among blood donors in the Niger Delta of Nigeria, we recorded a prevalence of 1.1%, the highest contribution being from males (1.2%), while the highest infection burden was among the age bracket of 18-27 years. Commercially remunerated donors had the highest burden (1.2%), followed by family replacement donors with (0.7%).

In the other study on the prevalence of antibodies to Hepatitis C virus among 366 consecutively recruited blood donors, we recorded a value of 3% among the subjects tested. We also noted that the anti-HCV prevalence was higher in the less educated (4.6%) than the highly educated (1.4%) and was found to be almost two times higher among

the unmarried (4.1%) compared to married subjects (2.2%) and the highest age group contribution was from the 30-39 age bracket.
Thus, these data of the 1% prevalence of HBV among blood donors and 3% of anti-HCV among the general population all confirm the need of the compulsory implementation of pre-transfusion screening of all donor units and exclusion of units with surrogate markers for both HCV and anti-HCV. We also advocated for an urgent health education of the Niger Delta area aimed at behavioural change from practices which facilitate the transmission of both HBV and HCV and the immediate take off of the newly established National blood transfusion service run on the basis of low risk voluntary blood donation.

4.2.1.2.3. Transfusion Transmitted Infections (TTIs) with mixed organisms involving HIV, Hepatitis B and C, syphilis and Malaria.
We carried out five studies on TTIs involving mixed infections with HIV, Hepatitis B and C, Syphilis and Malaria.

Here, we undertook three studies to determine the prevalence of HBV , HCV antibodies and malaria antigens among HIV infected individuals in the Niger Delta of Nigeria (Ejele, Nwauche and Erhabor, 2004; Ejele, Erhabor and Nwauche, 2005; and Wariso and Nwauche, 2011).

Both HBV and HBV infections are a global public health problem and a significant cause of both morbidity and mortality in Nigeria and many parts of the world. HIV and HBV share the same epidemiologic mode of transmission: sexual contact (heterosexual and homosexual), intravenous drug use and use of infected blood/blood products and mother-child (transplacental) transmission. In view of the importance of HBV co-infection in patients infected with HIV in Nigeria and the apparent lack of data in the Niger Delta, we carried out this study of the prevalence of HBV among HIV and reported a value of 9.7%.

This finding highlights the need to pay attention to the recognition of potentially severe concurrent illness in these patients that may increase morbidity and mortality of HIV infected patients in the Niger Delta of Nigeria. We also assessed the prevalence of antibodies to HCV in HIV infected patients and reported a figure of 0.9%. It was also instructive

that the highest co-infection rates were among commercial sex workers(3.3%), long distance drivers (2.2%) , and also from individuals from the low socio-economic level with informal education (1.8%).

Malaria and HIV infections are now endemic in Sub-Saharan Africa, presenting with high morbidity and mortality. It has been reported that HIV infection affects the susceptibility to malaria, its clinical course and also impairs antibody responses to malaria antigens. This coinfection has been reported in Nigeria in a study in Jos in which they found a malaria antigen prevalence of 21% (Uneke et al, 2005). In our own study we reported a prevalence of 26.5% of malaria antigens in HIV infected patients in Port Harcourt.

Admittedly, blood transfusion takes place in less than optimum conditions in Nigeria. The combined risk of TTIs in the Niger Delta was demonstrated through two of our publications on the risk of transfusion transmissible viral infections among blood donors in the Niger Delta of Nigeria (Ejele, Erhabor and Nwauche, 2005) and trends in the prevalence of some transfusion transmissible infections among blood donors in Port Harcourt (Ejele, Erhabor and Nwauche, 2004).

The study on the risk of viral TTIs confirms the high prevalence of TTIs among blood donors with the values of 1%, 1.1% and 0.5% for HIV, Hepatitis B surface antigen and anti-HCV while the latter study on the trend of TTIs among blood donors is a five year review of the prevalence of HIV, HBV and syphilis. It documents an average prevalence rate of 1.1%, 1.3% and 0.1% positivity for HIV, HBV and Syphilis respectively and indicates the desirability and benefits of the exclusion of all blood donors. There is also need for the renewed intensification of preventive programmes which emphasize a combination of behavioural and social changes.

4.2.1.2.4. Studies on the Laboratory management of highly active antiretroviral therapy (HAART).

Three baseline studies were carried out in this field to establish reference data that will assist clinicians in making appropriate clinical decisions as regards the management of HIV/AIDS in this locality:

i. CD4 T-cell Lymphocytes and HAART management in the Niger Delta.
ii. Laboratory monitoring of HAART in the Niger Delta.
iii. Adherence to HAART in the Niger Delta.

i. CD4 T-cell Lymphocytes and HAART management in the Niger Delta

CCD4 lymphocytes are a subset of thymocyte-derived lymphocytes expressed in the peripheral blood and lymphoid blood and lymphoid tissues. The relationship between lymphocytes especially the helper CD4 subset and HIV is well established. This essentially entails the invasion of CD4 cells by HIV being that they offer the virus the biological environment enriched by blood with basic metabolic nutrients that it requires to grow, multiply and subsequently destroy the host CD4 cell as the mass of new virions exit from it to infect another CD4 cell.

This phenomenon causes a depletion of the CD4 lymphocyte subpopulation which leads to immune deficiency and increased susceptibility of the body to suffer from recurring infections. This immune deficiency inevitably offers the virus the capacity to invade and breakdown other tissues of the body outside of the blood system, giving rise to the clinical condition referred to as acquired immune deficiency syndrome (AIDS).

It is therefore evident that CD4 cells play a central role in the pathology of HIV/AIDS hence the laboratory medicine physician relies heavily on its status for the management of HIV/AIDS. Accurate and reliable measure of lymphocyte are essential for the assessment of the immune system of HIV-infected persons and can be used as a guide for initiating and monitoring response to treatment using the standard regimen of highly active antiretroviral therapy (HAART).It also enables the clinician to correctly assess disease progression from the HIV – infection status to the establishment of full blown AIDS in an individual.

In this regard, we carried out four studies on the status of CD4 in the laboratory management of HAART:
In the first study, we determined the baseline CD4 reference range of healthy adults in Port Harcourt (Ejele, Nwauche, Erhabor and Babatunde, 2005). We observed a mean CD4 lymphocyte count of 685 ± 99 cells/µl among healthy adults in Port Harcourt. Thus, the reference range obtained in this study confirms that the caucasian values are not really applicable in this environment. The values obtained here may be of value for clinical management of HIV/AIDS, data interpretation and research studies in Nigeria especially in the Niger Delta.

CD4 cell counting requires the establishment of elaborate laboratory infrastructure such as flow cytometry that is not practicable in resource-limited settings such as the Niger Delta. There is also lack of trained manpower and high cost of laboratory monitoring which pose a major problem to the implementation of HIV therapy in this environment. In this second study titled "the correlation between absolute and CD4 lymphocyte counts in HIV- infected Nigerians: can absolute lymphocyte count serve as a surrogate for CD4 cell count in resource limited setting?" (Erhabor, Ejele, Nwauche and Uko, 2005), we investigated the relevance of the use of absolute lymphocyte count as a cost effective alternative to CD4 count in monitoring treatment in HIV-infected persons in resource-poor localities.

Patients were classified at CD4 lymphocyte count thresholds of <200, 200-350 and >350 cells/ µl. The results obtained show that in HIV infected Nigerians, especially in the Niger Delta, there is a modest correlation (r=0.41) between CD4 and absolute counts. This study therefore suggests that there is a correlation between CD4 and absolute lymphocyte counts and that absolute lymphocyte count may be used as an inexpensive, readily available, and minimal alternative to other expensive methods of CD4 enumeration in conjunction with WHO staging and clinical status of patients in assessing prognosis, guiding therapy and monitoring response in resource-limited settings in sub-Sahara African.

Infection with HIV results in progressive generalized-immune suppression due predominantly to the cytopathic effects of HIV on CD4-helper-T-inducer lymphocytes. The mechanism for this pathogenesis of CD4 cell decline are varied, however, it could be attributed to activity of HIV during its asymptomatic phase leading to the compensatory elevation of complimentary CD8 cell subpopulation to maintain a consistent T-cell number. This results in the enrichment of CD8 T-cells but that this compensatory homeostatic effect tends to fail about 2 years in the transitory period from the basic HIV infected status to the onset of full blown AIDS when CD8 T-cells are also lost.

CD4 cell decline has therefore been utilized as a prognostic indicator for progression to AIDS which has been estimated to occur about ten years from the time of HIV infection in adults. Symptoms typically occur when the CD4 cell count has dropped to <300 cells/ µl while the average survival time after AIDS diagnosis in untreated patients is 15 months.

CD4 T-cells decline in untreated HIV positive patients at a rate of 25-60 cells/ / µl per year. The available data on the rate of decline of CD4 cells in HIV-positive subjects are mainly from Europe and America and may not adequately reflect the African or Nigerian picture.

Furthermore, there is scarcity of data in this crucial field of HIV therapy hence our decision to evaluate the decline of CD4 T-cells in this environment (Erhabor, Ejele, Nwauche and Buseri, 2005). In our study, we observed that CD4 T-helper lymphocyte cells in HIV-positive untreated subjects decline at a mean rate of 12 cells/ µl per 8 weeks or at a mean rate of 72 cells/ µl per year and that there is disease progression in untreated HIV/ AIDS Africans.

The well-established data on the decline of CD4 cells and disease progression invariably highlights the dilemma of the optimum time to commence HAART particularly in view of its high cost, inaccessibility to all who need and also that it is unable to effectively eradicate HIV infection with currently available antiretroviral regimens. This is due to the establishment of a pool of latently infected CD4 cells during the

earlier stages of acute HIV infection. There is also the associated adverse effects of lactic acidosis and pancreatitis.

However, the potential benefits of early combination antiretroviral therapy are that it produces early suppression of viral replication, reduces the risk of opportunistic infection, preservation of immune functions and prolongation of disease-free survival. Previous studies indicate that virologic and immunologic responses and survival time are relatively higher in patients starting HAART at a CD4 count compared to starting therapy at a low CD4 count of <200.

In our study (Ejele, Erhabor and Nwauche, 2005) we compared the CD4 T-cell response in individuals starting HAART at different baseline CD4 count and determining whether there was any immunological advantage in staring HAART at a higher CD4 count of >350 cells / µl rather than at a count of 200-350 cells/ µl or <200 cells / µl.

Our study suggests that significant immunological response occurs in HIV-positive individual initiating HAART at baseline CD4 count of <200 and that there is no short-term immunological advantage in starting HAART at a baseline CD4 count of >350 cells/µl rather than 200-350 or <200 cells /µl. This observation is another evidence of the usefulness of CD4 count as a measure of disease progression and prognostic marker in the determination of the optimal time to initiate HAART in this environment.

ii. Laboratory monitoring of HAART in the Niger Delta

The natural history in addition to the cytopathic effects of HIV all imply derangements and abnormalities of the cellular tissues of the body particularly the components of the immune/reticular endothelial system which act as the first line defense of the body.

This scenario is compounded further when the adverse effects of HAART are considered especially in the light of their suppression of the bone marrow, cytopathic effects on the liver and the other vital organs of the body. Haematological abnormalities are among the common manifestations of HIV infection and AIDS and this is usually

dominated by the cytopenias. This observation prompted us to carry four studies to investigate the profile of some laboratory parameters in relation to HIV infection. The determination of some haematological parameters in HIV infection was the focus of our first study under this category (Erhabor, Ejele, Nwauche and Buseri, 2005).

In this study we observed a high prevalence of anaemia (80%), leucopenia and thrombocytopenia (10%) neutropenia (24%) and it indicates the need for routine haematological assessment of HIV infected individuals by physicians caring for HIV/AIDS patients. This will ensure that rational decisions relating to haematological complications are made based on regularly updated laboratory indices as regards routine monitoring of patients before and after initiation of HAART, and also in relation to morbidity and mortality of patients in this locality.

In subsequent follow-up study, we evaluated the cytopathic effects of HIV on hepatic tissues (Ejilemele, Nwauche and Ejele, 2007). These cytopathic effects manifest as abnormalities of liver function tests which are common and may be due to direct inflammation induced by the HIV virus on the liver cell. It may also be due to the gall bladder diseases and infection of with bacterial, viral or other opportunistic infections. However, there is paucity of information regarding the pattern of liver diseases in HIV patients.

Our observations in this study was that abnormalities of the liver function tests were high (87.6%) of which (85.5%) were hepatocellular injury while (14.5%) were cholestatic liver injury. The last two studies of this section under consideration deals with the evaluation of effects of HAART on the haematological and immunological profile of HIV-infected individuals in this environment (Ejele, Erhabor and Nwauche, 2005; Erhabor, Ejele and Nwauche, 2006).

The haematological effects of HIV infection is commonly dominated by cytopenias especially anaemia (80%), and also of thrombocytopenia and neutropenia. The major reason for this finding is due to bone marrow suppression and the direct cytopathic effects of the virus. However,

these abnormalities are further worsened by the toxicities caused by the drugs that make up the HAART regimen e.g. Zidovudine causes anaemia and neutropenia due to severe myelosuppression while Didanosine and other nucleoside analogues do not cause anaemia; but have the opposite effect of increased haemoglobin hence its use in patients not tolerant of zidovudine. Furthermore, Lamivudine is associated with neutropenia and macrocytosis.

On the other hand, the initiation of antiretroviral therapy with three drugs consisting of two nucleoside reverse transcriptase (Zidovudine and didanosine) and one non-nucleoside reverse transcriptase (Nevirapine or Efavirenz) or a protease inhibitor(Saquinavir) in the HAART regimen have been shown to: profoundly and durably inhibit HIV production, extend overall long term effectiveness, help in the preservation of overall long-term effect and provide a salvage therapy option should initial treatment fail, without the rapid development of drug resistance.

These drugs have resulted in slow progression from HIV to full-blown AIDS being that HAART almost invariably reduces plasma viraemia and a rapid increase in blood CD4 lymphocyte count in a majority of patients. This rapid increase in CD4 lymphocyte cells is because the cells are initially redistributed from lymphoid tissue followed by a later continuous slow repopulation with newly produced naïve cells by thymopoiesis.

Thus, with the onset of HAART therapy especially the federal Government-initiated pilot ART scheme in about 100 sites all over Nigeria, we deemed it beneficial to study both the haematological and immunological complications associated with HIV/AIDS and the HAART regimen. This was done in order to ensure that mortality and morbidity are minimized, and that the quality of life and medical cost were optimized. The haematological abnormalities seen were the statistically significant therapy dependent increase in the haemoglobin, platelet and a decrease in ESR from their abnormal baseline values. These results clearly demonstrate that HAART may improve the observed cytopenias in HIV infected Nigerians.

Conversely, there was a statistically significant variation in the therapy dependent increases in CD4 count of HAART treated subjects based on pre-therapeutic baseline CD4 count. The study therefore indicates the importance of evaluating the CD4 lymphocyte count of HIV infected patients before the initiation of HAART, its use as a prognostic marker in predicting the initial response to HAART and in determining the optimal time to initiate therapy.

iii. Adherence to HAART regimen in the Niger Delta

In the light of the foregoing, we see that the advent of antiretroviral therapy has brought about a significant change in the perception of HIV/AIDS from an incurable disease to a more manageable chronic illness. The benefits of this treatment specifically includes the improvement in immunologic status and a reduction in the viral load which invariably results in the incidence of hospitalization and mortality. Treatment effectiveness however, requires a high level of adherence to medication regimen since missing even of a few doses of antiretroviral medication can lead to drug resistant strains of HIV.

Hence, low adherence has been associated with detectable viral load >500 viral RNA copies / ml of plasma and with cross-resistance to other anti-retrovirals of the same class. Adherence is defined to have occurred when an individual patient takes >95% of the prescribed doses of a medication. Cross-resistance can arise due to non-adherence and can potentially interfere with future therapeutic regimens for HIV-infected patients undergoing treatment, and also for those who subsequently become infected with resistant strains of HIV. It has been shown that a sizeable proportion of patients do not attain high levels of adherence even in this locality hence the aim of this study was to determine the level of adherence and to evaluate the factors responsible for non-adherence to antiretroviral therapy among HIV-infected Nigerians (Nwauche et al, 2006)

Table 4: Baseline characteristics of respondents to HAART adherence study

Characteristics	Adherent Respondents n (%)	Non-adherent Respondents n (%)	p-values
Age			
Median (range)	35.04±8.06	34.21±7.64	0.32
Income			
Median (range)	29.740±8.93	7.624±5.81	0.001
Sex			
Males	24(26.1)	58(61.1)	0.001
Females	66(73.9)	37(38.9)	
Adherence based on treatment groups			
Hospital Initiative	22(33.3)	44(66.7)	0.001
Federal government	66(55.5)		

Table 5: Reasons for Non-adherence to HAART therapy

Table for non-adherence	n	%	p-value
Non-availability	18	19	0.001
Cost Constraint	53	55.8	
Medication Side Effect	17	17.9	
Doctors strike	3	3.2	
Pregnancy	1	1.1	
Job related	3	3.2	

Table 6: Adherence to therapy based on marital status, educational status and occupation

Variable	N (%)	N (%)	p-value
Marital Status			
Single	47(51.1)	38(40.0)	0.004
Married	35(38.0)	40(42.1)	
Divorced	4(4.3)	7(7.4)	
Widowed	6(6.5)	10(10.5)	
Educational Status			
Non formal	21(22.8)	30(31.6)	0.005
Primary	19(20.7)	27(28.4)	
Secondary	27(29.3)	20(21.1)	

Tertiary	25(27.2)	18(18.9)	
Occupational Groups			
Business	5(5.4)	10(10.5)	0.001
Health care worker	1(1.1)	1(1.1)	
Clergy	1(1.1)	2(2.1)	
Applicants	19(20.7)	30(31.6)	
Armed forces	4(4.3)	4(4.2)	
Artisan	22(23.9)	14(14.7)	
Civil Servant	17(18.5)	12(12.6)	
Farmer	1(1.1)	5(5.3)	
House wife	6(6.5)	6(6.3)	
Students	16(17.4)	11(11.5)	

This study observed an adherence level of 49.2% and identified the following as factors associated with non-adherence: cost of anti-retrovirals, education status, medication adverse effect, occupational factors, and high pill burden of prescribed regimen ($p<0.05$). Efforts should be made to institute supervised medication delivery and the simplification of therapeutic regimen to reduce the pill burden and substitution with treatment combination and strategies that minimize negative adverse effects, coupled with the re-intensification of patient's education and counselling.

4.2.1.2.5. HIV/AIDS, Reproductive Health and Sexual Orientation in the Niger Delta Area of Nigeria

The HIV/AIDS pandemic has been a major public health challenge globally especially in the sub-Saharan region of Africa including the Niger Delta area of Nigeria which necessitated a major research attention from us over the years.

Studies on the reproductive health and sexual orientation of the population of the Niger Delta of Nigeria.

Studies on the socio-cultural perspectives of the reproductive health and sexual orientation of individuals, couples and families were also the focus of our research attention and included the following publications in the under-listed categories:

4.2.1.2.5.1 Impact of HIV/AIDS on family life

The transmission of HIV infection requires very intimate contact between individuals either in a consenting or non-consenting relationship, and implies in many circumstances contact between mucous membranes and the exchange of body fluids that facilitate the transmission of the virus from carrier to victim. The transmission of HIV from men to their female partners is more likely and efficient than from women to men while there exists a correlation between increased concentrations of HIV in blood and enhanced transmission by all routes.

Furthermore, the concentration of HIV in genital tract secretions from males and females is increased at times when enhanced transmission is suspected such as in primary infection or in the later stages of the disease, while HIV discordant couples could be correlated directly with the blood plasma HIV RNA levels in infected subject. When the blood plasma viral load was less than 3,500 viral load copies/ml, the transmission probability was 0.0001(one per 10,000 episodes of sexual activity. It has also been established that not every episode of sexual activity has an equal risk of HIV transmission. Some exposed uninfected women do have the advantage of hereditary resistance perhaps suggesting the contribution of innate or acquired host defenses against infection. An association between increased concentration of vaginal immunoglobulin-A directed against HIV envelope and reduced risk of HIV infection have also been demonstrated.

There is paucity of data in Nigeria on the several factors that are associated with heterosexual transmission of HIV such as viral subtype, host immunity, length of exposure, frequency of transmission, coital and behavioural risk to heterosexual transmission of HIV. The family relationship therefore is a veritable hallowed social institution which has become embroiled in the HIV/AIDS pandemic which prompted the attention of our research efforts in two studies (Akani, Erhabor, Opurum, Ejele, Nwauche, 2005; Omunakwe, Okoye, Efobi, Onodingene, Chinenye, Nwauche, 2014).

The first study is titled *"HIV sero-discordance among Nigerian couples: challenges and controversies"*. In this study therefore, our aim

it was to determine the prevalence of HIV sero-discordance and the associated predisposing factors.

The following tables demonstrate the results obtained in this study:

Table 7: Prevalence of HIV sero-discordance based on age, viral subtype and HBs Ag status.

Age Group (Years)	Infected N=52	Couples %	Uninfected N=52	Couples %
21-30	22	42.3	14	26.9
31-40	16	30.8	34	65.4
41-50	14	26.9	4	7.7
Viral Subtype				
HIV 1	46	88.5	-	-
HIV 2	4	7.7	-	-
HIV 1&2	2	3.9	-	-
HBsAg status				
HBsAg positive	3	5.8%	-	-

Table 8: Prevalence of HIV sero-discordance based on likely predisposing factors.

Predisposing Factors	Infected N=52	%	Uninfected N=52	%
Extramarital	40	76.9	22	42.3
Alcoholism	38	73.1	22	42.3
Surgery	4	7.7	4	7.7
Transfusion	6	11.5	6	11.5

Table 9: Prevalence of HIV sero-discordance based on duration of marriage

Duration of marriage (years)	Infected N=52	%	Uninfected N=52	%
5 years	28	53.9	28	53.9
5-10 years	20	38.7	20	38.7
11-15 years	2	3.9	2	3.9
16-20 years	2	3.9	2	3.9

Table 10: Prevalence of HIV sero-discordance based on occupational groups

Occupation	HIV infected in sero-discordance N=52	%	HIV uninfected in sero-discordance N=52	%
Artisans	2	3.9	4	7.7
Bankers	2	3.9	-	-
Businessmen	6	11.5	8	15.4
Civil Servants	8	15.4	10	19.2
Computer Analysts	-	-	2	3.9
Youth Corpers	2	3.9	-	-
Drivers	2	3.9	2	3.9
Farmers	-	-	2	3.9
House Wives	20	38.5	14	26.9
Nurses	2	3.9	-	-
Oil Workers	2	3.9	4	7.7
Seamstress	2	3.9	-	-
Traders	2	7.7	6	11.5

These results obtained from the 100 couples tested for HIV seropositivity, 52% were discordant while 48% were cordant. HIV-1 was the predominant viral subtype among those infected in HIV sero-discordant relationship (84.6%) compared to (7.1%) for HIV-2 and (3.9%) for dual HIV-1 and 2 infection. Furthermore, among the subset of those with HIV sero-discordance, (5.8%) also had Hepatitis B surface antigenaemia. The peak HIV prevalence occurred in the 21-30 years age group.

History of extramarital affairs, alcoholism, viral subtype, age range and duration of marriage were seen as independent behavioural and sexual risk factors for HIV infection among spouses that were HIV-infected in sero-discordant relationships. The highest incidence of HIV sero-discordance occurred among couples <5 years old in marriage. Females accounted for the highest infection burden (61.5%) compared to males (38.5%) among those HIV-infected in sero-discordant relationships while the highest incidence of HIV infection among sero-discordant couples occurred among housewives. These data call for risk reduction

behavior, empowerment of vulnerable groups, effective life planning skills, as well as behavioural change among couples, in addition to efforts to ensure the early detection of sero-status among couples that will enhance timely antiretroviral therapy and reduction of the spread of HIV.

The subject of our second study in this section was on the disclosure of HIV status to partners. The fact of the continued transmission of HIV infection still remains an important health concern in sub-Saharan Africa; despite concerted effort by governmental and non-governmental organizations to control the transmission of the disease, and to improve the quality of life of those already infected. Hence, the attempt to focus on newer strategies in order to achieve greater control outcomes of this pandemic. Voluntary counselling and testing for HIV affords individuals the opportunity to get correct information about the disease, modalities of care and where to go to obtain care.

It also provides information for the non-infected individuals on how to stay negative and prevent exposure to HIV. In this regard, Sexual partner notification (PN) is an important public health strategy for the control of sexually transmitted diseases (STI). Disclosure amongst HIV patients and their partners serves many goals; first it may motivate the sexual partner to seek testing, change in behaviour and ultimately reduce the transmission of HIV. It also affords the individual the opportunity for social support, improved and prompt access to care, increased opportunity to discuss and implement HIV risk reduction and more opportunities to plan for the future with the informed partner. Despite the benefits of disclosure, this strategy has not been effectively utilized in some settings because of the concerns regarding privacy protection, social harm and apparent lack of community and political support.

As a result, there have been significant reports of domestic violence and abuse amongst women that disclosed their HIV-positive status to their partners. The most common barriers to status disclosure have been fear of loss of economic support, rejection and discrimination, fear of domestic violence, fear of accusation of infidelity and disappointment

and upset by family members. These notwithstanding some studies have shown that PN can be effective in sub-Saharan Africa, and it is a useful tool for rapidly and efficiently expanding the HIV treatment and prevention effort in many communities.

This study therefore aims to evaluate the disclosure behaviours of adult HIV-positive patients receiving HAART in this University of Port Harcourt Teaching Hospital, Rivers State, Nigeria, identify major challenges in the status disclosure process with a bid to develop or adopt new interventions to improve this practice in our own environment.

In our study, the reasons for non-disclosure were fear of discrimination, shame and marital insecurity. In this study, it took the clients a mean duration of 4.75±12.8 SD months to disclose their status to anyone. Disclosure was mostly to spouses (in married couples), family members (parents and siblings) and friends. Some, 21 (8.4%), disclosed to their other sexual partners, family members and not to their spouses. This may be due to the concern that if their spouses were aware of their HIV status, they may become violent, physically abusive and may disrupt the family relationship. We also found that 14.4% had not disclosed their status. This would be a major cause for transmission of the virus amongst sero-discordant couples and a major cause of resistance to HAART for those who have commenced treatment. As seen in this study, more than half of those who have not disclosed their status do not use condom during sexual intercourse; this is also a risk for HIV transmission and resistance to HAART, for the person on therapy.

Prevention of transmission of HIV in sero-discordant partnerships is an important HIV prevention strategy. In our study, 71 (28.4%) of the respondents were sero-discordant while majority of the people who reported discordance were females 27 (75%).

There is need, from this study, to adopt more proactive measures towards initiation of disclosure. It can be introduced during the pre-test counselling, after diagnosis and returning to the issue on a regular basis during follow-up counselling. There is also the need to train more health

workers on the process of PN, especially in regions with high prevalence of the HIV and a low disclosure rate as seen in this study.

4.2.1.2.5.2. Reproductive health and sexual orientation

The current pandemic of HIV/AIDS is known to be driven by several predisposing factors which include illiteracy, poverty, gender inequality, ignorance and high risk behavior patterns. These high risk lifestyle and behavioural pattern include homosexuality and poor uptake of condom usage in sexual activity. There is a paucity of data regarding HIV transmission in the Niger Delta especially among the migrant work force. In view of this lack of data in this area of the reproductive health and sexual orientation of the residents of the Niger Delta, we embarked upon relevant research and four of these are discussed as follows:

i. Homosexuality in the Niger Delta (Nwauche and Akani, 2006).

One of the high risk behaviour patterns that have been reported to fuel the HIV/AIDS pandemic is homosexuality which is not a common feature in Nigeria where the major mode of transmission is through the heterosexual route. The homosexual sexual orientation describes the sexual orientation of men who have sex with men of which there have been a flurry of report in the recent past to throw up supporting evidence to demonstrate its biologic/genetic basis (McCuen, 1994). The practice of homosexuality itself is a deviant sexual behaviour in the African culture and in the Christian faith.

One of the major catastrophes of the HIV/AIDS scourge is its impact on the industrial workforce, economy and the social fabric of the society especially in the Niger Delta of Nigeria which is the hub of the oil and gas industry in Nigeria. In this regard, there has been a continued influx of both skilled and unskilled migrant workforce (indigenous and expatriate) into this region. In view of the obvious impact of these critical socio-economic factors on the dynamics of HIV/AIDS, we deemed it necessary to evaluate the existence of homosexual behavior amongst the migrant work force of the oil industry, since they are an important subgroup who are economically empowered and play an important role in sexual networking which ultimately leads to explosion of HIV/AIDS in the society.

The following tables profile the prevalence of homosexuality in this environment and their behavioral patterns:

Table 11: Profile of Homosexual migrant oil workers

		No.	%
Marital status			
Married		17	100
Single		0	0
Age	<45 Years	10	58.82
	>45 Years	7	41.18%

Table 12: Regularity of Condom Use amongst Homosexual migrant oil workers

Condom Use		Not Used regularly	%	Used regularly	%
Not Convenient	5	4	80	1	20
Convenient	12	9	75	3	25

Table 13: Attitude of Homosexuals to Multiple Sexual Partnerships

Age Group	Homosexuality	Multiple Sexual Partnership (MSP)	(MSP)
		Yes	No
<45 years	10 (58.82%)	4 (57.14%)	5 (50.0%)
>45 years	7 (41.18%)	3 (42.86%)	5 (50.0%)
Total	17 (100%)	7 (41.18%)	10 (58.82%)

Table 14: Attitude of Homosexuals to Condom Use

	Yes	%	No	%
Convenient (n=17)	12	70.59	5	29.40
Convenient (n=17)	10	58.82	7	44.18

In this study, we reported the prevalence of homosexuality in this environment to be 5.14% while we did not record any case of lesbianism. The fact that all the homosexuals were married not only indicates that we did not identify any "*stand alone*" homosexual

behavior in our cohorts but that the practice of "*closet homosexuality"* by all of them is a form of bisexuality. There was 70.6% usage of condoms in sexual activities among the homosexuals but 29.4% did not use condoms; while all the subjects who practiced homosexuality were below the age of 45 years.

Again, our data also suggested that those who engaged in homosexual activities showed an increased tendency (41.18%) to also indulge in other high risk activities such as multiplicity of sexual partners.

The behavioural analysis of this cohort reveals that majority found condom use to be convenient, used it regularly and are also engaged in multiple sex partnerships. Thus, there is need to adopt strategies towards behavior change that will be incorporated into programmes aimed at increasing personal risk perception of HIV infection participation, particularly targeting high risk groups such as homosexuals.

ii. Assessment of high risk sexual behavior and HIV transmission among migrant oil workers in the Niger Delta of Nigeria (Nwauche and Akani, 2006).

Ever since the onset of the HIV/AIDS pandemic a few decades ago and its initial report among homosexuals in the United states of America, a lot of interest has been directed at the impact of sexuality, sexual orientation, sexually related attitudes and behaviours, and reproductive health in the spread of HIV/AIDS. In this regard, the massive hetero-sexual predominance in the spread of HIV/AIDS in this environment (80%) is mainly attributed to the migrant work force which includes long distance commercial drivers and commercial sex workers.

In our study, we have now determined to specifically evaluate the migrant work force of the oil and gas industry of the Niger Delta of which there is a paucity of data as to the status of its sexual orientation and high risk sexual life style. The prevalence of high risk sexual behaviour (HRSB) amongst the migrant oil workers was found to be 7.7% while low risk life style was 92.3%. The distribution of high risk life style among our cohort shows that bisexuality (closet

homosexuality) was the commonest with 43.5% followed by HRSB while the least common was multiplicity of sexual partners with 26.1%, and were mostly those who were above 45 years. This study therefore confirms the profile of HRSB amongst the oil workers in the Niger Delta who will benefit from the requisite interventionist and prevention programmes to control the spread of HIV/AIDS in this environment.

ii. Condom use amongst oil industry workers (Ugboma and Nwauche, 2007).

We also carried out a follow up study to specifically ascertain the level of awareness of the use of condoms and commitment to prevention of sexually transmitted infections amongst the migrant oil/gas industry workforce being that the spread of sexually transmitted infections in this cohort is still active.

Condom use was commonest amongst the 35-44 years bracket (41.2%) and extra marital relationships was the highest reason for condom use (26.1%). Most of the responders accessed their condoms from the chemist shops (64.2%). Condom accident was noted to have occurred in 49.7% of the respondents, of which the type of accident that was commonest was rupture/bursting (85.4%). Though the level of condom use is high, user failure is very evident thereby exposing the individuals to sexually transmitted infections including HIV.

iv. Gender differences in students' knowledge of HIV/AIDS in Niger Delta of Nigeria (Ugboma, Koofreh and Nwauche, 2010).

In this fourth study, we evaluated the impact of the critical mass of Information, education and communication tools and strategies that have been deployed over the recent past to elicit the desired behavior change among youths who have been identified as one of the most vulnerable groups at risk of contracting HIV infection. It is therefore expected that knowledge and prevention of HIV/AIDS in schools should be very high. It has been observed that youths in sub-Saharan Africa constitute 35% of all HIV/AIDS cases and that adolescents are at a high risk of contracting HIV/AIDS because of socio-cultural pressures, physical development, behavioural factors including early initiation into sexual activity. This rate was exacerbated by short term

relationships, frequent partner changes, multiple partners, low rate of condom use and negative attitudes. The main objective of this study was to assess how much this large pool of information on HIV/AIDS has affected the lives of these youths in terms of how they understand and appreciate the HIV/AIDS scourge, and if it has changed their sexual attitude and behaviour or not.

Table 15: Knowledge of HIV/AIDS Problems

Knowledge on HIV/AIDS	Females	Males	Total
YES	596(80.5%)	800(79.4%)	1.396(79.9%)
NO	144(19.5%)	208(20.6%)	352(20.1%)
Total	740(100%)	1008(100%)	1.748(100%)

Table 16: Impact of knowledge of HIV/AIDS

Impacted on sexual behavior	Female	Male	Total
YES	267(15.27%)	444(25.40%)	711(40.67%)
NO	341(19.51%)	440(25.17%)	781(44.68%)
NO COMMENT	132(7.55%)	124(7.10%)	256(14.65%)
Total	740(42.33%)	1,008(57.67%)	1,748(100%)

The participant's general knowledge on HIV/AIDS was high (79.9%). Less than 15% acknowledge its presence in semen and vaginal secretions although a greater 74% believe HIV/AIDS is transmitted through sex. Condom use is low (15.7% females and 33.3% males). More girls (56.4%) prefer to abstain from sex until marriage than boys (34.9%) while only 38% agreed to voluntary HIV testing. These results clearly indicate that the youths should be targeted with youth-friendly programmes that will impact on their perception regarding the benefits of adopting low risk lifestyles.

4.2.1.2.6. Epidemiology and management of occupational exposure to blood borne viral infections in the Niger Delta.

Blood pathogens acquired through occupational exposure are a major professional hazard among health workers. Over 20 pathogens have been transmitted to health care workers via needle stick injury. Health care workers particularly in the developing countries are at a serious risk of infection from blood-borne pathogens and the increased risk of occupational injuries. Unsafe practices like careless handling of

contaminated needles, unnecessary injections on demand, re-use of inadequately sterilized needles and improper disposal of hazardous waste can potentially increase the risk of occupational exposure to blood-borne pathogens.

The risk of infection varies with the type of exposure, the prevalence of the infection in the specific population and the availability of post-exposure prophylaxis. Although the post exposure use of zidovudine by HCWs appears to reduce the risk of HIV transmission by 79%, there have been reports of post-exposure treatment failure. Adherence to the standard precaution and adequate documentation of occupational exposure are sub-optimal and the knowledge about post exposure prophylaxis among health care workers is poor.

Thus, we carried out a study to determine the epidemiology of occupational exposure to HIV, HBV and HCV infection in HCWs in a tertiary health facility in a resource limited setting in the Niger Delta of Nigeria (Erhabor, Ejele and Nwauche, 2007):

Table 17: Baseline Characteristics of Exposed Health Care Workers

Baseline Characteristics	Mean	SD	Number Exposed N=13	% Exposed	*2	P-value
Age(years)	34.15	6.8				
Gender: Male			5	38.5	29.96	0.001
Female			8	61.5		
Area of Hospitals affected						
Pediatrics			6	46.2	7.72	0.05
Laboratory			4	30.8		
Surgery			2	15.4		
Obstetrics and Gynecology			1	7.7		
Professional Group						
Physician			3	23.1	13.62	0.001
Laboratory scientist			2	15.4		
Trainee laboratory assistant			1	7.7		
Laboratory technician			1	7.7		
Medical Student			6	46.2		

The most common mechanisms of injury were unexpected patient movement, needle resheating, and withdrawal of needle. The risk of exposure was higher in females (61.5%) than in males (38.5%). All exposed workers were sero-negative to HIV, HbsAg and anti-HCV at exposure. The source patient was known in all cases with evidence of infection being present for HIV (5=38.5%); (1=7.7%) had HBV while none had anti-HCV infection. Only I (7.7%) confirmed case of HBV sero-conversion occurred in a HCW who was not previously vaccinated against HBV but did receive post exposure HBV vaccination.

Post exposure prophylaxis to HIV infection was by HAART and resulted in a 100% protection and shows superiority over monotherapy prophylaxis with zidovudine which indicated a value of 79%. There is need therefore to address the issue of occupational exposure in Africa by providing training on universal, precaution, phlebotomy, modifying procedures that have risk, developing institutional policy for handling of sharps and post-exposure management of health care workers, provision of protective HBV vaccine for all HCWs coupled with the provision of post exposure prophylaxis for exposed HCWs.

4.2.1.3. Study on safe blood services in Rivers State.

Here, we carried out two studies to evaluate the provision of safe blood services in Rivers State:

i. Nwauche C A, Arokoyu SB. The distribution of safe blood facilities in Rivers State (2003).
ii. Ejele OA, Nwauche CA (2004): Determination of paternity disputes in the Niger Delta region of Nigeria.

The first study here was on the provision of safe blood facilities in Rivers State within the context of their spatial location efficiency and accessibility to the target population. The ideal system of achieving sustainable self-sufficiency in the supply of safe blood is through the establishment of a well-organized, efficient and functional National Blood Transfusion service whose duty would entail the standardization and control of the blood banking practices and procedures in the supply of safe blood in the country such as donation, processing, and transfusion of blood and blood products based on the principle of voluntary non-remunerated blood donor system.

An important variable in the provision of safe blood to the majority of citizens is the issue of accessibility resulting from the distribution pattern of safe blood facilities. Generally, facilities or services tend to be attracted to points of population concentration, which may or may not be centrally located within the boundaries of the region. Although, it is difficult to make all facilities lie within the reach of the entire population, it is necessary, however, that as many people as possible have access to few available ones.

It is therefore within this perspective that this study (Nwauche & Arokoyu, 2003) is conceived to examine the distribution of safe blood facilities in Rivers State with the view to determine their locational efficiency and the impact on health care delivery, especially the supply of safe blood.

Table 18: Accessibility to Safe Blood Facilities in Rivers State

S/NO.	L.G.A.	NO. OF HEALTH ESTABLISHMENTS	POPULATION (1991)	L.G.A. FACILITY DENSITY
1	Abua/Odual	3	134,420	44,807
2	Ahoada East	1	90,621	90,621
3	Ahoada West	1	91,193	91,193
4	Akuku-Toru	2	102,169	51,085
5	Andoni	1	177,547	177,547
6	Asari-Toru	1	166,788	166,788
7	Bonny	1	76,124	76,124
8	Degema	1	95,889	95,889
9	Eleme	1	74,631	74,631
10	Emohua	3	154,923	51,641
11	Etche	3	197,561	65,854
12	Gokana	2	159,461	79,731
13	Ikwerre	1	125,385	125,385
14	Khana	2	207,111	103,876
15	Obio/Akpor	1	263,017	263,017
16	Ogba/Egbema/Ndoni	2	190,751	95,376
17	Ogu/Bolo	1	43,673	43,673
18	Okrika	1	157,678	157,678
19	**Omuma***	-	**44,735**	-
20	Opobo/Nkoro	1	51,928	51,928
21	**Oyigbo***	-	**85,318**	-
22	Port Harcourt	8	440,399	55,050
23	**Tai***	-	**56,542**	-
	TOTAL		**3,187,864**	**State Density =86,158**

Note: * represents the LGAs without any safe blood facility.

The essential data generated from this study shows that 3 of the 23 LGAs in Rivers State have no safe blood facility. These are Omuma, Oyigbo and Tai LGAs, meaning that the 186,595 people resident in these LGAs have no access to government safe blood facilities in their areas. Thus, the health needs of these people must be met by the health facilities in the other LGAs or by patronizing private medical outfits whose services may be expensive.

Again, the results show that the mean density of 86,158 persons per government safe blood facility is very high. In 10 LGAs, the facility densities are much higher, ranging from 90, 621 for Ahoada East to 177,547 for Andoni and 263,017 for Obio/Akpor. In recent years, the HIV/AIDS and Hepatitis pandemic have highlighted the risk of TTIs and the need and urgency to develop safe and effective blood transfusion services in the Niger Delta. It is therefore strongly recommended that a well-organized, safe and functional blood transfusion service be urgently established in the state through appropriate legislation and funding; and the provision of more safe blood facilities in the high density Local Government areas Rivers State.

The second study was in Forensic Haematology (paternity disputes resolution) in which we evaluated the services offered to support the resolution of disputed parentage in Rivers state. Proud parentage is social strength in African culture and knowledge of the biological father of a child is of great importance in a patrilineal society like ours. Hence, we observed that there is the need to generate data that would support the provision of forensic haematology services to address the rising demands for the resolution of parental disputes from the Social Welfare Department, Police, Churches and Religious groups, aggrieved families/individuals and communities.

Over time, various methods have been utilized for this purpose including: cultural rules and regulations of the society in question, ABO and Rhesus blood groups, additional blood groups-MNSs, Kidd, Duffy, Kell, Lutheran and Xg. These improved the paternity exclusion rate to 50% while the addition of more sophisticated tests like HLA and DNA

typing raised the exclusion rate to nearly 100%. (98% and 99%). However, these sophisticated tests are not available in most parts of this country including our Centre here in Port Harcourt.

Our experience (Ejele & Nwauche, 2004) in using blood groups (ABO, Rh and sometimes other blood group systems) in addition to haemoglobin genotype is here reported. The total cumulative paternal exclusion rate in our series was 16.7% which is a far cry from the gold standard DNA – based tests. This data emphasizes the inadequacy of the screening tests in our centre and the need to upgrade them to enable the resolution of the medicolegal and social problems encountered by our disputants and the index cases.

4.2.2 Rhesus D protein and Haemolytic Disease of the Newborn (HDN)

In modern blood transfusion practice, the advent of the scientific knowledge of the activity of blood group antigens and antibodies implies the mandatory test of compatibility and prevention of life-threatening complications that arise in clinical settings of mismatch when an antibody in the serum of a recipient of blood transfusion cross-reacts with a corresponding antigen carried on the surface of the Red Blood Cell (RBC) of a donor.

These complications of blood transfusions which might lead to the death of the recipient commonly includes Haemolytic Transfusion Reactions (immediate or delayed HTR) and Haemolyic Disease of the Newborn (HDN) which are important causes of both maternal and fetal morbidity and mortality.

The Rh *D* antigen is still the leading cause of HDN although many other antigens bound to the surface of RBC have been implicated.

My specific contributions to the knowledge of Rh Blood group in Nigeria.

The bulk of my work on blood groups therefore centered on studies of the RH D protein of the RH (Rhesus) blood group system.

4.2.2.1. The basic profile of the Rh D protein

The Rh D protein is the most immunogenic blood group antigen known to man hence RH blood group activities in clinical practice have been arbitrarily classified into the RH ‘’*D*” positive and RH “*D*” negative subgroups; even though it has been shown that the other common Rh phenotypes such as *c, C, E and e* are also important causes of both HDN and HTR**.**

It possesses a very high immunogenic property with the attendant life-threatening HDN and HTR when Rh-negative individuals are sensitized by Rh-positive blood/blood products. It is the most immunogenic antigen of the Rh blood group which is very polymorphic and consists of at least 45 independent groups; ranking as the second most important blood group system after the ABO blood group system.

The Rh D antigen is carried by the Rh protein which is a complex of variant forms of Rh D and RHCE proteins with a glycosylated homolog (RHAG). The Rh proteins are only expressed when RHAG is present on the erythrocyte membrane. These variant forms of the RHD exhibit considerable quantitative and qualitative characteristics which have given rise to different grades of the RhD antigen such as the true RhD antigen, weak D (formerly D^U) and partial D phenotypes.

4.2.2.2. The status of the Rh D antigen in Nigeria.

i. Over the years, there have been several studies in this country particularly in the western part of Nigeria, especially the data from the seminal works of Worlledge et al which have indicated a uniform pattern of a very high prevalence of the Rh D antigen as 90.5-100% while Rh D negative status was 0-9.5%.
ii. The converse is the case in which very high Rh D Negative figures have been reported in the UK 20% and Basque 17%.
iii. The review of the data of other published reports in Nigeria showed that the prevalence of Rh D antigen was between 90.5-92.74% while that of Rh D negative was 7.26-9.5%.

The import of the above data include the following:

i. A very high prevalence of Rh D positive profile in all ethnic groups studied in Nigeria such as the Ibos, Yorubas, Efiks, Ibibios, etc.
ii. The low Rh D negative figures in all the ethnic groups studied.
iii. The increased risk of iso-immunization of Rh D negative mothers on account of the very high Rh D positivity in this environment i.e. the risk of their being sensitized by the paternally derived antigens in the fetus they are carrying in their womb.
iv. The necessity for the proper management of Rh negativity in Nigeria.

4.2.2.3. The Haemolytic Disease of the Newborn

Based on the foregoing data confirming the uniformly low Rh D negative picture across Nigeria coupled with the demonstrated increased risk of Rh iso-immunization among Rh D negative mothers, we decided to investigate this phenomenon for the following reasons:

a. The very low Rh D negative status coupled with the concomitant high levels of Rh D positive status that was demonstrated in the previous studies necessitated a specific evaluation of the status of Rh D negative females of reproductive age in the Niger Delta. This is due to the fact that they were the age group that were most at risk of developing the Haemolytic disease of the Newborn in which the exposure of the maternal circulation to that of her foetus triggers the production of antibodies against the paternal antigens in the fetus. These antibodies subsequently mount immune response against the Rh D positive fetus in the subsequent pregnancies, and this may result in the intra- uterine haemoysis of the RBCs, Jaundice, intra uterine growth retardation and premature fetal death.
b. In blood transfusion practice, D^U individuals (who are actually weakly positive for the RH D antigen) are commonly mistyped as Rh D negative through the use of polyclonal antibodies with grave consequences such as transfusion reactions for both male and female recipients and Rh iso-immunisation.
c. The need to establish a firm platform for the management of the True Rh D Negative individuals in this environment:

i. The identification of the TRUE Rh D Negative individuals.

ii. This correct determination of TRUE Rh D negatives is crucial as it would prevent them from being mistakenly transfused with Rh D positive blood in which case they would become iso-immunized with Rh D antigens with the consequent grave complication of haemolytic transfusion reactions.
iii. They would RIGHTLY be administered with the highly expensive recommended dose of the prophylactic (preventive) Rh immunoglobulin which is meant to suppress the production of antibodies against the RH D antigen in the event of any possible sensitization they may have experienced.
iv. The scarcity of Rh D Negative blood/blood products entails the need for their judicious use in ONLY administering them to those who are truly RH D negative.
v. To save cost and personnel.

The report of these investigations are as follows:

I. Study of the Rh D negative status of females of reproductive age in Port Harcourt (Nwauche and Ejele, 2004): Here, we found prevalence of the RH D negative status to be 9.5% while that for Rh D positive profile was 90.5% This data agrees with other findings by other workers in Nigeria and among people of African descent in Trinidad and Great Britain with figures of 2.5% and 7% respectively. However, this picture of high Rh D positivity and low Rh D negativity is at variance with the general trend in Caucasians where Rh D negativity it is 17 % in Basque and 20-40% in the UK and may be referable to differential racial expressivity arising from both genetic and phenotypic events.

Furthermore, these data show a variegated contribution to the picture of Rh D negativity amongst adult females of reproductive age by the various ethnic groups in the cosmopolitan city of Port Harcourt. Here, the highest contribution was from the Ibos 47 (4.2%), followed by the Ijaws 40(3.61%) while there was none for the Ogonis. This differential finding confirmed the previously reported work of David-West, Abba, 1981 where a report was made of high figures among the Yorubas and low figures for the Efik-Ibibios. This therefore shows that the

prevalence of Rh D negativity not only varies between the different populations of the world but also varies even within somewhat homogenous groups as shown in the pattern exhibited by the various groups within Nigeria which is characterized by low Rh D negative status.

The clinical implication of this finding include:

i. The leading role of anti-D in causing HTR and HDN is emphasized.
ii. The high risk of sensitization of both the transfusion recipient and pregnant mother calls for diligence in blood practice in this environment as regards blood grouping, cross matching and elimination of clerical errors.
iii. The adoption of the practice of running the two-step weak D (D^U) testing method in the management of the Rh D negative pregnant mother in terms of determination of true Rh D negative from those who are typed as false Rh D negative who may be weak D or partial D variants.

II. The prevalence of D^U phenotype amongst Rhesus D negative females in Port Harcourt, Nigeria (Nwauche et a, 2002).

The proper management of the Rh iso-immunized gravida or pregnant woman is essential to prevent fetal morbidity and mortality hence it is crucial then to undertake the premarital and prenatal identification of Rh D negative and Rh D^U women. This dangerous scenario is further highlighted by the by the scarcity of Rh D negative donors, the high cost of the Rh anti-human (immune) globulin(Rhogam), the ill-equipped blood banks of most health institution in Nigeria and the strain that has been put on the National health service by the current HIV/AIDS and Hepatitis pandemic.

Blood grouping in blood transfusion practice is achieved through the use of antisera which may be polyclonal or monoclonal in nature. However, it is common in blood transfusion practice to mistype Rh D^U individuals who are actually weak Rh D reactive as Rh negative through the use of polyclonal antisera. This is because The Rh D antigen is known to exhibit considerable variation in the strength of its immunogenicity due to the mosaic nature of its constituent parts.

Thus, the D^U red cell is said to have fewer D antigen sites per red cell than normal D positive cells, hence they present with weaker-than expected D antigen that may be mistyped as Rh D negative (Nwauche and Ejele, 2005).

These D^U cells vary both quantitatively and qualitatively such that they may make allo-anti D due to the fact that they lack part of the D mosaic, meaning that they carry a partial D antigen and have made antibody to the missing part of the Rh D antigen that they recognize as "*foreign*".

The two-step D^U phenotype testing using the Coomb's reagent therefore is employed to differentiate the TRUE Rh D negatives from D mosaic/weak D antigen individuals of which very little work had been carried out in this country especially in the Niger delta except the classic studies of Worlledge et al in the western part of Nigeria.

In our studies here in Port Harcourt, we reported a D^U prevalence of 0.95% which is consistent with those reported among caucasians in the UK with a prevalence of 0.6% contrary to that reported by David-West AS who noted a high prevalence of 7.5% among the Yorubas of western Nigeria in donors who were Rh D negative in a study involving 13 ethnic groups.

Here, we reported a prevalence of 2.13% among the Ibos who were Rh D negative. It was also instructive that no D^U phenotype was described among the Ijaws in both the Worlledge study and ours while they accounted for the second highest contribution (38.10%) of the Rh D negatives in our study.

Table 19: Prevalence 0f Rhesus D Negative Amongst Adult Females In Port Harcourt

Ethnicity	Rhesus Negative	Rhesus Positive	Total
Ibo	47(4.24%)	363(32.76%)	410(37%)
Ijaw	40(3.6%)	439(39.62%)	479(43.23%)
Ikwerre	4(0.36%)	61(5.51%)	65(5.86%)
Yoruba	7(0.63%)	35(3.16%)	42(3.79%)
Efik-Ibibio	3(0.18%)	66(5.96%)	69(6.22%)
Edo	2(0.27%)	5(0.45%)	7(0.63%)
Ogoni	-	16(1.44%)	16(1.44%)
Hausa	2(0.8%)	18(1.62%)	20(1.80%)
Total	105 (9.5%)	1003(90.5%)	1108(100%)

Table 20: Prevalence 0f D^u Phenotype amongst Rhesus Negative Females

Ethnicity	Rhesus Negative	D Positive	D Negative
Ibo	47(44.76%)	1(0.95%)	46(43.81%)
Yoruba	7(6.67%)	-	7(6.67%)
Ikwerre	4(3.81%)	-	4(3.81%)
Ijaw	40(30.10%)	-	40(30.10%)
Edo	2(1.9%)	-	2(1.90%)
Efik-Ibibio	3(2.86%)	-	3(2.86%)
Hausa	2(1.90%)	-	2(1.90%)
Total	105(100%)	1(0.95%)	104(99.05%)

The results of our studies within the context of previous studies in different parts of Nigeria suggest a variegated distribution of D^U phenotype in the country, being high in the western part and completely absent among the Ijaws and Efik-Ibibios of the Niger Delta. Again, there was no D^U among the Ikwerres who share strong cultural homogeneity with the mainstream Ibos who produced the only D^U recorded in this study. This further depicts the heterogeneity in the prevalence of D^U even among somewhat homogeneous entities, as seen between the Ikwerres and Ibos.

The implication of these findings in relation to the management of Rh negativity in the study environment are significant. Firstly, the results seem to suggest that management of Rh negatives in Nigeria is probably

best carried out on a staggered module in view of the differential distribution of D^U phenotype in the country. Thus, it may be beneficial to re-appraise the current practice of administering anti-human immunoglobulin (Rhogam) to all Rh D negative female without prior D^U testing across the country being that it may be suitable in the western part while it may not be cost effective in the Niger delta of Nigeria.

Secondly, in view of the scarcity of Rh D negative blood for transfusion in areas of high D^U prevalence, it may be desirable to carry out D^U testing on all prospective samples but may not be feasible in the light of the possible high cost to the National Health Service that is currently saddled with other crucial challenges of blood transfusion.

4.3. Sickle Cell disease and blood coagulation disorders: The other areas of my specific contributions were in the studies of sickle cell disease and bleeding disorders.

4.3.1. Sickle cell disease

This disease is another classic demonstration of the essence of blood to human life as is the case here where there occurs a malfunctioning of one of the genes of the essential oxygen and life giving protein called haemoglobin. Thus, this abnormal change in one of the genetic sites leads to the formation of an abnormal haemoglobin called haemoglobin S (HbS) that tends to clump together while forming abnormal shaped RBSCs that are characterized by sharp edges and called "***sickle cells***". The normal haemoglobin A is inherited from each parent to give a two-gene combination otherwise called "***genotype" e. g. Hb* AA.** However, if the abnormal Hb S, is inherited from either parent, the genotype is Hb AS, but is SS if both parents pass on the abnormal Hb S to their offspring. This means that some individuals are "***carriers"*** (Hb AS) while others are fully affected victims (Hb SS) and suffer from sickle cell anaemia (SCA).

This change in this abnormal haemoglobin called haemoglobin S (HbS) generally causes the clumping and sticking together of the RBCs leading to the slowing in the flow of blood. This pooling of blood

subsequently worsens the clumping together of the blood cells which causes the blockade of the blood vessels so that cells and tissues positioned after the block are denied the supply of oxygen and vital nutrients while carbon dioxide and other metabolic wastes pile up in the blood. This pooling and accumulation of waste metabolic substances subsequently leads to several complications including frequent infections, acute painful episodes commonly called "***sickle crisis***" and organ failure-bone marrow, kidney, heart, lungs, brain and spleen; and sometimes death of patients.

Interestingly, several reports have showed a strong link between the endemic malaria infection in this locality and the severity of sickle cell anaemia (SCA) and its effect on vital organs such as the spleen (West O, Ejele OA, Nwauche CA, Fawehinmi HB (2004). Thus, we see that the spleen is one of the most frequently affected organ in SCA in Nigeria.

This prompted us to initiate three studies to evaluate the effects of SCA on the spleen and kidney and to review the current opinion in the management of SCA. Our review of the relevant literature on the subject of splenic changes in sickle cell disease showed that the essential change in SCA is enlarged spleen or "*splenomegaly"* and the subsequent shrinkage in size called "*auto-splenomegaly"*.

These changes were due to several factors such as high levels of irreversibly sickle cells and chronic malaria infection and they predispose the patient to several complications such as increased susceptibility to infections, pooling of blood within the spleen and hypersplenism. In view of the above changes, it is important to ensure regular patient monitoring and follow-up in order to prevent complications, recurrent crisis and death (Okoh, Nwauche and Ejele, 2006).

Our second study in this field was necessitated by the frequency of kidney-related complications especially in Nigerian children. One of the presenting features of this kidney failure is proteinuria or leaking of protein in the form of Albumin into the urine due to the damage and "of

the kidney in SCA. Our study was to evaluate the prevalence of "*microalbuminuria*" in children with SCA in Port Harcourt with the view to determine its suitability to be an early indicator of kidney complications and failure and the prevalence was found to be high(42.7%). Thus, its screening would enable early identification and intrervention of kidney –related complications in children with SCA in the Niger Delta (Yaguo-Ide, Akani and Nwauche, 2011).

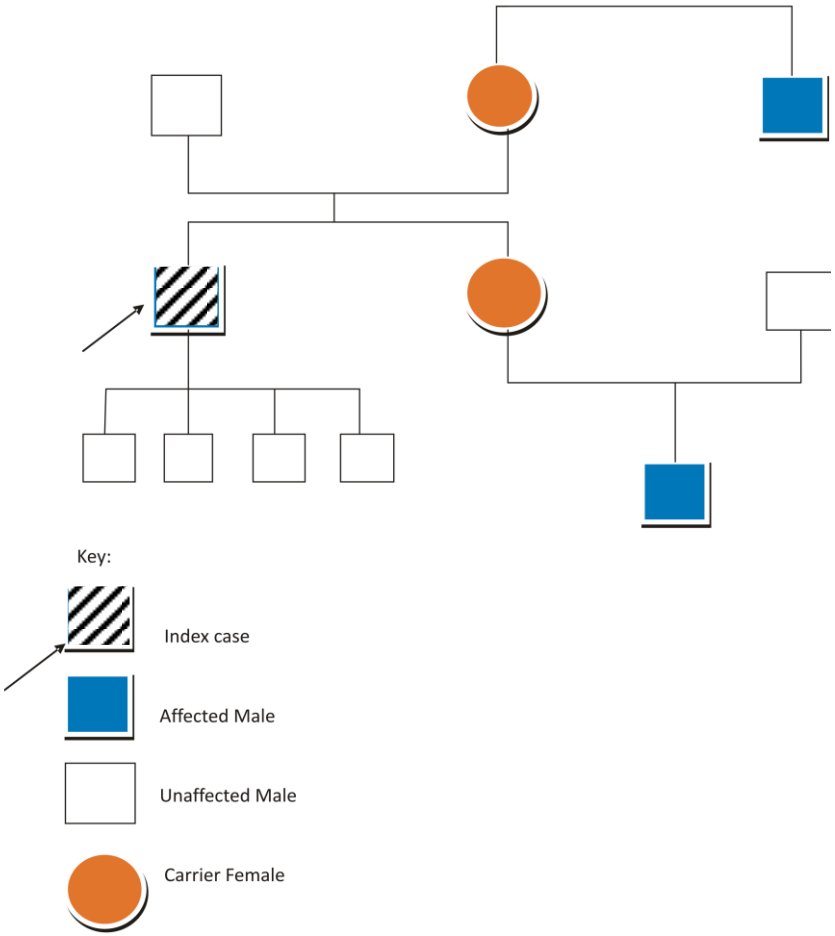
The third study was on the current concepts in the management of SCA (Korubo and Nwauche, 2013) in which we noted the shift in recent times from the old conservative approach that was mostly preventive, supportive and symptomatic; consisting of folate therapy, prophylactic penicillin from birth to about five years of age, vaccination against encapsulated organisms, pain relief, hydration and blood transfusion. Over the past ten to fifteen years, there has been a movement towards the incorporation of newborn screening using high performance lipid chromatography (HPLC), or gene analysis employing polymerase chain reaction methods; transcranial Doppler ultrasound and stroke prevention, iron chelation especially for multiply transfused SCA patients; Haemoglobin F inducers such as hydroxy urea and stem cell transplant.

4.3.2. Bleeding disorders

Bleeding disorders could often be life-threatening and arise due to abnormalities of the blood vessel wall, coagulation proteins or the platelets. We investigated three aspects of bleeding disorders that have not been adequately reported in this environment. They each address three types of bleeding: the first is due to deficiency in coagulation factors, the second is associated with overwhelming infection in a newborn whose coagulation system is still immature while the last is referrable to thrombocytopaenia.

The first study (Ekeke and Nwauche, 2004) was a case report of haemophilia that presented as a massive peno-scrotal haematoma following a minor injury. This was a confirmation that haemophilia is present in this locality which is similar to the experience of Essien, 1973.

Figure 1: Family Pedigree of patient O.I.



The second study was a case report of the occurrence of disseminated intravascular coagulation (DIC) in a neonate in which there is uncontrolled widespread coagulation which eventually consumes the coagulation proteins and the platelets, with a resultant generalized oozing and bleeding from the orifices and openings in the body. Newborns are vulnerable to developing DIC following infections because of the immaturity of their coagulation system. This is because

the inadequacy in both qualitative and quantitative deficiency is often overwhelmed by an extraordinary condition like infections which are commonplace in our environment.

The lessons learnt from the review of this case in this environment is that DIC is life-threatening condition which in a neonate can be both dramatic and rapid. As it is a secondary clinical disorder manifestation the survival of patients will depend on the vigorous treatment of the primary underlying disorders such as infections so as to control the triggers of blood coagulation (vessel wall injury, coagulation proteins and platelet activation) as well as replacement of the consumed coagulation factors. Lack of appropriate diagnostic facility and blood components for replacement therapy are obvious limitations in a deprived medical facility as is commonplace in the Niger Delta (Ugwu, Eneh, Nwauche, 2007).

The third publication was a case report on Amodiaquine induced thrombocytopenia (Nwauche and Ejele, 2004). Bleeding due to reduced platelet thrombocytopaenia) count is an important cause of morbidity and mortality in clinical practice particularly in resource poor regions such as the Niger Delta, where coagulation/blood transfusion services and facilities are still rudimentary. Amodiaquine is an antimalarial that is in common use in this region and it has severe side effects, including neutropenia and agranulocytosis, which a recent report suggested might be due to the direct toxic effect of the drug on the abnormally sensitive myeloid progenitor cells.

In this regard, drug-induced thrombocytopaenia is important and may be either dose-dependent or idiosyncratic in which case the abnormal and sometimes life-threatening bleeding complication may be hardly predictable. This is further highlighted by the prevailing culture of self-medication and fake/ sub-standard drugs in this environment. The patient self-administered Amodiaquine for fever that was uncontrolled by antimalarials, antibiotics and analgesics which was followed by the reduced platelet count. This brings into focus the need to identify the subpopulation of patients who are at risk of developing abnormal or

exaggerated reaction to drugs, particularly within the context of self-medication which is rampant and widespread in the Niger Delta.

5. Future: Blood groups and Malaria

The impact of malaria on the public health of resource-limited economies of the world is still a major problem particularly in Africa where 89% of all malarial deaths occur. It affects more than 100 countries (nearly 10% of the world's population) while there are 300-400 million cases per year, with 2-3 million deaths every year.

Malaria is caused by Plasmodium spp (P. falciparum P. vivax P. malariae, P. ovale.),but falciparum is more prevalent and virulent. It is transmitted by Anopheles mosquitoes. Naturally acquired immunity is usually incomplete, slow to develop and strain specific. There is low antibody (IgG and IgM) response in children less than 14years, and only 22% of children in these areas have detectable antibodies compared to 84% of adults. IgE levels are elevated in severe and cerebral malaria. Even in adults, the degree of response is incomplete, and most people have life-long low level plasmodium infections.

Pathogenesis

The pathogenesis of Plasmodium infection entails merozoite invasion of erythrocytes, which implies an implicit interaction between the red cell membrane proteins and the invading plasmodium antigens. Malaria parasites spend a good part of their life cycle invading and growing within red blood cells (RBCs).

These parasites have specific receptor–ligand interactions to facilitate RBC binding, some of which involve blood group antigens. A number of epidemiological studies are being done to investigate the effects of blood group polymorphisms and null phenotypes on malaria especially identifying molecules and pathways that are implicated in severe and life threatening malaria**.**

In this regard, Plasmodium falciparum erythrocyte membraneprotein-1 (PfEMP-1) is a variable antigen expressed by *P. falciparum*. It is present on the surface of infected host erythrocytes and mediates

erythrocyte binding to vascular endothelium which enables the parasite to avoid splenic clearance. Furthermore, merozoites express merozoite surface proteins or antigens (MSA or MSP) which helps in the invasion of RBCs.

Blood groups

Blood group antigens serve as genetic markers of several clinical conditions including malaria; the clearest example being the well elucidated inter-relationship between Plasmodium vivax and the Duffy antigen. Thus, the products of research on blood groups and malaria may have a potential impact on the development of new anti-malarial chemotherapy, vaccines and reduction of the global burden of malaria.

ABO Blood group

The association between ABO blood group and malaria have both been studied and researched for a long time. Preliminary evidence suggest increased susceptibilty to life-threatening malaria in blood group A persons and resistance in blood group O, even though there is a higher prevalence of malaria among them.

However in much recent studies, it has `been confirmed that O blood group confers "*resistance*" while rosetting is implicated in the pathogenesis of severe malaria. Rosettes are formed by the binding of P. falciparum-infected RBCs to uninfected RBCs. This forms clusters of cells which obstruct blood flow in small blood vessels (Rowe, Opi , Williams, 2009).

In this regard, several works have shown that larger, stronger rosettes are formed in non-O blood groups (A, B or AB) than in group O RBCs. Again, infected RBCs that form rosettes are significantly lower in clinical isolates from O blood group patients. The reason for this is because A and B antigens are receptors for rosetting on uninfected RBCs which bind PfEMP1 expressed on the surface of infected RBCs. Rosettes that form in group O RBCs are smaller and weaker and involves other RBC molecules which act as alternative receptors for rosetting. The implication for this is that people with severe malaria who require blood should be transfused with O blood group blood.

Transfusion with non O blood could promote rosetting. Presently, research focuses on drugs and vaccines that will prevent rosetting as an intervention for life threatening malaria.

My specific research focus: The interaction of blood groups and Malaria

The well-established link between merozoite invasion of erythrocyte and the implicit interaction between the red cell membrane proteins and the invading plasmodium antigens suggests a potential window for the development of new anti-malarial chemotherapy, vaccines and reduction of the global burden of malaria. This finding thus indicates the need to investigate the link between blood groups and different malaria parasites in Port Harcourt, Nigeria where there exists a paucity of data in this field of malaria research.

Our study titled "*The Interaction between Malaria parasites and Blood Groups in Port Harcourt*" Nwauche CA, Chijioke-Nwauche IN, Sutherland C, Mary C. Oguike MC, Ebong OO, 2011) was designed to investigate the link between blood groups and different malaria parasites in Port Harcourt, Nigeria which is the centre of the oil and gas industry in West Africa. Furthermore, we investigated the incidence of Plasmodium ovale and the specificity of the parasite strain in relation to various blood groups in this environment.

142 males (57.72%) and 104 females (42.28%) aged 16-60 years attending the Braithwaite Memorial Hospital and blood donors presenting at the University of Port Harcourt Teaching Hospital Blood Bank were enrolled into the study; and their samples were analyzed for microscopy and molecular genotyping of parasite strains.

Results:

Plasmodium falciparum was positive in 207 (84.1%) and negative in 39 (15.9%) by microscopy. Results of the blood group screening against microscopy shows that blood group O Rh positive was the highest with 163 (66.2%) followed by blood group A Rh positive 43 (17.5%), B Rh positive 26 (10.6%), O Rh negative 7 (2.85%), AB Rh positive 5 (2.03%), B Rh negative 1 (0.41%) and A Rh negative 1(0.41%).

1. Future Research Studies in malaria:

- UPTH Malaria scourge-research team for pilot study set for rollout in 1st quarter of 2016.
- Prevalence of Plasmodium species in the Niger Delta beginning from Rivers State.
- Mapping of *Plasmodium falciparium spp* resistance markers in Rivers State, with particular reference to *mdr1* mutant genes due to its relationship to ACT resistance and the IPTp and IPTi prophylactic programmes in pregnant women and children.
- The Interaction between Malaria parasites and Blood Groups.
- Evaluation of the WHO 3Ts (Test, Treat and Track) strategy in the 3 senatorial zones of Rivers state.

2. Further academic leadership in malaria research:

- **International malaria Colloquium, 16-20 May, 2016 (IMC 2016):** 1st international malaria conference in Nigeria, bringing together researchers, patients, practitioners, international and National collaborators / stakeholders, Pharmaceutical industry for five days of state of the art updates, hands on workshop on malaria diagnosis and clinical workshop in the management of severe malaria, Phytomedicine symposium, update courses on applying molecular techniques to the control/elimination of malaria, etc.

- **Journal of Phytomedicine and Malaria (JMP):** We have set up and a high profile Editorial board of advisers with a global spread of leading expert in various disciplines of malaria research to work with an Editorial committee. A Journal rollout is underway and the first edition will be launched at the forthcoming IMC. This Journal will bridge the yawning gap in the dissemination of veritable indigenous original research in the field of malaria and malaria-related phytomedicine studies.

- **Monthly seminars:** Regular meeting of researchers to deepen academic discuss in malaria control/ elimination strategies and investigation.

- **Rivers state Malaria Network (RSMnet):** Initiation of regular collaborative meeting of all stakeholders actively engaged in malaria control activities in Rivers state-CMRAP research faculty (College of Health Sciences; Faculties of Science and Pharmaceutical Sciences, Social sciences, Humanities); University of Port Harcourt Teaching Hospital, Medical doctors (NMA, MDCAN, ASSOPON, etc); pharmacists (PSN, ACPN, etc); Medical Laboratory Scientists (AMLSN), Nurses , R/S MOH, R/S Primary Health care Board, NGOs, Natural medicine practitioners, etc.

- **Malaria club in schools:** Current WHO strategy and slogan is "invest in the future: defeat malaria; so we have initiated our schools outreach programmes to reach out to the youth. We have commenced with about four schools around the vicinity of the university.

- **Malaria House:** Plans are underway to launch a malaria house project. This will kick start the sourcing of funds for the building of a state of the art , purpose-built facility that will have, research laboratories, insectarium, offices, animal house, lecture theatres, seminar rooms, etc.

- **Sylvanus J. S. Cookey Professor of Malaria Studies:** Played a major role in the establishment of this Professorial chair in the Centre for Malaria Research and Phytomedicine (CMRAP), University of Port Harcourt.

- **MOU with the London School of Hygiene and Tropical Medicine (LSHTM):** Also initiated the linkage with the LSHTM in 2011 while observing a six-week bench fellowship on hands-on molecular diagnosis of plasmodium spp at the LSHTM , London.

- **Academic programmes in Malaria**-Giving impetus to the quest to establish a certificate course in malaria and also a Postgraduate diploma in malaria studies in CMRAP.

- **Environmental management of malaria:** Developing a frame work to mobilize a city-wide community involvement to enhance our environmental waste management that will entail the adoption of a "clean drains" policy. This will ensure that our city and communities are free of standing puddles of dirty water and drains, etc.

- **Legislation:** Engaging relevant government agencies and the State House of Assembly to enforce extant laws and legislations regarding proper environmental management. This may also include the enactment of new legislations, if and where necessary.

3. Further contributions to the research and practice of Haematology at the University of Port Harcourt Teaching Hospital:

- **Blood component therapy:** As head of the Department of Heamatology; and the Transfusion Medicine Consultant in the blood bank, I initiated the upgrade of blood transfusion practice from the now obsolete ***"whole blood"*** to the current practice of "***blood component therapy***" involving fractionation of whole blood into sedimented and platelet units.

- **Stem Cell transplantation:** Laid the foundation for stem cell transplantation in this centre by writing a 15-20 year plan. This plan involved manpower training and retraining, capacity building, public and patient enlightenment, etc. Initiated the acquisition of the first Apharesis machine in Nigeria and probably in West Africa and was used to train key stem cell transplant health personnel from different centres in Nigeria at the National Hospital Abuja; including staff from University of Benin teaching Hospital who eventually became the first centre to perform BMT in Nigeria-2012/2013.

- **Haematology Daycare Ward:** Established the Day care ward where patients with blood cancers are diagnosed, treated with chemotherapy and cared for on an outpatient basis.

- **Residency training Programme:** Have contributed to the training of 12 Resident Doctors as Consultants amongst whom is Dr Mrs. Kaladada Korubo who was adjudged to be the best graduating fellow in 2012, Faculty of Pathology of the National Postgraduate Medical College of Nigeria. These consultants are dispersed into the various areas of the Niger delta where they are offering specialist care in the field of haematology and blood transfusion.

6. Recommendations

A. Blood Cancers

The lessons learnt from our research of blood cancers in the Niger Delta are as follows:

- Poor health seeking behavior.
- Inadequate personal health care plan.
- Regular periodic health check-once or twice a year.
- Late presentation to health care facilities.

It is therefore recommended that:

1. More effort should be invested to enlighten the public regarding the adoption of a pro-active attitude of regular periodic health check, preferably once or twice a year.
2. Attempts should be made to incorporate this into the National Health Insurance Scheme (NHIS).
3. Public enlightenment, health education and awareness programmes should be strengthened and targeted at discouraging high-risk lifestyles such as smoking, alcoholism, vegetable and fruit-poor diet and high consumption of processed foods, etc.
4. Blood Cancer Research infrastructure: A Cancer Research Institute should be established in the university, and should have a provision for an endowment of a chair in cancer research. A Molecular Medicine reference Laboratory should also be incorporated into this institute and should be saddled with the task of providing the platform for molecular diagnosis and treatment of blood cancers and should be of international standard to discourage medical tourism. Specifically, the University should harness and empower the existing pool of experts that have already been trained in the art

of stem cell transplantation, with a mandate to set up a viable transplant programme in this center.

B. Blood transfusion and HIV/AIDS Medicine in the Niger Delta.

Government and all stakeholders engaged in the quest to provide safe blood should address and adopt the following recommendations:

1. Strengthening of the National Blood Transfusion service to operate on an efficient basis and should therefore be burdened with the responsibility to provide blood that is safe and free of transfusion transmissible infections (TTIs) and to institute measures that will prevent the transmission of these infections in the general population.

   Specifically, the National blood service should collaborate with State blood transfusion agencies to adopt the following measures:

a. An efficient blood bank service that will ensure careful donor recruitment and selection which incorporates the use of a cocktail of screening tests designed to filter out potential donors that have been infected by any of the TTIs especially HIV, Hepatitis B and c, and syphilis.
b. The identification, counselling and treatment of those who are infected by any of the TTIs especially HIV and Hepatitis B and C to control their spread in the general population.
c. Awareness creation, public enlightenment and health education of various segments of the society with sufficient evidence-based information that will encourage behavior and attitudinal modification, which is critical to the control of their transmission being that they are based to a large extent on the lifestyle of those infected.
d. To specifically engage vulnerable sections of the society such as women, widows, teenagers, migrant workforce, and commercial sex workers.
e. To institute programmes that will promote sound reproductive health, engender behavioural change and the adoption of low risk sexual orientations.
f. The provision of counselling services for couples and families who might be faced with social pressures of disclosure and sero-discordance.

C. Sickle cell disease and blood coagulation disorders.
The most effective tool to stem the transmission of SCA is through the adoption of preventive measures that entail the strengthening of public enlightenment and counselling services in the health centres and in community/faith-based organizations and centers. These preventive strategies should incorporate newborn screening using high performance lipid chromatography (HPLC) and gene analysis employing PCR-based methods in selected sites to ensure sustainability.

In respect of blood coagulation disorders, it is also my recommendation that more effort should be made to increase the awareness and capacity to manage blood disorders in this locality thus: To adequately address the lack of appropriate diagnostic facilities and blood components for replacement therapy; and to identify the subpopulation of patients who are at risk of developing abnormal or exaggerated reaction to drugs, particularly within the context of self-medication which is rampart and widespread in the Niger Delta.

D. Be a Life giver: The golden rule enjoins us to do unto others as we would love others to do unto us. Thus, it is my recommendation that we:

1. Adopt a personal lifestyle to be a life giver to those we relate with in our official and social circle of daily interactions.
2. That we should not ask what the University of Port Harcourt can give to us…but we should each be life givers to the institution; and personnel of our various units, teams, Departments, Centres or Institutes, and Faculties and College that constitute this citadel of learning and excellent Education. Being clothed with the mindset of a life giver would add value to this unique University and ensure that you would leave it better than you met it whenever you make your exit from this establishment.
3. That we each make a personal connection with the source and giver of life for we CANNOT give what we do not have. Sustainability of our access to life is guaranteed by a life committed to an intimate and loving relationship with the source of all life, the Almighty El Shaddai God…Blood is the altar and platform of this life.

7. Mr. vice Chancellor, Sir, Permit me to conclude this Inaugural lecture by reading a poem written for this occasion by our last daughter:

Poem
Plasma
Platelets
Red cells
White cells-
Blood;
Life.

Meandering the routes of our
bodies;
Keeping us alive
Wholly,
Essentially-
The essence of us.
The drumming in our ears,
The beating of our hearts.
All flesh,
All man,
One blood,
One life.
Connected by our hearts,
Separated by our choices.
Choose;

To flow, or not to flow?
To live, or not to live?
Choose. ***Ruby Chijioke-Nwauche***

Mr. Vice Chancellor, Sir. I began this lecture by drawing inspiration from God.

To end this lecture, may we draw inspiration from this poem. The main thrust of this inaugural lecture is that blood is the essence of life. This poem inspires us to choose…

Choose life.

Blessings!!!!!

Professor Chijioke Adonye Nwauche

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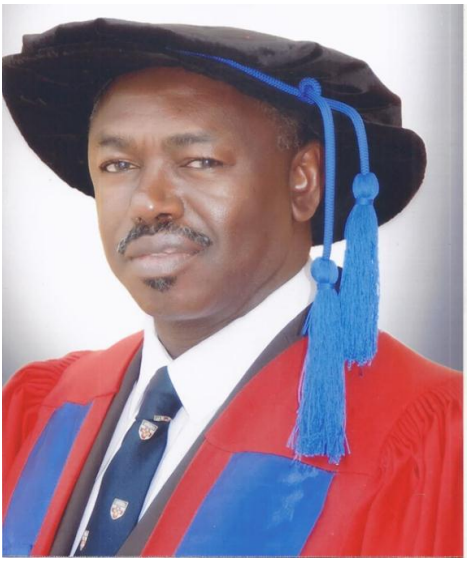
CITATION ON PROFESSOR CHIJIOKE ADONYE NWAUCHE

B.Med.Sc *(UPH)*; MBBS *(UPH)*; MSc *(LONDON)*; FWACP (Laboratory Medicine).



Professor Chijioke Adonye Nwauche was born to the late Eze (Hon.) Israel O. Nwauche, Ezeala Okobo and Mrs Jemimah I. Nwauche, on 11th October, 1959 in Aba, the then East Central State of Nigeria. He hails from Umuagbai- Ndoki, Oyigbo Local Government Area of Rivers State.

Professor Nwauche attended Ibeku Central School, Umuahia and later Urban County Council School 1, Umuahia, Abia State where he obtained his First School Leaving Certificate, in 1973. He obtained his secondary education at Federal Government College, Enugu, Government College Umuahia and Oboro Secondary School, Oboro, Umuahia between 1973 and 1978. He was subsequently admitted into the University of Port Harcourt as part of the Pioneer set of Medical Students. He obtained the Bachelor of Medical Sciences (Honors) degree in Physiology in 1983 and the Bachelor of Medicine and Bachelor of Surgery degree in 1986 as part of first set of 13 medical doctors ever produced by this University.

While a resident (of UPTH and UCH, Ibadan) and a junior lecturer in our Department of Haematology, Blood transfusion and Immunology, he went to the Imperial College School of Medicine (formerly Royal Postgraduate Medical School, Hammersmith Hospital), University of London, London for an MSc in Haematology between 1996 and 1997. He completed his residency upon his return and obtained the Fellowship of the West African Postgraduate College of Medicine in Laboratory Medicine in 1998 to become the first indigenious Consultant Haematologist in Rivers and Bayelsa states.

Professor Nwauche, whose research interests include HIV/AIDS Medicine, Transfusion medicine, haemato-oncology, neonatal Haematology and coagulation disorders, is widely published and is responsible singly and jointly, for 61 articles in local and international journals, one monograph and one chapter in a book. A former acting Head of Department, Professor Nwauche is currently a professor of Haematology, Blood Transfusion and Immunology in the Faculty of Basic Medical Sciences and honorary consultant Haematologist at the University of Port Harcourt Teaching Hospital.

He has served as the Deputy Chairman, Medical Advisory committee (Planning, research and statistics) of the University of Port Harcourt Teaching Hospital. He is currently the Coordinator of our MBBS/BDS Part II Program, the Chairman of the Faculty of Basic Medical Sciences Seminars Committee and the serving Director of the Centre for Malaria Research and Phytomedicine. He is a recipient of several awards and fellowships including the MacArthur three months fellowship on Advanced Oncology at the University of the Wittswatersrand, Johannesburg, South Africa and a six-weeks bench fellowship on the molecular diagnostic methods of malaria at the London school of Hygiene and Tropical medicine, London.

Professor Nwauche is a member of the Nigeria Medical Association and Medical and Dental Consultants Association of Nigeria. He is also a member of Nigeria Society for Haematology and Blood Transfusion where he served as National Secretary for two-terms (four years 2009-2013).

He is also a member of the Association of Pathologists of Nigeria and International Society of Haematology, among others. He is a former member of the Board of Directors of Delta Rubber Company Limited, Umuanayagu, Okomoko-Etche, Rivers State.

A devout born again Christian and minister of the Gospel, Chijioke Nwauche was a presenter of Christian programs (Trumpet Call) on radio and television between 2002 and 2005. He also authored 3 Christian books, several booklets and pamphlets and undertaken Christian and Medical missions to several countries in Africa and abroad, including Rwanda, Democratic Republic of Congo, Sierra Leone, Liberia, Ethiopia, the Philippines, and Ukraine.

Professor Nwauche is married to Pharmacist (Dr) Ifeyinwa N. Chijioke Nwauche and they have four children.

Vice Chancellor Sir, ladies and gentlemen, I present to deliver the 129th inaugural lecture of the University of Port Harcourt; author, distinguished academic, a minister of the gospel, respected family man, my friend, Professor Chijioke Adonye Nwauche.

Thank you.

Professor Iyeopu M. Siminialayi