A

TECHNICAL REPORT

ON

STUDENTS' INDUSTRIAL WORK EXPERIENCE SCHEME (SIWES)
(APRIL 2024 – SEPTEMBER 2024)

UNDERTAKEN AT

ABICARE HOSPITAL
NO. 1, PEACE STREET, OFF-AWOLOWO ROAD, TANKE, ILORIN, KWARA STATE.

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SUBMITTED TO
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IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR IN SCIENCES (B. Sc.) DEGREE IN BIOCHEMISTRY

SEPTEMBER, 2024

CERTIFICATION

This is to certify that this report is a detailed account of the Students' Industrial Work Experience Scheme (SIWES) undertaken by **ISHOLA, Josephine Tosin** (21/55EH239) at **ABICARE HOSPITAL** situated at No.1, Peace Street Off-Awolowo road, Tanke, Ilorin, Kwara State for a period of six (6) months, and has been prepared in accordance to regulations guiding the preparation of reports in the Department of Biochemistry, University of Ilorin.

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ACKNOWLEDGEMENTS

I thank God Almighty for his safety and how he lead me throughout my training period. I also thank my parents for their immense guidance, support, prayers during my training. Without them, my SIWES programme would have been impossible.

I appreciate Dr. Lawani, the medical director of Abicare Hospital for his love and support and how he made sure to bring the best out of us through series of assignments given to us and also oral question and answer sessions.

I appreciate the Lab supervisor, Miss Chika for the unquantifiable love she showed to us, for how she was always ready to train us and also give us the opportunity to carry out most of the tests after we are being taught.

Finally, I also wish to appreciate my level adviser, Dr. Mrs. Soji Omoniwa O., my departmental SIWES coordinator and all the lecturers of biochemistry department.

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ABSTRACT

This report is an account of the knowledge and experience gained during the Students' Industrial Work Experience Scheme (SIWES) programme, done at ABICARE HOSPITAL which lasted for a period of 6 months (April-September, 2024). SIWES is a programme designed for students in the higher institutions of learning to acquire practical experience in their various fields of study. During the six months of attachment, I was privileged to work in the Clinical Laboratory. In this report, I accounted for the processes carried out in the laboratory unit and how these processes were used to achieve the results for each test carried out in the lab. At the end of the report, the problems encountered during the scheme were stated and the suggestions for improvement of the SIWES scheme were given.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BRIEF HISTORY/BACKGROUND OF SIWES

SIWES which stands for Students Industrial Work Experience Scheme, is a structured programme in Nigeria designed to provide Nigerian students in universities, polytechnics, and college of education with practical work experience in their respective fields of study.

SIWES was established in 1973 as a response to the need for students to acquire practical skills in their chosen professions during their course of study. It is mandatory for students in disciplines such as engineering, technology, environmental sciences, life sciences, medical sciences and applied sciences.

The programme typically lasts for three to six months, depending on the institution and course of study. During this period, students are attached to relevant industries, research institutes, or organisations where they gain practical experience. The coordination of SIWES is overseen by the Industrial Training Fund (ITF) in collaboration with the Ministry of Education and other relevant stakeholders. The ITF is responsible for placement, monitoring, and assessment of students during the scheme.

SIWES has been instrumental in bridging the gap between theoretical knowledge and practical skills among Nigerian students. It helps in preparing them for the labor market and enhances their employability upon graduation.

The Department of Biochemistry, University of Ilorin sends her 300 level students on a mandatory six (6) months industrial training to help achieve this.

During my six months at my SIWES placement of intense participation in this programme, I benefited a lot from the programme, which includes:

- Exposure to enabling environment where personal attributes such as critical thinking, creativity, time management, leadership and resourcefulness amongst others can be enhanced.
- Gap bridging between knowledge acquired in school and the relevant production skills required in work organisation.
- Appreciation of work method, equipment and machine handling experience.
- Enhancing contact with potential employers.

1.2 AIMS AND OBJECTIVES OF SIWES IN NIGERIA

- Prepare students for employment by developing a better understanding of workplace dynamics, professional ethics, and expectations.
- Enlist and strengthen employer's involvement in the whole educational process and prepare students for employment after graduation.
- Enhances students' skills and competencies in their respective fields of study, and gain exposure to industry-specific tools, techniques, and methodologies that may not be readily available within their academic institutions.
- Provides students with an opportunity to gain hands-on experience and apply theoretical knowledge acquired in the classroom to real-world work environments, thereby bridging the gap between theory and practical.
- Strengthening national development by equipping students with relevant skills and knowledge which is vital for national development goals such as economic growth, technological advancement, and sustainable development.

The objectives of SIWES programme are all about strengthening future employees. They aim to achieve a broad spectrum of objectives that collectively enhance students' educational outcomes, professional readiness, and contribute to national development. This programme is a successful attempt to help students understand the underlying principles of their possible future work. After passing the programme, the student can concentrate on the really necessary factors of their field of work.

CHAPTER TWO

2.0 DESCRIPTION OF ESTABLISHMENT OF ATTACHMENT

2.1 LOCATION AND BRIEF HISTORY OF ESTABLISHMENT (ABICARE HOSPITAL)

Abicare hospital is a reputable private hospital, located at No 1, Peace Street, Off-Awolowo Road, Ilorin, Kwara state, Nigeria. It was founded on the 2nd of September, 2022 by Dr. Lawani Olufemi Ademola. The facility has, a clinical laboratory, a theater, a labour room, 15 beds and several wards.

2.2 OBJECTIVES AND VISION OF ABICARE HOSPITAL

Abicare hospital has a mission of promoting great health and complete wellness of people with professionalism, knowledge, safety, competence and integrity to help accomplish the immediate and long-term improvement desired by the patients.

The core values include;

Excellence: We value excellence in all we do, and continuously seek to improve our service, knowledge and care.

Compassion: We provide genuine, holistic and compassionate care that is accessible to all and centered on the individual needs of each client, their family and the community.

Stewardship: We accept the responsibility of care entrusted to us.

Partnership: We know we can only succeed in our mission by forging strong, respectful relationships with the clients we serve, colleagues and the community.

Integrity: We will do the right thing always.

2.3 ORGANISATIONAL STRUCTURE OF ABICARE HOSPITAL

The everyday activities of the hospital at each point were conducted by professional staffs which include; Doctors, Nurses, Pharmacists, Cleaners, Receptionists, Force men, with each departments having a head. The organisational structure of the company is illustrated below.

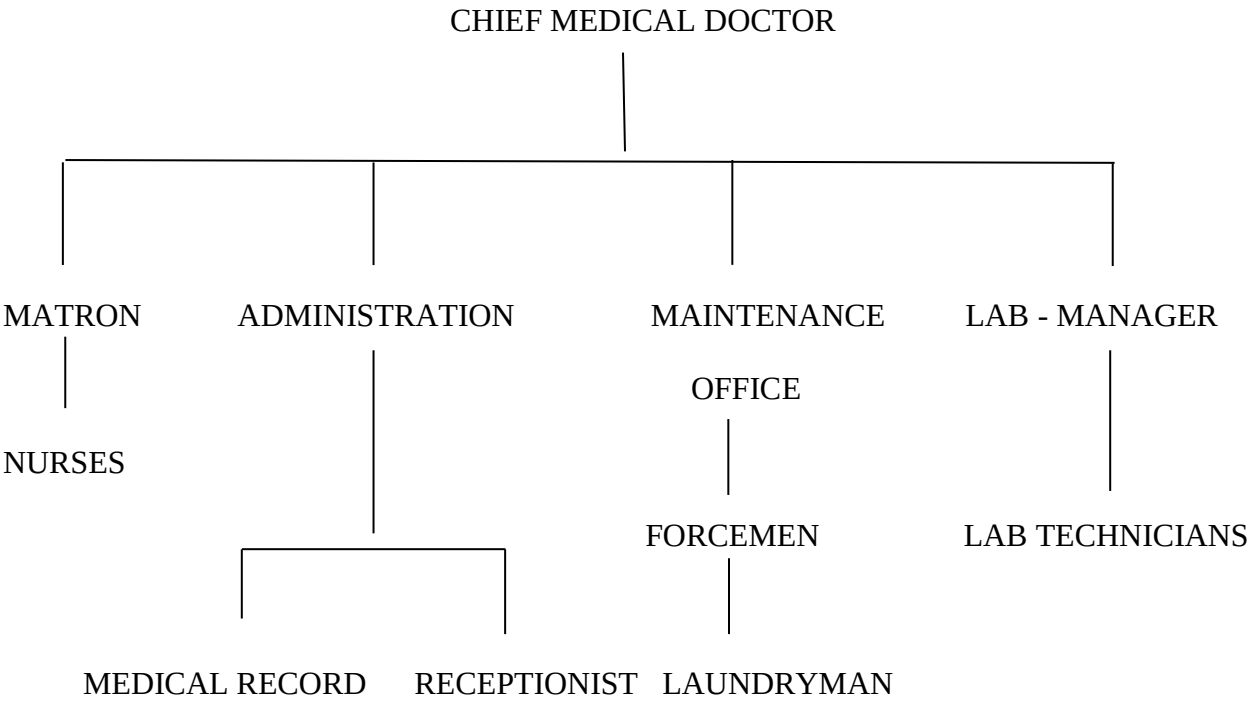

Figure 2.1: Organisation structure of Abicare Hospital

2.4 DEPARTMENTS IN ABICARE HOSPITAL

The hospital is divided into various departments/units and they include:

1. **MEDICALS**: The medical department is a group of qualified personnel that provides quality medical and nursing care to a wide range of patients, serving patient population from young children to adults. There are groups of personnel under the medical departments, they include:
    - **Doctor:** A doctor is a professional who practices medicine, and is interested in promoting, maintaining or restoring health through the study, diagnosis, prognosis and treatment of

diseases, injury and other physical impartments. The Head of Department is Dr. Olufemi Lawani.

- **Nurse:** They are group of people that shows care, love and support for patients by managing physical needs, preventing illness and treating health condition. The head nurse assigns functions to the other nurses who will perform the nursing tasks to all the patients in a unit. They also record and monitor patients' vital signs and they also work alongside with the doctors and other medical staff to determine the optimal plan, either to administer drugs, inject (intravenous, intramuscular, or subcutaneous) or infusion.
- **Laboratory department:** This department comprises of professionals that does receiving, labeling and safely storing of samples to be tested, also determining and performing complex tests needed to help the medical unit to detect the medical condition of a patient. This unit is also available to discuss and answer any questions regarding the result recorded.
- **Pharmacy department:** A pharmacist is a healthcare professional positioned to be responsible for dispensing optimal medications, reviewing prescriptions, organising the pharmacy, quality testing, monitoring and reporting drug safety, delivering and labeling medications, formulating and re-formulating dosages, preparing and providing information and advices to patients to ensure safe medication use. The department also ensure the highest quality and most cost-effective pharmaceutical care.

2. **ADMINISTRATIVE DEPARTMENT**: The hospital administrative department is responsible for the day-to-day operation of the hospital. They organise, contribute and oversee the health services and daily activities of a healthcare facility. This department is responsible for the

hospital growth and development. They set up all the protocol and procedures for all the hospital departments.

- **Medical records unit:** This unit deals with medical data, recording and maintaining all in-patients and out-patients client's files. Data from this department helps the hospital to get statistics that improve hospital service growth.
- **Human resource unit:** This unit is actively responsible for the hospital growth and optimum services.

3. **RECEPTION:** They are responsible for basic clerical tasks such as answering phone while maintaining a consistent phone manner, using a proper telephone etiquette. This department also make appointments and book patients in, when they arrive for an appointment in accordance with the practice system and to provide a helpful and friendly service to patients, also ensuring that the reception area is tidy and welcoming. They also register new patients and update existing patients' demographic by collecting the patient details, including personal and financial information. They are responsible of handling queries and complaints via phone, email and general correspondence.
4. **CLEANERS:** They are responsible for maintaining a safe and hygienic environment for patients, staff, and visitors. They clean and disinfect patient rooms, bathrooms, and common areas, sanitize medical equipment, furniture, and surfaces, empty trash and recyclables, restocking supplies (e.g., toilet paper, soap, detergent, disinfectants etc.), maintain floor cleanliness manage linen and laundry.
5. **SECURITY:** The hospital security officers protect staffs, patients and visitors ensuring that all hospital properties are secured. They patrol buildings and its grounds, monitors all activity in and out of the hospital and endeavor to prevent vandalism, theft, fire and disturbance within the

hospital facility. They are always on the lookout for all sorts of issues at the hospital, including maintenance issues which may compromise people's safety or integrity of the establishment.

CHAPTER THREE

3.0 WORK DONE AND EXPERIENCE GAINED IN THE LABORATORY

On my first day of resumption, I was introduced to the various departments and staffs of the hospital. I was assigned to the clinical laboratory (a place where tests are done on clinical samples in order to get information about a patient's health), which deals with the collection of samples and carrying out of clinical tests and also briefed on the safety rules of the laboratory.

3.1 SAFETY RULES IN THE LABORATORY

All laboratories must adhere to strict biosafety principles and practices, enforcing rigorous guidelines for workers and visitors, treating all incoming and outgoing specimens as potentially infectious. To mitigate contamination and laboratory hazards, strict precautions are mandatory for personnel and visitors.

3.1.1 GENERAL LABORATORY GUIDELINES

1. Laboratory coat and hand gloves should be worn in the laboratory.
2. All persons in laboratories including students, staffs and visitors must wear safety glasses, goggles or face shields at all times where potential eye hazards exist.
3. Eating, drinking, chewing gum and applying cosmetics are prohibited in the laboratory.
4. Do not store food or beverages in the same refrigerators or freezers with chemicals, biohazards or radioactive materials.
5. Never conduct unauthorized experiments or engage in horseplay in a laboratory. Immediately report any unsafe behavior to the instructor.
6. Wear appropriate clothing. In particular, you must wear closed toes (i.e., No sandals or flip-flops) in the laboratory.
7. Fingers nails should be cut short.

8. Hairs should be covered with hair net.
9. Wearing an iPod, Bluetooth or any other device that interferes with hearing is not allowed.
10. Never pipette anything by mouth.
11. The work area must be kept clean and uncluttered. All chemicals should be labeled and stored properly.
12. Labeling of samples should be done with care.
13. The hazards of chemicals used should be known (e.g., corrosiveness, flammability, reactivity, stability and toxicity).
14. Always pay attention to your surroundings and be aware of what others are doing. Always be courteous.
15. Remove contaminated gloves before touching common use devices (door knobs, faucets, equipment). Discard gloves before leaving laboratory.
16. Always wash hands and arms with antibacterial soap and water before leaving the laboratory.

Maintaining adequate safety in the laboratory and good laboratory practice were highly required to achieve good results on daily occupational practice.

3.1.2 LABORATORY EMERGENCY GUIDELINES

These were the emergency guideline given to us:

- Know the where about of the nearest fire extinguisher, fire blanket, first aid kit, eye wash equipment, shower and telephone.
- Any accident or injury must be reported to the lab instructor immediately, no matter how small it may seem.

- Burns: Small burns from touching hot objects should be placed under cold running water for at least 20 minutes, major burns need immediate medical attention.
- Relocate: Everyone in the immediate work area should evacuate to a safe location through the nearest exit.
- Alert: In case of fire, clear out of the laboratory first, before calling an emergency number.

3.2 LABORATORY EQUIPMENT AND THEIR USES

1. **Microscope:** This was used to enlarge and examine samples and magnification of microorganisms that were not visible to the human naked eye. Its parts include object lens which have 100x, 40x, and 10x objective lenses, diopter adjustment, eye piece, nose piece, stage, condenser, light source, on/off switch iris diaphragm, etc.

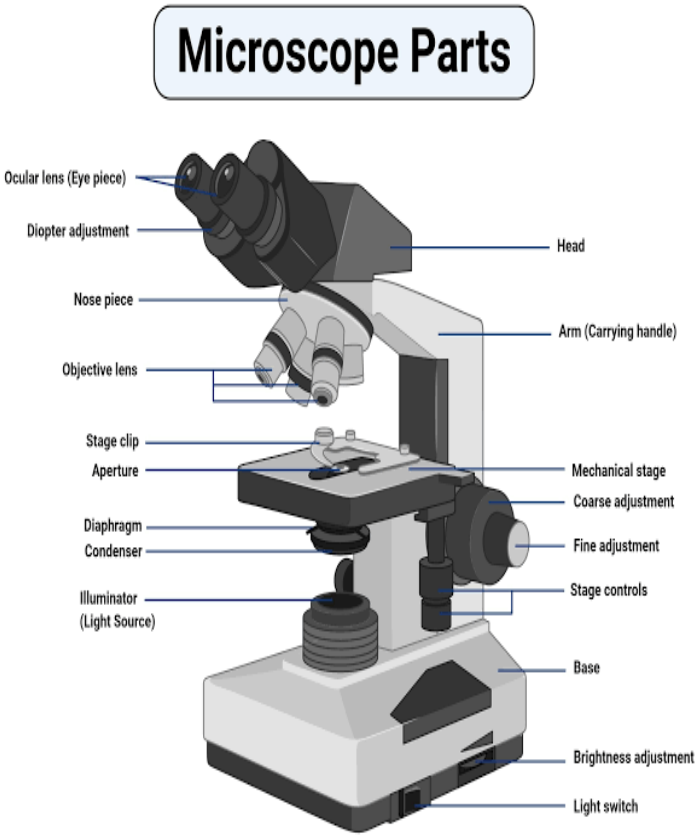

Figure 3.1: Microscope

2. **Centrifuge:** It was used for spinning and sedimentation of specimen such as; blood to enable separation into its different components, urine to enable separation of its constituents, using centrifugal force. Its part includes rotor, drive shaft, electric motor, chamber, control panel test tube holders, and so on.

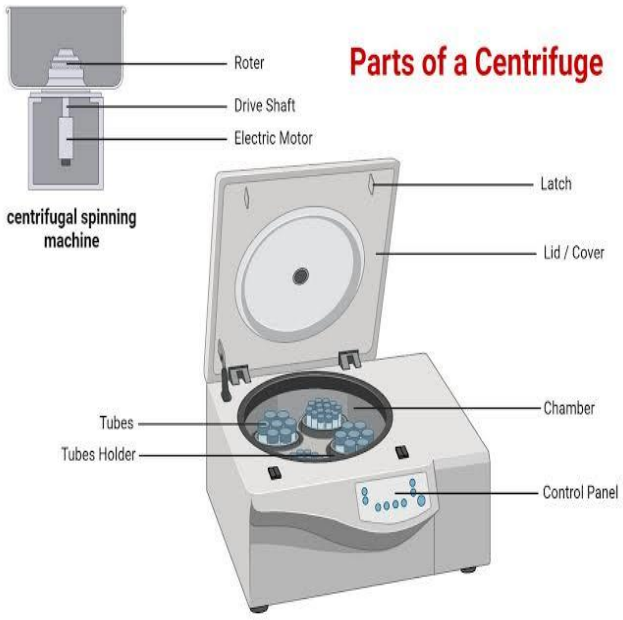

Figure 3.2: Centrifuge

3. **Refrigerator**: This was used to provide suitable temperature for preserving and storing of reagents, unused media, blood sample, etc.

Figure 3.3: Refrigerator

4. **Weighing balance**: This was used for weighing samples.

Figure 3.4: Weighing Balance

5. **Lancet:** This is a sterile needle that was used to prick the fingertips for the collection of blood.

Figure 3.5: Lancet

6. **Capillary tube:** It was used for collection of blood sample from the pricked area of a fingertip.

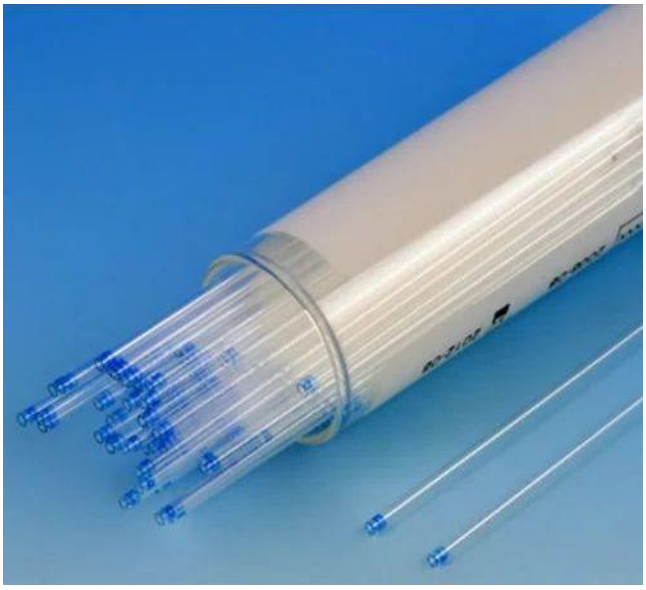

Figure 3.6: Capillary tube

7. **Universal bottle**: This was used for collecting samples like, urine, stool, sputum, etc.

Figure 3.7: Universal bottle

8. **Glucometer**: This was used to determine the glucose level in the body with the aid of its test strip.

Figure 3.8: Glucometer

9. **Tourniquet**: It was used to restrict blood flow and facilitate vein access for blood collection and also aid in needle placement and minimize bleeding.

Figure 3.9: Tourniquet

10. **Sampling bottle**: These bottles were used for collecting, storing, and transporting samples for analysis e.g. universal bottle, Ethylenediaminetetraacetic (EDTA) bottle (which contains anticoagulant that prevents blood from clotting and can also sediment

blood into their various segments), plain bottle (which does not contain anticoagulant) etc.

Figure 3.10: Sampling bottles

11. **Syringe and needle**: This was used for precise measurement and collection of blood, tissue or fluid samples.

Figure 3.11: Syringe and needle

12. **Micro-pipette**: This was used to measure small amount of liquid with a volume range between 0.1- 1000µl and can be used to transfer fluid from one container to another with

precision and accuracy. Its parts include the tip cone, tip ejector collar, tip ejector, digital display, push button and ergonomic grip cover.

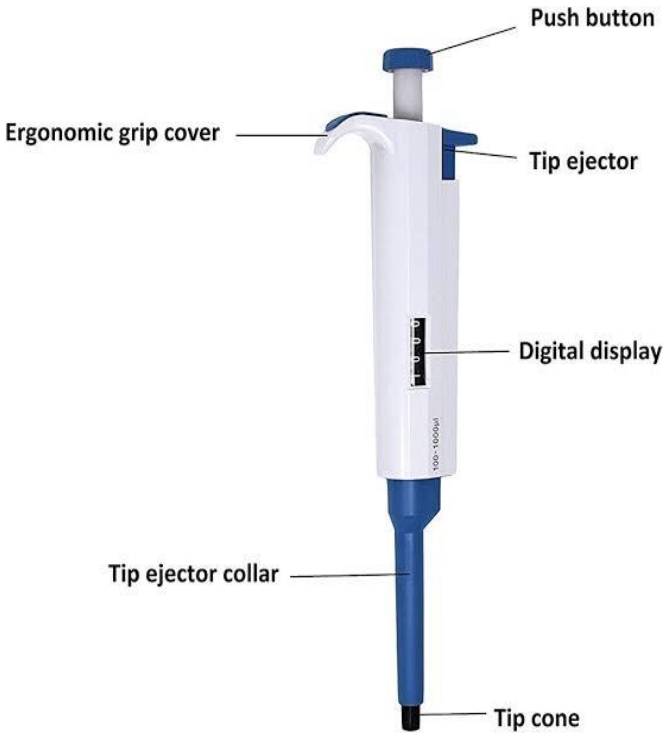

Figure 3.12: Micro-pipette

13. **Latex powdered medical examination glove:** It is a personal protective equipment (PPE) that was used to prevent exposure to harmful substances, microorganisms, and chemicals or a broad range of hazard.

Figure 3.13: Latex powdered medical

14. **Glass slide:** It is a thin flat piece of glass that was used to support and hold samples for microscopic examination, staining, or other laboratory procedures.

Figure 3.14: Glass slide

15. **Vaginal swab stick:** It is a medical device that was used to collect biological samples from the vaginal canal for diagnostic purposes like, vaginal infections (e.g., bacterial vaginosis, yeast infections), detection of sexually transmitted infections (STIs), etc.

Figure 3.15: Vaginal swab stick

3.3 LABORATORY SECTIONS AND TESTS PERFORMED

3.3.1 PHLEBOTOMY SECTION

This was where samples (blood, urine, sputum, etc.) were collected and stored for further processing in the laboratory.

There were various sample bottles used at the phlebotomy section that differs in color, shape, size with various specific purposes.

3.3.1.1 EQUIPMENT/MATERIALS USED IN THE PHLEBOTOMY

1. **Tourniquet:** It was used to search for vein. Prolong venous occlusion can cause changes in the concentrations of blood constituents, therefore, the use of a tourniquet was minimized. Whenever a tourniquet was used to make a vein more prominent, it was always released before withdrawal of blood. The use of a tourniquet was limited to less than one minute.
2. **Personal Protective Equipment (PPE)**

- Phlebotomy uniform: Served as protection to the body
- Disposable gloves/hand gel: Protection against spillage.

3. **Ethylendiaminetetraacetic acid (EDTA) bottle:** The anticoagulant in the bottle enabled its use for haematology test, because it allowed the best preservation of cellular component and morphology of blood cells.

Test carried out with this specimen bottle includes:

- Packed cell volume test (PCV)
- Malaria parasite test
- Pregnancy test
- Full blood count

4. **Plain bottle:** This particular specimen bottle has no anticoagulant present in it. The specimens collected in the plain bottle were usually for testing hormone profile. The following tests were carried out for this specimen bottle:

- Reproductive hormone profile
- Parathyroid hormone

5. **Syringe and needle:** This is a sterile device that was used to withdraw various types of body fluid from a swollen joint or blood from veins. The syringe and needle varied in size.
6. **Lancets:** to get blood sample using the capillary method by pricking the thumb.
7. **Hand gloves:** These were used at the phlebotomy and laboratory unit as preventive measures. There were different types of gloves, serving different purposes.

- Latex glove
- Neoprene glove
- Nitrile glove

8. **70% alcohol swab:** This was used as a disinfectant for the area in which piercing was to be made.
9. **Disposable bin:** They include the biohazard bins (red or yellow), non-hazardous bins (black), sharp containers (rigid and puncture-resistant), used for disposing waste.

3.3.1.2 STANDARD OPERATION PROCEDURE FOR BLOOD COLLECTION

Blood samples were collected using two procedures. They are;

1. The Capillary method, and
2. The Venipuncture method

The Capillary Method of Blood Collection

To carry out this method, a suitable site for the puncture was selected, which is usually the tip of the thumb, lobe of the ear and the toe in babies. The selected site was cleaned thoroughly with a sterile swab cotton wool (soaked in 70% alcohol or methylate spirit) and was allowed to dry. A quick prick was made with a sterilized disposable lancet, the puncture was about 3mm deep. The first drop of blood was coped off with a dry cotton wool, then, subsequent drops of blood were carefully collected using the capillary tube (the blood flowed into the capillary tube by capillary action). Having obtained the required quantity of blood, a slight pressure was then applied over the punctured site with sterile swab cotton to stop the blood flow.

Figure 3.16: Capillary method of blood collection

The Venipuncture Method of Blood Collection

Pre-venipuncture procedure;

1. The equipment needed for the test were prepared:
    - Sterile gloves
    - Needle (21-23G)
    - Syringe

- Tourniquet
- 70% Isopropyl alcohol swab.

Venipuncture procedure;

1. The patient was seated comfortably, the both arms were examined to select the one with the most prominent vein for the venipuncture and then the arm was positioned at 30-45˚ angle.
2. The most prominent vein in the arm was selected.
    - The patient was asked to clench their fist. This will make the vein more prominent.
    - When necessary, the bend of the elbow was tapped to make the vein more visible.
    - A suitable vein to puncture at the bend of the elbow was felt with the fingertip rather than plunging the needle into a poor vein that looks ‘alright’.
    - On some occasions, blood was taken from the back of the hand whenever a prominent vein was not found in the arm region.
3. The tourniquet was applied 3-4 inches above the chosen vein.
    - The tourniquet was tightened to restrict venous return.
4. The needle hub was aligned with the syringe nozzle, twisted and pushed onto the syringe nozzle until secured.
5. The site was disinfected with a 70% Isopropyl alcohol swab.
6. The solution was allowed to dry completely.
7. The cover from the multi-sample needle was removed and discarded into a clinical waste bin.

8. The needle was held at 15-20˚ angle (almost parallel to the patient's arm), then, it was inserted bevel-up into the vein, and the needle was advanced until blood flowed into the hub.
9. The needle-holder was held steadily and the blood was withdrawn gently by pulling the plunger.
10. The blood was withdrawn to fill the appropriate level indicated in the barrel.
11. On filling the barrel, the tourniquet was slackened by pressing down on the release clip that is on the side away from the arm.
12. The needle was removed from the vein and a clean pad of cotton wool was quickly applied on the surface.
13. The patient was asked to keep pressure on the punctured site to stop further bleeding.
14. The needle and syringe were discarded in a sharps bin.
15. The tourniquet was removed from the patient's arm.
16. When bleeding from the venipuncture site stopped, micropore tape was applied tightly over the cotton wool.

Figure 3.17: Venipuncture method of blood collection

3.3.2 HAEMATOLOGY SECTION

This section is responsible for analyzing blood and its component to diagnose and monitor various blood-related disorders. It is concerned with Haemoglobin (blood penalty test), Full Blood Count, Malaria, ABO groups, HB-Genotype. Haematology test is the test used in carrying out the investigation of anaemia, infection and pyrexia of unknown origin, investigating haemoglobinopathies and monitoring patients receiving antiretroviral therapy (ART).

3.3.2.1 List of tests under Haematology

The list of tests under Haematology which involved the use of a whole blood sample are as follows;

1. **PCV (packed cell volume):** It is also known as haematocrit. Blood is a mixture of cells and plasma. This test is conducted to know the percentage of blood cells present in the whole blood of a patient i.e., how much of the blood consists of red blood cells. It is also used to diagnose anemia. The value is expressed as a percentage or fraction of cells in blood. For example, a PCV of 40% means that there are 40 milliliters of cells in 100 milliliters of blood.

- The word haematocrit means to separate blood. Thereby, measuring the proportion of blood volume occupied by the red blood cell.
- This test gives information about RBC concentration and it is helpful to know the haemoconcentration.
- This is basically a measurement of total blood volume and RBCs ratio as a percentage.
- It is can also be used to check dehydration, and polycythemia vera.

Aim: To detect the percentage of red blood cell in the sample.

Materials Used for PCV Test

1. Lancet

2. 70% Isopropyl alcohol cotton swab
3. EDTA containing blood capillary tubes
4. Hb Haemoglobin testing system and its test strip
5. Blood sample

Test Procedure

A 10µl-20µl whole blood sample was collected from the patient using a sterile lancet, after wiping the selected fingertip which was usually the thumb with an alcohol swab, it was then massaged from the base to the tip of the finger to increase the blood flow. The lancet was then used to prick the already wiped fingertip and the capillary tube was used to collect the whole blood. After obtaining the required amount of blood, a slight pressure was applied over the punctured site with a sterile swab cotton wool to stop the blood flow. HB Haemoglobin meter test strip was inserted into the space provided for the test strip in the testing system after powering it on, and the sample (whole blood) was then transferred from the capillary tube onto the sample application area, then the HCT value was displayed within 5 to 10 seconds at the bottom of the screen.

Result

The range of packed cell volume for both male and female is as follows;

Age	HCT%
Newborn	44 to 65
2 to 8 weeks	39 to 59
2 to 6 months	35 to 50
6 to 12 months	29 to 43
1 to 6 years	30 to 40
6 to 18 years	32 to 44
Adults	
Male	42 to 52
Female	37 to 47
Pregnant female	>33
Old people	Values may slightly decrease

An increase or decrease in the blood range of a male/female may result to a fatal health condition.

Increase in PCV

An increase in packed cell volume could cause dehydration, low availability of oxygen and it may reflect a condition called Polycythaemia where there are too many red blood cells.

Decrease in PCV

Decrease in PCV could cause destruction of red blood cells, too much water in the body (over hydration), kidney disease, nutritional problems (iron and vitamin deficiency). Decreased values are indication of anemia and are also seen in leukemia, lymphoma, etc.

2. Malaria Parasite

Malaria parasite is a mosquito-borne infectious disease caused by a parasite that affects humans and other animals, it is a threat to the body system as they destroy the red blood cells present in

the body. People with malaria often experience chills, flu-like illness, tiredness, vomiting in severe cases. It can cause seizures, coma, yellow skin or death. These symptoms usually begin ten (10) to fifteen (15) days after being bitten by an infected mosquito. If not properly treated, people may have recurrence of the disease months later and in those who have recently survived an infection, reinfection usually causes milder symptoms and this partial reinfection disappears over months to years depending if the person is not exposed to mosquito. Malaria is a single-celled microorganism which belongs to the genus, plasmodium. The disease is mostly spread by the female Anopheles mosquito, which introduces the parasites from the mosquito's saliva into the person's blood, then the parasite travels to the liver where they mature and reproduce.

There are four species of plasmodium that affects human, they are:

1. *Plasmodium vivax* (P.vivax).
2. *Plasmodium ovale* (P.ovale).
3. *Plasmodium falciparum* (P.falciparum).
4. *Plasmodium malariae* (P.malariae).

In addition, *Plasmodium knowlesi* is a type of malaria that infect macaque (which are monkeys that inhabit throughout Asia, North Africa and Europe) and also infect humans causing malaria that is transmitted from animal to human (Zoonotic malaria).

Materials Used for Malaria Test

1. Alcohol disinfectant swabs
2. Lancet
3. Capillary tube
4. Timer
5. Blood sample

6. Malaria test kit (test cassette and buffer solution)

Test Procedure

The expiry date on the test pouch was checked, a latex medical examination glove was worn. New gloves were used for each patient. The test cassette was removed from the already opened pouch. Alcohol swab, was used to sterilize the patient's fingertip, and then allowed to dry before pricking the fingertip with a sterile lancet to get about 5µl of blood using a capillary tube. The lancet was discarded into the sharp box immediately after piercing the finger. Then, few drops of sample were dropped on the sample port marked 'A' of the malaria parasite test cassette, two drops of buffer solution were also added into the round hole marked 'B' and the timer was set for about 15 minutes after adding the buffer (for optimization) solution. The result was then interpreted, the gloves were disposed, the test result was recorded in the lab register and the test cassette was disposed in a non-sharp waste container.

Interpretation of the Malaria Parasite Test Result

NEGATIVE: Only one distinct red line appears at the control band area. This indicates no malaria antigen present in the blood sample or the malaria infection is below the detectable.

POSITIVE: Two bands, one on the test line "T" and another on the control line "C" appears within the result window indicates the presence of the parasite, P.falciparum.

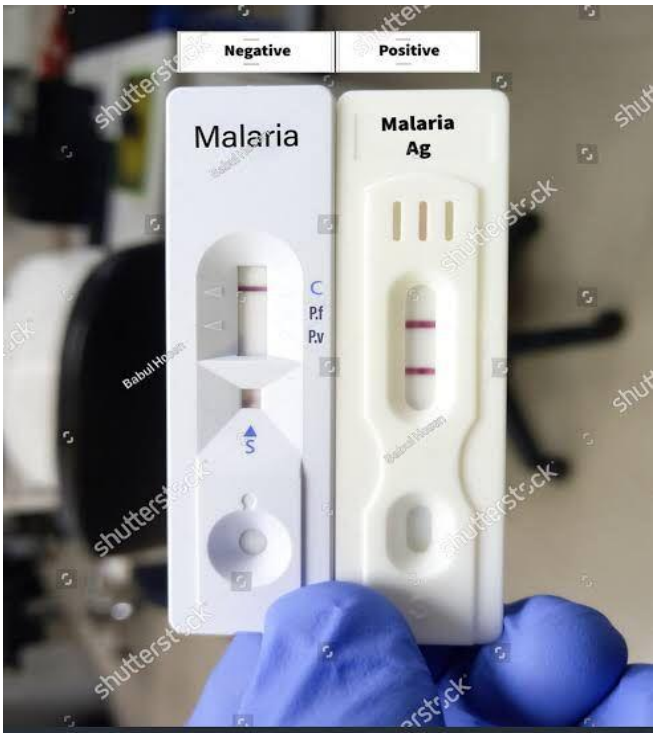

Figure 3.18: Malaria test cassette

3. Blood Group (ABO)

This is a method designed to reveal the group to which a particular blood belongs. It is done to reveal if a patient has a rhesus factor on the surface of the red blood cell. The single most common cause of transfusion-related fatalities is due to a patient being transfused with ABO incompatible blood. These reactions occur because individuals form potent, naturally occurring antibodies to ABO red cell antigens which they do not possess. When transfused with ABO incompatible blood, an immediate antigen/antibody reaction occur which if not detected in time, may be fatal. The terms 'D' positive and 'D' negative refer to the presence or absence of the 'D' antigen on the red blood cells.

85% of the general populations have the D antigen on their red blood cells. After A and B antigens, the D antigen is the most important antigen in transfusion practice. The D antigen is very

immunogenic. Individuals who lack the D antigen must be given D negative blood to prevent antibody stimulation.

Blood is often grouped according to the ABO blood typing system. The four major types of blood are;

i. Type A
ii. Type B
iii. Type AB
iv. Type O

Group A: This blood group has A-ANITGEN, and B-ANTIBODIES. It can only donate or give out blood to patient with blood groups A and AB, but can only receive blood from blood groups A and O.

Group B: This blood group has B-ANITGEN, and A-ANTIBODIES. It can only donate or give out blood to patient with blood groups B and AB, but can only receive blood from blood groups B and O.

Group AB: This blood groups have both A and B-ANTIGEN, and lacks ANTIBODIES. It can only donate or give out blood to patient with blood groups AB, but can receive blood from blood groups A, B, AB and O. They are known as universal recipients.

Group O: This blood group lacks ANTIGEN, but has both A and B-ANTIBODIES. It can donate blood to patients with blood groups A, B, AB and O, but can only receive blood from blood groups O. They are known as universal donors.

The individual blood groups could either be positive or negative, depending on the Rhesus factor.

All blood groups with Rh factor positive are: A+, B+, AB+ and O+. While, blood groups with Rh factor negative are: A-, B-, AB- and O-.

All negative blood groups can donate blood to their corresponding positive groups.

O- Is referred to as universal donor while blood group AB+ is known as universal acceptor.

Principle of the Blood Group Test

All people belong to one of the four inherited blood groups: A, B, AB and O. The letters A and B refer to the kind of antigen found on an individual's red blood cells. An antigen is a protein on the cell which triggers an immune response, such as the formation of antibodies, against the antigens which the red blood cell lacks. Most people also have an inherited condition of the red blood cells known as the Rh factor, or antigen D. When the D antigen is present, a person's blood type is designated Rh positive. When antigen D is missing, the blood type is classified Rh negative.

Materials Used for Blood Group Test

1. Blood sample (Venous or capillary)
2. Anti-A, Anti-B and Anti-Rh (D) sera
3. Blood grouping slides or tiles
4. Dropper
5. Gloves
6. Alcohol swab

Procedure

A glass slide was cleaned and wiped free of water. A drop of blood was placed on the glass slide in three different spots using a micropipette. The spots were named as A, B and D. Anti-A serum was added to spot A, anti-B serum to spot B and anti-D to spot D. The contents of each spot were

mixed with separate wooden swab sticks and spread to fill the whole area of the individual spots. The slides were rocked for few seconds and observed for agglutination.

Interpretation of the Test Result

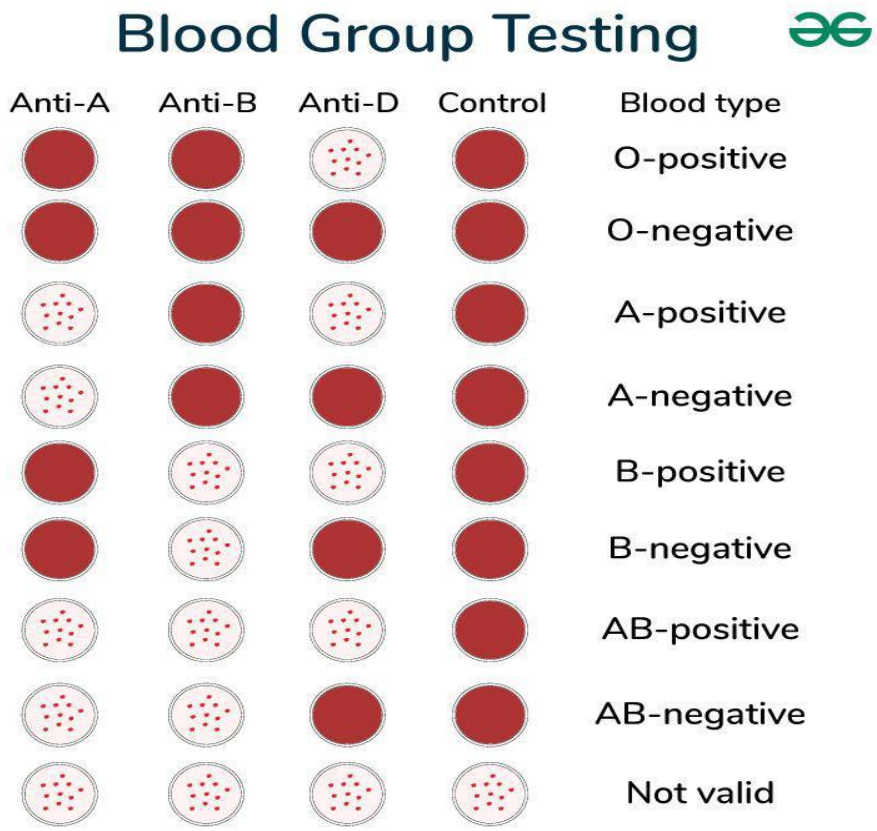

Figure 3.19: Blood group result interpretation

CHAPTER FOUR

4.0 INTRODUCTION

This chapter focuses on my experience in three sections of the laboratory: Serology, clinical chemistry, and microbiology. It aims to give an overview, describe the testing procedures and interpretation of the test results in each section.

4.1 SEROLOGY SECTION

Serology is the scientific study of serum and other bodily fluid. It is a test that looks for antibodies in the blood, and such antibodies are usually formed in response to an infection. Serological tests may be performance for diagnostic purposes when an infection is suspected, in rheumatic illness, and in many other situations. This section is concerned with the laboratory investigation which involved the formation of immune complex (agglutination) from antigen and antibody reaction in the blood (serum). Clinical tests carried out in this section include; Widal tests, Hepatitis B surface Antigen (HBsAg), pregnancy test, HIV, etc. Blood, especially serum is used.

4.1.1 Test Carried Out in the Serology Section

The following tests carried out were;

4.1.1.1 Hepatitis B Surface Antigen Test (HBsAg)

Hepatitis is an infection involving the liver. It can be acute and self-resolving, or it can be chronic, leading to cirrhosis and liver cancer. It is a virus that spread through blood and bodily fluid. Hepatitis is transmitted when blood, semen, or another bodily fluid from a person infected with the virus enters the body of someone who is not infected. This may be through a punctured skin, shared needle, or the exchange of body fluids and in most cases is caused by one of three viruses: Hepatitis A (HAV), Hepatitis B (HBV) or Hepatitis C (HCV). The antigen found in the envelope of HBV is designated Hepatitis B Surface antigen (HBsAg) and its presence in serum or plasma

indicates active HBV infection. The presence of HBsAg in serum or plasma is an indication of an active Hepatitis B infection, either acute or chronic. In a typical Hepatitis infection, HBsAg will be detected 2 to 4 weeks before the ALT level becomes abnormal and 3 to 5 weeks before symptoms or jaundice develop. HBsAg has four principal subtypes: adw, ayw. adr, and ayr. Because of antigenic heterogeneity of the determinant, there are serotypes of Hepatitis B virus.

Principle

The HBsAg One step Hepatitis B surface Antigen Test Strip (Serum/Plasma) is a rapid test to qualitatively detect the presence of HBsAg in a blood serum or plasma sample. The test utilizes a combination of monoclonal and polyclonal antibodies to selectively detect elevated levels of HBsAg (which is a surface protein of the Hepatitis B virus) in serum or plasma. The One Step Hepatitis B surface Antigen Test Strip (Serum/Plasma) is a qualitative, lateral flow immunoassay for the detection of HBsAg in serum or plasma. The membrane is pre-coated with anti-HBsAg antibodies on the test line region of the strip. During testing, the serum or plasma specimen reacts with the particle coated with anti-HBsAg antibody. The mixture migrates upward on the membrane chromatographically by capillary action to react with anti- HBsAg antibodies on the membrane and generate a colored line. The presence of this colored line (HBsAg binding to the antibodies that are immobilized on the test strip) in the test region indicates positive results, while its absence indicates a negative result. To serve as a procedural control, a colored line will always appear in the control line region indicating that proper volume of specimen has been added and membrane wicking has occurred.

Materials Used for Hepatitis B Test

1. Hepatitis B surface Antigen test strip and buffer solution
2. Gloves

3. Sterile lancet
4. Capillary tube
5. Blood sample
6. Alcohol swab

Procedure

The expiry date on the test pouch was checked, a latex medical examination glove was worn. New gloves were used for each patient. The test strip was removed from the already opened pouch. Alcohol swab, was used to sterilize the patient's fingertip, and then allowed to dry before pricking the fingertip with a sterile lancet to get about 10-20µl of blood using a capillary tube. The lancet was discarded into the sharp box immediately after piercing the finger. Then, few drops of blood sample were dropped on the sample pad of the test strip and a drop of buffer was added for optimization, the presence of two lines on the strip indicates that the patient is HbsAg positive and the diagnosis is tested confirmed. But the presence of a line on the HbsAg-determine-blood-strip indicates that the patient is HbsAg negative and the diagnosis can also be annulled (Invalid).

NOTE: A low HBsAg concentration might result in a weak line appearing in the test region (T) after an extended period of time; therefore, the result is not to be interpreted until after 30 minutes.

Interpretation of Result

POSITIVE: Two distinct red band would appear. One line in the control region (C) and another line in the test region (T) would appear.

NEGATIVE: One coloured line would appear in the control line region (C). No apparent line would appear in the test line region (T).

INVALID: Control line failed to appear. Insufficient specimen volume or incorrect procedural techniques are the most likely reasons for the control line to not appear.

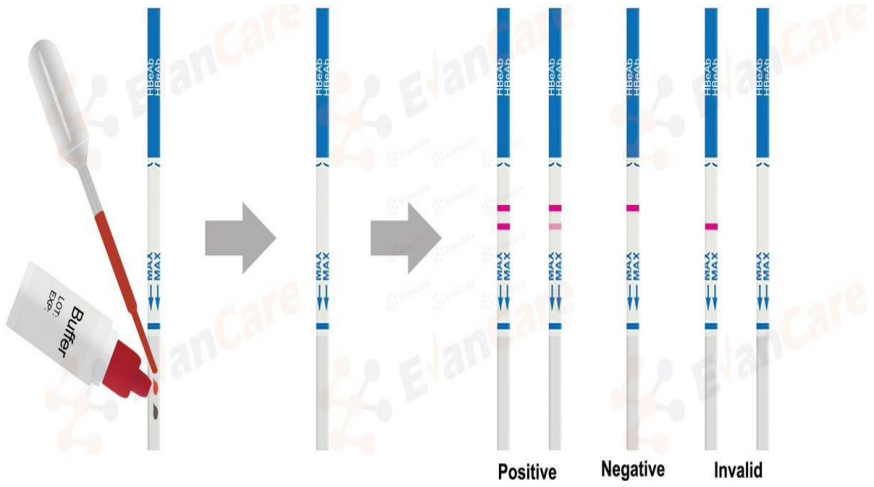

Figure 4.1.1.1: Hepatitis B test strip

4.1.1.2 Pregnancy Test (PT)

Human chorionic gonadotropin (HCG) is a glycoprotein hormone produced by the developing placenta shortly after fertilization. In normal pregnancy, HCG can be detected in both urine and serum as early as 7 to 10 days after conception. HCG levels continue to rise very rapidly, frequently exceeding 100 mIU/ mL by the first missed menstrual period, and peaking in the l00, 000-200,000 mIU/ mL range about 10-12 weeks of pregnancy. The appearance of HCG in both urine and serum soon after conception, and its subsequent rapid rise in concentration during early gestational growth, make it an excellent marker for the early detection of pregnancy. The HCG One Step Pregnancy Test Strip (Urine) is a rapid test that qualitatively detects the presence of HCG in urine specimen at the sensitivity of 25mIU/mL.The test utilizes a combination of monoclonal and polyclonal antibodies to selectively detect elevated levels of HCG in urine. At the level of claimed sensitivity, the HCG One Step Pregnancy Test Strip shows no cross-reactivity interference from the structurally related glycoprotein hormones such as

human Follicle Stimulating Hormone (hFSH) and human Luteinizing Hormone (hLH), at high physiological levels.

Materials Used for Pregnancy Test

1. Pregnancy test kit (e.g., strip, cassette)
2. Urine sample or serum from a centrifuged blood sample
3. Universal bottle (for urine sample)
4. Syringe and needle (for collection of blood sample)
5. Test tube (for centrifuging blood sample)
6. Centrifuge (to separate serum from whole blood)
7. Gloves
8. Alcohol swab

Procedure

A 2ml whole blood sample was collected in an EDTA bottle using venipuncture method. The blood sample was spun in a bucket centrifuge to separate the blood cells from the plasma. Few drops of serum were dropped in the serum hole of the B-HCG-determine-strip using a dropper. After waiting for few minutes, the presence of two lines on the strip indicated that the patient is B-HCG positive and the patient was said to be pregnant. But, in some cases, only one red band was visible (the control line) on the B-HCG-determine-blood-strip which indicated that the patient was B-HCG negative and the patient was said not to be pregnant. Situation where line failed to appear, insufficient sample volume or incorrect procedural techniques were the most likely reasons for the control line disappearance, the result was said to be invalid.

For the urine test, the sample was collected using a universal bottle, then the HCG test strip was inserted into the urine for some seconds, then after few minutes the result was read.

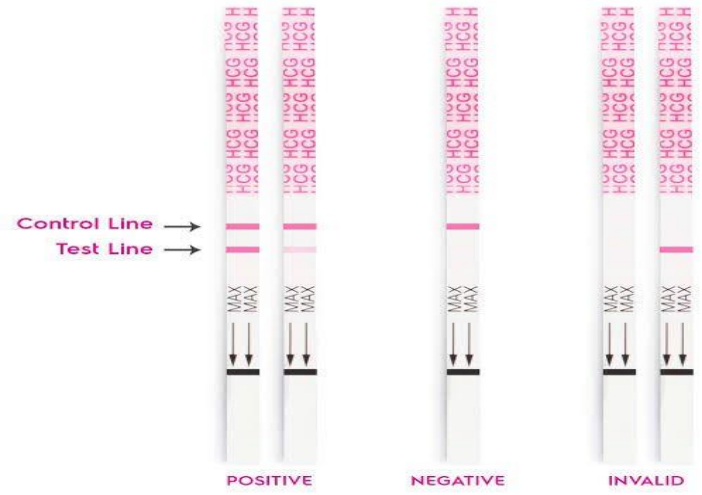

Figure 4.1.1.2: Pregnancy test strip

4.1.1.3 HIV Test

Human Immunodeficiency Virus test is an antibody test that is usually done on a blood sample. The virus interferes with the body's ability to fight infection, alter the immune system, increases the risk and impact of other infections and diseases, and can be transmitted through contact with infected blood, semen or vaginal fluid. HIV is the cause of the spectrum of disease known as HIV/AIDS. HIV is a retrovirus that primarily infects components of the human immune system as CD4+T cells, macrophages and dendritic cells. It directly and indirectly destroys the CD4+T cells. Most people infected with HIV develop specific antibodies (seroconvert) within three to twelve weeks after the initial infection. Antibody test in children younger than 18 months are typically inaccurate, due to the continual presence of maternal antibodies. Thus, HIV infection can only be diagnosed by Rapid Test (Finger prick blood test or Oral fluid test), Enzyme-Linked Immunosorbent Assay (ELISA) test, Western blot, PCR test (which detects viral RNA OR DNA),

or via testing for the p24 antigen. Much of the world lack access to reliable PCR testing, and most people wait until either symptom develops or the child is old enough for accurate antibody testing.

Materials Used for HIV Test

1. HIV rapid test kit (Strip or cassette, buffer solution)
2. Lancet
3. Gloves
4. Capillary tube
5. Blood sample
6. Alcohol swab

Principle

Using Lateral Flow Assay (LFA) technique, when the blood sample is dropped on the sample pad, it migrates through the test strip by capillary action, the HIV antibodies then bind to the HIV antigens. Conjugate particles bind to the antigen-antibody complex and thereafter, accumulates at the test line. Non-specific antibodies bind to conjugate particles, forming a control line.

Procedure

Personal protective equipment (PPE) was worn, the expiry date on the test strip packaging was checked, and a latex medical examination glove was worn. New gloves were used for each patient. The foil/plastic covering the test strip was removed carefully so as not to touch the strip itself. Alcohol swab, was used to sterilize the patient's fingertip, and then allowed to dry before pricking the fingertip with a sterile lancet to get about 5-10µl of blood using a capillary tube. The lancet was discarded into the sharp box immediately after piercing the finger. Then, few drops of blood sample were dropped on the sample pad of the test strip and a drop of buffer was added for optimization, the presence of two lines on the strip indicates that the patient is HIV positive and

the diagnosis is tested confirmed. But the presence of a line on the HIV test strip indicates that the patient is HIV negative and the diagnosis can also be annulled (void).

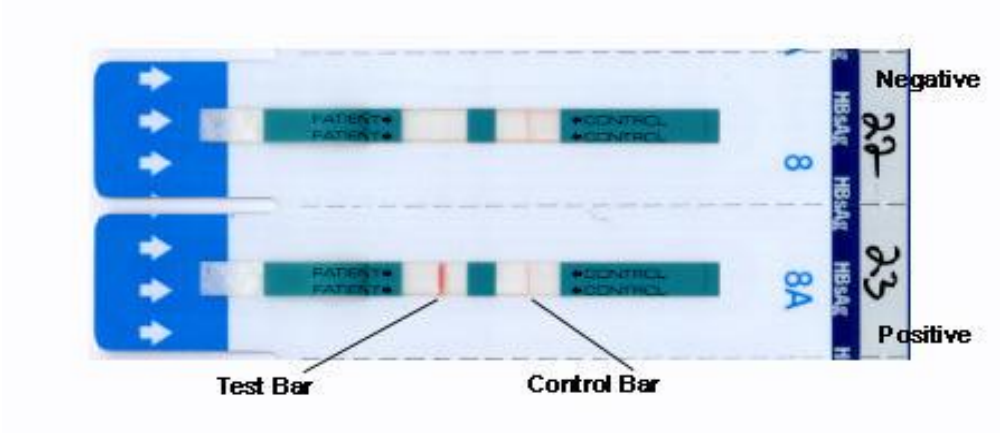

Figure 4.1.1.3: HIV Test strip

4.1.1.4 Widal Test

A Widal test is a method that can be used to help make a presumptive diagnosis of enteric fever, also known as typhoid fever. Enteric fever is a threatening illness caused by infection with the bacterium, *Salmonella enteric serotype typhi* (*S. Typhi*). Widal test is an agglutination test which detects the presence of serum agglutinus (H and O) in patients' serum with typhoid and paratyphoid. It was developed by Georges Ferdinand Widal in 1896. Bacterial suspension which carries antigen will agglutinate on exposure to antibodies to *Salmonella* organisms. Patients' suffering from enteric fever would possess antibodies in their sera which can react and agglutinate serial doubling dilutions of killed, coloured *Salmonella* antigens in an agglutination test.

Principle

The widal test is based on the agglutination reaction between antibodies in the patient's serum and antigens from the Salmonella Typhi. Antibodies (Immunoglobulins-IgM, IgG) produced by the patient's immune system in response to Salmonella Typhi infection in the serum recognize and bind to specific epitopes on the antigens. The antibodies then form cross-links between antigens,

creating a network of antigen-antibody complexes which aggregates, forming visible clumps. The antigens used in the test are “H” and “O” antigens of *Salmonella Typhi* and “H” and “O” antigens of *S. Paratyphi*. The paratyphoid “O” antigens are not employed as they cross react with Salmonella typhi “O” antigen due to the sharing of factor 12 and it is not specific enough to distinguish between typhoid and paratyphoid. “O” antigen is a somatic antigen (cell wall component) and “H” antigen (flagella component) is flagellar antigen.

Materials Used for Widal Test

1. Widal test kit (containing salmonella typhi/salmonella paratyphi antigens)
2. Serum or blood sample (collected in a sterile tube)
3. Test tube
4. Centrifuge
5. Gloves
6. Dropper
7. Syringe and needle
8. Tourniquet
9. Alcohol swab
10. Widal test glass slide or tiles

Procedure

The blood sample was gotten using the venipuncture method, and then centrifuged for not more than 2mins at 1,500-2,000 x g (gravity) to separate into its different layers. After centrifuging, one drop of the patient’s serum was dropped using a dropper on the eight circles on the widal test glass slide and the antigens were added to it. It was mixed together and rocked for the duration of five minutes. The result was read with the rating scale of 1:360 titer value. The most reacted and

agglutinated portion took 1:360 (definite infection), a fairly agglutinated portion took 1:40-1:80 (possible infection), a merely agglutination took 1:20- 1:40 (borderline result-Equivocal), and no agglutination was denoted as 1:20 (no significant antibody response). These titer values indicate the level of antibodies against the Salmonella paratyphi in the patient's serum.

Positive Result: When there is agglutination, it is a positive test result and if the positive reaction is observed with 20ul of test sample, it indicates presence of clinically significant levels of the corresponding antibody in the patient serum.

Negative Result: When there is no agglutination, it is a negative test result and indicates absence of clinically significant levels of the corresponding antibody in the patient's serum.

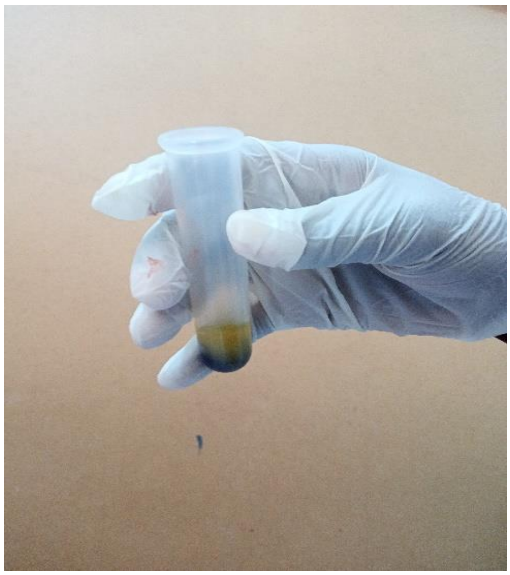

Figure 4.1.1.4a: Centrifuged whole blood

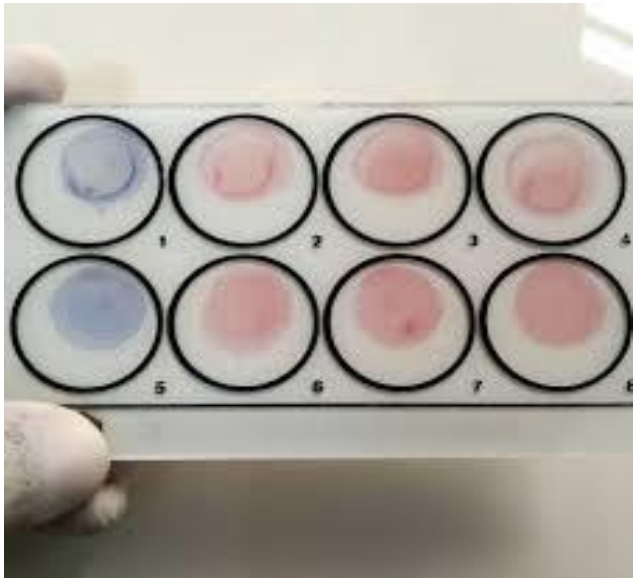

Figure 4.1.1.4b: Widal test glass slide

4.2 CLINICAL CHEMISTRY SECTION

Clinical Chemistry, also known as clinical biochemistry is the branch of laboratory medicine that deals with the analysis of bodily fluids, such as blood, urine, and cerebrospinal fluid, to diagnose

and monitor various diseases and disorders. These tests include, routine tests, specialized tests, urinalysis tests, toxicology tests and Point-of-Care Testing (POCT).

4.2.1 Tests Carried Out in the Clinical Chemistry Section:

The following tests carried out were;

4.2.1.1 Blood Glucose

This is a Point-of-Care Testing that is done using a Glucometer. It is a test that helps in the estimation of the glucose present in a patient's blood. Glucose is a type of sugar; it is the body's main source of energy. A hormone called insulin helps move glucose from the blood stream into the cells. Too much or too little glucose in the blood can be a sign of a serious medical condition. The glucose in the blood is obtained from the food taken in. This glucose gets absorbed by intestines and distributed to all of the cells in the body through the bloodstream and breaks it down for energy. The body tries to maintain a constant supply of glucose for the cells by maintaining a constant blood glucose concentration. The concentration of glucose in the blood, expressed in mg/dl, is defined by the term glycaemia. The value of blood sugar in humans generally ranges from 70 - 100 mg/dL (3.9-6.1mmol/L) for Fasting Blood Glucose and 70-200mg/dL (5.9-11.0mmol/L) for Random Blood Glucose. Blood sugar levels are regulated by the hormones, insulin and glucagon, which act antagonistically. These two hormones are secreted by the islet cells of the pancreas, and thus are referred to as pancreatic endocrine hormones. When the blood glucose levels are high, insulin hormone secreted which causing liver to convert more glucose molecules into glycogen and when the blood glucose levels are low glucagon secreted and act on liver cells to promote the breakdown of glycogen to glucose and increases the blood glucose concentrations. Essentially blood glucose levels determine the time of secretion of these hormones.

The blood glucose level is easily changed under the influence of some external and internal factors such as body composition, age, physical activity and sex. Diabetes is a disease related by the abnormal metabolism of blood sugar and defective insulin production. So, blood sugar levels are an important parameter for the study of diabetes. The level of glucose circulating in blood at a given time is called as blood glucose level. The blood glucose level varies at different time on various part of the day. Hypoglycemia is a possible side effect of diabetes medications in which blood glucose level drops below 70mg/dl. In people with diabetes, the body doesn't produce enough insulin or respond to insulin properly. The result is that sugar builds up in the blood stream, damaging the body's organs, blood vessels and nerves. The blood glucose analysis is ordered to measure the amount of blood at the time of sample collection. It is used to detect both hyperglycemia and hypoglycemia and via helping the diagnosis of diabetes. An ideal blood glucose estimation method should determine only glucose. It is adaptable for both macro- and semi-micro- techniques. Reagents are relatively inexpensive and the method should require a minimum of time, techniques and apparatus, be accurate and yield reproducible results. Glucose oxidase is an enzyme highly specific for glucose and is not react with blood saccharides. So, it has been employed for the estimation of blood glucose. High blood glucose level (hyperglycaemia) may be a sign of diabetes (a disorder that can cause heart disease, blindness, kidney failure and other complications). Low blood glucose level (hypoglycaemia) can also lead to a major health problem, including brain damage, if not treated. These are different tests to determine the blood glucose level of a patient: The time of sample collection divides this test into 2 types, which include: Fasting Blood Sugar (FBS), Random Blood Sugar (RBS).

1. **Fasting blood sugar:** The patients must stay clear of food for about 8-12hours before glucose analysis can be done. That is no caloric intake for at least 8hours.

4. **Random blood sugar: T**he sample can be collected any time of the day and does not involve the patient staying away from food for a certain period. The test is carried out using the Glucometer.

   The normal value ranges for the serum and plasma levels are as follows:

   FBS : 3.9 -6.1mmol/L

   RBS : 6.0-11.0mmol/L

If the patient is below the reference range (normal value), it is hypoglycemia which can lead to redness, body weakness, then the action of insulin secretion must be inhibited.

If the patient is above the reference range, it is then hyperglycemia, which results in hypertension, and ultimately diabetes with the classic symptoms of polydipsia, polyphagia and unexplained weight loss.

Materials Used for Blood Sugar Test

1. Glucometer
2. Test strips (compatible with the glucometer)
3. Lancet device (for finger stick)
4. Sterile lancets (for single-use)
5. Gloves
6. Alcohol swab
7. Capillary tube

Procedures

Personal protective equipment (PPE) was worn, the expiry date on the test strip packaging was checked, a latex medical examination glove was worn, and new gloves were used for each patient. Alcohol swab, was used to sterilize the patient's fingertip, and then allowed to dry before

pricking the fingertip with a sterile lancet. The first drop of blood that result was wiped off to avoid cross interference. Then, the finger was pressed firmly to get another concentrated and pure drop of blood of about 5-10µl of blood using a capillary tube. The lancet was discarded into the sharp box immediately after piercing the finger. The blood was then dropped on the test strip inserted in the glucometer and then reading was taken accordingly.

Figure 4.2.1.1a: Glucometer

Figure 4.2.1.1b: Blood glucose test strip

4.2.1.2 Urine Analysis

Urine is a liquid waste product produced by the kidneys and excreted through the urinary system. It is a vital component of the body's waste removal process. Normal urine consists of approximately 95% water and 5% waste products being made up of urea, uric acid, creatinine, sodium, potassium, chloride, calcium, phosphate. The composition varies widely from day to day depending upon the food and fluid intake.

Urine is normally clear and pale yellow in colour, due to the presence of pigment, urochrome, which is said to be a compound of urobilin, urobilinogen and a peptide substance. Urochrome is a

product of endogenous metabolism, and it is fairly constant in amount from day to day. In concentrated urines, there is the same amount of urochrome, thereby giving a much darker appearance, ranging from dark yellow to brown-red in colour.

Urinalysis test is a test of urine used to detect and manage a wide range of disorders such as urinary tract infection, kidney disease, diabetes, etc., using a urine dipstick test. Urinalysis involves checking the appearance, concentration and content of the urine. Macroscopical and chemical examination of urine may yield useful information in many abnormal conditions. Infections of the kidneys, ureters, bladder and urethra may result in the presence of pus cells, red blood cells and organisms in the urine. When the kidney becomes inflamed, various types of casts may be identifiable in the urine. Reducing substances, ketone, bile, and protein can be found in a variety of pathological condition.

Principle

The principle of Urine Dipstick Testing is based on chemical reactions between the urine sample and the reagents coated on the dipstick pads. The enzymatic reactions produce colored products in which the changes indicate presence or absence of analytes.

Materials Used for the Test

1. Urine dipstick (urinalysis test strip) with desired parameters
2. Gloves (Latex or nitrile)
3. Clean sterile container (e.g. Universal bottle)
4. Reference chart
5. Fresh, midstream urine sample
6. Timer

Procedure

The urine sample collected was obtained after a period of not less than four hours of urine retention. The mid-stream urine sample was collected in a sterile universal bottle while having gloves on. A urine test strips or dipstick which is a basic diagnostic tool used to determine pathological changes in a patient's urine in standard urinalysis is dipped into the urine ensuring all pads were submerged for a maximum of 1-2 seconds, and excess urine was tapped off. The standard urine test strip that may comprise up to ten different chemical pads or reagents which reacted (changed color) when it was immersed in, and removed from the urine sample, the result was read in as little as 60 to 120 seconds after it was dipped in the urine by comparing color changes on the strip to the reference chart. The analysis includes testing for the presence of leukocyte, nitrite, blood, protein, glucose, ketones, pH, specific gravity, bilirubin, urobilinogen. The results were all documented in the patient's medical chart.

pH: This indicated acid-base balance. The lungs and kidneys are the main regulator of an organism's acid/alkali balance. The balance is maintained through the controlled excretion of acidic hydrogens in the form of ammonia ions. Monohydrogenated phosphate, weak organic acids and through the reabsorption of bicarbonate through glomerular filtration in the convoluted tubules of the nephron, the pH of urine normally vary between 4.5 and 8 with the first urine produced in the morning generally being more acidic and the urine produced after meals generally more alkaline. The determination of urinary pH has two objectives, one is for diagnostic and the other is for therapeutic. On the other hand, it provides information regarding the balance between acid and alkali in a patient and allows identification of the substances that are present in the urine.

Specific gravity: This indicated hydration level. The specific gravity of urine is the measure of the density of the substances dissolved in it depending on the number of dissolved particle and their mass.

One of the kidneys important functions is to reabsorb water after glomerular filtration. This complex process of reabsorption is usually one of the first renal functions to be affected by disease, the molecules with the greatest mass contributes more to the measure of specific gravity than smaller molecules.

Blood: This indicated haematuria. Blood may be present in the urine in the form of intact red blood cells (haematuria) or as the product of red blood cell destruction, haemoglobin (haemoglobinuria). Blood present in large quantity can be detected visually. Haematuria produces cloudy red urine, and haemoglobinuria appears as a clear red specimen. The most common causes of haematuria are: neuphrolithiasis, glomerular disease, tumors, pyelonephritis, exposure to nephrotoxins, and treatment with anticoagulants. Non-pathological haematuria can be observed after strenuous exercise and during menstruation. Haemoglobinuria is not detectable using a microscope due to the lysis of red blood cells in the urinary tract.

Glucose: This indicated diabetes. Under normal conditions, nearly all glucose removed in the glomerulus is reabsorbed in the proximal convoluted tubule, if the glucose level increases, as happens in diabetes mellitus, the capacity of the convoluted tubule to reabsorb glucose is exceeded (an effect known as *renal reabsorption threshold*). The detection of glucose by test strips is based on the enzymatic reaction of glucose oxidase. This enzyme is catalyzed by the oxidation of glucose.

Ketone: It indicates diabetic ketoacidosis. Ketone bodies refer to three intermediate products (acetone, acetoacetic acid, and beta-hydroxybutyric acid) in the metabolism of fatty acids. Elevated concentrations of ketones are not generally found in urine, as all these substances are completely metabolized, producing energy, carbon(II)oxide and water. However, the disruption of carbohydrate metabolism can lead to metabolic imbalances and the appearance of ketones as a

by-product of the metabolism of an organism's fat reserves. An increase in fat metabolism can be the result of starvation or malabsorption, the inability to metabolize carbohydrates (as occurs for example, in diabetes mellitus) or due to losses from frequent vomiting.

Bilirubin: Bilirubin indicates liver disease. It is a highly pigmented compound that is a by-product of haemoglobin degradation. The haemoglobin that is released after the mononuclear phagocyte system (located in the liver and spleen) withdraws old red blood cells from circulation and degraded into its components (iron, photoporphyrin, and protein). The system's cells convert the photoporphyrin into unconjugated bilirubin that passes through the circulatory system bound to protein, particularly albumin. The kidney is unable to filter out this bilirubin as it is bound to protein, however, it is conjugated with glucoronic acid in the liver to form water-soluble conjugated bilirubin. This conjugated bilirubin does not normally appear in the urine as it is excreted directly from the intestine in bile. Intestinal bacteria reduce the bilirubin to urobilinogen, which is later oxidized and either excreted with feces as stercobilin or in the urine as urobilin. Conjugated bilirubin appears in the urine when the normal degradation cycle is altered due to obstruction of the biliary ducts or when the kidney's functional integrity is damaged. This allows the escape of conjugated bilirubin into the circulation as occurs in hepatitis and hepatic cirrhosis. The detection of urinary bilirubin is an early indication of liver disease and its presence or absence can be used to determine the causes of clinical jaundice.

Urobilinogen: This also indicates liver disease. Intestinal bacteria convert the conjugated bilirubin that is excreted by the bile duct into the intestine into urobilinogen and stercobilinogen. Part of the urobilinogen is reabsorbed into the intestine then circulated in the blood into the liver where it is excreted. A small part of this recirculated urobilinogen is filtered out by the kidneys and appears in urine (less than 1mg/dl). Any deterioration in liver function reduces its ability to process the

recirculated urobilinogen, the excess that remains in the blood is filtered out by the kidney and appears in urine. When hemolytic disorders occur, the amount of unconjugated bilirubin that is present in the blood increases, causing an increase in hepatic excretion of conjugated bilirubin, resulting in increased amounts of urobilinogen that in turn causes an increase in reabsorption, recirculation and renal excretion.

Leukocytes: Leukocytes, also known as white blood cell are a central part of the immunes system which indicates infection. The urine test strip for white blood cells detects leukocyte esterases, which is present in azurophilic granules of monocytes and granulocytes. A positive test for leukocyte esterases normally indicates the presence of bacteria and a positive nitrite test. Infections caused by trichomonas, Chlamydia and yeast produce leukocyturia without bacteriauria. The inflammation of the renal tissues (intestinal nephritis) can produce leukocyturia, in particular toxic interstitial nephritis with predominant eosinophils.

Protein: Of the routine chemical tests performed on urine, the most indicative of renal disease is the protein determination. It indicates kidney damage. Proteinuria is often associated with early renal disease, making the urinary protein test an important part of any physical examination. Normal urine contains very little protein, usually less than 100-300mg/l or 100mg per 24hours is excreted. This protein consists primarily of low-molecular weight serum proteins that have been filtered by the glomerulus and proteins produced in the genitourinary tract. Due to its low molecular weight, albumin is the major serum protein found in the plasma, the test is more sensitive to albumin because albumin contains more amino groups to accept the hydrogen ions and other protein.

Nitrite: This indicates bacterial infection. This test is a rapid screening method for possible asymptomatic infections caused by nitrate-reducing bacteria (enteric bacteria). Negative results

can be obtained in the presence of non-nitrate-reducing microorganisms. Nitrate-reducing bacteria need to remain in contact with nitrate for long enough to produce detectable amounts (first urine produced I the morning or at least with a urine retention of 4hours).

Diseases Identified with a Urine Test Strip

- Disease of the kidney and urinary tract
- Carbohydrate metabolism disorders (diabetes mellitus)
- Liver disease and haemolytic disorders
- Urinary infections

Reagent	**Read time**	**Composition**	**Description**
Specific Gravity (SG)	60 seconds	Bromothymol blue indicator; buffer and non-reactive ingredients	Determines urine Specific Gravity between 1.000 and 1.030. Results correlate with values obtained by refractive index method within 0.005
pH	60 seconds	Methyl red sodium salt; bromothymol blue; non-reactive ingredients	Permits the quantitative differentiation of pH values within the range of 5-9.
Leukocytes (LEU)	120 seconds	Derivatized pyrrole amino acid ester ; diazonium salt; buffer; non-reactive ingredients	Detects Leukocytes as low as 10-15 white blood cells (Leu/µL) in Clinical urine.

Nitrite (NIT)	60 seconds	P-arsanilic acid; N-(1-naphthy) ethylenediamine; non- reactive ingredients.	Detects sodium nitrites as low as 0.05-0.1 mg/ dL in urine with a low specific gravity and less than 30mg/dL Ascorbic acid.
Protein (PRO)	60 seconds	Blue; buffer and non-reactive ingredients.	Detects protein concentration as low as 0.12-0.15mg/Dl
Glucose (GLU)	60 Seconds	Glucose oxidases; peroxidise; Buffer; 3,3',5,5'-tetra methylbenzidine (TMB); non-reactive ingredients.	Detects glucose as low as 25-40 mg/dL (1.25-2 mmol/L) in urine with a low specific gravity.
Ketone Bodies (KET)	60 seconds	Sodium nitroprusside buffer	Detects acetoacetic acid as low as 5mg /dL (0.5mmol /L)
Urobilinogen (URO)	60 seconds	4-methoxybenzene diazoniumtetrafluoroborate; buffer and non-reactive Ingredients	Detects urobilinogen as low as 0. 8~ l.0mg/dL (13.6-17µmol /L)
Bilirubin (BIL)	60 seconds	2,6-dichloroaniline; buffer and non-reactive ingredients	Detects bilirubin as low as 0.6- 0.8mg / dL (10.2 -13 .6µmol/L)
Blood (ERY, Hb)	60 seconds	3,3',5,5'- tetramethylbenzdine (TMB); diisopropylbenzene	Detects intact erythrocytes as low as 5~ 10 Ery/µL or 0.015-0-03 mg/dl

		dihydroperoxide; buffer and non-reactive ingredients	haemoglobin in urine specimens with ascorbic acid content of < 5Omgl /dL

4.3 MICROBIOLOGY TEST SECTION

Microbiology testing is the process of detecting, identifying, and characterizing microorganisms (bacteria, viruses, fungi, parasites) in various samples. It plays a crucial role in diagnosing infections, guiding treatment decisions, and preventing outbreaks. The tests include;

1. Bacteriology test: A test which detects and identify bacteria such as *Neisseria gonorrhoeae*.
2. Virology test: A test which detects and identify viruses.
3. Mycology test: A test which detects and identify fungi.
4. Parasitology test: A test which detects and identify parasites.
5. Molecular Microbiology Test: A test which uses DNA/RNA techniques to detect microorganisms.

4.3.1 Test Carried Out in the Microbiology Section Include;

Gonorrhea Test (*Neisseria gonorrhoeae*)

Neisseria gonorrhoeae is a gram-negative, diplococci bacterium that causes sexually transmitted infections (STI) gonorrhea. It is non-motile and non-spore forming. *Neisseria gonorrhoeae* exhibits distinct biochemical properties, including oxidase positivity, catalase positivity, urease negativity, nitrate reduction positivity, and glucose fermentation positivity. These characteristics aid in its identification and differentiation from other Neisseria species.

Neisseria gonorrhoeae inhabits human mucosal surfaces, particularly the genital, oral, and rectal areas. It thrives in warm, moist environments. The bacteria adhere to epithelial cells, invade tissues, and trigger inflammation, leading to tissue damage and immune evasion.

Neisseria gonorrhoeae possesses several virulence factors, including: Pili (facilitates adhesion to epithelial), outer membrane proteins (contributes to invasion and immune evasion), lipooligosaccharides (induce inflammation) and IgA1 protease (cleaves immunoglobulin A1, impairing host immunity).

Materials Needed for Gonorrhea Test

1. Microscope
2. Clean glass slide
3. Cover slip
4. Gram stain
    - Crystal violet
    - Iodine
    - Acetone
    - Safranin
5. Swab samples (urethral, cervical, vaginal)
6. Sterile swab stick
7. Gloves

Procedure

Swab sample from the urethra, cervix, or vagina was collected using sterile swab stick, the swab was rolled on a glass slide to create a thin smear and then allowed to air dry. Crystal violet stain was applied for a duration of 1-2 minutes, then it was rinsed with distilled water. Iodine was then applied for not more than 1-2 minutes, and thereafter, rinsed with distilled water, it was decolorized with acetone for 30 seconds to 1 minute, and then rinsed with distilled water. Lastly, it was counter stained with safranin for 1-2 minutes and rinsed with distilled water.

The stained slide was then placed under the microscope and observed at 100x magnification to identify *Neisseria gonorrhoeae* diplococci.

Result Interpretation

Positive result: presence of *Neisseria gonorrhoeae* diplococci

Negative result: absence of *Neisseria gonorrhoeae* diplococci

Equivocal result: inconclusive or unclear results

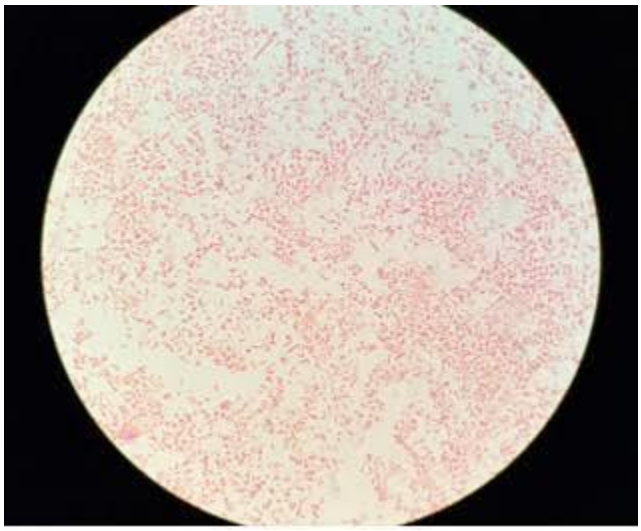

Figure 4.3.1: Microscopic view of Neisseria gonorrhoeae

CHAPTER FIVE

5.0 Summary, Conclusions and Recommendation

5.1 Summary of Attachment Activities

The six months industrial attachment with ABICARE HOSPITAL has been one of the most interesting, productive and instructive experience. It has exposed me to real work experience that I would otherwise not have gained from theoretical studies in tertiary institutions.

I was also exposed to the operations of other departments such as medical laboratory scientist and laboratory technologist with their roles and importance in the hospital laboratory.

I learnt how to handle and use several equipment and instruments in the laboratory, such as the Hb Hemoglobin testing system, microscope, the centrifuge, etc. I've learnt how to collect blood samples using the venipuncture method (syringe to get blood through the vein), capillary puncture (collection of blood from the small prick on the finger using a sterile lancet).

I was able to acquire more knowledge as regards to how patients are to be treated, communicated to, and also the importance of keeping medical records of patients and the confidentiality of a patient's medical history. I've also been able to meet and interact with several workers, colleagues and people in fields related to mine which has consequently helped me in building my future career.

The SIWES (Student Industrial Work Experience Scheme) programme made me discover and realize that there is more knowledge to be learnt outside the four walls of the classroom and beyond the school environment, this knowledge added more value and experience to prepare me for the journey ahead as soon-to-be graduate. I sincerely appreciate SIWES for giving me this opportunity.

5.2 Problems Encountered

In the course of carrying of the programme to me, the major problem encountered was the difficulty in securing a SIWES placement. Another problem encountered was distance from my home to my place of attachment, which cost much to afford transport fare. Lastly, restriction to use some of the equipment due to their expensive cost.

5.3 Suggestions for the Improvement of the Scheme

In view of the relevance of SIWES programme, it is important that it is sustained by the government through the industrial training fund (ITF) as it exposes the students to work tools, facilities and equipment that may not be available in their respective institutions in relation to their course of study. From my observation during the six months SIWES programme, the following are my suggestions for the improvement of the scheme:

1. The government and the school authority should assist the student in securing a good place for their SIWES programme, as some students found it difficult to secure a place relevant for their course of study. Such problems could render the scheme ineffective.
2. ITF allowances should be made available to students monthly during the course of the training so as to minimize financial difficulties that may arise as a result of transportation.