CHAPTER ONE

INTRODUCTION

1.0 INTRODUCTION

Knowledge and Technology Transfer is the connecting link between basic and applied research and between applied research and development.

- Commercial utilization and economic exploitation of Intellectual Property Rights (IPR), especially *patents*, are one aspect of Knowledge and Technology Transfer between science and economy.
- Licensing and sale of patents have a long tradition in the Anglo-Saxon countries (Research Corporation founded 1912 in the USA).

1.1 DEFINITION OF RESEARCH METHODOLOGY

Research is derived from two words: **Chercher**; meaning to ***seek*** or to ***search***, and **Re**; meaning ***again***. Research can be defined as an enquiry carried out to secure information for solving problems. On the other hand, it is simply the process of arriving at dependable solutions to problems through the planned and systematic **collection**, **analyses** and **interpretation** of data. It is the most important tool for advancing knowledge, for promoting progress and for enabling man to relate more effectively to his environment, to accomplish his purposes and to resolve his conflicts.

Comment [S11]: •Systematic, controlled investigation of presumed relationships among variables

Medical Laboratory research has experienced a remarkable growth of late, providing scientists with knowledge from which to practice. Yet many health care questions remain to be answered by researchers and many answers remain to be used by practicing personnel.

It is thus important for Medical Laboratory personnel at all levels to develop research skills. These are achieved with the aid of related subjects; Clinical Laboratory Diagnosis, Clinical Laboratory Management, Quality Control (QC)/ Quality Assurance (QA), Statistics / Biostatistics, Communication (Language: English/ French/ German/ Spanish/ Dutch) and Sociology, amongst others. In this wise, theory, education and practise are linked together by scientific research.

1.2 TYPES OF RESEARCH

There are three types of research:

- Fact-finding which consists of a search for facts without any attempt to generalize or to use these facts to solve a problem.
- Critical interpretation which makes use of the method of logical reasoning to arrive at the solution of problems.
- Complete research which aims at solving problems and stating generalizations after a thorough search for the pertinent facts.

Further, research can be classified in various ways; based on write-ups or methodology and design.

1. **Base on write-ups**: Write-ups vary from school to school and include; Seminar paper, Dissertation, and Theses, as well as the level of the research or education.

2. **Base on methodology and design**: This is base on application and there are several types. These are; descriptive (historical and documentary research, longitudinal studies, and cross-sectional studies), developmental, correlation research, true experimental, quasi experimental, case or field research, causal comparative and action research.

The nature of the problem plays a major role in determining what approach(es) is/ are suitable.

a) Descriptive: The purpose is to describe systematically a situation or area of interest factually and accurately for instance population census studies, public opinion surveys.

There are different types of descriptive research that may be worth considering; historical and documentary research, longitudinal studies, and cross-sectional studies.

b) Developmental: The purpose is to investigate patterns and sequences of growth and / or changes as a function of time for instance a longitudinal study following an initial sample of 200 children from six months of age to adulthood.

c) Correlational: The purpose is to investigate the extent to which variations in one factor correspond with variations in one or more other factors based on correlation coefficients for instance to investigate the relationship between food intake and glucose/ or haemoglobin levels in chickens or rabbits.

d) True experimental: The purpose is to investigate the possible cause-and-effect relationships by exposing one or more experimental groups to one or more treatment conditions and comparing the results to one or more control groups not receiving the treatment (random assignment being essential). For instance; to investigate the effects of "fever grass", or "*dogo yaro*" on malaria patients identified in the St Elizabeth's Catholic General Hospital Shisong, using random assignment to groups receiving three different levels of the extract and two control groups with and without a placebo respectively.

e) Quasi-experimental: The purpose is to approximate the conditions of the true experiment in a setting which does not allow the control and/ or manipulation of all relevant variables.

1.3 THE IMPORTANCE OF RESEARCH IN THE HEALTH SETTING

The main goal of any profession is to provide its customers/ clientele with maximum effective and efficient services. This goal can be attained through research as follows:

1. **Professionalism**: There is the increasing need to extend the base of Clinical Laboratory Diagnosis knowledge. This can be achieved only by research, as it is an important tool in health care delivery.

2. **Accountability**: The quality of laboratory practice cannot be improved until information-based accountability becomes a part of laboratory practices. Scientists who merge research evidence into their clinical decisions are being professionally accountable to their clients and are helping technicians to achieve their own identity.

3. **Social Relevance**: Today all health care professionals are asked to document their role in the delivery of health services.

1.4 THE PROBLEMS OF RESEARCH IN CAMEROON

Numerous factors hinder research efforts in Cameroon and many Sub-Saharan countries. These are:

1. Illiteracy: This remains the most serious problem facing Cameroonians and the people of West and Sub Sahara Africa. Though there are advancements in educational standards, illiteracy rates are still high in Cameroon, Chad, Nigeria, Sierra Leone, Ghana, Mali, Central African Republic due to ignorance, poverty, capital flight, civil strife, "brain drain" and disasters.

Illiterates cannot read and write and so cannot attend to questionnaires or communicate well.

2. Secrecy: Many regions in Cameroon tend to have a special liking for secrecy. Even in the Ministries, information for public consumption is considered "secret". People dislike any activity that appears as "nosing around" or trying to probe them.

3. Scanty/ Paucity statistics: Research in Shisong/ Cameroon is still in its infancy. Most of the background data are not readily available.

4. Language: Some tribes (Ewondos, and Nsos in Cameroon; Tutsis and Hutus in Rwanda; Ibos in Nigeria) in Sub-Sahara Africa are so fund of their language that it will need only one of theirs to cope with them.

1.5 THE PURPOSE OF SCIENTIFIC RESEARCH

In research studies, there is the occurrence of the question, "Why do research?" It is, therefore, as well to be sure of what can be gained from undertaking a research-based study or from simply taking a research perspective in your pursuit of a deeper understanding of an initiative or situation at work.

It may be an end in itself if you embark on a specific research for a qualification, for instance to be awarded a diploma or a degree in MLT. However employers and sponsors are keen on the advantages that research enquiries are yielding. Thus the purposes of scientific research are:

- to gain an academic qualification or professional experience, for the individual,
- to provide solutions/ suggestions to problems faced by a profession/ institution,
- to further make use of existing evidence to solve problems,
- to analyze situations which go beyond description, and
- to provide interpretations for past, present and future problems.

1.6 RESEARCH LEVELS DEFINED

As research grows, levels are defined. These are:

- Level I (Practice),
- Level II (Collaboration)
- Level III (Participation)
- Level IV (Research Leadership)

CHAPTER TWO

THE NATURE OF SCIENCE

2.0 THE NATURE OF SCIENCE

The fundamental purpose of science is the accumulation and classification of experience, and the systemization of such experience into a relatively small number of broad general laws and principles governing the specific categories into which phenomena are classified. In the early stages of science, the task is to gather, define and classify experiences in order to obtain an understanding of their inter-relationships. In the latter stages, the task is to reduce to a minimum the number of laws necessary to express these relationships.

2.1 WHAT IS SCIENCE? THE TRAITS OF A MODERN SCIENTIST

It is the systematic (step-by-step) study of nature. This is done by the use of the scientific method (2.2 below). There are many branches of science; classified according to different fields of study: Health sciences, Food/ agricultural sciences, Environmental sciences; according to subjects of study: biology, physics, chemistry, and economics.

Anyone who studies or pursues a carrier in anyone of the branches of science is called a scientist. Some of them are biologists, chemist, entomologists, Medical Laboratory Technologist, and have traits which are common to them.

The Traits of a Modern Scientist: The modern scientist must realize that science itself is amoral, and that the scientist *per se*, has neither obligations nor responsibility for h/ her findings. But as a citizen of a country, this puts h/ her under obligation and responsibility. The modern scientist is faced with moral problems beyond those of the average citizen.

As for features, there is no standard "scientific personality" that characterizes all scientists. Generally they are considered non-social intellectuals who seldom go out of their laboratories. However the following traits should be typical of a scientist:

1. Enthusiasm and research zeal,
2. Intelligence, adaptability, resourcefulness and versatility,
3. Creativity, initiative, originality, ingenuity and intuitiveness,
4. Expertise and competence in their area of investigation, and
5. Determination and drive.

Other traits frequently encountered in literature are intellectual curiosity, open-mindedness, and freedom from bias, persistence and thoroughness.

2.2 THE SCIENTIFIC METHOD

Science could be said to put forward a consistent and structured picture of the world. These are however not true for some aspects of life; for instance religion. However, science demands that ideas

should be tested against the real world. Experiments, where possible are essential to the "scientific method". The scientific method is not a single structured procedure; it is an exclusive way of arriving at the "truth". It is actually a collection of beliefs and activities, stressing three processes that interact with each other. These are; to **explain**, to **quantify**, and to **predict**. This then leads to the purposes of science; Describe, Explore, Explain, Predict and control.

The stages/ steps in the scientific method are:

- A hypothesis: This is actually the question or topic of work to be done.
- The aim(s):
- A theory: this is a model for an answer to the question.
- Methodology.
- Analyses of data.
- Discussion(s), conclusion(s) and recommendation(s).

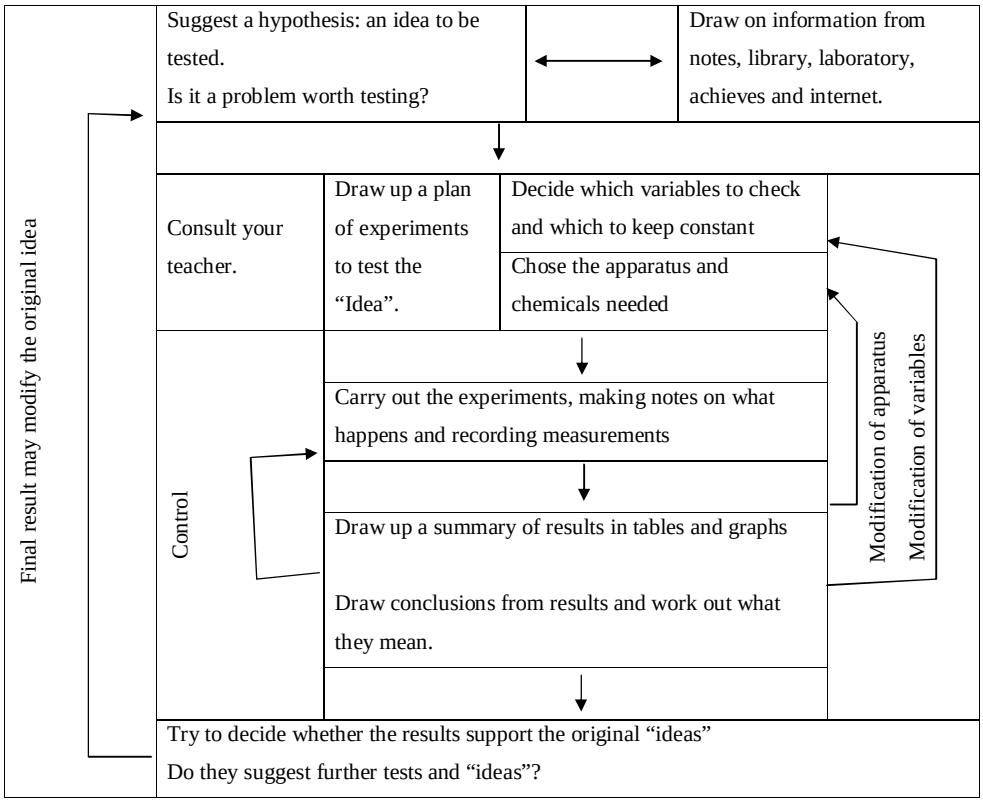

Figure 1: The steps in the scientific method

2.3 THE RESEARCH QUESTION

2.3.1 The Research Question

The research question is a concise, interrogative statement written in the present tense and including one or more variables or concepts.

Research questions focus on:

- Describing variables
- Specifying the population being studied
- Examining testable relationships among variables

Research questions should:

- Define specific question area
- Reflect a review of the literature
- Identify the potential significance to MLT
- Reflect the feasibility of studying the research question

Some examples of research questions include;

1. Do self-management educational interventions improve haemoglobin levels and decrease morbidity in children and adolescents with parasitic infections? MLT

2. How do women with ovarian cancer experience cancer recurrence? SRM/ MW

3. Do patients with low haemoglobin levels who perceive active consumption of green vegetables certain about a better quality of life? MLT

In framing a research question, three Key elements are important:

1. The situation (patient, patient population)
2. The intervention
3. The outcome (effect of treatment/ intervention): Does it make a difference?

2.3.2 Variables

A variable is an attribute or property in which organisms vary (people, events, and objects). The following three variables are sorted in this course;

1. The **independent** (*x*) and **dependent** (*y*) variables: The independent variable; which has the presumed effect or cause on the dependent variable (*y*). This variable can be manipulated or can not be manipulated by the investigator. The dependent variable, the presumed effect that varies with a change in the independent variable (*x*), it is usually not manipulated. Generally, the questions are;

- Is *x* related to *y*?
- What is the effect of *x* on *y*?
- How are x_1 and x_2 related to *y*?

This is the most useful way to categorise variables, because it is easily applicable, and simple.

2. The **active** and **attribute** variables: In this case, the manipulated variables are the active and measured variables. Examples of active variables include; anxiety, fear, and happiness. Those that cannot be manipulated and measure are the attribute variable.

3. The **continuous** and **categorical** variables: A continuous variable is one that can take an ordered set of values within a certain range; age ranges, haemoglobin ranges amongst others. Categorical variables are otherwise called nominal variables, for instance ABO blood groups, gender, race and so forth.

2.4 WHAT IS A HYPOTHESIS?

A hypothesis (*Pl*: hypotheses) is a formal statement of the expected relationship(s) between two or more variables in a specified population that suggests an answer to the research question. It is a statement that predicts the outcomes of a study.

Hypotheses are propositions or statements about reality which you wish to test in your research. On the other hand, a hypothesis is a conjectural statement of the relationship between two or more variables in a population. This conjecture may or may not be true. They are always in declarative sentence form, and they relate either generally or specifically, variables to variables.

Hypotheses are guides to the investigator or researcher in the entire process of research endeavour and they keep the researcher on the main line of his study. They tend to serve as assumed answers to his principal questions, the correctness of which he assesses in the course of the study. Open-mindedness and persistent objectivity in testing his hypotheses during the course of the research study are essential.

2.4.1 Types of Hypotheses (H_o and H_a or H_1 and H_2)

There are two types of statistical hypotheses for each situation: the null (H_o or H_1) and the alternative (H_a or H_2) hypothesis.

The **null hypothesis** is a statistical hypothesis that *states that there is no difference between a parameter and a specific value, or that there is no difference between two parameters.* The **alternative hypothesis** (operational or research hypothesis) on the other hand *states that there exists a difference between a parameter and a specific value, or that there exists a difference between two parameters*. In addition to these two, is the **general hypothesis**.

2.4.2 Hypotheses Writing or Formulation. Considering the Dependent Variable *y* and the Independent Variable *x*

Hypotheses are statements you wish to test. It puts forward a considered view of a relationship between two or more variables; $y = f(x)$ for two variables, or $z = f(x) + f(y)$, or $y = f(x_1) + f(x_2)$ for more than two variables. The formulation of hypotheses is essentially parallel to the selection of a suitable *research problem* or *research question*.

In hypothesis writing, it is important to note the following;

- Variables to be tested
- Population to be studied
- Design to be used

- Outcomes predicted
- Causal: Cause and effect versus associative
- Simple: Relationship between 2 variables
- Complex: Relationship between 3 or more variables
- Directional: States which way the relationship should exist
- Nondirectional: States the relationship exists, but not the direction
- Null (H_o): Statistical hypothesis
- Research: Alternative hypothesis (H_1 or H_a)

Is the research feasible by virtue of its hypothesis, in terms of;

- Time
- Money
- Expertise
- Access to subjects
- Facilities and equipment
- Is it ethical?

Some examples of hypotheses are:

1. There will be a significant difference in menopausal hot flashes between conditions of fasting and experimentally sustained (130-140 mg/dl) blood glucose concentrations. MLT or SRN or MW

2. There will be a positive relationship between phase-specific telephone counseling and emotional adjustment in women with breast cancer and their partners. SRN or MW

3. The incidence and degree of severity of subject discomfort will be less after administration of medications by the Z-track intramuscular injection technique than after administration of medications by the standard intramuscular injection technique. SRN or MW

4. Therapeutic back massage (TBM) will reduce the effects of stress experienced by spouses of patients with cancer as measured by a positive change in mood, a decrease in perceived stress, heart rate, and blood pressure at two post-intervention time points compared to a control group of spouses of patients with cancer. SRN or MW

Let's consider the following situations in the formulation of hypotheses;

Situation A: An MLT II student is interested in finding out whether anti-retrovirals (ARVs) will lead to drug toxicity of the liver. He is particularly concerned with the GPT/ GOT levels of the patients on ARVs. Will the GPT/ GOT levels increase, decrease or remain unchanged after a patient takes the medication?

Since the student researcher knows that the mean GPT/ GOT levels for the population under study is GPT (4 – 17U/L for women and 6 – 24U/L for men), the hypotheses for this situation are H_o: μ = 4 – 24U/L and H_a: $\mu \neq$ 4 – 24U/L.

Situation B: An angry contractor (because of constant light interruptions) wishes to reduce electricity bills in Shisong by using a special type of insulation in cables. If the average of the monthly electric bills is

3.500Fcfa, his hypotheses about electricity costs with the use of insulation are H_o: $\mu \geq 3.500$Fcfa and H_a: $\mu < 3.500$Fcfa.

Exercise 1: State the null and alternative hypotheses for each of the following conjectures.

1. An SRN III student on posting at the PHC of the St Elizabeth's Catholic General Hospital (SECGH) thinks that if expectant mothers use vitamin pills, the birth weight of their babies will increase. The average birth weight of the population of Bui is 2.25 kg.

2. A graduate from GBHS Tobin feels that enrolling into MLT I or SRN I of the CSHS will change his job situation after graduation. He is not sure whether the number of the 2011 graduates from MLT III or SRN II to be employed will be higher or lower. In the past, the mean of MLT III or SRN III graduates employed was 35%.

3. A TCL worker of the SECGH Shisong hypothesizes that the mean number of confirmed seropositive patients on ARVs defecting from free treatment can be decreased by paying their "one-way" transport to the Centre. The mean number of defective cases per 1000 is 108.

After stating the hypothesis, the researcher's next step is to design the study. He selects the correct *statistical test*, chooses an appropriate *level of significance*, and formulates a plan for conducting the study. In situation **A**, for instance, the researcher will select a sample of patients who will be placed on ARVs. After allowing a period of time for the drug to be absorbed, the researcher will measure each person's GOT/ GPT levels.

2.4.3 Hypothesis testing (see statistics notes of MLT I). Experimentation, Validation (Accepting/ Rejecting H_o and H_a or H_1 and H_2) and Conclusion Leading to Theory

The formulation of a hypothesis is followed by testing. In order to find out whether 15-year old boys differ from 15-year old girls in language ability, it will be necessary to collect as large and as random a sample of boys and girls as possible. Next, verbal tests will be administered, and the means ascertained. A large difference in favour of the girls would offer strong evidence that girls of 15 are in general are more able linguistically than are boys of 15.

Considering situation A, if the mean GPT level of the sample was, say 4 – 24 U/L, the researcher would probably conclude that this difference was due to chance and would not reject the null hypothesis. But if the sample mean were, say, > 24U/L, then in all likelihood the researcher would conclude that the medication increased the levels of GPT of the users and would reject the null hypothesis. The question is, "Where does the researcher draw the line?" The difference must be significant and in all likelihood not due to chance. The numerical value obtained from a statistical test is called the **test value**.

In this type of statistical test, the mean is calculated for the data obtained from the sample and is compare with the population mean. Then a decision is made to reject or not to reject the null hypothesis on the basis of the value obtained from the statistical test. If the difference is significant, the null hypothesis is rejected. If it is not, then the null hypothesis is not rejected.

In the hypothesis-testing situation, there are four possible outcomes. In reality, the null hypothesis may or may not be true, and a decision is made to reject or not reject it on the basis of the data obtained from a sample. The four possible outcomes are shown in figure 2 below. Note that there are two possibilities for a correct decision and two possibilities for an incorrect decision.

	H_o True	***H_o False***
Reject H_o	**Error** Type I (alpha)	**Correct decision**
Do not reject H_o	**Correct decision**	**Error Type II (beta)**

Figure 2: Possible outcomes of a hypothesis test

A **type I (alpha) error** occurs if one rejects the null hypothesis when it is true.

A **type II (beta) error** occurs if one does not reject the null hypothesis when it is false.

The hypothesis-testing situation is likened to a jury trial, wherein there are four possible outcomes as in figure 3 below. In a jury there are four possible outcomes. Either the defendant is guilty or innocent, and he will be convicted or acquitted.

Exercise 2: (a) What kind of error is committed by Padre Fred if he punishes a student when he did not commit the crime? (b) What kind of error is committed if Padre Fred fails to punish a student when he actually committed the crime?

	H_o True (innocent)	***H_o False (not innocent)***
Reject H_o (convict)	**Error** Type I	**Correct decision**
Do not reject H_o (acquit)	**Correct decision**	**Error Type II**

Figure 3: Hypothesis testing and jury trial. The hypotheses are; H_o: The defendant is innocent, H_a: the defendant is not innocent (that is guilty)

Accepting or Not Accepting the Null Hypothesis

Testing the null hypothesis results in one of two outcomes:

1. / Accepting (failing to reject) the null hypothesis as true, in which case it is concluded that any differences in the results are:

(a) not statistically significant, therefore are probably

(b) due to sampling error or chance.

2. / Not accepting (rejecting) the null hypothesis as false, in which case it is concluded that any differences in the results are:

(a) statistically significant, therefore are probably

(b) due to some determining factor or condition other than chance.

Accepting the null hypothesis also means that the corresponding research hypothesis is not supported or disconfirmed. On the other hand, rejecting the null hypothesis also means that the corresponding research hypothesis has survived a test of disconfirmation and, in that sense, is supported.

The **level of significance** is the maximum probability of committing a type I error. This probability is symbolized as α (Greek letter **alpha**). That is, $P = \alpha$. The probability of a type II error is symbolized by β, that is $P = \beta$. In most hypothesis testing, β cannot easily be computed; however α and β are related in that decreasing one increases the other.

Statisticians generally agree on using three arbitrary significance levels: the 0.10, 0.05, and 0.01 level. That is if the null hypothesis is rejected, the probability of a type I error will be 10%, 5% or 1%, depending on which level of significance is used. Here is another way of putting it: when $\alpha = 0.10$, there is a 10% chance of rejecting a true null hypothesis; when $\alpha = 0.05$, there is a 5% chance of rejecting a true null hypothesis; and when $\alpha = 0.01$, there is a 1% chance of rejecting a true null hypothesis. In a hypothesis-testing situation, the researcher decides what level of significance to use. This is followed by choosing a *critical value* from a table of the appropriate test (say *z* – test, *t* – test, or another).

The critical value(s) separates the critical region from the non-critical region and has symbol C.V. The **critical** or **rejection** region is the range of values of the test value that indicates that there is a significance difference and that the null hypothesis should be rejected. The **non-critical** or **non-rejection** region is the range of values of the test value that indicates that the difference was probably due to chance and the null hypothesis should not be rejected. The critical value(s) could be on the right/ left side of the mean for a **one-tailed test**, or on both sides of the mean for a **two-tailed test**.

Hypotheses testing can be done using any one of the following statistical tests: *z* – test/ score for a mean, *t* – test for a mean, *z* – test for a proportion, *chi-square* (X^2) – test for a variance or standard deviation, the *Pearson* correlation Coefficient (*r*), the *Mann-Whitney* and *Wilcoxon* tests for non-parametric statistics, and analysis of variance (ANOVAR) – test (F – test).

Exercise 3: Project hope – TSSF Shisong reports that the average cost of rehabilitation of street children in Kumbo is 12,613,000Fcfa/year. To see if the average cost of rehabilitation is different at Njinikom, a researcher (Padre Fred) selected a random sample of 35 street children at Njinikom and found that the average cost of their rehabilitation is 12,613,000Fcfa/year. The standard deviation of the population is 1,625,500Fcfa/year. At $\alpha = 0.01$, can it be concluded that the average cost of a street child rehabilitation at a particular centre is different from 12,336,000Fcfa/year?

Solution

Step 1. State the hypothesis and identify the claim.

H_o: μ = 12,336,000Fcfa/year and H_a: $\mu \neq$ 12,336,000Fcfa/year (claim).

Step 2. Find the critical values. Since α = 0.01 and the test is a two-tailed test, the critical values are +2.58 and -2.58.

Step 3. Compute the test value.

$$Z = \left(\frac{X - \mu}{\sigma / \sqrt{(n)}} \right)$$; where X = sample mean, μ = population mean, σ = population standard deviation

$$Z = \left(\frac{12{,}613{,}000 - 12{,}336{,}000}{1{,}625{,}500 / \sqrt{(35)}} \right) = 1.01$$

Step 4. Make the decision. Do not reject the null hypothesis, since the test value falls in the non-critical region as shown in figure 4 below.

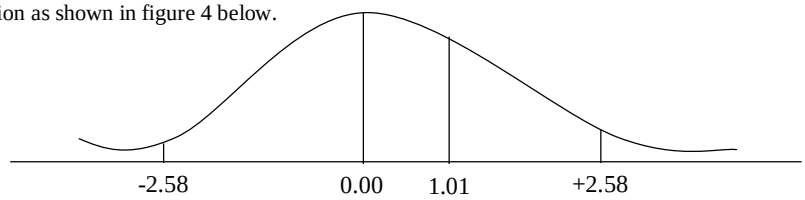

Figure 4: critical and test values for the example above

Step 5. Summarize the results. There is no enough evidence to support the claim that the average cost of street child rehabilitation at the particular centre is different from 12,613,000Fcfa/year.

The Outcomes of Hypothesis-Testing Situations

Students/ researchers sometimes have difficulty summarizing the results of a hypothesis test. Figure 5 shows the four possible outcomes and the summary statement for each situation.

	I. Claim is H_o	
Reject H_o		**Do not reject H_o**
There is enough evidence to reject the claim		There is not enough evidence to reject the claim
	II. Claim is H_a	
Reject H_o		**Do not reject H_o**
There is enough evidence to support the claim		There is not enough evidence to support the claim.

Figure 5: Outcomes of a hypothesis-testing situation

First of all the claim can be either the null or alternative hypothesis, and one should identify which one it is. Second, after the study is completed, the null hypothesis is either rejected or not rejected.

2.5 WHAT IS A THEORY? THE CHARACTERISTIC FEATURES OF A GOOD THEORY

A theory is an attempt of synthesizing and integrating empirical data for maximum clarification and unification. Every one has a number of personal theories based on postulates and assumptions of varying degrees of adequacy and truths from which he makes deductions of various degrees of cruciality and of course, of accuracy. The Medical Laboratory Scientist / Technician for instance, has many theories about patients. These may be based partially on personal experience, or reading of relevant literature.

Some Purposes of a Theory

1. It synthesizes isolated bits of empirical data into a broader conceptual scheme of wider applicability. It permits deeper understanding of data and translates empirical findings into a more readily understood, retained, and adequate form.

2. It permits the prediction of the occurrence of phenomena and enables the investigator (scientist/ technician) to postulate, and eventually, to discover the unknown and unobserved phenomena.

3. It acts as a guide to discovering facts; it pinpoints crucial aspects to be investigated and crucial questions to be answered. By identifying areas in need of exploration, it stimulates research in areas that are lagging.

4. Theory is based on the assumption that detailed empirical findings are special cases of more general laws, and that progress cannot be made as long as observations are simply accumulated. Theories cannot develop without empirical facts.

5. Just as facts underlie theories, theories underlie facts, each raising the other on a spiral to more scientific formulations. Research and theory go hand in hand; theory guides and stimulates research while research tests and stimulates theory development resulting in more adequate theories and better and clearer facts.

Characteristic Features of a Good Theory

A good theory must possess the following characteristics;

1. It must permit interpretations and deductions which can be tested empirically – that is, it must provide the means for its own interpretation and verification.

2. It must be compatible both with observation and with previously validated theories. It must be grounded in empirical data which has been checked and verified and must rest on sound postulates and hypotheses.

3. It must be stated in simple terms; that theory is best which explains the most in the simplest form. A theory must explain the data adequately and yet must not be so comprehensive and detailed as to be unwieldy.

4. Scientific theories must be based on empirical facts and relationships.

CHAPTER THREE

STARTING A RESEARCH

3.0 THE STEPS IN THE RESEARCH METHOD

A very good research is one which is well planned and assured of yielding significant and reliable results. The most effective insurance against unwitting errors is sound and thorough planning which foresees problems and makes acceptable allowances where unavoidable difficulties exist.

Thus the Medical Laboratory Technician/ Scientist, after conceiving a research idea/ or topic has to set up a plan in a way analogous to an architectural plan. Thus planning which is also called the **proposal**, has its specifications and always precedes the actual research work. In planning, the following steps are useful but may vary:

1. Basic difficulty/ Problem: What is it that has caught your interest?

2. Rationale and theoretical base: Can this be fitted into a conceptual framework that gives a structured point-of-view?

3. Statement of the purpose or problem: What is it that you plan to investigate? What are the general goal(s) of the study? What are the aims of the study? Define the problem.

4. Question(s) to be answered: When the research is finished, what is/ are the question(s) to which reasonable answers can be expected?

5. Statement of hypotheses or objectives: Spell out the particular research hypotheses you will test or the specific objective(s) at which the research is aimed. Be concrete and clear, ensuring each hypothesis or objective is stated in terms of **observable behaviour** allowing objective evaluation of the results.

6. Design and procedure: State who your subjects will be, how they will be selected, the conditions under which the data will be collected, treatment variables (say *x, y,* and *z*) to be manipulated, what measuring instruments or data gathering techniques will be used, and how the data will be analyzed and interpreted.

7. Assumptions: What assumptions have you made about the nature of the behaviour you are investigating, about conditions under which the behaviour occurs, about your methods and measurements, or about the relationship of this study to other studies and situations.

8. Limitations: What are the limitations surrounding your study and within which conclusions must be confined? What limitations exist in your methods or approach; sampling restrictions, uncontrolled variables, faulty instruments, and other compromises to internal and external validity?

9. Delimitations: Have you arbitrarily narrowed the scope of the study? Did you focus only on selected aspects of the problem, certain areas of interest, a limited range of subjects, and level of sophistication involved?

10. Definition of terms: List and define the principal terms you will use particularly where terms have different meanings to different people. Emphasis should be placed on **operational** or **behavioural**

definitions. The glossary is, in some cases preferred, if there are too many terms, and preferably taken to the end of the write-up. The glossary is however, mostly applicable to textbooks.

3.1 SELECTING A RESEARCH TOPIC/ SOURCES OF RESEARCH PROBLEMS

Many students/ researchers are faced with the problem of selecting a research topic; some abandon for new ones, while others continue till the end to re-start all over.

3.1.1 Guidelines for Selecting a Research Topic

Although there are no standard rules that, either singly or collectively, which will guarantee the suitability of a research problem, a number of suggestions might be listed for the guidance of the student/ researcher in selecting a research topic.

1. The topic must be of interest to the scholar. While interest sometimes develops familiarity it does not seem likely that the student can do h/ her best work on a topic that has no personal meaning for h/ her.

2. The topic should be sufficiently original that it does not involve objectionable duplication.

3. The topic must be researchable. Some problems are of a philosophical nature, that is, they can be discussed but not to the point where objective evidence can provide a solution.

4. The topic must be significant. Specifically the topic should be capable of adding new information to the present state of knowledge.

5. The research into the problem must be feasible. The scholar/ student must make sure that data are available in the situation in which h/ she finds h/ herself.

3.1.2 Choosing a Research Topic

Some students are more sensitive than others to the existence of problems and are, therefore, more capable of selecting suitable research topics. Two major factors involved in the selection of a topic are: **experience** and **creativity**. These can be broken down as follows:

1. Choose a topic you know something about. It is logical to expect that good problems stem from a clear understanding of the theoretical, empirical, and practical aspects of the subject, derived from personal experience and from a **thorough review of literature**.

2. Choose a topic on which you have an open mind. The second major contributor to the wide choice of a problem is creativity and the other, personality factors that make for originality, flexibility, initiative, ingenuity and foresight. These attributes must operate within the framework of what is already known, and generally, familiarity with the given field is conducive for original thinking. However you have to be guided by the following;

Inductive: Generalizations from specific observations, particular to general; Qualitative

Deductive: Hypothesis or questions from theory, general to particular; Quantitative

For a student seeking a problem for investigation, the following suggested questions are advantageous:

1. In your field of interest, what practical problems have to be met by those individuals who do the actual work?

2. In current and recent research, what problems are under active work?

3. What facts, principles, generalizations, and other findings have resulted from research in your field?

4. What practical implications for school work may be drawn from your results?

5. To what extent have the findings of research actually been applied in your field?

6. What problems remain to be subjected to research and what problems are now emerging?

7. What are the chief difficulties to be met in prosecuting the researches yet to be conducted in your field?

8. What are the interrelationships between research in your field and research in adjacent fields?

9. What research techniques or procedures have been developed in your field?

10. What concepts have been operative, either explicitly or implicitly, in the research in your field?

3.1.3 Research Designs, Methods and Strategies (in brief)

After selecting and choosing a topic, you will need to select the appropriate design for the study. A research design is described as a 'plan, blueprint or guide for data collection and interpretation – sets of rules that enable the investigator to conceptualize and observe the problem under study'.

In this light, there are different research designs, some of which are:

- survey research,
- experimental research,
- case studies, and
- progressive focusing designs amongst others.

3.2 WRITING A RESEARCH PROPOSAL. GUIDELINES FOR WRITING THE RESEARCH PAPER I

The aim(s) of this sub-topic is to empower the student to be successful in designing a study proposal for research and funding.

The Elements of a Research Proposal

- A **proposal** is the only way to inform your Sponsor/ funding agency and/or Supervisor on how you intend to carry out your work. A working proposal is a personal statement on how the research is going to be achieved. It is also called a protocol in some contexts. It may include the following sections in brief:
- A **background and problem statement** which is a detailed statement of the issue(s) to be researched, including references to other works, and perceives gaps in knowledge. This section should include a brief preliminary overview of the literature/ research (with references) done in the field related to the problem(s) and a statement as to how the research project will contribute to the solution of the problem(s) identified.
- **Objectives:** A brief statement of the specific objective(s) of the research.

- **Materials and methods (or simply methodology):** This is a statement detailing how the research objective(s) is/ are achieved. These include methods of data collection, laboratory procedures, and data analyses. Some proposals may include Time-table (time line), duration of study and budget.

In detail, there are the elements that are found in the research proposal, as follows:

A/ Project Title/ Cover Page

(a) **The title**: it should

- Be informative
- Bear no abbreviations.
- Be clear and unambiguous (don't make it "cute").
- The words you use in your title should clearly reflect the focus of your proposal. The most important words should come first, then the less important words.
- Try and use only a single sentence for your topic.

(b) **The cover page**: Cover pages vary for different institutions/ funding agencies. Thus check out the following when writing a proposal for research or funding.

- Check if your school/ funding agency has any specifications for a cover page.
- Usually the cover page includes signatures of key people in your institution/ organization (head of department, supervisor, contract officer, and so forth).
- If your proposal is built on collaborating with other groups or laboratories/ hospitals, it is usually a good idea to include their names on the cover page.
- Your cove page should look professional and neat. However, do not waste time using fancy report covers, expensive binding, or other procedures that may send the wrong message.

B/ Project Overview/ Executive Summary/ Abstract

(a) **Abstract**: This is a summary of the study which can only be written when the study has been completed. It is **not** a statement of intent. Its purpose is to provide an outline of the aim(s), methods, results and implications of the study for the busy reader. It is usually between 700 and 1,000 words in length (in CSHS, we ask for ≤ 300 words). In most cases it is usually one page, and is written in the past tense and needs to provide the following degree of detail.

- The research question or hypothesis (introductory paragraph).
- The theoretical framework used if appropriate (introductory paragraph).
- The general design (methodology paragraph).
- The sample size and features (methodology paragraph).
- The research methods used (Methodology paragraph).
- Key findings (results paragraph).
- Implications of the findings (Conclusion or discussion paragraph).

The abstract should normally have no citations that is referencing in the text. Further, the abstract is used only after carrying out the research work and doing a write-up for presentation/ publication.

There are usually two types of abstracts amongst others;

- Empirically-based
  - **I**. Introduction: What was the question?
  - **M.** Methods: How did you try to answer it?
  - **R**. Results: What did you find?
  - **D**. Discussion: What does it mean?

This format is called the IMRAD format and is the format used for scientific writing.

- Issues/Programme-based
  - Issue
  - Activities
  - Lessons learned
  - Recommendations

On the other hand, the Abstract is a summary of the study, with the primary emphasis on results and conclusions. Very briefly present the question(s) asked the experimental design, a summary of observations, and list conclusions. Be very succinct: the abstract should be a single paragraph, no more than one page. It should stand on its own; therefore, do not refer to any other part of the report, such as a figure or table. Avoid long sections of introductory or explanatory material. As a summary of work done, it is written in past tense. Start your introduction on new page.

(b) **Project overview/ Executive summary**

- Think of the Study Overview as an Executive Summary. Be specific and concise. Do not go into details on appeals of your proposal that are further clarified at a latter point in your proposal.
- The study overview should "paint a picture" of your proposal in the mind of the reader. It should establish the framework so that the rest of the proposal has a frame of reference.
- Use the study overview to begin to show your knowledge of the organization from which you are requesting funds. Key concerns of the funding organization can be briefly identified in relation to your proposed study.
- If you will be collaborating with other organizations make sure some of their interests are also highlighted in the study overview.
- The best time to prepare the study overview is after you have completed the entire proposal (and you understand all aspects of your proposal very well). Let the overview be your last piece of writing and then insert it at the beginning of the proposal.
- Try to keep in mind that someone will be reviewing your proposal and you will like to have this person be very positive about what you have written.

Exercise 4: State the difference(s) and similarities (if any) between an abstract and an overview.

It should be noted that your proposals here in the CSHS shall be read by the staff of your department. However, you may have someone out there more competent in terms of finances who could read and

finance your study. At any point in time, find out from your sponsor or supervisor or tutor the guidelines for writing an executive summary.

C/ Background Information/ Statement of the Problem/ Relevance of the Study

- Think of this section as a **Review of Relevant Literature**. Cite previous projects and studies that are similar to what you are proposing. Show the funding agency/ your parents/ school that you know what you are proposing because you are familiar with what has preceded you.
- Try to be careful in your use of language. You could ask a friend (a language expert) to read and correct your proposal before submission.
- Position your study in relation to other efforts and show how your study:

(i) will extend the work that has been previously done,

(ii) will avoid the mistakes and/ or errors that have been previously made,

(iii) will benefit patients/ clients/ public/ personnel and advance or influence policy.

- Use the statement of the problem to show that your proposed study is definitely needed and should be funded/ accepted for research.
- It is essential to include well documented statements of the need(s)/ problem(s) that is the basis/ bases of your study. What is/ are the pressing problem(s) that you want to address? How do you know this/ these problem(s) is/ are important? What other source(s)/ program(s) similarly supports this/ these need(s) as major need(s)?
- Check to see that the potential funding agency/ school is committed to the same need(s)/ problem(s) that your proposal addresses. Clearly indicate how the problem(s) that will be addressed in your study will help the potential funding agency/ school in fulfilling their own goals and objectives.
- Is there a special reason why you and/ or your organization is/ are uniquely suited to conduct the study? (Geographical location, language expertise, prior involvements in this area, close relationship to the study clientele, to mention a few).
- When you get to the methods section of your proposal, it will be important to refer back to the need(s) you have identified in this section (and show how your method(s) will respond to this/ these need(s)).
- Say if you have conducted a needs assessment (survey, interviews, focus groups write this as a short report to be cited and included in the proposal *preferably as an appendix*).

D/ Project Details/ Study Objectives

Identifying the research problem and developing a question to be answered are amongst the first steps in the research process.

(a) **Goals and Objectives**: Try to distinguish between your goals and objectives and include both in your proposal.

Goals are the large statements of what you hope to accomplish but usually are **not measurable**. They create the setting for what you are proposing.

Objectives are operational, tell specific things you will be accomplishing in your study and are **very measurable**. Your objectives will form the bases for the activities of your study and will also serve as the bases for the **evaluation** of your study.

Present measurable objectives for your study. If you are dealing with "things" it is easier for them to be measured than if you are dealing with abstract ideas.

(b) **The Research question**: This is the specific purpose of the study, stated in the form of a question.

The research question should apparently be a simple one and the scholar/ researcher should keep the question in h/ her mind at all times. Further, the research question should be designed such that it could be answered tentatively by hypothesis.

(c) **Hypotheses**: Hypothesis is/ are proposition(s) or statement(s) about reality which you wish to test in your research (**see section 2.4 above**). It is a tentative prediction or explanation of the relationship between two or more variables. A prediction to the answer to the research question.

(d) **Clientele/ Subjects/ Study population**: Include specific information about the population or clientele on which your study is focused. It is as well a defined set of items with certain properties.

- Exactly who / what are your subjects? Are they people, animals, objects, or events?
- In what ways have you already had contact with the clientele group?
- Can you show that you have the support of the clientele group to move ahead with the study?
- In what ways have members of the clientele group been involved in the preparation of the proposal?
- Which other agency/ agencies is/ are involved with this clientele group (and have they been included in your proposal)?

(e) **Methodology (Methods)/ or Methods and materials**: After selecting the right research question and deciding on the design of study, follows the selection of the method of enquiry. You should be able to answer yes to each of the following questions when choosing your method.

- Is this method going to get the kind of information I need?
- Can I be sure that I am building up as accurate a picture of the event(s) I am studying as I possibly can?
- Can I manage to do this with the people concerned in the time available?

However, in a proposal/ research write-up, the following elements are required:

(i) Study design: Experimental, quasi-experimental, hospital or community based, qualitative or quantitative study.

(ii) The **study area**

- Geographical location, temperature, climate (that is rainfall/ seasons).
- Kind of study; retrospective, perspective, progressive, or otherwise.
- Economy, social life style, housing.

(iii) Subjects/ **Clientele** (see above)

- Exclusion/ inclusion criterion/ criteria.
- Recruitment plans.

- Sampling; ordered, random, stratified, clustered amongst others.
- Method of assignment to study group(s)

(iv) Data collection: Data is a single item of data or information gathered in the research process. Collection of data is based on the design of the study and can use any of the following instruments of data collection; interviews, survey with or without questionnaires, and so forth.

Data collection strategies include:

- Physiological or biological measurements (laboratory measurements are included)
- Observational methods (laboratory measurements are included)
- Interviews
  - Open-ended
  - Closed-ended
- Questionnaires
- Records or available data
  - Hospital records
  - Historical documents
  - Audio or video tapes

The following are therefore enhanced in data collection;

- Variables; outcomes, predictors, confounders.
- Measures/ instruments.
- Procedure(s) and quality control.

(v) Statistical consideration:

- Sample size ($n = 300 \pm 5$, or $n \geq 300$ for hospital based study, and $n = 500 \pm 5$, or $n \geq 500$ for community based study). At the end of the study, state the percentage of the sample size that you realized in your study within the study period, for instance 100 out of the 150 filarial slides or stool samples were read, yielding a 66.67% realization of the sample size. Please try to keep up to the require sample size, by collaborating with your mates.
- Data presentation: Tables, frequency/ cumulative frequency tables, pie-charts, histograms, bar charts, or otherwise. Use tables alongside only one type of visuals; pie-charts only.
- Data analyses and interpretations: χ^2 – test (goodness of fit, or independence test), student t – test, F – test, analysis of variance (ANOVA) and others as deemed needed and fit. This also depends on whether the hypothesis was simple univariate or complex multivariate hypothesis.

(vi) Ethical consideration and clearance: Usually obtained in cases of work to be done on human subjects and is based on the study in question. Around here; Shisong or otherwise, they are usually signed by the Matron/ Director/ Chief Medical Officer of the hospital/ laboratory concerned, or the District Medical officer/ or the Medical officer for schools in the district of health services or schools concerned. In the Cameroon Baptist Convention (CBC), there is an ethical clearance committee that

scrutinizes the proposal as well as the curriculum of the scholar, prior signing the ethical clearance. The issue of setting up an ethical clearance committee is still a proposal and under scrutiny by the various diocesan health committees.

(vii) Materials: These should be divided into instruments and reagents. The following are important factors sorted for by prospective sponsors/ funding agencies:

- There should be a link between methods described and objectives previously defined. Be explicit in your writing and say exactly how the methods will fulfil your study's objective(s) and helps deals with the problem(s) in which your proposal is focused.
- Ensure you clearly present the innovative aspects of your idea.
- State if specific methods proposed are important to your clientele.
- This section should clearly indicate how the methods to be used will allow the outcomes of your study to have values for others beyond your study.

(f) **Staff/ Administration**: Use this section to describe the role(s) of your colleagues, who shall work with you. Also ensure that you state the role of your administration in your work.

E/ Available and Needed Resources

Available resources: It is important to make mention of the resources which are available. These include; local, institutional, appeals for funding, logistics.

Needed resources: These are the resources require for running the study from planning till reporting. They include;

(a) Personnel: (see staff/ administration).

- Include short descriptions of each of your collaborators.
- Ensure that you notify all those who are concerned.

(b) Facilities: State the facilities to be used; whether rental or not. Some are classrooms, laboratory collection rooms, cyber cafes, or otherwise.

(c) Equipment / Supplies/ Communication: Not all can be funded, but the following may be funded;

- Tape recorder
- Video cassette
- Computer system
- Desks/ chairs/ tables
- Lamps
- Intercom
- Photocopy machines.

It will help if you have really done a finding on the actual cost of equipment you specify.

How will you be sharing information of your study with others? Newsletter! Website! Notice board!

(d) Budget: Make your budget realistic.

- Have someone (a project designer) to review your budget and see how reliable you are.
- Check with your agency/ school to see if they have a suggested budget category that they want you to use.

Table I: A suggested budget format for a three year/ month/ semester/ term/ week funding proposal

	Period **1**	Period **2**	Period **3**
PERSONNEL			
Personnel ≠ 1, 2			
Sub-total			
FACILITIES (list)			
Classroom(s)			
Hall(s) / Dormitory			
Sub-total			
EQUIPMENT			
Centrifuge(s) et al			
Sub-total			
SUPPLIES (list)			
Reagents (List)			
Sub-total			
COMMUNICATION (list)			
Phone/ Fax			
Postage			
Sub-total			
TRAVEL			
Fuel			
Vehicle rental			
Sub-total			
Others that might not have been included (List)			
	Period **1**	Period **2**	Period **3**
TOTAL			
SUM TOTAL			

F/ Time Line: A clear indication of the time frame for the study and the times when each aspect of the study will be implemented. Try creating the time line as a graphic representation (not too many words). If done well it will help demonstrate the feasibility of the study in a very visible way. *This should be included preferably as an appendix.*

G/ Evaluation Plan: It is important to describe in your proposal exactly how you would decide whether or not your study has been successful, achieved its objectives, and so forth. The evaluation plan will tell the prospective funding agency how you will be going about showing them at the end of the study that their investment in you was a good one.

- If you plan to use a survey or questionnaire to help in evaluating the success of your study, you may want to include in the Appendices a draft of what you are considering for the questionnaire/ survey.
- Your evaluation plan does not have to be elaborate but it is important to indicate to the prospective funding agency that you have not forgotten this important step.

H/ Appendices: This should be devoted to those aspects of your study that are of secondary interest to the reader. Begin by assuming that the reader will only have a short time to read your proposal and it will only be the main body of your proposal (not the appendices). Then, assume that you have gotten the attention of the reader who would now like some additive information. This is the purpose of the appendices. Here are some possible sections to be included in the appendices:

- Dissemination plan
- Timeline
- Letters of support
- Cooperating agency descriptions
- Evaluation plans
- Authorization letters
- Maps
- Useful formulae

CHAPTER FOUR

PREPARING FOR THE RESEARCH PROPER

4.0 DESIGNING THE STUDY/ RESEARCH; SURVEY RESEARCH, EXPERIMENTAL RESEARCH, CASE STUDIES, AND PROGRESSIVE FOCUSING DESIGNS

The following designs are possible, but the experimental is mostly used by Medical Laboratory Technicians or Scientists.

Table: Types of research designs

Design	*When used*
Survey	Snapshot of setting/ views/ attitudes
Experimental	**Testing purposes. To identify causation (for instance effects of y upon *z*).**
Case studies	In-depth study of individual/ area/ setting
Progressive focusing	Understanding behaviour and social settings

Conceptually there is some overlap between these designs; for instance both case studies and surveys are largely descriptive and exploratory. In addition, different designs can draw on similar methods and forms of analyses. Some research questions however do not fit into the existing designs. However, irrespective of the type of research, it should serve to provide the plan for answering the research question or testing the hypothesis.

The **experimental research** is based on the scientific tradition, described as the 'Traditional Deductive Model' or 'Hypothetico-deductive Model' (Figure 6 below).

Basically, there are three types of experimental design

- One group pre-test-post-test,
- Pre-test-post-test control group design, and
- The quasi-experimental pre-test-post-test design which is a variant of the second design.

The **survey** is a non-experimental, descriptive research method. Surveys can be useful when a researcher wants to collect data on phenomena that cannot be directly observed (such as opinions on library/ laboratory services). Surveys are used extensively in library and information science to assess attitudes and characteristics of a wide range of subjects, from the quality of user-system interfaces to library user reading habits.

In a survey, researchers *sample* a *population*. A *population* is any set of persons or objects that possesses at least one common characteristic. Examples of populations that might be studied are;

1. all 2010 graduates of the MLT at the CSHS of Shisong, or
2. all the users of CSHS libraries or laboratories.
3. all those who succeeded in the competitive entrance into the CSHS.

Since populations can be quite large, researchers directly question only a *sample* (that is, a small proportion) of the population.

Types of Surveys

Data are usually collected through the use of questionnaires, although sometimes researchers directly interview subjects. Surveys can use **qualitative** (for instance ask open-ended questions) or **quantitative** (for instance use forced-choice questions) measures. There are two basic types of surveys: **longitudinal surveys** and **cross-sectional** surveys.

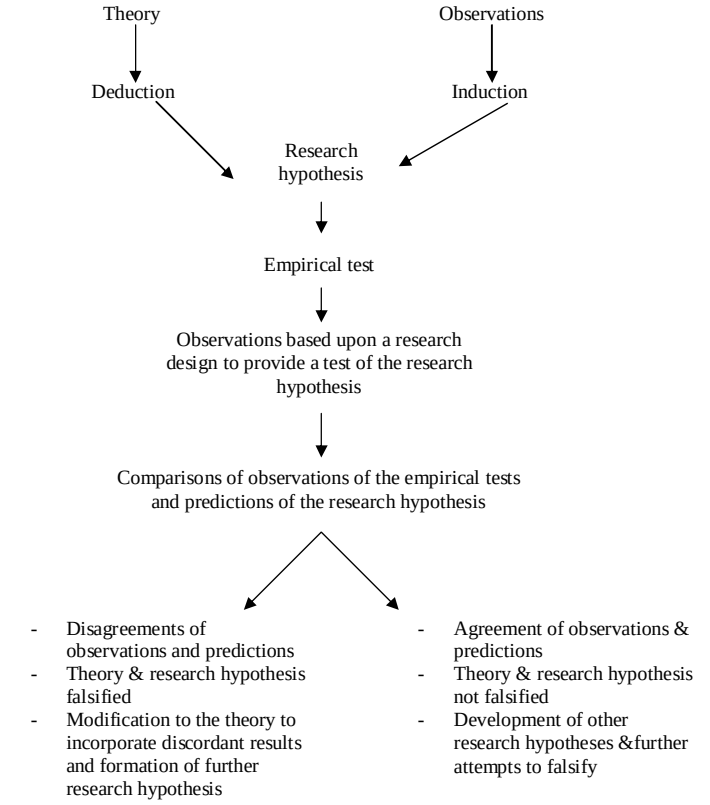

Figure 6: An experimental research design

a) Longitudinal Surveys; Longitudinal surveys gather data over a period of time. The researcher may then analyze changes in the population and attempt to describe and/or explain them. The three main types of longitudinal surveys are **trend**, **cohort**, and **panel** studies.

i. Trend Studies; Trend studies focus on a particular population, which is sampled and scrutinized repeatedly. While samples are of the same population, they are typically not composed of the same people. Trend studies, since they may be conducted over a long period of time, do not have to be conducted by just one researcher or research project.

A researcher may combine data from several studies of the same population in order to show a trend. An example of a trend study would be a yearly survey of librarians asking about the percentage of reference questions answered using the internet.

ii. Cohort Studies; Cohort studies also focus on a particular population sampled and studied more than once. But cohort studies have a different focus. For example, a sample of 2009 graduates of MLT at the CSHS of Shisong could be questioned regarding their attitudes toward paraprofessionals in libraries/ laboratories. Five years later, the researcher could question another sample of 2009 graduates, and study any changes in attitude. A cohort study would sample the same class, every time.

iii. Panel Studies; Panel studies allow the researcher to find out why changes in the population are occurring, since they use the same sample of people every time. That sample is called a panel. A researcher could, for example, select a sample of CSHS graduate students, and ask them questions on their library/ laboratory/ internet usage. Every year thereafter, the researcher would contact the same people, and ask them similar questions, and ask them the reasons for any changes in their habits. Panel studies, while they can yield extremely specific and useful explanations, can be difficult to conduct. They tend to be expensive, they take a lot of time, and they suffer from high attrition rates. *Attrition* is what occurs when people drop out of the study.

b) Cross-sectional surveys/ studies: These can be undertaken at a variety of scales. At the macro-scale they include the decennial census organized by the Office for Population Census, and Surveys (OPCS), whilst at the micro-scale, these studies include attitude or opinion studies of staff working in an educational or health-care setting; *CSHS or St. Elizabeth General Hospital* for instance. The survey is a valuable tool for the researcher. They are highly descriptive, highlighting what exists, but they can also form the basis of some statistical analyses (for instance correlation studies), whereby the collection of data allows the researcher to seek relationships between data.

For every type of survey, there is always planning and it involves a number of stages, and is usually organized according to the skill(s) of the researcher. Some of the points in the stages are; the research question, type(s) of sampling, pilot study, edit/ code, tabulate/ analyze, and report.

4.1 ESTABLISHING AND TESTING OF QUESTIONNAIRES (SAMPLING TECHNIQUES) AND SURVEY INSTRUMENTS.

A questionnaire is a group of questions, designed to obtain some information (data) from a defined sample of a population. It is made up of well structured **opened** or **closed** questions. Open-ended questions, are those to which the respondents provide answers, while close-ended questions are those for which the researcher provides options of answers to the respondent and h/ she simply ticks or 'codes'.

Question Design: It is important to design questions very carefully. A poorly designed questionnaire renders results meaningless. There are many factors to consider when designing a questionnaire, some of which are:

1. Make items clear (don't assume the person you are questioning knows the terms you are using).
2. Avoid double-barrelled questions (make sure the question asks only one clear thing).

3. Respondent must be competent to answer (don't ask questions that the respondent won't accurately be able to answer).

4. Questions should be relevant (don't ask questions on topics that respondents don't care about or haven't thought about).

5. Short items are best (so that they may be read, understood, and answered quickly).

6. Avoid negative items (if you ask whether librarians should not be paid more, it will confuse respondents).

7. Avoid biased items and terms (be sensitive to the effect of your wording on respondents).

Busha and Harter provided the following list of 10 hints for establishing questionnaires:

1. Unless the nature of a survey definitely warrants their usage, avoid slang, jargon, and technical terms.

2. Whenever possible, develop consistent response methods.

3. Make questions as impersonal as possible.

4. Do not bias later responses by the wording used in earlier questions.

5. As an ordinary rule, sequence questions from the general to the specific.

6. If closed questions are employed, try to develop exhaustive and mutually exclusive response alternatives.

7. Insofar as possible, place questions with similar content together in the survey instrument.

8. Make the questions as easy to answer as possible.

9. When unique and unusual terms need to be defined in questionnaire items, use very clear definitions.

10. Use an attractive questionnaire format that conveys a professional image.

Generally, a questionnaire should bear the title and purpose(s) of the research, an ethical statement on confidentiality of results (for laboratory based research), the questions organized to obtain data needed for the research only, the phrase “strictly confidential” at the end of the page, as well as the name of the analyst and supervisor. In addition to these, include a vote of thanks to the participant. After designing the questionnaire, it should be tested in a pilot study and possibly corrected before the actual research (figure 7).

Representative Sampling

A **sample** is *representative* when it is an accurate proportional representation of the **population** under study. If you want to study the attitudes of CSHS students regarding library/ laboratory services, it would not be enough to interview every 50^{th} person who walked into the library/ laboratory. That technique would only measure the attitudes of CSHS students who use the library/ laboratory, not those who do not.

In addition, it would only measure the attitudes of CSHS students who happened to use the library/ laboratory during the time you were collecting data. Therefore, the sample would not be very representative of CSHS students in general. In order to be a truly representative sample, every student at CSHS would have to have had an equal chance of being chosen to participate in the survey. This is called *randomization.*

If you stood in front of the CSHS main office and walked up to students, asking them questions, you still would not have a random sample. You would only be questioning students who happened to come to campus that day, and further, those that happened to walk past the CSHS main office. Those students who never walk that way would have had no chance of being questioned. In addition, you might unintentionally be biased as to who you question. You might unconsciously choose not to question students who look

preoccupied or busy, or students who don't look like friendly people. This would invalidate your results, since your sample would not be randomly selected.

If you took a list of CSHS students, uploaded it onto a computer, then instructed the computer to randomly generate a list of 2% of all CSHS students, then your sample still might not be representative. What if, purely by chance, the computer did not include the correct proportion of seniors, or honours students, or graduate students? In order to further ensure that the sample is truly representative of the population, you might want to use a sampling technique called *stratification*.

In order to stratify a population, you need to decide what sub-categories of the population might be statistically significant. For instance, graduate students as a group probably have different opinions than undergraduates regarding library usage, so they should be recognized as separate strata of the population.

Once you have a list of the different strata (*singular*; stratum), along with their respective percentages, you could instruct the computer to again randomly select students, this time taking care that a certain percentage are graduate students, a certain percentage are honours students, and a certain percentage are seniors. You would then come up with a more truly representative sample. (*Also refer to your statistic notebooks of MLT I*).

Exercise 5: Using the sample questionnaire in figure 7 as an example, write / design a questionnaire for any two of the following research topics:

1. Seroprevalence of syphilis and malaria parasitaemia in prospective blood donors visiting the St Elizabeth Catholic general Hospital Laboratory, Shisong – Kumbo.
2. Seroprevalence of viral infections in prospective blood donors visiting the St Elizabeth Catholic general Hospital Laboratory, Shisong – Kumbo.
3. Prevalence of anaemia in children (0 – 5 years) in Bui.
4. Prevalence of intestinal parasites amongst secondary students in the Kumbo Municipality.
5. Prevalence of intestinal parasites in human immune virus positive (HIV^+) and HIV^- individuals attending the Saint Elizabeth's Catholic General Hospital and Cardiac Centre Shisong.
6. Prevalence of Rheumatiod Factor (RF) and Anti-Streptolysin O (ASO) in patients presenting with arthritis visiting the Saint Elizabeth's Catholic General Hospital and Cardiac Centre Shisong

It should be noted that there are other types of questionnaires existing and that this is only one example amongst many.

PREVALENCE OF MALARIA PARASITAEMIA AMONGST PROSPECTIVE BLOOD DONORS VISITING THE ST ELIZABETH CATHOLIC GENERAL HOSPITAL, SHISONG

N.B: *Please fill the blank spaces, underline where necessary, and tick/ or code in the box(es) where necessary*

Purpose(s):	▪ To determine the rate of the malaria parasite amongst prospective blood donors visiting the Shisong Hospital laboratory. ▪ To identify groups which are at risk of transmitting the malaria parasite to patients.
Participation:	It is voluntary and free will. **Confidentiality of record**s: your information shall not be disclosed to anyone other than you, except on authorization to a third party.

1. Patient's/ Subject's/ Client's identification/ biodata

Name/ Serial Nº:	Age:	Gender: (**M/ F**):	Weight(Kg):
Profession:	Marital status: Single ☐, Married ☐, Divorced ☐, Widow(er) ☐		
Residence:	Ethnic group:	Province of origin:	Nationality:
Education status:	**0, 1, 2, 3**:		
Religion:	Christian (**1**), Muslim (**2**), Traditional (**3**)		

2. Blood donation record

a) Have you ever donated blood before? (**Y/ N**):

b) If **yes**, when? ≤ 4months ago ☐, 5months ago ☐, ≥ 6months ago ☐

c) How many times have you donated blood before? ≤ 3 ☐, 4 ☐, 5 , ≥ 6 ☐

d) Are you currently pregnant? Yes ☐, No ☐, I don't know ☐

e) Are you currently breastfeeding? (**Y/ N**):

3. Malaria History

a) Have you had fever in the last 3weeks? Yes (**A**), No (**B**), I don't know (**C**):

b) If **yes**, what kind of fever was diagnosed? Malaria, Typhoid, I don't know

c) If **malaria/ typhoid**, did you take treatment? (**Y/ N**):

d) If **yes**, where did you get treatment? Home (h), Hospital (**H**):

e) How often do you suffer from malaria? Never (**O**), Not very often (**1**), Once a year (**2**):

f) Do you have a treated mosquito net? (**Y/ N**):

g) If **yes**, how often do you treat it? Never, Not very often, Once a year, Twice a year

3. Laboratory test results

Blood group: A, B, AB, O. **Rh**: Pos, Neg			[Haemoglobin]$_{g/dl}$:
Syphilis:	**VDRL**: Reactive, Non-reactive		**TPHA**:
Malaria:	**Thick** film:	**Thin** film:	Specie:
Viral serology:	HIV:	HBsAg:	HCV:

Strictly confidential!!!

Thank you for your collaboration.

Supervisor: Name, for instance ***Mr. Cho Frederick***	**Analyst**: Name for instance ***Sherika Martha Nkor***

Key: M=Male, F=Female, Y=Yes, N=No, 0=No education, 1=primary education, 2=secondary education, 3=tertiary.

Figure 7: A sample questionnaire. Which other purpose(s) can this questionnaire serve? Which other topic can be applied (if any) to this questionnaire

4.2 ESTABLISHING AND TESTING OF STANDARD OPERATING PROCEDURES (SOPS). CALIBRATION OF EQUIPMENTS AND ESTABLISHING OF CALIBRATION CURVES AS NECESSARY

This consists of reviewing the laboratory methods to be used, commencing with reagent preparation(s). All the reagents required, are prepared according to manufacture's instructions as much as possible. In the course of the pilot study, the researcher or student should then test for the accuracy, precision and reliability of reagents prepared. This can be achieved by use of statistical formulae; standard deviation (SD; σ), variance (σ^2), and coefficient of variation (CV), to name a few. If the coefficient of variation is significantly small, it means the method(s) is/ are reproducible and reliable. Thus with varying concentrations of the standard (if there is any), calibration curves can be established, by plotting a graph of concentration against absorbance. To conclude, an SOP is established to be used in the course of the research.

4.3 RESEARCH TECHNIQUES: In Medicine and the Sciences, 3 types of research techniques are commonly used

Historical Research Technique; This is an attempt to understand a phenomenon by determining its process of growth and dynamics of internal change.

Descriptive Research Technique; These are designed to obtain pertinent and precise information concerning the current status of phenomena and whenever possible to draw valid general conclusions from facts discovered.

Experimental Research Technique; In research, experimental method establishes a logical association between manipulated factors and observed effects. The researcher defines a **problem** and proposes a tentative **answer** or **hypothesis**. He tests the hypothesis and accepts or rejects it in the light of the controlled variable relationship that he has observed.

The Historical Approach to Research: The process of learning and understanding the background and growth of a chosen field of study or profession can offer insight into organizational culture, current trends, and future possibilities. The historical method of research applies to all fields of study because it encompasses their: origins, growth, theories, personalities, crisis, and so forth.

Both quantitative and qualitative variables can be used in the collection of historical information. Once the decision is made to conduct historical research, there are steps that should be followed to achieve a reliable result. In the broadest terms, these are **content** and **discourse** analyses.

CHAPTER FIVE

THE RESEARCH WRITE-UP

GUIDELINES FOR WRITING THE RESEARCH PAPER II

There is a bit of variation in format, organization, referencing system and so on, but the basics are always the same. In all sections of the paper, present tense should be used to report background that is already established. For example, "The cell membrane is the barrier which separates the inside of the cell from the outside." Use future tense for work that you will do. For example, "We will test the hypothesis that some anti-microbial agents can permeate the cell membrane during division to inhibit growth." Always use past tense to describe results of a specific experiment, especially your own. For example, "Application of the antibiotic Chloramphenicol restricted growth of *E. coli*".

A Dissertation/ study may be said to contain three essential parts. These are;

- The preliminaries/ Front materials.
- The text; which consists of chapters 1 – 5 or body of the work.
- The reference matter; which in another context is known as the bibliography.

5.0 THE FRONT MATERIALS: The front materials, also known as the preliminary pages are made up of the following;

- Title Page/ Cover Page
- Certification
- Dedication(s)
- Acknowledgement(s) (where applicable)
- Abstract (IMRAD format) / include résumé in French if you are a francophone that is you will have both the abstract and the résumé in your write up. This is accepted widely in the world.
- Table of Contents (with page references)
- List of Tables (if any, with titles and page references)
- List of Figures (if any, with titles and page references); tables and figures should be listed separately and on different pages
- List of Appendices (if any, with title and page references)

Title page/ Cover page: The title page should bear the following;

- The name of the country: either in English **only** or both official languages followed by the motto.
- MINSANTE in full: either in English **only** or both official languages. For a Francophone, the French version should be written on the left and vice versa for an Anglophone. However, in the CSHS Shisong, it has been generally agreed that the Anglophone method be respected.
- CSHS in full, with logo (if possible; logo should be a microscope with a snake coiled round it) and motto (*The Patient's Recovery is our Pride*).
- Department of MLT in full that is, "Department of Medical Laboratory Technology".
- The officially approved title of the Dissertation followed by the candidate's full name

- Particulars of submission should appear on the lower half of the page and should read "A **Dissertation**/ **Study** submitted in partial fulfilment of the requirements for the award of a Medical Laboratory Technology Diploma". This shall be respected without customization, except your supervisors asks you to do so.
- The date of presentation, for instance; *Shisong, July 2011 or simply; July 2011.*

REPUBLIQUE DU CAMEROUN
Paix-Travail-Patrie
****

REPUBLIC OF CAMEROON
Peace-Work-Fatherland
****

MINISTERE DE LA SANTE PUBLIQUE
****

MINISTRY OF PUBLIC HEALTH
****

CATHOLIC SCHOOL of HEALTH SCIENCES

The Patient's Recovery is our Pride

Comment [MTH2]: The microscope should be rounded with a snake. This is different from that of the nurses and midwives

DEPARTMENT OF MEDICAL LABORATORY TECHNOLOGY

Your topic

By

Your name

A Dissertation Submitted in Partial Fulfilment of the Requirements for the Award of a Diploma in Medical Laboratory Technology

SUPERVISOR
Supervisor's name
Supervisor's qualifications

Place of Presentation

Month, Year of Presentation

Comment [MTH3]: For instance, Shisong

- The colour of the cover pages should be **ORANGE for Medical Laboratory Technology**, **Blue for Nurses**, **and Pink for Midwives**.

The person reading, grading or judging a scientific paper (or final write-up) can be most objective if the author remains anonymous while the paper is read. Your name, date, and title of the paper should be on a cover page, and not on any other part of the paper.

Certification: This is also known as the rubric of the validating institution (available from your tutor/ supervisor).

***Dedication(s)*:** This page is usually reserved for dedications to the Almighty, loved ones; parents, guardians, uncles/ aunts … When there is only one dedication, it is titled "**Dedication**", but if more than one, then it is titled "**Dedications**" that is, in plural. For instance;

In Thankfulness Dedicated to

GOD ALMIGHTY, for His abundant mercy, care and love throughout my life and stay in Shisong; the cradle of Health Education in Cameroon;

And to my family members

PARENTS: Papa's Name, Mama's Name; through whom God gave me life, for their love and care in raising me up;

SIBLINGS: Brother/ Sister1, Brother/ Sister2, Brother/ Sister3…

***Acknowledgement(s)*:** Credit must be given to individuals who have made significant contributions to the research. These may, for example, include supervisors, technicians, and organizations (example: providers of financial support, facilities, and so forth). If there is only an individual to be acknowledged, it is titled in singular. Hierarchy and qualification of those acknowledge is highly discriminated here!!! It is equally emphasized in the CSHS that you acknowledge your supervisors first on a single paragraph, and that you must seek the consent of some dignitaries before acknowledging them.

Abstract: The abstract bridges the gap between the title and the main body of the thesis, and should be brief and informative. It should broadly summarize the overall content of the dissertation, point out new information, and may replace the need for a summary. It should lay emphasis on results and conclusions. The abstract should be restricted to one page (approximately 300 words or less). (*Refer to proposal write-up for more details*).

Table of contents: The table of contents appears after the title page, dedication(s), acknowledgement(s) and the abstract, and does not, therefore, index dissertation/ study preliminaries. It does list, in order, the list of tables, list of figures, and the title of major divisions and subdivisions exactly as they appear in the body of the dissertation/ study. Also included are items of reference matter. If there is a list of appendices this is incorporated with the other preliminaries in the table of contents.

List of tables, figures and appendices: Tables and figures are otherwise termed as visuals. How do the visuals support your points and get your ideas across? List of tables, figures and appendices should appear on separate pages. Tables and Figures are numbered consecutively throughout the manuscript. No distinction need be made between drawings, diagrams, graphs, maps, photographs, amongst others; they should all be designated as figures. Ensure that all the visuals are clearly labelled with captions / titles and sources, and remember to refer to each, and comment on its significance in the text.

5.1 CHAPTER ONE: *INTRODUCTION/ NATURE AND BACKGROUND OF THE STUDY*

It should have some or all of the following, in the order 1.0, 1.1, 1.2, … Introduction, Statement of the problem, Background of the problem, Rationale for the study, Research question(s) and / or hypotheses, Assumptions and Definition of Operational Terms.

The purpose of the introduction is to orient the reader. It should contain a statement of the problem being investigated so that the reader can proceed with the nature and purpose of the dissertation/ study in mind. It will briefly outline the aim(s), objective(s) (general and specific or only general), scope and general character of the research/ study, not forgetting the research question and the hypotheses, assumptions and definition of terms. The definition of terms may be substituted with a glossary, in the case of a textbook, which is included in the list of appendices.

5.2 CHAPTER TWO: *LITERATURE REVIEW/ PRIOR RESEARCH AND RELATED RESEARCH*

The review of literature is frequently incorporated as a separate section, with the object of providing a concise, up-to-date and orderly review of the state of knowledge (prior and related research) that has direct relevance to the problem being investigated. In literature search; library or internet, always use reading cards (see later sections).

- Systematic summary and critical evaluation of scholarly literature on a topic
- Succinct; adequately represents positive and negative findings of an area
- Adequate number of resources
- Synthesis

5.2.1 The purposes for literature review: Literature review, can be done for one or all of the following reasons;

- For knowledge
    - Reviewing the literature
    - Reading to learn
- For a study
    - Known versus unknown
    - Gaps
    - Discover unanswered questions
    - Discover frameworks used to study the problem
    - Generate research questions/ hypotheses
    - Helps to narrow design and methods
    - Helps to determine need for replication
- As a consumer
    - Known versus unknown
    - Gaps
    - Traditions

- Strengths and weaknesses of an area
- Developing evidence-based practice uncovers a new practice that can be used or further tested or revised.

5.2.2 Use of the Library: Journals, Textbooks and Previous research: After having decided on the research question and the title, you are now ready to think about the different types of information you will need. These will have different sources and demands different skills from you as you seek and use them.

Library-based information includes articles, reports and books which will be used to support your arguments as you review the literature available and your decisions as you select your research design and research methods.

5.2.3 Use of internet: The internet can be used to browse documents on via the World Wide Web. Journals, books, and publications are being published electronically in ever growing numbers. Thus there is the need for you to structure your search queries, and to develop search strategies to help you access good quality information sources.

Some search engines you can use include; *Google*, *yahoo*, *aol*, … Some useful websites as well for health research topics are; www.healthinternetwork.net with ID cae 001 and password 53956, www.nejm.org, www.cdc.org, www.who.org, www.pubmed.entry, www.bmj.org, … In the internet search, if you happen to know the name of a researcher who has been published, you can search for h/ her name instead. For instance; type "name of researcher" and search.

Whether you are doing a library or internet search, always use index cards. The index card (simply an A4 paper) should contain the following information:

- Books (Secondary sources)
  - Author's surname (also known as first or given name) and initials
  - Date of publication
  - Title in full (and any subtitle)
  - Edition (if not the first)
  - Publisher's name and place of publication
- Periodicals/ Journals; Primary sources: (in addition to author, date and title; as above)
  - Number of volume(s)
  - Number(s) of pages that is, first – last pages (for instance 1110 – 1120)
- Any short notes about the article.

These cards should be cross-referenced to any notes you may have taken as you read the text that is shown in the card.

In this era of new technology, you could set up a research log; that is for those who have access to computers. The research log which is more efficient and accurate can be either in print or electronic form. Such a log can be used to jot down ideas about your topic and possible sources and to keep tract of print and online materials. Whenever you record an online source in your log, include the URL. The following can help you to set an electronic research log;

1. Create a new folder, and label with an easy to remember name.
2. Within this folder, create subfolders that will help you manage your project / study. These might include deadlines, notes on hypothesis, working bibliography, background information, organizational plan, visuals, drafts and others as deemed necessary.

You could equally use this log to record your thoughts on material you are reading, as well as links to websites.

In the course of your search for literature, ensure you keep the following in mind; the **research question**, the **scale of the library**, and be **orderly**.

Exercise 6: Using any three textbooks of your choice; write a review on any two of the following

- *Staphylococcal* infections,
- Clinical Laboratory Management,
- The malaria parasite,
- Quality Control and Assessment,
- Quality and Security,
- Sample collection and processing

5.2.4 References: Citations are made in the text, and a list is made in the end. This is also known as the bibliography.

Citation in the text could be as follows; … a prevalence of 5.7% (Ndiyun D, 2008), … The source of tables or figure is also cited at the foot of the table or figure and in brackets; for instance (MINSANTE, 2008). See details below.

In citing, single authorship has precedence over joint authorship, and is usually done alphabetically and in increasing order of date.

(Nchang FC, 2008)

(Nchang FC, 2010)

(Fon ST. and Nchang FC, 2008)

A. **The Harvard referencing method**: This is the listing of authors in alphabetical order at the end of the write up irrespective of how they occur in the write-up (see details at the end).

B. **The Vancouver referencing method**: It is the listing of authors with consecutive numbering as they occur in the write-up. In the text, references are marked with superscript Arabic numerals.

C. **The American Psychological Association (APA)**:

i) Use the **author's name** in a **signal phrase** to introduce the cited material, and place the date, in parentheses, immediately after the author's name. For a quotation, the page number preceded by *p*., appears in parentheses after the quotation.

> As Meyer (2011) observed, many female children in Djottin follow their mothers to the farm and thus are more exposed to the malaria parasites than males.
>
> Epie (2011) noted that "a few days after recipients receive blood from donors; the malaria and filarial parasites could be treated with anti malaria drugs" (p. 13).

ii) Author's name in a **parenthetical reference**: When you do not mention the author in a signal phrase in your text, give the author's name and the date, separated by a coma, in parentheses at the end of the cited material.

> One study found out that 90% of the malaria positive cases in Djottin are falciparum malaria (Meyer, 2011).

iii) Two authors: Use both names in all citations. Join the names with *and* in a signal phrase, but use an ampersand (&) instead in a parenthetical reference.

> Lonji and Nirus (2011) have suggested that more work should be done with a larger sample size in both study areas and for a longer period of time.

> A recent study has suggested that antiseptic techniques used in hospitals should be controlled quarterly in order to minimize hospital acquired infections (Afungdang & Apoumoun, 2011).

iv) Three to five authors: List all the authors' to the first reference. In subsequent references, use just the first author's name plus *et al.* ("and others").

> Lonji, Nirus, Nanyongo, and Ndzewiyiy (2011) reached different conclusions by designing a study that was less dependent on community survey than were previous studies.

> Based on result, Lonji et al. (2011) determined that students in senior secondary school classes took insignificant measures towards personal hygiene and sanitation.

v) Six or more authors: Use only the first authors' name and *et al.* in every citation, including the first.

> As Lonji et al. (2011) demonstrated, constant and prolonged health education is the potential for reducing intestinal parasites in the community.

vi) Corporate or group author: If the name of the organization is long, spell it out the first time you use it, followed by an abbreviation in brackets. In latter references, use the abbreviation only.

First citation **(**Centres for Disease Control and Prevention [CDC], 2006)

Latter citations (CDC, 2006)

vii) Unknown author: Use the title or first few words in a signal phrase or in parentheses. Italicize a book or report title; place an article in quotation marks.

> The school profile for the region substantiates this trend (*Guide to secondary schools*, 2003).

viii) Two or more authors with the same last name: If your list of references includes works by different authors with the same last name, include the authors' initials in each citation.

> S. Lonji (2011) conducted the groundbreaking study of intestinal parasitic infections in secondary school students.

ix) Two or more works by an author in the same year: Assign lowercase letters (*a*, *b*, and so on) alphabetically by title and include the letters after the year.

> Tekwe (2009b) examined this trend in more detail.

x) Electronic document: To cite an entire web site, include its address in parentheses in your text (http://.cshs.com); you do not need to include it in your list of references. Otherwise, cite a Web or electronic

document as you would a print source, using the author's name and date; including the chapter or figure, as appropriate, and giving a full citation in your list of references. To cite a quotation, include the page or paragraph numbers.

In his report, Ako stressed the importance of "ensuring continuous testing of the malaria parasite I primary school kids before drug administration" (2010, para. 3).

5.2.4 Permission to produce material: When literary material exceeds a certain length, permission from the author is needed before publication in your work. Any such information not permitted is considered as **plagiarized** material. Plagiarism is criminal and is sanctioned in some institutions by an indefinite suspension.

Further, some other useful information on the www is coded and needs to be paid for before access.

5.2.5 Critical analyses of scientific documents (journals): Please search the internet on this

5.3 CHAPTER THREE: ***Methodology***; In some write-ups, this is known as "Materials and Methods". Refer to the proposal write-up. Ensure you state how you would control your method in order to have relevant, reliable, reproducible, and precise results.

You must document all methods performed in your study. Do not, under any circumstances, report methods "word-for-word" from any of the written sources you used. You need to summarize, in your own words, what you did. Also, do not give unneeded detail. For example, instead of "I took up 1 ml of bacterial broth from a 5 ml tube with a 2 ml plastic pipette and expelled it onto the surface of one agar plate"; write "One agar plate was inoculated with 1 ml of bacterial broth". We can also see that in this latter sentence passive voice was used to report methods, a standard for most scientific publications. To give another example, one would write "Cells were grown at 37°C." instead of "We grew the cells at 37°C."

While it is tempting to report methods in chronological order in a narrative form, it is usually more effective to present them under headings devoted to specific procedures or groups of procedures. Some examples of separate headings are "Sources of Materials," "Inoculation Procedures", "Analytical Procedures", "Measuring Zones of Inhibition," and "Statistical Methods."

5.4 CHAPTER FOUR: *Results/ Data analyses*: This topic is also termed: Results, analyses, and interpretations.

Raw data include all observations or data that you get from your experiment. Raw data are never included in your scientific paper (or final write-up) unless they are needed to give evidence for specific conclusions which cannot be obtained by looking at an analysis, or summation, of the data.

Results obtained, should be presented in tables and any one of the following; histograms, pie charts, bar charts, scatter plots and frequency curves. You are advised to use tables and only one kind of **visuals** (the visuals must be uniform; pie charts only, or bar charts only). The data should be analyzed according to gender, age, marital status, race, dependent/ independent variables and making use of the statistical test(s); *chi* (χ^2) square – test, *z*/ *t* – test, … These statistical tests, should be used to test hypotheses proposed in chapter one (that is hypotheses testing).

Whichever aspect that is analyzed, should be grouped according to statistical norms; say four – five groups if pie charts are to be used. Results obtained, should be analyzed and interpreted according to the various variables as deemed by you and your supervisor; gender, age, marital status, location, or otherwise.

Typing Considerations: (This shall be applied to the whole document).

- Manuscripts typed in **double-spacing form with 14 characters, using Times New Roman** will be preferred. However one and half-spacing is the form accepted in the CSHS Shisong.
- There must be a margin of 30 mm (1.18") on the left-hand side of the page to allow binding, and minimum margin of 20 mm (0.7") on the right-hand side and 20 mm (0.7") at the top and bottom of the page, as required by the CSHS school regulations.
- Pages should be numbered sequentially on bottom centre for the MLT department of CSHS. The title page is understood to be "i"; the remaining preliminaries are numbered sequentially using the lower-case roman numerals. **These considerations MUST be respected!!!**
- **Tables and figures (visuals):** All tables and figures (*including those presented in the Result*) should be titled and numbered with Arabic numerals and upper case roman numerals respectively. Tables and figures carry no terminal punctuation. The table title should appear on top of the table, while the figure title appears bellow the figure. When tables and figures are from a different source, the source of reference should appear below. Example: Source: (Nchang F, 2008). The title should explain what the table or figure is showing. For example, "Table 2. Means (M) and Standard Deviations (SD) of Inhibition Zone Diameters (mm)".
- **Italics:** Use italics for (or, if italic type is not available, underline) foreign words or phrases, for instance *et al.* and *a priori.* Use of the binominal nomenclature should conform to internationally accepted practice where the first letter of the generic name is capitalized, followed by the specific name in lower case letters and, if required, the surname of the responsible author. Generic and specific names are italicized, as: *Plasmodium falciparum.* Broader classifications are not italicized, but the first letter is given a capital letter, as Gymnospermae
    - **Citation in text or in text citation:**
    - **Example 1:** (Dzelamonyuy, 2001) reported…..
    - **Example 2:** According to (Nulah, 2002),…or,…as reported by (Limunga, *et* al., 2002)
    - **Example 3:** ...the two results were identical (Limunga, and Nchang, 2007).
    - **When many authors are cited for the same statement** chronology should be respected. For instance: …..(Bongkisheri, 1999; Limunga, 2005 and Nchang, 2008)

Results: The presentation of results should be a factual statement of the observations, measurements and other information which the investigator has provided. This should be clear, concise and sequential, and should not be interrupted with interpretation and discussions.

- Tables, graphs, ., should be used when they are the most effective way of presenting data. They should be comprehensive without reference to the text, and the contents of tabular and illustrative matter should not be repeated in the text.

• All tables and figures should be introduced in the text and should follow as closely as possible the first reference to them.

5.5 CHAPTER FIVE: *SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS*:

• Summary is generally a gross summary of your work and is considered as 5.0 titled introduction or simply summary. It gives an idea of your methodology, results, analyses, and interpretations.

• Discussion is generally reserved until near the end of the dissertation/ study, and provides the opportunity to put results into perspective. New facts should be related to the existing knowledge and inferences drawn in a logical and objective manner. Unsolved aspects frequently emerge and appropriate suggestions concerning further research in these areas may be made in the form of Recommendations either separately or combined with summary, or conclusions.

• The conclusions should be drawn logically from the evidence provided. The discovery of apparent solutions to a problem should be clearly defined.

In some organizations or institutions, this chapter is simply called “Discussion” and data obtained is interpreted here. Decide if each hypothesis is supported, rejected, or if you cannot make a decision with confidence. Do not simply dismiss a study or part of a study as "inconclusive". Make what conclusions you can, then suggest how the experiment must be modified in order to properly test the hypothesis(es).

Explain all of your observations as much as possible, focusing on mechanisms.

When you refer to information, distinguish data generated by your own studies from published information or from information obtained from other students. Refer to work done by specific individuals (including yourself) in past tense. Refer to generally accepted facts and principles in present tense.

"John Doe (1964) found that Chloramphenicol prevents the formation of peptide bonds during protein synthesis while Erythromycin inhibits translocation."

Most studies will require a critique of the experiment. Determine if you asked the right question in the first place. Decide if the experimental design adequately addressed the hypothesis, and whether or not it was properly controlled. For example: "There were a few problems with the data. A few of the interactions between antibiotic and microbe showed a great amount of inhibition along with absolutely no inhibition. Many of the antibiotic disks were out of date (some as long as 15 years) which may have caused some of the disks to lose their potency. A loss of potency would cause a decrease in inhibition. Although it could be assumed from this fact that the positive inhibition data is the more accurate, it cannot be said with certainty."

5.6 THE REFERENCE

Referencing or citation in the text: There are several systems in use, only the most used shall be explained here. However, the most important points are that you are consistent, thorough and logical in your use of the system. The main purpose of referencing is to acknowledge the sources of information that have helped to shape your thinking and to enable a reader to find the text you have drawn upon.

There are different ways of citing or acknowledging the work of others.

1. You may simply refer to the work in the course of you discussion:

Several researchers in this area (Dzelamonyuy, 1991; Nulah, 1991, Ndiyun and Ba'lan, 1992) have reached similar conclusions. They seem to be indicating that…

2. You may wish to take a very short direct quote from another text:

What (Namondo, 2009) describes as 'moderate', (Chi, 2009) seems to read as 'high'.

3. There is no need in this case to give page numbers. If, however your quotation is slightly longer and from a book you should give a page number. You don't give page number references for articles as they are given in full in the list of references:

Namondo's description of this variation of haemoglobin as "moderate" (Namondo, 1991, p. 86) does not seem to be supported by ….

4. Longer quotations need to be separated from the text and indented. Again page number references are given for references from textbooks but not from articles:

One of the most damning descriptions of young people today has been provided by Nulah in his discussion of personal responsibility:

> *The foolhardy and underprepared optimists who leave our schools with scant regard for their own or the Nation's future do no one any service (Nulah, 1993, p. 76).*

We discourage long quotations in the CSHS Shisong, because they are not well manage and consequently lead to plagiarism.

5. All the citation quotes in brackets are usually followed by superscript Arabic numerals for the Vancouver referencing. For instance:

Several researchers in this area (Nkfunji, 1991; Nulah, 1991, Ndiyun and Ba'lan, 1992)[1] have reached similar conclusions. They seem to be indicating that…

What (Namondo, 2009)[2] describes as 'moderate', (Chi, 2009)[3] seems to read as 'high'. And so on.

List of References: in some texts, this is known as the bibliography.

- The list of references should contain the bibliographic details of all works cited by the writer except those of unpublished materials which are not available for loan through library services. Such items which may include personal communications from lecturers should be referred to in text footnotes.
- It is pertinent to observe the punctuation in each entry and the name of the publisher should be included (in the case of books). The following examples illustrate the main reference points:

a) Journal articles: These require author(s), date, title of article, title of journal (underlined or italicized), volume and part numbers of the journal, and pages of the article. Note the punctuations and alignment/ indentation in the following examples.

Limunga, C. L., Fon S. T., and Nchang, F. C. (2007): Health Education Strategy in the Control of Urinary Schistosomiasis. *Journal of the American Society of Clinical Laboratory Science* **19**(3):137.

Nchang, F. C. (2008): Survey of malaria parasitaemia in primary school children in rural Buea. *New England Journal of Medicine* **36**(1): 1101 – 1105.

b) Article in edited books/ Chapters in books: Here you give the author(s) of the chapter referred to in the study/ dissertation, date, the title of the chapter, the editor(s) of the book (underlined or italicized), place of publication, publisher and page number(s). For instance;

Fon, S.T., and Nchang, F.C. (2008): 'Schistosomiasis in Cameroon', in C.L. Limunga (ed.), *Textbook of Laboratory Medicine in the Tropics*, Baltimore: John Hopkins Press: 1 – 43.

Shey, G. U. (2009): 'Good handling of $CD4^+$/ $CD8^+$ count machine', in S. T. Fon (ed.), *Laboratory Management in Shisong*, Limbe: Press print: 43 – 59.

Chem, E. D. (2009): 'Environmental Microbiology', in F. C. Nchang (ed), *Environmental Sciences for State Registered Technicians*, Limbe: Press print: 115 – 135.

c) Text books: You need to give author(s), date title (underline or italicized), place of publication and publisher. For instance;

Fon, S.T., and Nchang, F. C. (2009): *Textbook of Laboratory Medicine in the Tropics*, Baltimore: John Hopkins Press: 1 – 43.

d) Thesis/ Dissertation/ Project and other unpublished papers: Here you give as much information as possible.

Jokwi, P. K. (1992): 'Coliforms Associated with Urinary Tract Infections in Females Attending Saint Elizabeth Catholic General Hospital Shisong' unpublished MLT Diploma thesis, Catholic School of Health Sciences Shisong – Cameroon.

Nchang, F.C. (2008): 'Seroprevalence of syphilis and malaria parasitaemia in prospective blood donors in the Buea Health District Area' unpublished BMLS Dissertation, University of Buea – Cameroon.

Tsafack, N. (2009): 'Variation of transaminases in HIV/ AIDS patients attending the St Elizabeth General Hospital Shisong' unpublished MLT Dissertation, Catholic School of Health Sciences Shisong – Cameroon.

e) Conference papers: You may have the chance to read or hear conference papers. You can reference them as follows;

Yongye, C. (2009): 'How to take care of People living with AIDS', Paper at the Kumbo Diocese annual Health Conference, Shisong – Kumbo.

1. When listed alphabetically at the end of the write-up, as it is above, it is called the Harvard referencing method.

2. When indicated in the text with Arabic numerals and listed at the end in respect to these numerals, it is called the Vancouver method of referencing.

3. The APA style is a bit different from the Harvard method.

The full list of references for the Vancouver method should include; first or given names and initials of all authors (unless more than 6, when only the first three are given followed by '*et al.*'); the title of the paper; journal title; year of publication; volume number; first and last page numbers.

Reference to books should give book title, place of publication, publisher and year; those of multiple authorship should also include chapter title, first and last page numbers, and first names and initials of editors. For example:

Fon S, and Nchang FC, Jokwi P, *et al*. Schistosomiasis in Cameroon. *Textbook of Laboratory Medicine in the Tropics*, Baltimore: John Hopkins Press, 1980. 1 – 43.

Shey GU. Good handling of $CD4^+$/ $CD8^+$ count machine. *Laboratory Management in Shisong*, Limbe: Press print, 1992. 43 – 59.

The details of the APA method are as follows, the full list of references should include:

a) Journal articles: Names and initials of all authors (unless more than 6, when only the first three are given followed by '*et al*.,' or '*et al*:'); title of the paper, journal title, year of publication; volume and part number; first and last page numbers.

b) Text books: Book title, place of publication, publisher and year; those of multiple authorship should also include chapter title, first and last page numbers, and names and initials of editors. For instance;

1. Limunga CL, Fon ST, Nchang FC, *et al*., Health Education Strategy in the Control of Urinary Schistosomiasis. *Journal of the American Society of Clinical Laboratory Science* 2007; **19**(3):137.
2. Nchang FC. Survey of malaria parasitaemia in primary school children in rural Buea. *New England Journal of Medicine* 2008; 36(1): 1101 – 1105.
3. Fon ST, Limunga CL, Shey GU. Specimen Collection and handling. In: Nchang F.C, eds. *Laboratory Management*. Limbe: Press print, 2008: 57 – 71.

The APA referencing method: The alphabetical list of the sources cited in your document is called *References.* If you are required to list everything you have read as background and not just the sources you cite, the list is called *Bibliography*. The list of references according to the APA can be prepared as follows;

- Start your list on a separate page after the text of your document but before any appendices or notes.
- Type the heading *References*, neither italicized nor in quotation marks.
- Double space and begin your first entry. Do not indent the first line of each entry, but indent subsequent lines one-half inch or five to seven spaces. Double-space the entire list.
- List sources alphabetically by authors' (or editors) last names. If the author is unknown, alphabetize the source by the first major word of the title, disregarding A, *An*, or *The*.

The APA style specifies the treatment and placement of four basic elements; author, publication date, title and other publication information.

- **Author**: List all authors' last names first, and use only initials for first and idle names. Separate the names of multiple authors with comas, and use ampersand (&) before the last author's name.
- **Publication date**: Enclose the date in parentheses. Use only the years for books and journals; use the year, a coma, and the month and day for newspapers. Do not abbreviate.
- **Title**: Italicize titles and subtitles of books and periodicals. For books and articles, capitalize only the first word of the title and subtitle and any proper nouns or proper adjectives. Capitalize all major words in a periodical title.
- **Publication information**: For a book, state the city of publication (add the country or postal abbreviation for the state if the city is unfamiliar), a colon, and the publisher's name, dropping any *Inc.*, *Co.*,

or *Publishers*. For a periodical, follow the periodical title with a coma, the volume number (italicized), the issue number (if appropriate) in parentheses and followed by a coma, and the inclusive page numbers of the article. For newspaper articles and for articles or chapters in books, include the abbreviation *p*. ("page") or *pp*. ("pages") before the page numbers.

- The detail of the APA method is as follows, the full list of references should include:

A/ Books

1. **One author**:

Nchang, F. C. (2008). *Laboratory diagnosis*. New York: Vintage Books.

2. **Two or more authors**:

Nchang, F. C., & Dzelamonyuy, E. C. (2010). *Statistics for research methods: A guide to research report writing*. Kumbo: National Printing Press.

3. **Corporate or group author**:

Committee on abrupt climate change, National Research Council. (2002). *Abrupt climate change: Inevitable surprises*. Washington, DC: National Academies Press.

Use the word *Author* as the publisher when the organization is both the author and the publisher.

Resources for Equipment Maintenance. (2010). *A technician's guide to coping with maintenance*. Shisong: Author.

4. **Unknown author**:

National Geographic atlas of the Middle East. (2003). Washington, DC: National Geographic Society.

5. **Editor**:

Ngwanue, W. (Ed). (2008). *Schistosomiasis in Cameroon*. Kumbo: Dzelamonyuy Elvis.

Shey, G. (Ed). (2009): Good handling of $CD4^+$/ $CD8^+$ count machine. Limbe: Tekwe Sylvanus.

6. **Multivolume work**:

Cheesbrough, M. (2004). *District laboratory practice in tropical countries* (Vols. 1 – 2). Cambridge, England: Cambridge University Press.

B/ Periodicals

1. **Article in a journal paginated by volume**

Nchang, F. C. (2008). Survey of malaria parasitaemia in primary school children in rural Buea. *New England Journal of Medicine, **36***, 1101 – 1105.

2. **Article in a journal paginated by issue**

Limunga, C. L. (2004). Health Education Strategy in the Control of Urinary Schistosomiasis. *Journal of the American Society of Clinical Laboratory Science*, *37*(2), 29 – 40.

3. **Articles in a newspaper**

Magne, R. (2011, June 29). Shisong hospital and nursing school news: Birth announcement. *The CSHS Post*, p. 5.

C/ Electronic sources: you can read more of this on www.apa.org. However, it should have the following elements; Author (if available), Publication date (latest update, or *n.d*. for "no date"), Title (either italicize nor

in quotation marks), Publication information (as you would for a print periodical), and Retrieved information (type the word *Retrieved* followed by the date of access, a coma, and the word *from*. End with the URL or other retrieval information and no period).

1. **Article in an online periodical**: If the article also appears in the print journal, no retrieval statement is required; instead, include the label [*Electronic version*] after the article title.

Limunga, C. L. (2004). Health Education Strategy in the Control of Urinary Schistosomiasis [Electronic version]. *Journal of the American Society of Clinical Laboratory Science, 37*(2), 29 – 40.

2. **Document from a website**: consult the www.apa.org site.

Consent

a. Original textual matter quoted from other authors must have formal citation and be appropriately referenced.

b. The consent of patients and approval of the protocol by an ethical committee or the relevant authority on ethical matters should be confirmed for human investigations.

c. Any statements which might be construed as being potentially defamatory must be avoided.

d. Any tables or illustrations previously published should be accompanied by the written consent of the copyright holder to republication, an acknowledgement included in the caption, and a full reference included in the list.

5.7 APPENDICES

• The appendix provides a place for material that would cluster the text. In it may be placed notes or methods, derivations, schedules, forms used in collecting materials, and illustrative materials and tables of analysis. If these materials are in separate categories, each category should form a separate appendix. The appendices should be lettered (Appendix A, Appendix B), and each should bear a title. Computer programs may be listed as appendices.

CHAPTER SIX

THE SCIENTIFIC PRESENTATION OF A SEMINAR/ PROJECT/ DISSERTATION/ OR THESES

6.0 WHAT IS A SCIENTIFIC PRESENTATION?

A presentation of facts and figures obtained from a study/ survey. A scientific presentation is thus the presentation of facts obtained from laboratory generated data, or data generated I a community survey.

One who puts forward facts of investigations or findings is called a **presenter**. H/ she could be presenting findings of group or individual work, carried out in the laboratory or in the field. Such work could be done solitarily, or as a group or under a competent supervisor.

Scientific presentations differ with institutions, and sometimes with departments in the same institution. In some cases, only the abstract is presented, and at other instances, the whole work is presented. Check from your supervisor how it is done in your case.

Generally, in presentations, there are a variety of audience; the primary audience (jury in our case and elsewhere), and the secondary audience.

6.1 THE QUALITIES OF THE PRESENTER

- Well dressed
- Courageous
- Audible and fluent in communication
- Organized
- Ability to manage time in the presentation of facts
- Should have a mastery of the work as it is h/hers
- Present to both the primary (jury) and secondary (the student body or otherwise) audience.
- Present with moderate gesticulation.

6.2 THE USE OF CARDBOARD PAPER OR CHALKBOARD

Here the presenter uses chalk, chalkboard and a pointer in an organized manner. The chalkboard is rolled into columns before hand or at the time of presentation. On the other hand, the presenter may employ the assistance of a colleague/ junior colleague, to roll the chalkboard with the aid of prepared scripts.

For cardboard paper, the presenter should prepare them before hand, and if possible, post them to the board/ stand prior to presentation. Also the assistance of a colleague could be employed.

6.3 THE USE OF POWER POINT AND PROJECTOR

This involves the use of new technology or information communication technology (ICT); a computer and projector otherwise known as a beamer. In this case, the presenter should be able to handle equipments with care. H/ She should be able to use the Microsoft power point to prepare slides which are

then projected onto a screen for the audience. If the class has to use this facility, then the following must be obeyed;

- all presenters should be able to prepare their power point presentations (at most 7 lines per page),
- the presentations of all presenters must be loaded in one joystick (flash) or one computer,
- the whole class should be able to employ the assistance of at least two software operators from their class, and
- all presenters, must print out multiple copies of their presentations, to pre-empt any light cuts. Such copies could be given to the primary audience, and a part of the secondary audience in the case of light cuts.

The outline for the presentation is as follows;

- Title slide
- Summary slide
- Abstract slide
- Introductory / Chapter one slide(s)
- Methodology / Chapter three slide(s)
- Result analyses/ Discussion slide(s)
- Conclusion and Recommendations slide(s)
- Acknowledgement and Thank you slide(s)

6.4 THE RESEARCH PAPER AND PUBLICATION/ THE ELEMENTS OF A RESEARCH PAPER FOR PUBLICATION. GUIDELINES FOR WRITING THE RESEARCH PAPER III

After a successful piece of work, it has to be published in various ways. In the University of Buea and the CSHS Shisong, research work is published as outlined in chapter five above, in three copies; student's copy, library copy and supervisor's copy.

However a well done piece of work can be published in a scientific conference or journal, by the student's supervisor, with the students name as that of a co-author. Publication specifications vary with journals. Some scientific journals include; The New England Journal of Medicine, The Journal of Parasitology, The British Medical Journal, The Lancet and The Tropical Doctor to name but a few.

Exercise 7: List all the scientific journals you can fine in the CSHS School library.

I/ Name/ Title of document, Name of author(s), and name of work place

This specifies the parameters as indicated by the journal in question.

II/ Introduction/ Summary/ Abstract: See sections above

III/ Method(s): see sections above. However, this has to be shorter than for the write-up for library, and has to suit the specifications of the journal or sponsor.

IV/ Data and conclusion: There has to be a logical presentation of data, in respect of statistic rules as well as the write-up requirements.

V/ Referencing with the Harvard, Vancouver, and APA method or otherwise: this is just as spelled out above.

CHAPTER SEVEN
ETHICS IN HEALTH RESEARCH

7.0 DEFINITION OF ETHICS AND MORALS (SEE ETHICS AND DEONTOLOGY; MLT I)

Ethics has no univocal definition and can be defined in various ways. An easy description of ethics is that it is a branch of philosophy which deals with the morality of human actions or behaviour.

Ethics can also be defined as the study of the fundamental principles of morality and their application in actual concrete situations.

The terms "ethics" and "morality" are often used interchangeably as synonyms; but the concept of morality is much broader than that of ethics.

Is Ethics a Science? Some people consider ethics a science while other dispute the claim. The controversy may be more semantic than substantive. What do we mean by science? In the strict and narrow sense "science" refers to what otherwise are called the natural, empirical, or descriptive sciences, such as physics, biology, chemistry.

Ethics is obviously no science in this sense, since it is not descriptive but rather normative and prescriptive. Some aspects of morality, however, are purely descriptive, such as when anthropologists or other social scientists study the "mores" of a particular culture or society. This is done without passing judgments as to whether or not such "mores" are defensible.

7.1 COMMUNITY/ HOSPITAL ETHICS

Health Research Ethics is a discipline that can be said to have been engendered in scandals and atrocities. Medical Research Ethics as distinguished from Medical Ethics in general was born with the Nuremberg Code (1947), following the Nuremberg Trials during which Nazi Medical Doctors were tried and sentenced by an international tribunal as war criminals for unethical experimentations on human beings.

The **Hippocratic Oath** (c. 400 BC) prescribed that the health of the patient be the sole concern of the physician and advised the latter to "abstain from whatever is deleterious or mischievous" but otherwise did not at all deal with research ethics.

The **Nightingale oath** prescribed for Nurses and Medical Laboratory Technicians. It is similar to the Hippocratic oath in that; all persons involve are health personnel and that both compel the personnel to take great care of the patient.

In addition to these oaths, there is a code of ethics for the health personnel, and customized by every health set up to suit is principles of functioning.

7.2 COMMUNICATION SKILLS (Check out in Cheesbrough, other textbooks, and your notebooks)

Communication is an interaction between one or more persons and involves the transmission of a **message** from the **source/ sender** to the **receiver/ audience**. The message is related to the audience through a **channel**, which could be the vocal chords of the speaker, radio, television or internet. For any message transmitted, there is a **feedback**.

In the health setting, there is the need to acquire communication skills, especially as these shall be of utmost importance in the day-to-day interaction with patients/ clients. These skills are also needed in the area of research.

Thus the communication skills are; **listening/ hearing** and **speaking/ reading/ writing**. It is important to stress that while listening and reading are skills of **reception**, speaking and writing are skills of **transmission**. Effective communication skills require a maximum of the sense modalities; seeing, hearing, smelling, touching and tasting.

In the health core, there is always the need for communication; whereby personnel exchange information regarding the operations of the hospital. It is the interchange of **ideas**, **facts** and **emotions** by two or more persons. To be effective, there are communication channels; **briefing**, **meetings**, and distribution of **bulletins**.

For the Medical Laboratory Technician, H/ She requires intra-personal and inter-personal communication. There are other aspects of communication that shall not be dealt with in this course.

BIBLIOGRAPHY

1. The Hard-Pressed researcher. A research handbook for the caring professions, by Anne Edwards and Robin Talbot. Prentice Hall. London. 2nd Edition, 1999.
2. Introduction to Research Methodology by E. C. Esuala. Africana-First Publishers Limited. Limbe. 3rd Edition, 2005.
3. Tropical Doctor. Volume 34, number 3, year 2004
4. Handbook in research and evaluation. For education and behavioural sciences, by Stephen Isaac and William B. Michael. Edits Publishers. California. 1st Edition 1971.
5. Essentials of nursing research. Methods, appraisal, and utilization, by Denise F. Polit, and Bernadette P. Hungler. Lippincott. Philadelphia. 4th Edition, 1985.

REFERENCES

The APA Style

Anne, E., & Robin, T. (1999). The Hard-Pressed researcher. *A research handbook for the caring professions.* London: Prentice Hall. 2nd Edition.

Esuala, E.C. (2005). *Introduction to Research Methodology*. Limbe: Africana-First Publishers Limited. 3rd Edition.

Tropical Doctor. Volume 34, number 3, year 2004.

Stephen, I., & William B. M. (1971). Handbook in research and evaluation. *For education and behavioural sciences*. California: Edits Publishers. 1st Edition.

Polit, D. F., & Hungler, B. P. (1985). *Essentials of nursing research. Methods, appraisal, and utilization.* Philadelphia: Lippincott 4th Edition.