# NATIONAL OPEN UNIVERSITY OF NIGERIA

## FACULTY OF HEALTH SCIENCES

### DEPARTMENT OF ENVIRONMENTAL HEALTH SCIENCES

### COURSE CODE: EHS 310

**EHS 310 Control of Communicable and Non-Communicable Diseases**

# COURSE GUIDE

**EHS 310: COMMUNICABLE AND NON-COMMUNICABLE DISEASES CONTROL**

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**CONTENTS** **PAGE**


# EHS 310:- COMMUNICABLE AND NON-COMMUNICABLE DISEASES CONTROL

NATIONAL OPEN UNIVERSITY OF NIGERIA

DEPARTMENT OF ENVIRONMENTAL HEALTH SCIENCE

FACULTY OF HEALTH SCIENCES

COURSE CODE: EHS 310

COURSE TITLE: COMMUNICABLE AND NON-COMMUNICABLE DISEASES CONTROL

COURSE UNIT: 2 UNITS

## INTRODUCTION

*EHS 310- Communicable and Non-Communicable Diseases Control* is a two (2) unit course with three (3) modules and nine (9) units. Communicable diseases are those diseases that spread from one person to another or from an animal to a person. The spread may occur via air borne viruses or bacteria or through blood or other body fluids. Most of the common diseases in Africa are communicable diseases. They occur at all ages but are most serious in childhood and they are to a great extent preventable. The terms infectious and contagious are also used to describe communicable disease. Non-communicable diseases (NCDs) are chronic conditions that do not result from an infectious process and hence are not communicable. Such a disease usually has a prolonged course, that does not resolve spontaneously, and for which a complete cure is rarely achieved. NCDs are important because they currently make the largest contribution to deaths in most developing countries, although they are largely preventable by means of effective interventions that tackle common modifiable risk factors. The control of communicable and non-communicable diseases are therefore important national health goals in Nigeria.

## WHAT YOU WILL LEARN IN THIS COURSE

In this course, you have the course units and a course guide. The course guide will tell you what the course is all about. It is general overview of the course materials you will be using and how to use those materials. It also helps you to allocate the appropriate time to each unit so that you can successfully complete the course within the stipulated time limit. The course guide also helps you to know how to go about your Tutor-Marked Assignment which will form part of your overall assessment at the end of the course. Also, there will be regular tutorial classes that are related to this course, where you can interact with your facilitator and other students. I encourage you to attend these tutorial classes.

### Course Aim

The overall aim of this course is to give you an understanding of communicable and non-communicable diseases control, which is an important aspect of health management.

### Course Objectives

It is expected that at the end of this course, you should be able to:

- Describe communicable diseases
    - Definitions, description and classifications
    - Understand epidemiological terms
- Describe the stages of disease prevention
    - Primary
    - Secondary
    - Tertiary
- Describe disease control methods
    - Biological
    - Chemical

    - Environmental
    - Chemotherapy
- Describe the strategies for drug delivery
    - Conventional drug delivery
    - Targeted chemotherapy
    - Mass chemotherapy
- Describe epidemiological patterns
    - The chain of infection
    - Disease risk factors
    - Signs and symptoms of diseases
- Emerging and re-emerging diseases
    - Factors of emergence and re-emergence of diseases
    - Emerging and re-emerging viral zoonotic diseases
    - Emerging and re-emerging bacterial and parasitic zoonotic diseases
- Introduce Non-communicable diseases (NCDs)
    - Definitions, Description and Classification
    - Risk factors
    - Epidemiological patterns
- Methods of prevention and control of NCDs and disorders
    - Behavior medication
    - Enforcement
    - Engineering measures
- Describe non-communicable diseases and non-disease chronic conditions
    - Hypertension
    - Coronary heart disease
    - Diabetes mellitus
    - Major genetic disorders (Sickle cell anemia)
    - Cancers (breast, lung, liver, ovary, cervix, leukemia and lymphomas etc.)
    - Asthma
    - Obesity
    - Nutritional deficiency
    - Drug abuse
    - Alcoholism

**Working through this Course**

The organization of this course takes cognizance of the fact that this might be the first time the student is being exposed to this specialized area. The subject is therefore simplified and aided with many illustrations to enable the student understand the important concept and terminologies in the course. Efforts have been made to avoid unnecessary details, especially those meant for medical professionals who have been grounded in clinical sciences in order not to confusion the students. The distinct contents of the course would help deliver the knowledge and skills needed by the

student to function effectively either in individual tasks or as a member of a public health team.

Although the course has been designed to support independent study, attending tutorial sessions and participating in the practical activities included in this course will greatly enhance understanding of concepts discussed, as it will avail the student the opportunity to seek clarifications on poorly understood sections. Studying the course resources and attending tutorial sessions and practical are therefore vital to enhancing not only student's grade but also their understanding and usability of the knowledge garnered from the course.

**COURSE MATERIALS**

The course materials are as listed below:

- The Study Guide
- Study Units
- Reference / Further Reading
- Assignments
- Presentation Schedule

**STUDY UNITS**

The study units in this course are outlined below:

**MODULE 1 INTRODUCTION TO COMMUNICABLE DISEASES (CDs) I.**

Unit 1: Description of communicable diseases
Unit 2: Stages of disease prevention
Unit 3: Disease control methods

**MODULE 2 MODULE 2 INTRODUCTION TO CDS II: DRUG DELIVERY STRATEGIES AND EMERGING/RE-EMERGING DISEASES**

Unit 1: Strategies for drug delivery
Unit 2: Epidemiological patterns
Unit 3.Emerging and re-emerging diseases

**MODULE 3 INTRODUCTION TO NON-COMMUNICABLE DISEASES (NCDs) AND DISORDERS**

Unit 1. Introduction to Non-communicable diseases (NCDs)
Unit 2: Prevention and control of NCDs and disorders
Unit 3: NCDs and non-disease chronic conditions in Nigeria

There are activities related to the lecture in each unit which will help your progress and comprehension of the unit. You are required to work on these exercises together with the TMAs to enable you achieve the objectives of each unit.

**ASSIGNMENT FILE**

There are two types of assessments in this course. First are the Tutor-Marked Assessments (TMAs); second is the written examination. In solving the questions in the assignments, you are expected to apply the information, knowledge and experience

acquired during the course. The assignments must be submitted to your facilitator for formal assessment in accordance with prescribed deadlines stated in the assignment file. The work you submit to your facilitator for assessment accounts for 30 percent of your total course mark. At the end of the course, you will be required to sit for a final examination of 1½ hours duration at your study center. This final examination will account for 70 % of your total course mark.

**PRESENTATION SCHEDULE**

There is a time-table prepared for the early and timely completion and submissions of your TMAs as well as attending the tutorial classes. You are required to submit all your assignments by the stipulated time and date. Avoid falling behind the schedule time.

**ASSESSMENT**

There are three aspects to the assessment of this course. The first one is the self-assessment exercises. The second is the tutor marked assignments and the third is the written examination or the examination to be taken at the end of the course. Do the exercises or activities in the unit by applying the information and knowledge you acquired during the course. The tutor-marked assignments must be submitted to your facilitator for formal assessment in accordance with the deadlines stated in the presentation schedule and the assignment file. The work submitted to your tutor for assessment will count for 30% of your total course work. At the end of this course, you have to sit for a final or end of course examination of about a three-hour duration which will count for 70% of your total course mark.

**TUTOR-MARKED ASSIGNMENTS**

This is the continuous assessment component of this course and it accounts for 30% of the total score. You will be given four (4) TMAs by your facilitator to answer. Three of which must be answered before you are allowed to sit for the end of course examination.

These answered assignments be returned to your facilitator. You're expected to complete the assignments by using the information and material in your readings references and study units. Reading and researching into your references will give you a wider view point and give you a deeper understanding of the subject.

1. Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you are not able to complete your assignment, make sure you contact your facilitator before the assignment is due to discuss the possibility of an extension. Request for extension will not be granted after the due date unless there in exceptional circumstances.

2. Make sure you revise the whole course content before sitting or the examination. The self-assessment activities and TMAs will be useful for this purposes and if you have any comment please do before the examination. The end of course examination covers information from all parts of the course.

**COURSE MARKING SCHEME**

| **Assignments** | **Marks** |
|---|---|
| Assignments 1 - 4 | Four assignments, best three marks |

| | |
|---|---|
| | of the four count at 10% each = 30% of course marks |
| End of course examination | 70% of overall course marks |
| **Total** | **100% of course materials** |

**Table 2: Course Organization**

| Unit | Title of Work | Weeks Activity | Assessment (End of Unit) |
|---|---|---|---|
| | Course Guide | Week | |
| 1 | Description of communicable diseases | Week 1 | Assignment 1 |
| 2 | Stages of disease prevention | Week 2 | Assignment 2 |
| 3 | Disease control methods | Week 3 | Assignment 3 |
| 4 | Strategies for drug delivery | Week 4 | Assignment 4 |
| 5 | Epidemiological patterns | Week 5 | Assignment 5 |
| 6 | Emerging and re-emerging diseases | Week 6 | Assignment 6 |
| 7 | Introduction to Non-communicable diseases | Week 7 | Assignment 7 |
| 8 | Prevention and control of NCDs and disorders | Week 8 | Assignment 8 |
| 9 | NCDs and non-disease chronic conditions | Week 9 | Assignment 9 |

**HOW TO GET THE MOST OUT OF THIS COURSE?**

In distance learning, the study units replace the university lecturer. This is one of the huge advantages of distance learning mode; you can read and work through specially designed study materials at your own pace and at a time and place that suit you best. Think of it as reading from the teacher, the study guide tells you what to read, when to read and the relevant texts to consult. You are provided exercises at appropriate points, just as a lecturer might give you an in-class exercise.

Each of the study units follows a common format. The first item is an introduction to the subject matter of the unit and how a particular unit is integrated with the other units and the course as a whole. Next to this is a set of learning objectives. These learning objectives are meant to guide your studies. The moment a unit is finished, you must go back and check whether you have achieved the objectives. If this is made a habit, then you will significantly improve your chances of passing the course.

The main body of the units also guides you through the required readings from other sources. This will usually be either from a set book or from other sources.

Self-assessment exercises are provided throughout the unit, to aid personal studies and answers are provided at the end of the unit. Working through these self-tests will help you to achieve the objectives of the unit and also prepare you for tutor marked assignments and examinations. You should attempt each self-test as you encounter them
in the units.

**The following are practical strategies for working through this course**

1. Read the Course Guide thoroughly.

2. Organize a study schedule. Refer to the course overview for more details. Note the time you are expected to spend on each unit and how the assignment relates to the units. Important details, e.g. details of your tutorials and the date of the first day of the semester are available. You need to gather together all this information in one place

such as a diary, a wall chart calendar or an organizer. Whatever method you choose, you should decide on and write in your own dates for working on each unit.
3. Once you have created your own study schedule, do everything you can to stick to it. The major reason that students fail is that they get behind with their course works. If you get into difficulties with your schedule, please let your tutor know before it is too late for help.

4. Turn to Unit 1 and read the introduction and the objectives for the unit.

5. Assemble the study materials. Information about what you need for a unit is given in the table of contents at the beginning of each unit. You will almost always need both the study unit you are working on and one of the materials recommended for further readings, on your desk at the same time.

6. Work through the unit, the content of the unit itself has been arranged to provide a sequence for you to follow. As you work through the unit, you will be encouraged to read from your set books.

7. Keep in mind that you will learn a lot by doing all your assignments carefully. They have been designed to help you meet the objectives of the course and will help you pass the examination.

8. Review the objectives of each study unit to confirm that you have achieved them. If you are not certain about any of the objectives, review the study material and consult your tutor.

9. When you are confident that you have achieved a unit's objectives, you can start on the next unit. Proceed unit by unit through the course and try to pace your study so that you can keep yourself on schedule.

10. When you have submitted an assignment to your tutor for marking, do not wait for its return before starting on the next unit. Keep to your schedule. When the assignment is returned, pay particular attention to your tutor's comments, both on the tutor-marked assignment form and also that written on the assignment. Consult you tutor as soon as possible if you have any questions or problems.

11. After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives (listed at the beginning of each unit) and the course objectives (listed in this course guide).

**FACILITATORS/TUTORS AND TUTORIALS**
Sixteen (16) hours are provided for tutorials for this course. You will be notified of the dates, times and location for these tutorial classes. As soon as you are allocated a tutorial group, the name and phone number of your facilitator will be given to you.

These are the duties of your facilitator: He or she will mark and comment on your assignment. He will monitor your progress and provide any necessary assistance you

need. He or she will mark your TMAs and return to you as soon as possible. You are expected to mail your tutored assignment to your facilitator at least two days before the schedule date.

Do not delay to contact your facilitator by telephone or e-mail for necessary assistance if you do not understand any part of the study in the course material. You have difficulty with the self-assessment activities. You have a problem or question with an assignment or with the grading of the assignment.

It is important and necessary you acted the tutorial classes because this is the only chance to have face to face content with your facilitator and to ask questions which will be answered instantly. It is also period where you can say any problem encountered in the course of your study.

**FINAL EXAMINATION AND GRADING**

The final examination for EHS 310: Communicable and Non-Communicable Diseases will be of 1½ hours duration. This accounts for 70 % of the total course grade. The examination will consist of questions which reflect the practice, exercises and the tutor-marked assignments you have already attempted in the past. Note that all areas of the course will be assessed. To revise the entire course, you must start from the first unit to the twelfth unit in order to get prepared for the examination. It may be useful to go over your TMAs and probably discuss with your course mates or group if need be. This will make you to be more prepared, since the examination covers information from all aspects of the course.

**SUMMARY**

Communicable and Non-Communicable Diseases Controlas a course introduces you first to those diseases that spread from one person to another or from an animal to a person and are termed communicable diseases. Secondly to non-communicable diseases (NCDs), which are chronic conditions that do not result from an infectious process and hence are not communicable. The course is important to you because these diseases are currently the largest contributors to deaths in most developing countries including Nigeria, although they are largely preventable through interventions that modify their risk factors.

On completion of this course, you will be able to define, describe and classify communicable and non-communicable diseases, understand epidemiological terms, describe the stages of disease prevention and control methods. In addition, you will be able to describe epidemiological patterns, have knowledge of disease prevention and control methods, know the diseases of public health importance in Nigeria, describe non-communicable diseases/disorders, and also describe some non-disease chronic conditions.

**Review Questions**

- Define communicable and non-communicable diseases?
- Why are non-communicable diseases important in Nigeria today?
- List the important non-communicable diseases of public health importance?

**CONTENTS** **PAGE**



## UNIT 1 DESCRIPTION OF COMMUNICABLE DISEASES

**CONTENTS**



### 1.0 INTRODUCTION

This unit on description of communicable diseases tells you more about the term communicable disease starting from the definitions of terms to and classification of infections and finally epidemiological patterns of communicable diseases.

### 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- define communicable diseases
- classify infections and diseases
- understand epidemiological patterns

.

### 3.0 MAIN CONTENT

#### 3.1 Definitions

Nigeria, as part of the developing world has health problems, which are infectious diseases (communicable diseases) that can be prevented by simple sanitary measures. Diseases can be classified according to two major dimensions, namely the time course and cause. According to the time course, they are further classified as acute (characterized by a rapid onset and a short duration), and chronic disease (characterized by prolonged duration). Based on the cause, diseases can be broadly categorized as infectious, (i.e. caused by living parasitic organisms such as viruses, bacteria, parasitic worms, insects, etc.), or as non-infectious (which are caused by something other than a living parasitic organism).

**Communicable diseases:** Most of the common diseases in Africa are environmental diseases (infectious) due to infection by living organisms. These are called

communicable diseases, because they spread from person to person, or sometimes from animals to people. They occur at all ages but are most serious in childhood and they are to a great extent preventable.

Some communicable diseases can be spread by casual contact, such as cold, flu and tuberculosis from respiratory droplets, from coughing, sneezing or runny nose. Others require contact with blood from an infected individual, as in the case of hepatitis B and AIDS virus. Some others require intimate contact with infected individual's body fluids or genitalia, such as herpes, and syphilis.

The causative agents of communicable diseases are microorganisms or pathogens that invade the body and are often referred to as infectious diseases. Examples of the microorganisms include, bacteria, fungi, viruses and protozoa. Their invasion of the body could lead to acute or chronic disease, accompanied by pathological alterations and manifested in adequate clinical symptoms in host. These symptoms are triggered in the host by;

- Pathologic effects of infectious agent, toxins, enzymes, and junctional membrane-components, virulence-factors, viral infection-caused cytolysis and cell-proliferation
- Immuno-response of attacked organism (inflammatory, allergic, autoimmune reactions)

### 3.2 Classification of Communicable diseases and infections

Communicable diseases are caused by pathogens, which are agents that cause infections or diseases, especially microorganisms like bacteria, protozoa, viruses, fungi and parasites like helminthes and ecto-parasites.

**Bacterial Infections:** Bacteria are a simple microscopic form of life. They can produce all the proteins needed for life. They use DNA as their genetic material. They are called *prokaryotes*because they do not contain a nucleus and membrane-bound organelles. In contrast, *eukaryotes* (animals, plants, fungi, and protozoa) do contain a nucleus or cellular organelles.

Bacterial diseases of man include streptococcus, staphylococcus and *E. coli* among many others. They cause wats, food poisoning, tuberculosis, whooping cough, gonorrhea, scarlet fever, diphtheria, pneumonia, cholera, typhoid fever etc;

**Viral infections:** Viruses can have either DNA or ribonucleic acid (RNA) as the genetic material. Under the Baltimore system of classification of viruses, they are assigned to one of seven groups based on the form of the DNA or RNA and not based on the diseases they cause:

I, double-stranded DNA viruses
II, single-stranded DNA viruses
III, double-stranded RNA viruses
IV, positive-sense single-stranded RNA viruses
V, negative-sense single-stranded RNA viruses
VI, reverse-transcribing diploid single-stranded RNA viruses;
VII, reverse-transcribing circular double-stranded DNA viruses.

Viroids are smaller than viruses and are known to be plant pathogens.

Examples of viral infections of man include common cold, viral hepatitis, influenza, herpes, poliomyelitis, papilloma, ebola and HIV/AIDS among many others. Many viruses that cause disease can live in the air or on the surfaces of things around us.You can catch the flu or a cold just by being around someone who has the disease. You can also catch the disease by touching silverware, a glass, or even a tissue that an infected person has used. Most diseases caused by viruses last only a few days or weeks. The body fights off the disease and destroys it.

**Parasitic infections:** A parasite is an organism that lives in close proximity to a host and completely depends on it. Parasites receive their nutrition from the host, using the host's blood or absorbing nutrients in the host's intestine. Although the parasites rarely kill the host, they do inflict significant harm. Parasites adversely affect the quality of life for companion animals and livestock; they also reduce production efficiency of livestock and may result in the death of an animal.

*Internal Parasites (Endo-parasites):*Internal parasites include protozoa, roundworms or nematodes, flatworms or trematodes, cestodes or tapeworms, and larvae of some flies.

*Protozoa:* Protozoa are single-celled eukaryotes with a nucleus and intracellular organelles. They impact their hosts as parasites, as zoonotic diseases, and by symbiotic ciliates participating in the fermentation in the caecum.

*Ecto-parasites:* These can be either insects or arachnids (ticks and mites, bugs, fleas, flies, lice, or mosquitos). Examples of insects that are ecto-parasites are, lice and fleas or are blood-sucking true flies such as mosquitos, and tsetse flies. These insects are frequently also vectors or secondary hosts for pathogenic bacteria (e.g., the plague-causing bacteria causing bubonic plague: *Yersinia pestis*), or are parasites such as protozoa (trypanosomes causing sleeping sickness, plasmodium causing malaria), tapeworms, and heartworms.

**Fungal infections:** These include athletic foot, ringworm, candidiasis etc.

### 3.3 Description of epidemiological patterns

**Epidemiology:** The word epidemiology comes from the Greek words *epi*, meaning on or upon, *demos*, meaning people, and *logos*, meaning the study of. In other words, the word epidemiology has its roots in the study of what befalls a population.

Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems. Epidemiology is data-driven and relies on a systematic and unbiased approach to the collection, analysis, and interpretation of data. Basic epidemiologic methods tend to rely on careful observation and use of valid comparison groups to assess whether what was observed, such as the number of cases of disease in a particular area during a particular time period or the frequency of an exposure among persons with disease, differs from what might be expected.

Epidemiology is therefore concerned with the frequency and pattern of health events in a population. Frequency refers not only to the number of health events such as the number of cases of meningitis or diabetes in a population, but also to the relationship of that number to the size of the population. The resulting rate allows epidemiologists to compare disease occurrence across different populations.

**Pattern** refers to the occurrence of health-related events by time, place, and person. Time patterns may be annual, seasonal, weekly, daily, hourly, weekday versus weekend, or any other breakdown of time that may influence disease or injury occurrence. Place patterns include geographic variation, urban/rural differences, and location of work sites or schools. Personal characteristics include demographic factors which may be related to risk of illness, injury, or disability such as age, sex, marital status, and socioeconomic status, as well as behaviors and environmental exposures.

Epidemiology is also used to search for determinants, which are the causes and other factors that influence the occurrence of disease and other health-related events. Epidemiologists assume that illness does not occur randomly in a population, but happens only when the right accumulation of risk factors or determinants exists in an individual. To search for these determinants, epidemiologists use analytic epidemiology or epidemiologic studies to provide the "Why" and "How" of such events. They assess whether groups with different rates of disease differ in their demographic characteristics, genetic or immunologic make-up, behaviors, environmental exposures, or other so-called potential risk factors. The findings provide sufficient evidence to direct prompt and effective public health control andprevention measures.

The 5W's of descriptive epidemiology are
What = health issue of concern
Who = person
Where = place
When = time
Why/how = causes, risk factors, modes of transmission

Thus, descriptive epidemiology covers time, place, and person. Compiling and analyzing data by time, place, and person is desirable for several reasons.

1. By looking at the data carefully, the epidemiologist becomes very familiar with the data. He or she can see what the data can or cannot reveal based on the variables available, its limitations (for example, the number of records with missing information for each important variable), and its eccentricities (for example, all cases range in age from 2 months to 6 years, plus one 17-year-old).

2. The epidemiologist learns the extent and pattern of the public health problem being investigated — which months, which neighborhoods, and which groups of people have the most and least cases.

3. The epidemiologist creates a detailed description of the health of a population that can be easily communicated with tables, graphs, and maps.

4. The epidemiologist can identify areas or groups within the population that have high rates of disease. This information in turn provides important clues to the causes of the disease, and these clues can be turned into testable hypotheses.

**Time**

The occurrence of disease changes over time. Some of these changes occur regularly, while others are unpredictable. Two diseases that occur during the same season each year include influenza (winter) and West Nile virus infection (August– September). In contrast, diseases such as hepatitis B and salmonellosis can occur at any time. For diseases that occur seasonally, health officials can anticipate their occurrence and implement control and prevention measures, such as an influenza vaccination campaign or mosquito spraying. For diseases that occur sporadically, investigators can conduct studies to identify the causes and modes of spread, and then develop appropriately targeted actions to control or prevent further occurrence of the disease. In either situation, displaying the patterns of disease occurrence by time is critical for monitoring disease occurrence in the community and for assessing whether the public health interventions made a difference.

Time data are usually displayed with a two-dimensional graph. The vertical or y-axis usually shows the number or rate of cases; the horizontal or x-axis shows the time periods such as years, months, or days. The number or rate of cases is plotted over time. Graphs of disease occurrence over time are usually plotted as line graphs or histograms.

***Secular (long-term) trends.***Graphing the annual cases or rate of a disease over a period of years shows long-term or secular trends in the occurrence of the disease. Health officials use these graphs to assess the prevailing direction of disease occurrence (increasing, decreasing, or essentially flat), help them evaluate programs or make policy decisions, infer what caused an increase or decrease in the occurrence of a disease (particularly if the graph indicates when related events took place), and use past trends as a predictor of future incidence of disease.

***Seasonality.*** Disease occurrence can be graphed by week or month over the course of a year or more to show its seasonal pattern, if any. Seasonal patterns may suggest hypotheses about how the infection is transmitted, what behavioral factors increase risk, and other possible contributors to the disease or condition.

***Day of week and time of day.***For some conditions, displaying data by day of the week or time of day may be informative. Analysis at these shorter time periods is particularly appropriate for conditions related to occupational or environmental exposures that tend to occur at regularly scheduled intervals. These patterns may suggest hypotheses and possible explanations that could be evaluated with further study.

***Epidemic period.*** To show the time course of a disease outbreak or epidemic, epidemiologists use a graph called an epidemic curve. Conventionally, the data are displayed as a histogram (which is similar to a bar chart but has no gaps between adjacent columns). The shape and other features of an epidemic curve can suggest hypotheses about the time and source of exposure, the mode of transmission, and the causative agent.

**Place**

Describing the occurrence of disease by place provides insight into the geographic extent of the problem and its geographic variation. Characterization by place refers not only to place of residence but to any geographic location relevant to disease occurrence. Such locations include place of diagnosis or report, birthplace, site of employment, school district, hospital unit, or recent travel destinations. The unit may be as large as a continent or country or as small as a street address, hospital wing, or operating room. Although place data can be shown in a table, a map provides a more striking visual display of place data. On a map, different numbers or rates of disease can be depicted using different shadings, colors, or line patterns.

Analyzing data by place can identify communities at increased risk of disease. Even if the data cannot reveal why these people have an increased risk, it can help generate hypotheses to test with additional studies. For example, is a community at increased risk because of characteristics of the people in the community such as genetic susceptibility, lack of immunity, risky behaviors, or exposure to local toxins or contaminated food?

**Person**

Because personal characteristics may affect illness, organization and analysis of data by "person" may use inherent characteristics of people (for example, age, sex, race), biologic characteristics (immune status), acquired characteristics (marital status), activities (occupation, leisure activities, use of medications/tobacco/drugs), or the conditions under which they live (socioeconomic status, access to medical care). Age and sex are included in almost all data sets and are the two most commonly analyzed "person" characteristics.

***Age.*** Age is probably the single most important "person" attribute, because almost every health-related event varies with age. A number of factors that also vary with age include: susceptibility, opportunity for exposure, latency or incubation period of the disease, and physiologic response (which affects, among other things, disease development). When analyzing data by age, epidemiologists try to use age groups that are narrow enough to detect any age-related patterns that may be present in the data. For some diseases, particularly chronic diseases, 10-year age groups may be adequate. For other diseases, 10-year and even 5-year age groups conceal important variations in disease occurrence by age.

***Sex.*** Males have higher rates of illness and death than do females for many diseases. For some diseases, this sex-related difference is because of genetic, hormonal, anatomic, or other inherent differences between the sexes. These inherent differences affect susceptibility or physiologic responses. For example, premenopausal women have a lower risk of heart disease than men of the same age. This difference has been attributed to higher estrogen levels in women. On the other hand, the sex-related differences in the occurrence of many diseases reflect differences in opportunity or levels of exposure.

***Ethnic and racial groups.***Sometimes epidemiologists are interested in analyzing person data by biologic, cultural or social groupings such as race, nationality, religion, or social groups such as tribes and other geographically or socially isolated groups. Differences in racial, ethnic, or other group variables may reflect differences in susceptibility or exposure, or differences in other factors that influence the risk of disease, such as socioeconomic status and access to health care.

***Socioeconomic status.*** Socioeconomic status is difficult to quantify. It is made up of many variables such as occupation, family income, educational achievement or census track, living conditions, and social standing. The variables that are easiest to measure may not accurately reflect the overall concept. Nevertheless, epidemiologists commonly use occupation, family income, and educational achievement, while recognizing that these variables do not measure socioeconomic status precisely.

## 4.0 CONCLUSION

You have learned the definitions, classifications and epidemiological patterns used in communicable diseases control dealing with the definition, characteristics and importance of the subject area. Diseases can be classified according to two major dimensions, namely the time course and cause. According to the time course, they are further classified as acute (characterized by a rapid onset and a short duration), and chronic disease (characterized by prolonged duration). Based on the cause, diseases can be broadly categorized as infectious, (i.e. caused by living parasitic organisms such as viruses, bacteria, parasitic worms, insects, etc.), or as non-infectious (which are caused by something other than a living parasitic organism). Epidemiological pattern refers to the occurrence of health-related events by time, place, and person.

## 5.0 SUMMARY

In this unit communicable diseases, have been defined as diseases that spread from person to person, or sometimes from animals to people. Communicable diseases are very important in countries such as Nigeria because, they are common, cause death and disability, cause widespread out breaks or epidemics, are preventable by fairly simple means; the poor and illiterate are vulnerable to many of them and lack access to modern health care service.

Communicable diseases are caused by pathogens, which are agents that cause infections or diseases, especially microorganisms like bacteria, protozoa, viruses, fungi and parasites like helminthes and ecto-parasites.

Epidemiology is concerned with the frequency and pattern of health events in a population. Descriptive epidemiology analyses events according to time, place, and person. Compiling and analyzing epidemiological data by time, place, and person is important because the information generated provides important clues to the causes of disease, and these clues can be turned into testable hypotheses.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. Define the terms communicable and non-communicable diseases.
2. Mention and describe the causes of communicable diseases
3. What do you understand as epidemiological patterns of disease?

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## UNIT 2: STAGES OF DISEASE PREVENTION

**CONTENTS**



### 1.0 INTRODUCTION

This unit on stages of disease prevention describes for you the stages of communicable diseases prevention including the primordial, primary, secondary and tertiary stages of prevention. You will learn the approaches to prevention of communicable diseases. This will help you in identifying appropriate measures for the prevention of communicable diseases that you, as an Environmental Health Practitioner, and other health workers will put into place in your community.

### 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- understand the general principles of disease prevention
- describe the primordial and primary stages of disease prevention
- describe the secondary stage of disease prevention
- describe the tertiary stage of disease prevention

### 3.0 MAIN CONTENT

The sanitary revolution produced the greatest transformation in the pattern of disease that the world had known since nomadic hunter-gatherers settled in permanent villages, and ultimately developed modern urban industrial communities. When we say prevention, it refers to measures that are applied to prevent the occurrence of a disease. When we however say control, it refers to measures that are applied to prevent transmission after the disease has occurred. Most of the measures for prevention of communicable diseases are relatively easy and can be applied using the community's own resources. Thus, you have an important role in educating the public to apply these measures effectively.

There are numerous methods and interventions available to prevent and control communicable diseases and four stages of preventive approaches can be applied to communicable diseases: primordial, primary, secondary, and tertiary (Figure I). These approaches can be exercised across the lifespan of individuals and across all sectors of the health care system. Nigerian health-care system has resources available to promote health and well-being, and also to treat individuals infected with infectious agents.

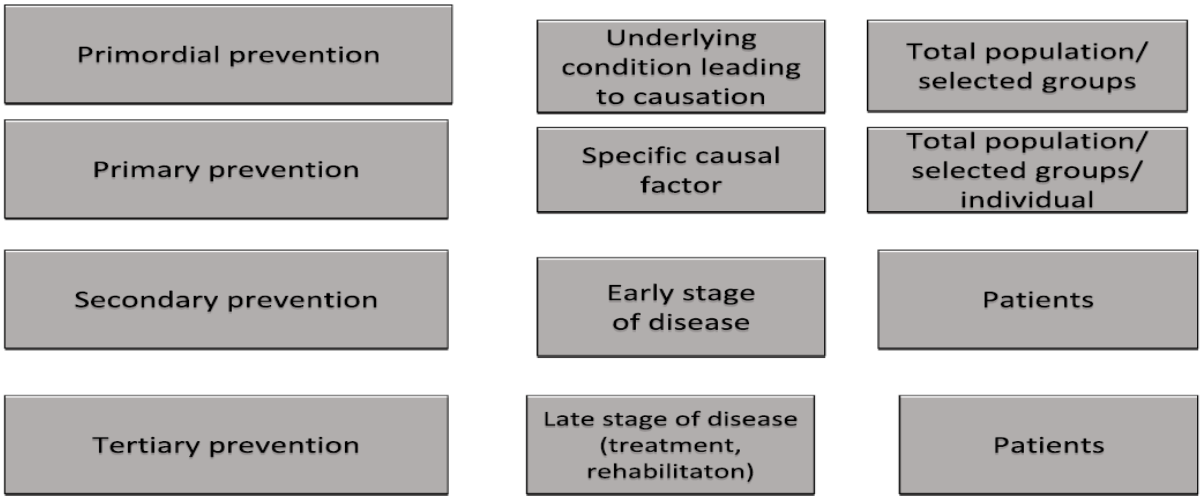


Fig. I: Stages of prevention

### 3.1 Primordial and primary stage of communicable disease prevention

***Primordial prevention***

Primordial prevention is defined as prevention of risk factors themselves, beginning with change in social and environmental conditions in which these factors are observed to develop, and continuing for high risk age groups. Primordial prevention is a relatively new concept, and is receiving special attention in the prevention of chronic diseases. For example, many adult health problems such as obesity and hypertension have their early origins in childhood, because this is the time when lifestyles are formed. It is therefore important to change the milieu that promotes major risk factor development. Primordial prevention calls for changing the socio-economic status of society. A better socio-economic status correlates inversely with lifestyle factors like smoking, abnormal food patterns and exercise.

It is also prevention of emergence or development of risk factors in countries where they have not yet appeared. Primordial prevention efforts are directed towards discouraging children from adopting harmful life styles. The main intervention is therefore through individual and mass education.

Examples of primordial prevention actions may include national policies and programmes on nutrition involving the agricultural sector, the food industry, and the food import-export sector or programmes to promote regular physical activity. Responsibilities for primordial prevention rest with the government, professional and non-governmental organizations, industry, hospitals, health clinics, health practitioners and health-care workers.

***Primary prevention***

Primary prevention is any effort undertaken to prevent the occurrence of diseases. This is one of the most important steps in disease prevention and control and even though all health care services play a role, this is most often the domain of public/community health services. Publicly funded childhood immunization programs are examples of primary prevention. Primary prevention also includes promoting healthy lifestyles and education specific to preventing the transmission of communicable diseases in recreational/personal service settings and preventing NCDs in the populace.The

provision of hepatitis A and hepatitis B vaccine to people infected with hepatitis C is an example of primary prevention (of hepatitis A and hepatitis B). Figure II shows the basic steps in primary prevention.

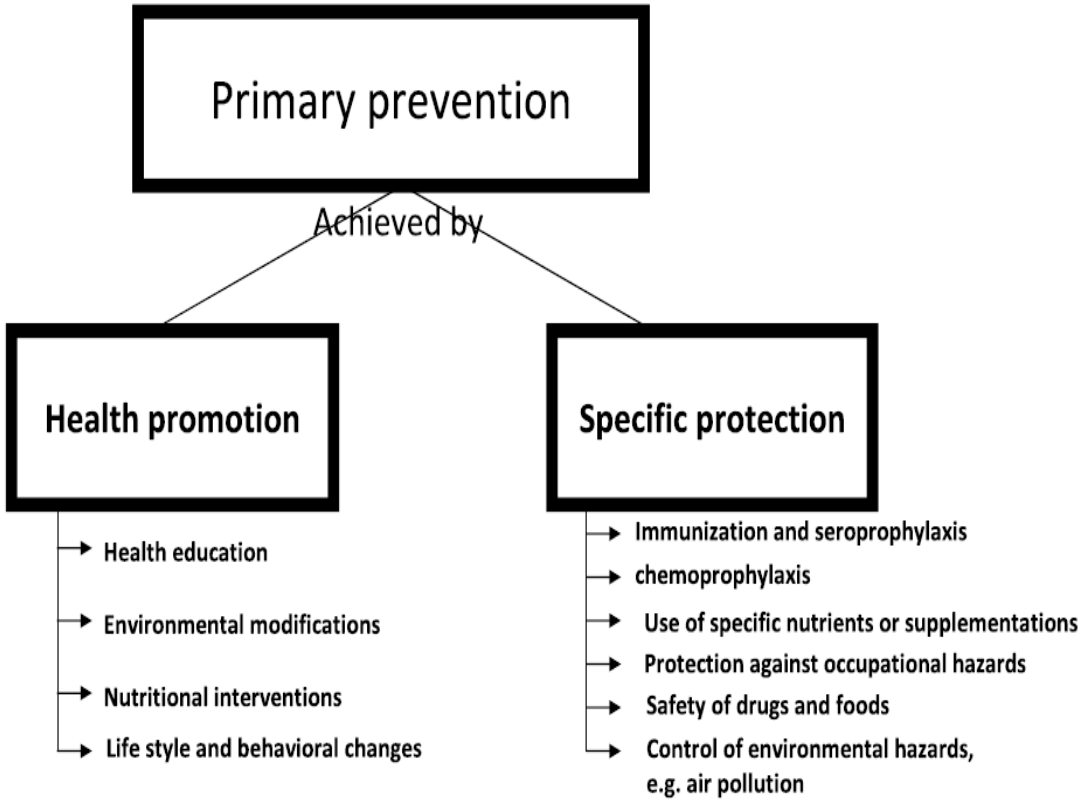


Fig. II: Steps in primary stage of disease prevention

The WHO has recommended the following approaches for the primary prevention of chronic diseases where risk factors are established:

a. Population (mass) strategy
b. High-risk strategy

***Population (mass) strategy:*** Population strategy is directed at whole population irrespective of individual risk levels. For example, studies have shown that even a small reduction in the average blood pressure or serum cholesterol of population would produce a large reduction in the incidence of cardiovascular disease. Population approach is directed towards socio-economic, behavioral and lifestyle changes.

***High-risk strategy:*** The high-risk strategy aims to bring preventive care to individuals at special risk. This requires detection of individuals at high risk by optimum use of clinical methods.

**3.2 Secondary stage of communicable disease prevention**

Unfortunately, it may not be possible to prevent all communicable diseases and illnesses. However, by implementing the secondary prevention approaches, it is possible to detect diseases in a timely fashion and possibly slow the progression of disease within the individuals or disease transmission in the population.

Understanding risk factors in the population and implementing methods of screening allows us to detect diseases at their early stages.

***Early diagnosis and treatment:*** WHO Expert Committee in 1973 defined early detection of health disorders as the detection of disturbances of homoeostatic and compensatory mechanisms while biochemical, morphological and functional changes are still reversible. The earlier the disease is diagnosed, and treated the better it is for prognosis of case and for the prevention of occurrence of other secondary cases.

For instance, screening for sexually transmitted infections (STIs) and blood borne pathogens allows health care providers to offer interventions that prevent secondary complications. Routine pap smears can allow for early detection and treatment of cellular abnormalities from a human papillomavirus (HPV) infection that left untreated may lead to cervical cancer. Screening people living with HIV or AIDS for coinfection with tuberculosis is also an example of secondary prevention (of tuberculosis).

**3.3 Tertiary stage of communicable disease prevention**

Tertiary prevention approaches include the efforts of health care providers to minimize the effects of an agent and prevent disability as a result of infection. Tertiary prevention is often the responsibility of health care providers working outside of public health. The provision of antiviral treatment to people infected with hepatitis C virus or people living with human immunodeficiency virus (HIV) or acquired immunodeficiency syndrome (AIDS) is an example of tertiary prevention. Interventions that should be accomplished in the stage of tertiary prevention are disability limitations and rehabilitation (Figure III).

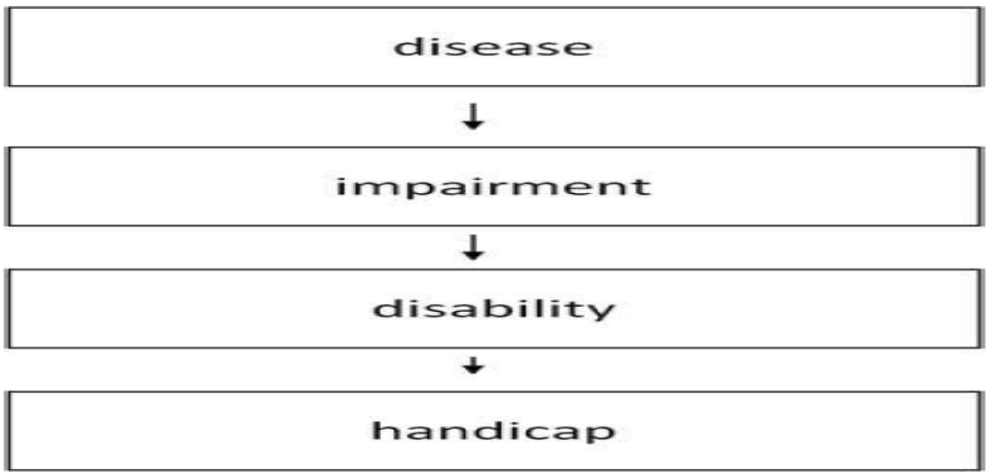


Fig. III: Tertiary prevention accomplishment targets

**Impairment** is any loss or abnormality of psychological, physiological or anatomical structure or function, while **disability** is any restriction or lack of ability to perform an activity in the manner or within the range considered normal for the human being. **Handicap** is termed as a disadvantage for a given individual, resulting from an impairment or disability, that limits or prevents the fulfillment of role in the community that is normal (depending on sex, age, and social and cultural factors) for that individual.

**Rehabilitation** on the other hand is the combined and coordinated use of medical, social, educational, and vocational measures for training and retraining the individual to the highest possible level of functional ability.

## 4.0 CONCLUSION

There are numerous methods and interventions available to prevent and control communicable diseases and there are four stages of preventive approaches can be applied to communicable diseases: primordial, primary, secondary, and tertiary. Primordial prevention refers to prevention of risk factors themselves, especially by changing the socio-economic status of society.

Primary prevention on the other hand is any effort undertaken to prevent the occurrence of diseases, with approaches for prevention of chronic diseases where risk factors are established being population (mass) strategy and high-risk strategy. Secondary prevention is aimed at detecting diseases in a timely fashion and possibly slowing the progression within the individuals or disease transmission in the population usually through early diagnosis and treatment. Tertiary prevention involves efforts to minimize the effects disease agents and to prevent disability as a result of infection.

## 5.0 SUMMARY

In this unit, prevention, have been defined as measures that are applied to prevent the occurrence of a disease, while control, it refers to measures that are applied to prevent transmission after the disease has occurred. The four stages of preventive approaches which can be applied to communicable diseases across the lifespan of individuals and across all sectors of the health care system are the primordial, primary, secondary, and tertiary.

Primordial prevention efforts such as national policies and programmes on nutrition involving the agricultural sector, the food industry, and the food import-export are directed towards discouraging children from adopting harmful life styles. Primary prevention includes promoting healthy lifestyles and education specific to preventing the transmission of communicable diseases such as provision of hepatitis A and hepatitis B vaccine to people infected with hepatitis C.

Secondary prevention refers to actions which halt the progress of a disease at its inception stage and prevent complications. The specific interventions are; early diagnosis (screening tests, and case finding programs) and adequate treatment. Tertiary prevention is often the responsibility of health care providers working outside of public health and refers to efforts of health care providers to minimize the effects of an agent and prevent disability as a result of infection.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. Define the terms primordial, primary, secondary and tertiary levels of disease prevention.
2. What do you understand by the terms, impairment, disability, handicap and rehabilitation?

## 7.0 REFERENCES/FURTHER READING

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# UNIT 3 DISEASE CONTROL METHODS

## CONTENTS



## 1.0 INTRODUCTION

This unit on disease control methods describes for you the different approaches applied to communicable diseases control including the biological, environmental, chemical and chemotherapeutic methods of control. Disease control is defined as a reduction in the incidence, prevalence, morbidity or mortality of an infectious disease to a locally acceptable level; elimination or reduction to zero of the incidence of disease or infection in a defined geographical area and eradication as permanent reduction to zero of the worldwide incidence of infection. You will learn the different applications of these methods to different disease situations. This will help you in identifying appropriate measures for the control of different types of communicable diseases that you, as an Environmental Health Practitioner, and other health workers will put into place in your community and beyond.

## 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- describe the methods and applications of chemical control of diseases
- describe the methods and applications of chemotherapeutic control of diseases
- describe the methods and applications of biological control of diseases
- describe the methods and applications of environmental control of diseases

Every year there are hundreds of millions of cases of insect- and rodent –borne diseases, indicating the major threat to global public health that vector-borne diseases are. Operational, financial and managerial problems, together with environmental change, pesticide resistance and population movement have caused an increase in the prevalence of many of these diseases in recent years. Such diseases which include malaria, filariasis, schistosomiasis, dengue, trypanosomosis and leishmaniosis, represent a significant impediment to social and economic development.

Selective vector control is an integral part of many vector-borne diseases control activities. Available vector control methods are mainly based on environmental management, biological control and use of chemicals. With rare exception, environmental management and biological control have limited application on their

own, and chemical control is still considered as the most important element in the integrated control of vector-borne diseases.
Effective application of any control measure must be based on a fundamental understanding of the ecology, bionomics and behavior of the target species. Effective vector control also requires careful training and supervision of pest control operations and periodical evaluation of the impact of the control measures on the vector density and disease statistics. Where applicable, environmental sanitation methods should be applied in conjunction with chemical pesticides.

### 3.1 Chemical and chemotherapy methods

***Chemicalmethods:*** The well-known insecticide classes (the organochlorines, the organophosphates, the carbamates and pyrethroids) are the mainstay of vector control programs. The role of organochlorines has diminished due to concerns over environmental impact, residues in export crops and safety of humans. DDT is however still used for malaria and leishmaniosis vector control in countries where it is available and where local vector species are susceptible.

*Pesticide selection:* In selecting a pesticide and the appropriate formulation, consideration should be given to the biological effectiveness against the pest concerned, the susceptibility status of the target organism, the registration status of the pesticide for the required use and its cost. If possible, small trials on the efficacy of the formulation and application method should be carried out under local conditions before committing to the purchase of large quantities. Consideration should also be given to transportation requirements and availability of application equipment. Due regard should also be given to the impact of the compounds on the environment, including fish, birds, and beneficial invertebrates. Determination of cost should be based on the expense of material as applied and not strictly upon the purchase price of the chemical.

*Pesticide formulation:* Pesticides are rarely used in their pure or technical form. Usually, the technical grade material is mixed with various non-insecticidal ingredients to create a pesticide formulation. These inert ingredients serve to either enhance stability of, reduce toxicity, improve efficacy or facilitate handling of the product. The type of pesticide formulation may markedly affect the results obtained in control. When absorbent surfaces are to be sprayed, suspensions of water-dispensable powders are frequently more effective biologically than emulsions or solutions, but they can leave an unpleasant deposit on the treated surfaces. Microencapsulated products tend to provide long-term control and are more effective in exposed environments, such as outdoors. Safety, efficacy, residual life and ease of handling must be considered when selecting a particular formulation.

Currently, pesticide compounds are presented as dustible powders or granules, emulsifiable concentrates, emulsion oil-in-water, capsule suspention, slow-release formulation, solution, suspention, suspension concentrate, technical grade, wettable powder and water dispensible powder.

The chemical control of disease vectors which has been very successful for some time is now faced with some difficulties due to the resistance of insects to the insecticides, to the decreasing number of candidate insecticides, to the increase of their price and to the

legal restrictions concerning their safe use and their environmental safety. Additionally, there is a growing problem of insecticide resistance that could render existing tools ineffective and potentially lead to a reversal of recent gains. Similar challenges exist for control of arboviruses such as dengue, chikungunya and Zika, which have emerged as major threats to public health in recent years. In the absence of effective drugs and vaccines, the ability to combat these diseases relies on vector control.

Again, chemical insecticides, are being undermined by the evolution of insecticide resistance. However, the key mosquito vectors of arboviruses, *Aedesaegypti*and *A. albopictus*, continue to spread into new areas, including parts of Europe and the US. Other emerging diseases, such as West Nile virus (transmitted by a diversity of mosquito species) and Lyme disease (transmitted by certain ticks) are also extending the threat of vector-borne diseases into temperate environments not typically associated with vector borne disease problems in recent history. These challenges create a demand for new control tools.

The present trend of vector control is to integrate various control techniques and to limit the use of insecticides to the control of the epidemiologically dangerous part of the vector population. This approach might prevent or delay the development of resistance.In recent times therefore, diverse technologies such as toxic sugar baits, house screening/modification, endectocides, repellants, lethal ovitraps, mass trapping and genetic control strategies are being researched and developed for better disease vector control.

Specifically, for malaria vector control, dramatic reductions in disease burden have been seen worldwide in recent years. The decline is largely attributable to the broad-scale use of long lasting insecticide treated nets (LLINs) and indoor residual sprays (IRS) against adult mosquitoes. The success of these insecticide-based interventions represents a foundational step in the global agenda to eliminate malaria. However, the current control tools alone are likely insufficient to eliminate malaria in many settings, even if their use could be intensified.

***Chemotherapy methods:***The term preventive chemotherapy (PC) was introduced by the World Health Organization (WHO), to cover the approach of treating populations at risk of human helminth diseases, to prevent transmission or morbidity of those diseases,with drugs either alone or in combination. Delivery is usually undertaken by mass drug distribution campaigns organized by national health services but delivered by communities, through school-based treatments or via the health services themselves. Increasingly, the strategy of PC is part of an expanded integrated programme to address the neglected tropical diseases (NTDs), including meeting targets for elimination or control, as delineated by World Health Assembly (WHA) resolutions. Further support for this integrated chemotherapy approach is already in place through donations of the required drugs by major pharmaceutical companies or procurement of the drugs at relatively low costs. This could be regarded as a pro-poor health policy and strategy that exploits the approach to integration.

There are however many tactical issues to be addressed concerning this strategy of integrated chemotherapy-based control and include;

What are the most efficient and cost-effective means to rapidly identify or map areas at highest risk of coinfections?
Will the approach be effective across a diversity of epidemiological and sociocultural settings?
How will integrated chemotherapy for specific age groups be tailored?
What are the most appropriate time intervals, delivery systems, and monitoring and evaluation systems, especially for drug interactions, compliance, and development and spread of resistance?
How should the move from morbidity control to transmission containment be executed?

The donation of ivermectin (as Mectizan) for the control and now elimination of onchocerciasis in 1987 by Merck & Co. Inc. was a landmark in the history of public health. Ivermectin kills microfilaria in the skin and inhibits their release by female worms, reducing transmission of *Onchocerca volvulus* by Simulium vectors. To interrupt transmission, a minimum of 15 years annual treatment is required, the duration of life of adult worms. The effectiveness of ivermectin as a microfilaricide led to the creation of the African Programme for Onchocerciasis Control (APOC) in 1995, targeting disease control in 19 endemic African countries. APOC's success has been built on the development of community-directed treatment with ivermectin, an approach which shifts responsibility of drug delivery from the health system to distributors selected by the community, who collect the drugs from the health service and decide on the time they would distribute drugs to their community.

Novartis donated curative treatments for leprosy, following the demonstration of the efficacy of multidrug therapy (rifampicin, dapsone and clofomazine). Glaxo-SmithKline committed to providing albendazole for the elimination of lymphatic filariasis in 1998, and Merck & Co. Inc. expanded their donation of ivermectin for countries co-endemic for onchocerciasis and lymphatic filariasis.

Another important helminthic parasite disease, schistosomiasis, caused by species of the genus Schistosoma, is reportedly endemic in 78 countries worldwide. Of the estimated 240 million infections globally, over 200 million occur in Africa although there are foci of *Schistosomamansoni* in Brazil and smaller countries in the Americas, and of *Schistosomajaponicum* and *Schistosomamekongi* in Asia. A cornerstone for the elimination of morbidity due to schistosomiasis is praziquantel, essentially the only medicine commercially available to treat human schistosomiasis. Despite the expansion in coverage of treatment of schistosomiasis with praziquantel from 12 million people in 2006 to 35 million people in 2011 and increased support for control, schistosomiasis remains a major public health problem. The expansion of the treatment with praziquantel has continued and from 2015 there were sufficient doses to treat 100 million people per year. Examples of successful elimination include the case of Egypt in which transmission is now restricted to local hotspots, so that *S. haematobium* induced bladder cancer has been dramatically reduced as a cause of mortality, and prevalence's of both *S. haematobium*and *S. mansoni* have been reduced by some 80 per cent with corresponding reductions in intensities of infection.

A report from Nigeria identified eleven major challenges following the experiences of the APOC programme (which focused on sustainable delivery of ivermectin as an objective, rather than elimination) include;
(1) maintaining timely drug distribution
(2) integrating distribution into existing primary healthcare services
(3) strengthening local health infrastructure
(4) achieving and maintaining optimal coverage
(5) establishing and up scaling self-monitoring by communities
(6) implementing operational research
(7) ensuring adequacy of community distributors
(8) increasing involvement of local NGDOs
(9) achieving financial sustainability;
(10) implementing equitable cost recovery systems
(11) engaging in effective advocacy.

**3.2 Biological control methods of diseases**

Biological control is defined as the use of predators, parasites, or pathogens, where the mode of action relies on the living organisms and as well as their derivatives in the control of disease vectors. This definition is based on the long-standing definition of biological control centers on the use of a natural enemy and not modification of the pest itself. This definition puts pesticides based on the toxin-forming bacteria *Bacillus thuringiensis* and *B. sphaericus* at the margins of biological control, although they are also valuable technologies. Use of toxins derived from plants or microbes, or insecticide juvenile hormone analogues are not considered biological control, even though these are often referred to as 'biological' products. The definition of biological control also excludes transgenic and gene drive technologies, where the vector itself is genetically modified for the purpose of population suppression or population replacement strategies, since there is no natural enemy involved. In figure IV, a typical biological control scenario is demonstrated by a *Peristenusdigoneutis*laying an egg on a tarnished plant bug nymph.

Fig. IV:*Peristenusdigoneutis*laying an egg on a tarnished plant bug nymph

Very few biological control interventions for vector borne diseases have progressed to the level of evaluating epidemiological outcomes. For example, biological control of mosquito larvae using fish has been researched for decades. However, recent evidence

that suggests that introducing larvivorous fish to anopheline breeding sites impacted malaria transmission or influenced adult anopheline density cannot be reliably established. Numerous studies on the other hand have identified fungal pathogens as potential biological control agents for use against mosquito larvae. However, the key challenge for larval control of mosquito vectors is not necessarily the lack of candidate products but the ability to deliver them in a cost-effective manner to breeding habitats that can be highly numerous, difficult to locate and transient. If the habitats cannot be treated because they are inaccessible or too numerous, or if the product requires frequent re-treatment because it does not persist, there is not obviously an advantage over current tools.

Biological control methods are however increasingly being applied to vector control and contribute to the development of sustainable Integrated Vector Management (IVM) strategies in which diverse tools, tactics, and resources are combined to reduce transmission of disease by vectors. Despite the fact that in agriculture there is established role of biological control in the development of Integrated Pest Management (IPM) strategies, the opportunities for the developing a biological control tool or tactic to the point of operational use for the control of human disease vectors has remained limited.

### 3.3 Environmental control/management

For several vector species, environmental sanitation through source reduction and health education is the fundamental means of control. It is ideally the primary method of control, with others serving as a supplement, not substitute. Environmental control/management seeks to change the environment in order to prevent or minimize vector propagation and human contact with the vector-pathogen by destroying, altering, removing or recycling non-essential containers that provide egg/ larval/ pupal habitats. Such actions should be the mainstay of vector-borne diseases control. Three types of environmental management are defined:

***Environmental modification*** – long-lasting physical transformations to reduce vector larval habitats, such as installation of a reliable piped water supply to communities, including household connections.

***Environmental manipulation*** – temporary changes to vector habitats involving the management of "essential" containers, such as frequent emptying and cleaning by scrubbing of water-storage vessels, flower vases and desert room coolers; cleaning of gutters; sheltering stored tyres from rainfall; recycling or proper disposal of discarded containers and tyres; management of plants close to homes that collect water in the leaf axils.

***Changes to human habitation or behavior*** – actions to reduce human–vector contact, such as installing mosquito screening on windows, doors and other entry points, and using mosquito nets while sleeping during daytime. Improvements in, and maintenance of, urban infrastructure and basic services contribute to the reduction in available larval habitats since large *Ae. aegypti* populations are often associated with poor water supply and inadequate sanitation and waste disposal services.

*Improvement of water supply and water-storage systems***:** Improving water supplies is a fundamental method of controlling Aedes vectors, especially *Ae. aegypti.* Water piped to households is preferable to water drawn from wells, communal standpipes, rooftop catchments (rain water harvesting) and other water-storage systems. However, potable water must be supplied reliably so that water-storage containers that serve as larval habitats – such as drums, overhead or ground tanks and concrete jars – are not necessary. The installation of reliable piped water supplies to houses should be accompanied by a communication strategy that discourages traditional storage practices.

*Mosquito-proofing of water-storage containers:*Water-storage containers can be designed to prevent mosquitoes from laying eggs on the surface of the water. Containers can be fitted with tight lids or, if rain-filled, tightly-fitted mesh screens can allow for rainwater to be harvested from roofs while keeping mosquitoes out. Removable covers should be replaced every time water is removed and should be well maintained to prevent damage that permits mosquitoes to get in and out. Expanded polystyrene beads used on the surface of water can prevent mosquitoes from laying eggs on the surface. However, these are only applicable in storage containers with an installed pipe to draw water from the bottom.

*Solid waste management:*In the context of dengue vector control, "solid waste" refers mainly to non-biodegradable items of household, community and industrial waste. The benefits of reducing the amount of solid waste in urban environments extend beyond those of vector control. Applying many of the basic principles can contribute substantially to reducing *Ae. aegypti* larval habitats. Proper storage, collection and disposal of waste are essential for protecting public health. The basic rule of "reduce, reuse, recycle" is highly applicable. Efforts to reduce solid waste should be directed against discarded or non-essential containers, particularly if they have been identified in the community as important mosquito-producing containers. Solid waste should be collected in plastic sacks and disposed of regularly. The frequency of collection is important: twice per week is recommended for housefly and rodent control in warm climates. Integration of *Ae.aegypti* control with waste management services is possible and should be encouraged.

*Street cleansing:*A reliable and regular street cleansing system that removes discarded water-bearing containers and cleans drains to ensure they do not become stagnant and breed mosquitoes will both help to reduce larval habitats of *Ae. aegypti* and remove the origin of other urban pests.

*Building structures:*During the planning and construction of buildings and other infrastructure, including urban renewal schemes, and through legislation and regulation, opportunities arise to modify or reduce potential larval habitats of urban disease vectors, including *Ae.aegypti, Culexquinquefasciatus* and *An. stephensi*. For example, under revised legislation in Singapore, roof gutters are not permitted on buildings in new developments because they are difficult to access and maintain. Moreover, property owners are required to remove existing gutters on their premises if they are unable to maintain them satisfactorily.

## 4.0 CONCLUSION

You have studied communicable disease control methods, which is a part of the general introduction to communicable diseases dealing with chemical, chemotherapy, biological and environmental control methods. Available vector control methods are mainly based on environmental management, biological control and use of chemicals. Environmental and biological control have limited application on their own, while chemical control is considered as the most important in the integrated control of vector-borne diseases.

Effective vector control requires careful training and supervision of pest control operations and periodical evaluation of the impact of the control measures on the vector density and disease statistics.

## 5.0 SUMMARY

In this unit, it has been shown that the well-known insecticide classes (the organochlorines, the organophosphates, the carbamates and pyrethroids) are the mainstay of vector control programs around the world. The success of such insecticide-based interventions represents a foundational step in the global agenda to eliminate important communicable diseases like malaria; although current control tools alone are likely insufficient to eliminate malaria in many settings, even if their use could be intensified.

Chemotherapy methods of control is defined as the strategy of treating populations at risk of human helminth diseases, to prevent transmission or morbidity of those diseases, with drugs either alone or in combination. The strategy has been adopted in the control of neglected tropical diseases (NTDs), and has received support through donations of the required drugs such as ivermectinfor filariasis control, rifampicin, dapsone and clofomazine for leprosy control and praziquantel for schistosomiasis control by major pharmaceutical companies or procurement of the drugs at relatively low costs.

Biological control is defined as the use of predators, parasites, or pathogens, where the mode of action relies on the living organisms and as well as their derivatives in the control of disease vectors. The methods are increasingly being applied to vector control and contribute to the development of sustainable Integrated Vector Management (IVM) strategies.

The goal of environmental control is to change the environment in order to prevent or minimize vector propagation and human contact with the vector-pathogen by destroying, altering, removing or recycling non-essential containers that constitute breeding habitats disease vectors. Thus,the method involves essentially environmental modification and manipulation as well as changes to human habitation or behavior.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss the role of pharmaceutical companies in chemotherapy control of diseases
2. How effective are biological control measures in sustainable integrated vector management?
3. Discuss the variousactions needed to reduce human–vector contact in environmental disease control approaches

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# MODULE 2 INTRODUCTION TO CDS II: DRUG DELIVERY STRATEGIES AND EMERGING/RE-EMERGING DISEASES

Unit 1: Strategies for drug delivery
Unit 2: Epidemiological patterns
Unit 3.Emerging and re-emerging diseases

## UNIT 1: STRATEGIES FOR DRUG DELIVERY

**CONTENTS** **PAGE**



## 1.0 INTRODUCTION

Drug delivery is defined as the approaches, formulations, technologies, and systems for transporting a pharmaceutical compound in the body in order to safely achieve its desired therapeutic effect. It is concerned with both quantity and duration of drug presence within the body. The concept of drug delivery is therefore heavily integrated with dosage form and route of administration. Conventional drug delivery system has little or no control over the drug release, and effective concentration at the target site. Site specific targeting systems refer to targeting of a drug directly to a certain biological location adjacent to or in the diseased organ or tissue. Mass chemotherapy differs from selective chemotherapy in offering treatment to all individuals in an endemic community regardless of infection status. This unit on strategies for drug delivery will explain to you the concepts of conventional drug delivery as well as targeted and mass chemotherapy.

## 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- Understand the concepts of drug delivery
- Discuss conventional drug delivery
- Explain the benefits of targeted and mass chemotherapy

## 3.0 MAIN CONTENT

### 3.1 Conventional Drug Delivery

Drug delivery technologies modify drug release profile, absorption, distribution and elimination for the benefit of improving product efficacy and safety, as well as patient convenience and compliance. This is often approached via a drug's chemical

formulation, which may also involve medical devices or drug-device combination products. Drug is commonly released from diffusion, degradation, swelling, and affinity-based mechanisms. Common routes of drug administration include the enteral (gastrointestinal tract), parenteral (via injections), inhalation, transdermal, topical and oral routes. Many medications such as peptide and protein, antibody, vaccine and gene based drugs, in general may not be delivered using these routes because they might be susceptible to enzymatic degradation or cannot be absorbed into the systemic circulation efficiently due to molecular size and charge issues to be therapeutically effective. For this reason many protein and peptide drugs have to be delivered by injection or a nano-needle array. For example, many immunizations are based on the delivery of protein drugs and are often done by injection.

The oral route of drug administration is the most common and important method of administering drugs for systemic effects. The parenteral route is not routinely used for self-administration of medication. The topical route of administration has only recently been employed to deliver drugs to the body for systemic effects. It is probable that at least 90% of all drugs used to produce systemic effects are administered by the oral route. When a new drug is discovered, one of the first questions a pharmaceutical company asks is whether or not the drug can be effectively administered for its intended effect by the oral route. If it cannot, the drug is primarily relegated to administration in a hospital setting or physician's office. Solid oral dosage forms represent the preferred class of product.

Conventional drug delivery system has little or no control over the drug release, and effective concentration at the target site. This kind of dosing pattern may result in constantly changing, unpredictable plasma concentrations. The rate and extent of drug absorption from conventional formulations may vary greatly depending on the factors such as-

- Physico-chemical properties of the drug
- Presence of excipients
- Physiological factors such as presence or absence of food,
- PH of the gastro-intestinal tract (GI)

**Problems of conventional drug delivery***:* An ideal dosage regimen in the drug therapy of any disease is one which immediately attain the desired therapeutic concentration of drug in plasma and maintains it constant for the entire duration of treatment. This is possible through the administration of conventional dosage forms in a particular dose and at particular frequency. The frequency of administration or dose interval of any drugs depends upon its half-life or mean residence time and its therapeutic index. In most cases, dosing interval is much shorter than the half-life of the drug, resulting in a number of limitations associated with such a conventional dosage form. These include;
I. Poor patient compliance; increased chances of missing the dose of a drug with short half-life for which frequent administration is necessary.

II. A typical peak valley plasma concentration time profile is obtained which makes attainment of steady state condition difficult.

III. The unavoidable fluctuation in the concentration may lead to under medication or over medication as the concentration fall or rise beyond the therapeutic range.

The fluctuating drug level may lead to precipitation of adverse effects, especially of a drug with small therapeutic index whenever over medication occurs. The need to overcome these limitations of conventional dosage forms, has led to the development of non-conventional dosage forms. The two major approaches to overcoming the situation are;
I. Development of new, better and safer drugs with long half-life and large therapeutic indices.

II. Effective and safer use of existing drugs through concepts and techniques of sustained/ controlled and targeted drug delivery systems.

Oral controlled/sustained release dosage forms have been tried due to their advantages. The design of such oral controlled/sustained release drug delivery systems is primarily aimed at achieving more predictable and increased bioavailability of drugs. Thus, many controlled release dosage forms have been devised by various researchers to modulate and release a drug over an extended period of time. The majority of these systems are matrix-based, and their principal drug release mechanism is based on drug diffusion through the matrix system, which is altered by;
-the pH of the medium
-presence of food
-the body's physiological factors (G.I. motility)

Another delivery method used is the osmotic drug delivery system. Unlike matrix systems, osmotic systems use the principle of osmosis as delivery force to release the drug from the system, and the release rate is unaffected by the body's pH and other physiological factors.

### 3.2 Targeted Chemotherapy

Current drug delivery research efforts include the development of targeted delivery in which the drug is only active at the target sites in the body (for example, in cancerous tissues), sustained release formulations in which the drug is released over a period of time in a controlled manner from a formulation, and methods to sustain the effectiveness of drugs which must pass through the stomach's acidic environment. In order to achieve efficient targeted delivery, the designed system must avoid the host's defense mechanisms and reach its intended site of action.

Targeted drug delivery, also called smart drug delivery, is a method of delivering medication to a patient in a manner that increases the concentration of the medication in some parts of the body relative to others. This method is founded mostly on nano-medicine, which aims to employ nanoparticle-mediated drug delivery to overcome the shortcomings of conventional drug delivery. The drug loaded nanoparticles are targeted at specific parts of the body where there is solely diseased tissue, thereby avoiding interaction with healthy tissue. The goal of a targeted drug delivery system is to prolong, localize, target and have a protected drug interaction with the diseased tissue.

**Rational for controlled drug delivery:** The basic rational for sustained/controlled drug delivery system is to alter the pharmacokinetics and pharmacodynamics of

pharmacologically active moieties by using novel drug delivery system or by modifying the molecular structure and or physiological parameter inherent in a selected route of administration. The benefits include;
i. Reduction in fluctuation of drug blood levels about the mean.
ii. Reduce the dosage frequency.
iii. To improve patient's compliance.
iv. To ensure safety and improve efficacy of drugs.
v. More consistent and prolonged therapeutic effect.
vi. Decreased incidence and intensity of adverse effects and toxicity.
vii. Better drug utilization.
viii. A greater selectivity of pharmacological activity.
ix. Delivery of drug at site at predicted time.

Examples of sustained release formulations include liposomes, drug loaded biodegradable microspheres and drug polymer conjugates. Sustenance of drug potency as they pass through the stomach is a major problem, especially for drugs that cannot be developed as solid tablets. Efforts to solve this problem has received limited success in research and drug development.

**Modified release delivery systems** may be divided conveniently into four categories.
a) Delayed release
b) Sustained release
    i) Controlled release
    ii) Extended release
c) Site specific targeting
d) Receptor targeting

**a) Delayed release:** These systems are those that use repetitive, intermittent dosing of a drug from one or more immediate release units incorporated into a single dosage form. Examples of delayed release systems include repeat action tablets, capsules and enteric coated tablets where time release were achieved by a barrier coating.

**b) Sustained release:** Sustained release systems include any drug delivery system that achieves slow release of drug over an extended period of time.
i) *Controlled release:* Controlled release systems also provide a slow release of drug over an extended period of time and can also provide some control, whether this is of a temporal or spatial nature, or both. In other words, the system is successful at maintaining constant drug levels in the target tissue or cells.
ii) *Extended release:* Pharmaceutical dosage forms that release the drug slower than normal manner at predetermined rate and necessarily reduce the dosage frequency by two folds.

**c) Site specific targeting:**Site specific targeting systems refer to targeting of a drug directly to a certain biological location adjacent to or in the diseased organ or tissue.

**d) Receptor targeting:** Receptor targeting systems refer to targeting of a drug directly to a certain biological location. In this case the target is the particular receptor for a drug within an organ or tissue. Site specific targeting and receptor targeting systems

satisfy the spatial aspect of drug delivery and are considered to be controlled drug delivery systems.

Oral modified release dosage forms can be classified in different ways. One way is to distinguish between single-unit dosage forms such as tablets and capsules and multi-particulate dosage forms such as pellets and beads.

**Single unit dosage forms:** Single unit dosage forms are defined as oral delivery systems that consist of one unit which contains a single dose of the drug and is intended to be administered singularly. Many single unit dosage forms have been developed for the modified release of bioactive materials. The most widely investigated example is the monolithic matrix based tablet.

The advantages of this dosage form include high drug loading and the availability of well characterized and cost-effective production methods. Drug release from these systems is controlled by a variety of mechanisms, including drug diffusion, tablet erosion, matrix swelling or a combination of these mechanisms. Film coated and osmogen controlled single unit dosage forms have also been studied for modified release applications. Single units include capsules, coated tablets, osmotic pumps, insoluble matrix tablets, soluble matrix tablets, degradable matrix tablets and ion exchange resins.

**Multiple unit dosage forms:** The concept of the multiple unit dosage form was introduced in the early 1950s. These solid oral dosage forms consist of a multiplicity of small discrete particulates, which include mini tablets, pellets and granules. These systems provide flexibility during formulation development and gives therapeutic benefits to patients. A significant advantage of multi-particulates is that they can be divided into desired doses without making formulation or process changes. They can also be blended to deliver simultaneously incompatible bioactive agents or particles with different drug release properties. Furthermore, these dosage forms are less susceptible to dose dumping than the reservoir or matrix type, and single unit tablet since the drug release profile does not depend on the drug release properties of a single unit.

Pellets for example, offer advantages as they constitute multiple unit dosage forms. Studies have indicated that they are rapidly and evenly dispersed in the gastrointestinal tract upon oral administration, thus maximizing drug absorption and reducing inter and intra subject variability due to differences in gastric emptying rates. Pellets can be filled into hard gelatin capsules or compressed into tablets, which rapidly disintegrate into multiple units. Such multiple units include pellets, granules, microcapsules, and beads etc.

### 3.3. Mass Chemotherapy

WHO defines mass or preventive chemotherapy as the large-scale preventive treatment against helminthiasis with safe, often single-dose, quality-assured medicines facilitated by several large-scale donations. It represents a major public health intervention, that has delivered over 1 billion treatments every year (1.5 billion globally in 2016), and provided an essential standard of care for those at risk of infection or associated disease.

Mass chemotherapy therefore differs from selective chemotherapy in offering treatment to all individuals in an endemic community regardless of infection status. This disease control approach also aims to reduce morbidity and to decrease the absolute number of worms in the human population, thereby reducing the overall rate of transmission. Mass chemotherapy has been shown to be an efficient method of population-based treatment when the prevalence of infection is very high. It also aims to treat those who may be infected but were missed due to insensitivity of ova detection methods.

**Parasite response:** How parasite populations respond (both in the short and long term) to perturbations induced by control intervention is dependent on the various factors which dictate the dynamics of growth and decay in parasite abundance within individual people and the community as a whole. The interactions between such factors as herd immunity and the intensity of transmissions, or parasite fecundity and parasite burden, are often complex and non-linear in form. It is, therefore, usually difficult to predict in advance how repeated mass application of chemotherapeutic agents will influence average parasite burdens and transmission within a community.

The degree of depression in the average intensity of infection immediately following mass treatment, from the level pertaining prior to control, will depend on the following;

- the efficacy of the drug employed
- the proportion of the population treated
- the time period over which this proportion receives treatment

Asingle mass treatment will usually not eradicate the parasite from the community, since the available anthelmintics are not 100% efficient (partly as a result of genetic variability within the parasite population). Therefore, immediately following treatment reinfection will take place and, in the absence of repeated mass treatment, the average worm burden will rapidly return to its pre-control level.

The 'return time' will depend on a variety of factors of which the most important are;

- the degree to which the average worm burden is depressed below its pristine level in the untreated community,
- the intrinsic force of infection within the population (the magnitude of the parasites' basic reproductive rate*)*
- the life-expectancy of the adult parasite.

The return time is inversely correlated with the magnitudes of all three factors. In areas of moderate to high transmission intensity, given moderate degrees of depression of average worm burden following a single mass treatment, the return time is typically less than 1 year for *Trichuris,* roughly 1 year for *Ascaris,* 2-4 years for hookworm and many years for schistosome infections.

**Epidemiological implications:** The ability of helminth populations to recover rapidly from depressions following a single mass treatment implies that effective long-term control can only be achieved by repeated treatments. Thus, the intensity (proportion treated) and frequency (time-interval between treatments) of mass treatment required to eradicate a specified helminth infection within a defined community can be estimated by means of simple models of transmission dynamics.

In practice, however, eradication is rarely a feasible objective since villages in endemic areas are usually not isolated from other infected regions. Visitors or immigrants would provide a constant source for the reinfection of such communities. Therefore, a more realistic aim should be *morbidity* eradication (as opposed to *parasite* eradication) given the assumption that the frequency of symptoms of disease is positively correlated with worm burden. A reduction in average worm burden resulting from mass treatment will, therefore, reduce morbidity, although the relationship is a non-linear one.

Again, the number of missed infections can be significant, since the distribution of the number of helminth ova excreted in an endemic population is strongly skewed towards light infections where sensitivity is lowest. Sensitivity of ova detection is also influenced by the skill of the observer, which can vary considerably. Missed infected individuals may therefore continue to be a reservoir of infection. Mass chemotherapy also aims to treat those who may not be able to provide a specimen. Accordingly, there is a potential for mass chemotherapy programs to reduce transmission as well as reduce prevalence of infection and morbidity.

**Mass schistosomiasis chemotherapy:** Schistosomiasis remains a public health problem in several parts of the world, particularly in Africa, with ≥200 million people infected in 2009. World Health Assembly set target adopted in 2001, aimed to reach ≥75% of all school-aged children who are at risk of morbidity from schistosomiasis and soil-transmitted helminthiasis. The major constraint to controlling the disease continues to be limited access to effective drugs. However, during the past several years progress has been made in scaling up schistosomiasis treatment.

Praziquantel is an efficacious single dose oral anti-helminthic with few side effects, and has been voted an effective drug for mass schistosomiasis chemotherapy. In highly endemic areas like Egypt, following mass chemotherapy with praziquantel only a small number of infected cases were detected (including those estimated) on follow-up in endemic communities, indicating that mass chemotherapy was a feasible and efficacious control approach in the area. In Mali, where mass chemotherapy of praziquantel was used to control *S. haematobium*in an area of 87 villages, overall prevalence was reduced from 68.8% to 39.4%.

## 4.0 CONCLUSION

In this unit you have learnt that drug delivery is the approaches, formulations, technologies, and systems for transporting a pharmaceutical compound in the body in order to safely achieve its desired therapeutic effect. You were informed that the common routes of drug administration are the enteral, parenteral, inhalation, transdermal, topical and oral routes. Targeted drug delivery, is the method of delivering medication to a patient in a manner that increases the concentration of the medication in some parts of the body relative to others. Mass chemotherapy on the order hand is the large-scale preventive treatment against helminthiasis and trachoma with safe, often single-dose, quality-assured medicines facilitated by several large-scale donations. Mass chemotherapy differs from selective chemotherapy in offering treatment to all individuals in an endemic community regardless of infection status.

## 5.0 SUMMARY

In this unit, you have learnt the definitions of the three drug delivery strategies, conventional delivery, targeted and mass chemotherapy. The oral route of drug administration is the most common and important method of administering drugs for systemic effects. Conventional drug delivery system has little or no control over the drug release, and effective concentration at the target site. The need to overcome this limitation has led to the development of non-conventional dosage forms such as drugs with long half-life and large therapeutic indices and techniques of sustained/controlled and targeted drug delivery systems.

Targeted chemotherapy in which the drug is only active at the target sites in the body, sustained release formulations in which the drug is released over a period of time in a controlled manner, and methods to sustain the effectiveness of drugs which must pass through the stomach's acidic environment are now available.

The effectiveness of mass chemotherapy as a method of population-based treatment when the prevalence of helminthiasis infections is very high have been demonstrated. How parasite populations respond to such mass chemotherapy is dependent on various factors that dictate the dynamics of parasite abundance within individual people and the community as a whole.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. What are the problems associated withconventional drug delivery?
2. Discuss the term modified release delivery systems
3. What do you understand by parasite response to mass chemotherapy?

## 7.0 REFERENCES/FURTHER READING

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## UNIT 2: EPIDEMIOLOGICAL PATTERNS

**CONTENTS** **PAGE**



### 1.0 INTRODUCTION

In the previous unit you learnt about the different strategies of drug delivery, which could be by conventional method, targeted or mass chemotherapy. In this unit you will be learning about epidemiological patterns starting with chain of infections, which underlines the basic principles of disease prevention and control. A disease agent in its reservoir or host is usually transmitted through an appropriate portal of entry to infect a susceptible host. Disease occurrence is also influenced by risk factors which include choices and habits that negatively impact wellness, including but not limited to deliberate lifestyle choices characterized by personal responsibility and practices. These diseases usually manifest in the form of signs and symptoms, which are physical responses linked medical fact or characteristic that is detected by a physician (sign) and a departure from normal function or feeling which is noticed by a patient (symptom).

### 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- explain the chain of infection
- Describe disease risk factors
- Understand the meaning of the terms signs and symptoms

### 3.1 The chain of infection

One of the basic principles of disease prevention and control is the chain of infection. An understanding of each link in the chain will assist in disease prevention. There are a number of socio-economic and environmental factors that have an impact on the spread of disease (Figure I & II). Some of these factors include population density, level of employment, income, weather condition (e.g., temperature, humidity and sunlight), pollutants, and geology/soil type. These factors should be taken into consideration when investigating communicable diseases.

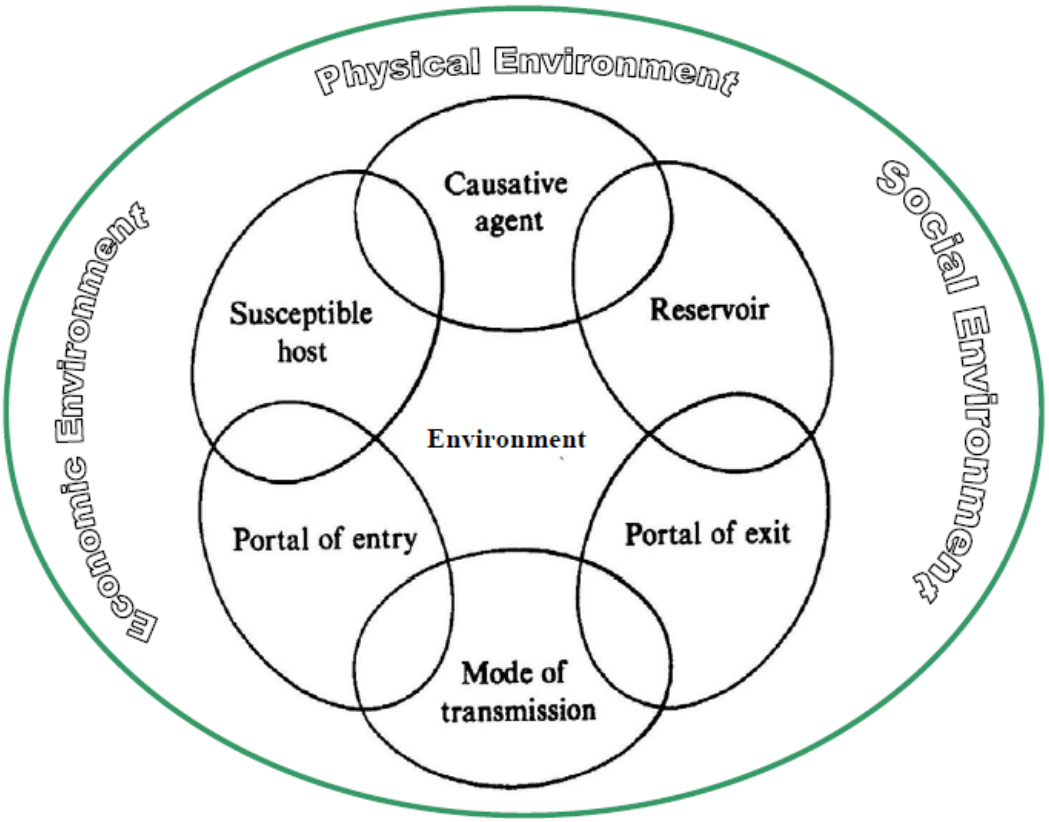


Fig. I:The chain of infection

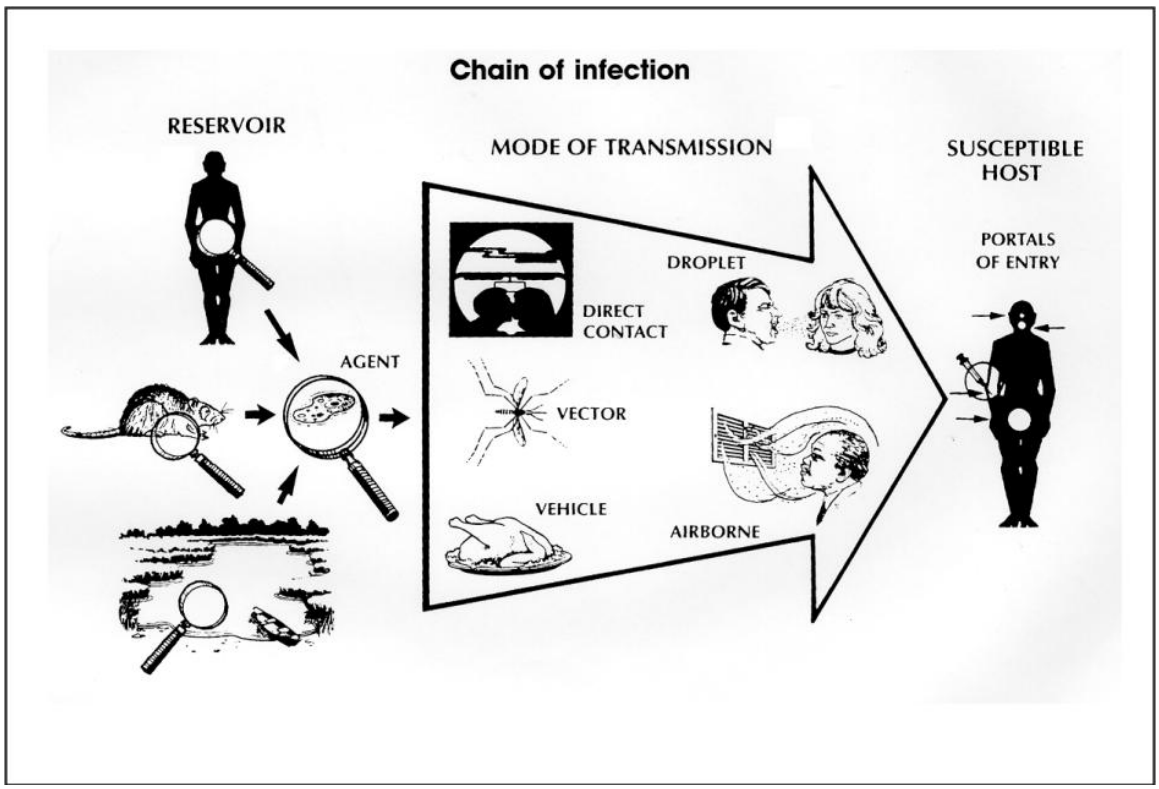


Fig. II:Chain of infection
Source: Centers for Disease Control and Prevention. Principles of epidemiology, 2nd ed. Atlanta: U.S. Department of Health and Human Services;1992.

More specifically, transmission occurs when the agent leaves its reservoir or host through a portal of exit, is conveyed by some mode of transmission, and enters through an appropriate portal of entry to infect a susceptible host.

**Reservoir**

The reservoir of an infectious agent is the habitat in which the agent normally lives, grows, and multiplies. Reservoirs include humans, animals, and the environment**.** The reservoir may or may not be the source from which an agent is transferred to a host. For example, the reservoir of *Clostridium botulinum* is soil, but the source of most botulism infections is improperly canned food containing *C. botulinum* spores.

***Human reservoirs*.** Many common infectious diseases have human reservoirs. Diseases that are transmitted from person to person without intermediaries include the sexually transmitted diseases, measles, mumps, streptococcal infection, and many respiratory pathogens. Because humans were the only reservoir for the smallpox virus, naturally occurring smallpox was eradicated after the last human case was identified and isolated. Human reservoirs may or may not show the effects of illness. As noted earlier, a carrier is a person with inapparent infection who is capable of transmitting the pathogen to others. Asymptomatic or passive or healthy carriers are those who never experience symptoms despite being infected. Incubatory carriers are those who can transmit the agent during the incubation period before clinical illness begins. Convalescent carriers are those who have recovered from their illness but remain capable of transmitting to others. Chronic carriers are those who continue to harbor a pathogen such as hepatitis B virus or *Salmonella* Typhi, the causative agent of typhoid fever, for months or even years after their initial infection.

***Animal reservoirs*.** Humans are also subject to diseases that have animal reservoirs. Many of these diseases are transmitted from animal to animal, with humans as incidental hosts. The term **zoonosis** refers to an infectious disease that is transmissible under natural conditions from vertebrate animals to humans. Long recognized zoonotic diseases include brucellosis (cows and pigs), anthrax (sheep), plague (rodents), trichinellosis/trichinosis (swine), tularemia (rabbits), and rabies (bats, raccoons, dogs, and other mammals).

***Environmental reservoirs*.** Plants, soil, and water in the environment are also reservoirs for some infectious agents. Many fungal agents, such as those that cause histoplasmosis, live and multiply in the soil. Outbreaks of Legionnaires disease are often traced to water supplies in cooling towers and evaporative condensersthat act as reservoirs for the causative organism *Legionella pneumophila.*

**Portal of exit**

Portal of exit is the path by which a pathogen leaves its host. The portal of exit usually corresponds to the site where the pathogen is localized. For example, influenza viruses and *Mycobacterium tuberculosis* exit the respiratory tract, schistosomes through urine, cholera vibrio in feces, *Sarcoptesscabiei*in scabies skin lesions, and enterovirus 70, a cause of hemorrhagic conjunctivitis, in conjunctival secretions. Some blood borne agents can exit by crossing the placenta from mother to fetus (rubella, syphilis,

toxoplasmosis), while others exit through cuts or needles in the skin (hepatitis B) or blood-sucking arthropods (malaria).

**Modes of transmission**

An infectious agent may be transmitted from its natural reservoir to a susceptible host in different ways. There are different classifications for modes of transmission. Here is one classification:

• Direct − Direct contact
− Droplet spread
• Indirect − Airborne
− Vehicle borne
− Vector borne (mechanical or biologic)

In **direct transmission**, an infectious agent is transferred from a reservoir to a susceptible host by direct contact or droplet spread. Direct contactoccurs through skin-to-skin contact, kissing, and sexual intercourse. Hookworm is spread by direct contact with contaminated soil.

**Droplet spread** refers to spray with relatively large, short-range aerosols produced by sneezing, coughing, or even talking. Droplet spread is classified as direct because transmission is by direct spray over a few feet, before the droplets fall to the ground. Pertussis and meningococcal infection are examples of diseases transmitted from an infectious patient to a susceptible host by droplet spread.

**Indirect transmission** refers to the transfer of an infectious agent from a reservoir to a host by suspended air particles, inanimate objects (vehicles), or animate intermediaries (vectors).

**Airborne** transmission occurs when infectious agents are carried by dust or droplet nuclei suspended in air. Airborne dust includes material that has settled on surfaces and become resuspended by air currents as well as infectious particles blown from the soil by the wind. Measles, for example, has occurred in children who came into a physician's office after a child with measles had left, because the measles virus remained suspended in the air.

**Vehicles** that may indirectly transmit an infectious agent include food, water, biologic products (blood), and fomites (inanimate objects such as handkerchiefs, bedding, or surgical scalpels). A vehicle may passively carry a pathogen — as food or water may carry hepatitis A virus.

**Vectors** such as mosquitoes, fleas, and ticks may carry an infectious agent through purely mechanical means or may support growth or changes in the agent. Examples of mechanical transmission are flies carrying *Shigella*on their appendages and fleas carrying *Yersinia pestis*, the causative agent of plague, in their gut. In contrast, in biologic transmission, the causative agent of malaria or guinea worm disease undergoes maturation in an intermediate host before it can be transmitted to humans

**Portal of entry**

The portal of entry refers to the manner in which a pathogen enters a susceptible host. The portal of entry must provide access to tissues in which the pathogen can multiply or a toxin can act. Often, infectious agents use the same portal to enter a new host that they used to exit the source host. For example, influenza virus exits the respiratory tract of the source host and enters the respiratory tract of the new host. In contrast, many pathogens that cause gastroenteritis follow a so-called "fecal-oral" route because they exit the source host in feces, are carried on inadequately washed hands to a vehicle such as food, water, or utensil, and enter a new host through the mouth. Other portals of entry include the skin (hookworm), mucous membranes (syphilis), and blood (hepatitis B, human immunodeficiency virus).

**Host**

The final link in the chain of infection is a susceptible host. Susceptibility of a host depends on genetic or constitutional factors, specific immunity, and nonspecific factors that affect an individual's ability to resist infection or to limit pathogenicity. An individual's genetic makeup may either increase or decrease susceptibility. For example, persons with sickle cell trait seem to be at least partially protected from a particular type of malaria. Specific immunity refers to protective antibodies that are directed against a specific agent. Such antibodies may develop in response to infection, vaccine, or toxoid (toxin that has been deactivated but retains its capacity to stimulate production of toxin antibodies) or may be acquired by trans placental transfer from mother to fetus or by injection of antitoxin or immune globulin. Nonspecific factors that defend against infection include the skin, mucous membranes, gastric acidity, cilia in the respiratory tract, the cough reflex, and nonspecific immune response. Factors that may increase susceptibility to infection by disrupting host defenses include malnutrition, alcoholism, and disease or therapy that impairs the nonspecific immune response.

**Implications for public health**

1. Knowledge of the portals of exit and entry and modes of transmission provides a basis for determining appropriate control measures. In general, control measures are usually directed against the segment in the infection chain that is most susceptible to intervention, unless practical issues dictate otherwise.

2. For some diseases, the most appropriate intervention may be directed at controlling or eliminating the agent at its source. A patient sick with a communicable disease may be treated with antibiotics to eliminate the infection. An asymptomatic but infected person may be treated both to clear the infection and to reduce the risk of transmission to others. In the community, soil may be decontaminated or covered to prevent escape of the agent.

3. Some interventions are directed at the mode of transmission. Interruption of direct transmission may be accomplished by isolation of someone with infection, or counseling persons to avoid the specific type of contact associated with transmission. Vehicle borne transmission may be interrupted by elimination or decontamination of the vehicle.

4. To prevent fecal-oral transmission, efforts often focus on rearranging the environment to reduce the risk of contamination in the future and on changing behaviors, such as promoting handwashing. For airborne diseases, strategies may be directed at modifying ventilation or air pressure, and filtering or treating the air. To interrupt vector borne transmission, measures may be directed toward controlling the vector population, such as spraying to reduce the mosquito population.

5. Some strategies that protect portals of entry are simple and effective. For example, bed nets are used to protect sleeping persons from being bitten by mosquitoes that may transmit malaria. A dentist's mask and gloves are intended to protect the dentist from a patient's blood, secretions, and droplets, as well to protect the patient from the dentist. Wearing of long pants and sleeves and use of insect repellent are recommended to reduce the risk of Lyme disease and West Nile virus infection, which are transmitted by the bite of ticks and mosquitoes, respectively.

6. Some interventions aim to increase a host's defenses. Vaccinations promote development of specific antibodies that protect against infection. On the other hand, prophylactic use of antimalarial drugs, recommended for visitors to malaria-endemic areas, does not prevent exposure through mosquito bites, but does prevent infection from taking root.

7. Finally, there are some interventions attempt to prevent a pathogen from encountering a susceptible host. The concept of herd immunitysuggests that if a high enough proportion of individuals in a population are resistant to an agent, then those few who are susceptible will be protected by the resistant majority, since the pathogen will be unlikely to "find" those few susceptible individuals. The degree of herd immunity necessary to prevent or interrupt an outbreak varies by disease. In theory, herd immunity means that not everyone in a community needs to be resistant (immune) to prevent disease spread and occurrence of an outbreak. In practice, herd immunity has not prevented outbreaks of measles and rubella in populations with immunization levels as high as 85% to 90%. One problem is that, in highly immunized populations, the relatively few susceptible persons are often clustered in subgroups defined by socioeconomic or cultural factors. If the pathogen is introduced into one of these subgroups, an outbreak may occur.

**3.2 Disease risk factors**

Health and wellbeing are affected by many factors – those linked to poor health, disability, disease or death, are known as risk factors. A risk factor is any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury. Some examples of the more important risk factors are underweight, unsafe sex, high blood pressure, tobacco and alcohol consumption, and unsafe water, sanitation and hygiene. These are choices and habits that negatively impact wellness including but not limited to deliberate lifestyle choices characterized by personal responsibility and, practices that lower physical, mental and spiritual health. To ensure

that the health system is aligned to the country's health challenges, policy makers must be able to compare the effects of different conditions that cause ill-health and premature death. Burden of disease analysis considers both the non-fatal burden (impact of ill-health) and fatal burden (impact of premature death) of a comprehensive list of diseases and injuries, and quantify the contributions of various risk factors to the total burden as well as to individual diseases and injuries.

Risk factors are often presented individually, however in practice they do not occur alone. They often coexist and interact with one another. For example, physical inactivity will, over time, cause weight gain, high blood pressure and high cholesterol levels. Together, these significantly increase the chance of developing chronic heart diseases and other health related problems. Ageing populations and longer life expectancy have led to an increase in long-term (chronic), expensive-to-treat diseases and disabilities.

In general, risk factors can be categorized into the following groups: behavioral, physiological, demographic, environmental and genetic.

**Behavioral risk factors:** These usually relate to 'actions' that the individual has chosen to take. They can therefore be eliminated or reduced through lifestyle or behavioral choices. Examples include:

a. smoking tobacco
b. drinking too much alcohol
c. nutritional choices
d. physical inactivity
e. spending too much time in the sun without proper protection
f. not having certain vaccinations
g. unprotected sex.

**Psychological risk factors:** Physiological risk factors are those relating to an individual's body or biology. They may be influenced by a combination of genetic, lifestyle and other broad factors. Examples include:

a. being overweight or obese
b. high blood pressure
c. high blood cholesterol
d. high blood sugar (glucose).

**Demographic risk factors:** Demographic risk factors are those that relate to the overall population. Examples include:

a. age
b. gender
**c.** population subgroups, such as occupation, religion, or income.

**Environmental risk factors:** Environmental risk factors cover a wide range of topics such as social, economic, cultural and political factors as well as physical, chemical and biological factors. Examples include:

a. access to clean water and sanitation
b. risks in the workplace

c. air pollution
d. social settings.

**Genetic risk factors:** These risk factors are based on an individual's genes. Some diseases, such as cystic fibrosis and muscular dystrophy, come entirely from an individual's 'genetic make-up'. Many other diseases, such as asthma or diabetes, reflect the interaction between the genes of the individual and environmental factors. Other diseases, like sickle cell anemia, are more prevalent in certain population subgroups.

**Understanding Risk Factors**

Part of learning how to take charge of one's health requires understanding the risk factors for different diseases. Some risk factors are beyond one's control because one may be born with them or exposed to them through no fault of their own. Some risk factors that one has little or no control over include:

- Family history of a disease
- Sex/gender—male or female
- Ancestry

Some risk factors that one can control include:

- What one eats
- How much physical activity one gets
- Whether one uses tobacco
- How much alcohol one drinks
- Whether one uses illegal drugs
- Whether one uses his/her seat belt

**Determinants of Health**

The range of personal, social, economic, and environmental factors that influence health status are known as determinants of health. Determinants of health fall under several broad categories:

- Social factors
- Health services
- Individual behavior
- Biology and genetics

It is the interrelationships among these factors that determine individual and population health. Because of this, interventions that target multiple determinants of health are most likely to be effective. Determinants of health reach beyond the boundaries of traditional health care and public health sectors; sectors such as education, housing, transportation, agriculture, and environment can be important allies in improving population health.

**Policymaking:** Policies at the local, state, and federal level affect individual and population health. For example, increasing taxes on tobacco sales, can improve population health by reducing the number of people using tobacco products. Some policies affect entire populations over extended periods of time, while simultaneously helping to change individual behavior. For example, the Road Safety Law authorizes the Federal Government to set and regulate standards for motor vehicles and highways.

This leads to increase in safety standards for cars, including seat belts, which in turn, reduces rates of injuries and deaths from motor vehicle accidents.

**Social:** Social determinants of health reflect social factors and the physical conditions in the environment in which people are born, live, learn, play, work and age. Also known as social and physical determinants of health, they impact a wide range of health, functioning and quality of life outcomes. Examples of social determinants include:

- Availability of resources to meet daily needs, such as educational and job opportunities, living wages, or healthful foods
- Exposure to crime, violence, and social disorder, such as the presence of hard drugs
- Social support and social interactions
- Exposure to mass media and emerging technologies, such as the Internet or cell phones
- Socioeconomic conditions, such as concentrated poverty
- Quality schools
- Transportation options
- Public safety
- Residential segregation

Examples of physical determinants include:

- Natural environment, such as plants, weather, or climate change
- Built environment, such as buildings or transportation
- Worksites, schools, and recreational settings
- Housing, homes, and neighborhoods
- Exposure to toxic substances and other physical hazards
- Physical barriers, especially for people with disabilities
- Aesthetic elements, such as good lighting, trees, or benches

Poor health outcomes are often made worse by the interaction between individuals and their social and physical environment. For example, millions of people in Nigeria live in urban slums that have unhealthy levels of pollutants air. In such communities there is often a higher prevalence of asthma in both adults and children compared with suburbs and rural environments.

**Health services:** Both access to health services and the quality of health services can impact health. Lack of access, or limited access, to health services greatly impacts an individual's health status. For example, when individuals do not have health insurance, they are more likely to delay medical treatment. Barriers to accessing health services include:

- Lack of availability
- High cost
- Lack of insurance coverage
- Limited language access

These barriers to accessing health services lead to:

- Unmet health needs
- Delays in receiving appropriate care

- Inability to get preventive services
- Hospitalizations that could have been prevented

**Individual behavior:** Individual behavior also plays a role in health outcomes. For example, if an individual quits smoking, his or her risk of developing heart disease is greatly reduced. Many public health and health care interventions focus on changing individual behaviors such as substance abuse, diet, and physical activity. Positive changes in individual behavior can reduce the rates of chronic disease in Nigeria.
Examples of individual behavior determinants of health include:

- Diet
- Physical activity
- Alcohol, cigarette, and other drug use
- Hand washing

**Biology and genetics:** Some biological and genetic factors affect specific populations more than others. For example, older adults are biologically prone to being in poorer health than adolescents due to the physical and cognitive effects of aging. Sickle cell disease is a common example of a genetic determinant of health. Sickle cell is a condition that people inherit when both parents carry the gene for sickle cell. The gene is most common in people from West African countries, Mediterranean countries, South or Central American countries, Caribbean islands, India, and Saudi Arabia.
Examples of biological and genetic social determinants of health include:

- Age
- Sex
- HIV status
- Inherited conditions, such as sickle-cell anemia, hemophilia, and cystic fibrosis
- Carrying the gene that increases risk for breast and ovarian cancer
- Family history of heart disease

**Social Determinants of Health**
Social determinants of health are economic and social conditions that influence the health of people and communities. These conditions are shaped by the amount of money, power, and resources that people have, all of which are influenced by policy choices. Social determinants of health affect factors that are related to health outcomes.
Factors related to health outcomes include:

- How a person develops during the first few years of life (early childhood development)
- How much education a person obtains
- Being able to get and keep a job
- The kind of work a person does
- Having food or being able to get food (food security)
- Having access to health services and the quality of those services
- Housing status
- How much money a person earns
- Discrimination and social support

**The relationships between determinants of health and social determinants of health**

Determinants of health are factors that contribute to a person's current state of health and may be biological, socioeconomic, psychosocial, behavioral, or social in nature. Scientists generally recognize five determinants of health of a population:

- Genes and biology: for example, sex and age
- Health behaviors: for example, alcohol use, injection drug use (needles), unprotected sex, and smoking
- Social environment or social characteristics: for example, discrimination, income, and gender
- Physical environment or total ecology: for example, where a person lives and crowding conditions
- Health services or medical care: for example, access to quality health care and having or not having insurance

Other factors that could be included are culture, social status, and healthy child development. Scientists do not know the precise contributions of each determinant at this time. In theory, genes, biology, and health behaviors together account for about 25% of population health. Social determinants of health represent the remaining three categories of social environment, physical environment/total ecology, and health services/medical care. These social determinants of health also interact with and influence individual behaviors as well. More specifically, social determinants of health refer to the set of factors that contribute to the social patterning of health, disease, and illness.

**The important of social determinants of health**

Addressing social determinants of health is a primary approach to achieving health equity. Health equity is "when everyone has the opportunity to 'attain their full health potential' and no one is 'disadvantaged from achieving this potential because of their social position or other socially determined circumstance." Health equity has also been defined as "the absence of systematic disparities in health between and within social groups that have different levels of underlying social advantages or disadvantages—that is, different positions in a social hierarchy." Social determinants of health such as poverty, unequal access to health care, lack of education, stigma, and racism are underlying, contributing factors of health inequities.

**Major non-communicable diseases (NCD) risk factors**

The second half of the twentieth century witnessed major health transitions in the world, propelled by socio-economic and technological changes which profoundly altered life expectancy and ways of living, while creating an unprecedented human capacity to use science to both prolong and enhance life. Among these health transitions, the most globally pervasive change has been the rising burden of NCDs. Simultaneously, urbanization, industrialization, and globalization are often accompanied by several undesirable lifestyle alterations in the form of a diet rich in saturated fat, salt, and excess calories, decreased physical activity, addictions like tobacco and alcohol, and augmentation of psychosocial stress.

**3.3 Signs and Symptoms of Diseases**

A medical sign is an objective indication of some medical fact or characteristic that may be detected by a patient or anyone, especially a physician, before or during a

physical examination of a patient. A symptom is a departure from normal function or feeling which is noticed by a patient, reflecting the presence of an unusual state, or of a disease.
A symptom is subjective, observed by the patient, and cannot be measured directly, whereas a sign is objectively observable by others. For example, whereas a tingling is a symptom (only the person experiencing it can directly observe their own tingling feeling), reddening of the skin is a sign (anyone can confirm that the skin is redder than usual). Symptoms and signs are often nonspecific, but often combinations of them are at least suggestive of certain diagnoses, helping to narrow down what may be wrong. The term symptom is sometimes also applied to physiological states outside the context of disease, as for example when referring to "symptoms of pregnancy. Many people use the term sign and symptom interchangeably.

Regardless of who notices that a system or body part is not functioning normally, signs and symptoms are the body's ways of letting a person know that not everything is running smoothly. Some signs and symptoms need follow-up by a medical professional, while others may completely resolve without treatment.

The diagnosis of symptoms and signs has come a long way. The identification of signs became increasingly more dependent on the doctor as time and technology progressed. Since the 1800s, a range of devices have become available to help doctors identify and analyze signs that even the patient may not have recognized. These include:

- Stethoscope: A doctor can use this to listen to the sounds of the heart and lungs.
- Spirometer: This helps to measure lung function.
- Ophthalmoscope: An eye specialist may use this to examine the inside of the eye.
- X-ray imaging: This can show damage to the bones.
- Sphygmomanometer: This is a device that fits around the arm and measures blood pressure.

During the 20th century, hundreds of new devices and techniques were created to evaluate signs. It was during this period in modern medical history that the terms "sign" and "symptom" developed separate meanings, as doctors and patients no longer needed to work together as closely to identify medical issues. Doctors can now see signs they would previously have relied upon patients to describe. By the modern definition, these would have been symptoms but are now classed as signs.

There is therefore very minute though important difference between the two, which are as follows:

1. The sign is observed by health care professionals, but symptoms are experienced or felt by the patient.
2. Examples of signs are asthma, tuberculosis, cancer, AIDS, etc. whereas itching, body ache, headache, nausea, are the symptoms felt by the patient itself.
3. Signs are measurable by monitoring pulse rate, temperature, X-ray, laboratory test, and other machines, whereas symptoms cannot be measured, they are only felt.
4. Signs are visible, symptoms are unclear and invisible.

5. The sign is an objective evidence of a disease; symptom is a subjective evidence of a disease.
6. Medical signs are of three types – Anamnestic signs, prognostic signs, diagnostic signs whereas medical symptoms are of three types – Chronic symptoms, relapsing symptoms, remitting symptoms.

**Symptoms**

Symptoms may be briefly acute or a more prolonged but acute or chronic, relapsing or remitting. Asymptomatic conditions also exist (e.g. subclinical infections and silent diseases like sometimes, high blood pressure). Therefore, symptoms may be classified into three main types,remitting, chronic and relapsingsymptoms

- **Remitting symptoms:** When symptoms improve or resolve completely, they are known as remitting symptoms. For examples, symptoms of the common cold may occur for several days and then resolve without treatment.
- **Chronic symptoms:** These are long-lasting or recurrent symptoms. Chronic symptoms are often seen in ongoing conditions, such as diabetes, asthma, and cancer.
- **Relapsing symptoms:** These are symptoms that have occurred in the past, resolved, and then returned. For instance, symptoms of depression may not occur for years at a time but can then return.

**Asymptomatic conditions:** Some conditions show no symptoms at all. For example, a person can have high blood pressure for years without knowing, and some cancers have no symptoms until the later, more aggressive stages. These are known as asymptomatic conditions, and even though the idea of symptoms is often linked to discomfort or abnormal function, a condition without symptoms can be deadly. Again, many types of infection do not show symptoms. These are known as subclinical infections, and they can be contagious despite not causing noticeable symptoms in the person carrying the infection. The infection can still be transmitted to other people during the incubation period, or the period during which the infectious agent takes hold of the body. Another danger of subclinical infections is that they can cause complications unrelated to the infection itself. For example, untreated urinary tract infections (UTIs) may cause premature births.

Examples of infections that do not cause symptoms initially are HIV, human papillomavirus (HPV) herpes simplex virus (HSV), syphilis, and hepatitis B and C. The first time a person will be aware of many asymptomatic conditions is during a visit to a doctor, normally concerning a different problem. It is therefore important to undergo regular health checks to identify any underlying problems that may not be obvious. Many cancers are asymptomatic during their early stages. Prostate cancer, for example, does not show symptoms until it has advanced to a certain point. For this reason, regular screening tests are important for at-risk individuals.

**Non-specific symptoms:** Non-specific symptoms are self-reported symptoms that do not indicate a specific disease process or involve an isolated body system. For example, fatigue is a feature of many acute and chronic medical conditions, which may or may not be mental, and may be either a primary or secondary symptom. Fatigue is also a normal, healthy condition when experienced after exertion or at the end of a day.

**Positive and negative symptoms:** In describing mental disorders, especially schizophrenia, symptoms can be divided into positive and negative symptoms.

- Positive symptoms are symptoms present in the disorder but not normally experienced by most individuals. It reflects an excess or distortion of normal functions (i.e., experiences and behaviors that have been added to a person's normal way of functioning). Examples are hallucinations, delusions, and bizarre behavior.
- Negative symptoms are functions that are normally found in healthy persons, but that are diminished or not present in affected persons. Thus, it is something that has disappeared from a person's normal way of functioning. Examples are social withdrawal, apathy, inability to experience pleasure and defects in attention control.

**Medical signs**

A medical sign is a physical response linked to medical fact or characteristic that is detected by a physician, nurse, or medical device during the examination of a patient. They can often be measured, and this measurement can be central to diagnosing a medical problem.

Figure I shows the systemic distribution of majors signs.

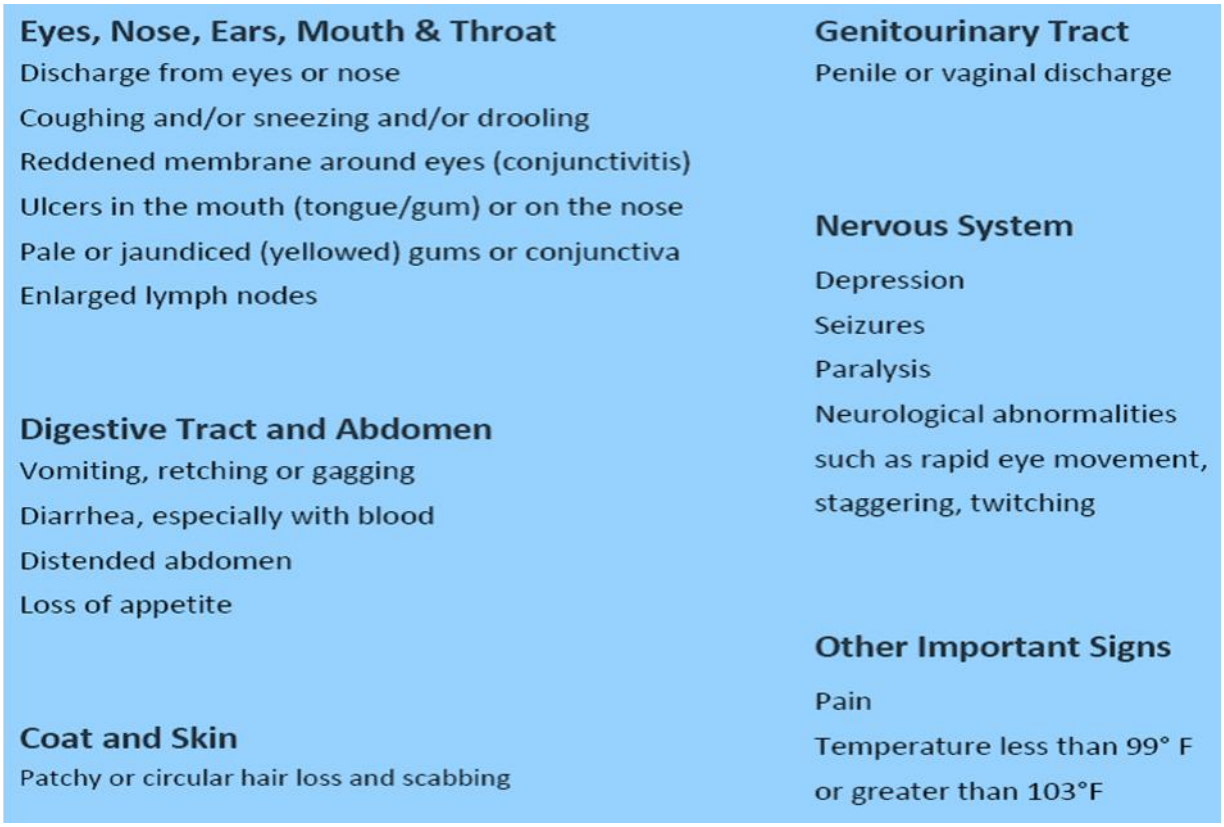


Fig I: Systemic distribution of major signs

There are four types of medical signs, anamnestic, prognostic, diagnostic and pathognomonic signs.

- **Anamnestic signs** refer to the past experience of the disease or conditions. An example is paralysis stroke, heart attack.

- **Prognostic signs** predict the future disease, means by observing the signs and symptoms doctor predicts the chances of occurrence of disease.
- **Diagnostic signs** show the actual disease from which the person is suffering currently.
- **Pathognomonic signs:** This means that a doctor can link a sign to a condition with full certainty. For example, the presence of a certain microbe in a blood sample can point to a specific viral infection.

Some examples of signs that can be linked to a disease by a clinician:

- *High blood pressure:* This can indicate a cardiovascular problem, an adverse reaction to medication, an allergy, or many other possible conditions or diseases. This will often be combined with other signs to reach a diagnosis.
- *Clubbing of the fingers:* This may be a sign of lung disease or a range of genetic diseases.

## 4.0 CONCLUSION

In this unit you learnt that socio-economic and environmental factors such as population density, level of employment, income, and weather condition impact the spread of disease. Disease occurrence is also influenced by risk factors, especially choices and habits that negatively impact wellness. Some of these risk factors are beyond one's control because one may be born with them or exposed to them through no fault of their own. The personal, social, economic, and environmental factors that influence health status (determinants of health) interrelate among themselves to determine individual and population health.

During the 20th century, hundreds of new devices and techniques were created to evaluate medical signs and during this period the terms "sign" and "symptom" developed separate meanings, as doctors and patients no longer needed to work together as closely to identify medical issues.

## 5.0 SUMMARY

In this unit you were told that disease transmission occurs when the agent leaves its reservoir or host through a portal of exit, is conveyed by some mode of transmission, and enters through an appropriate portal of entry to infect a susceptible host. Therefore, one of the basic principles of disease prevention and control is the chain of infection. An understanding of each link in the chain assists in disease prevention.

Certain attributes, characteristics or exposures of an individual that increases the likelihood of developing a disease or injury or those linked to poor health, disability, disease or death, are known as risk factors. In general, risk factors can be categorized into behavioral, physiological, demographic, environmental and genetic. Some risk factors such as eating habit, physical activity, tobacco usage etc can be controlled, while others like family history of a disease, sex/gender and ancestry cannot be controlled.

You were told that amedical sign is an objective indication of some medical fact or characteristic that may be detected by a physician, during examination of a patient, while a symptom is a departure from normal function or feeling which is noticed by a

patient, reflecting the presence of an unusual state, or of a disease. Symptoms are classified into three main types,remitting, chronic and relapsingsymptoms, while signs are classified into anamnestic, prognostic, diagnostic and pathognomonic signs.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. Draw a schematic diagram of the chain of infection
2. Outline the different cases of medical signs and symptoms
3. Discuss the term, determinants of health

## 7.0 REFERENCES/FURTHER READING

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## UNIT 3. EMERGING AND RE-EMERGING DISEASES

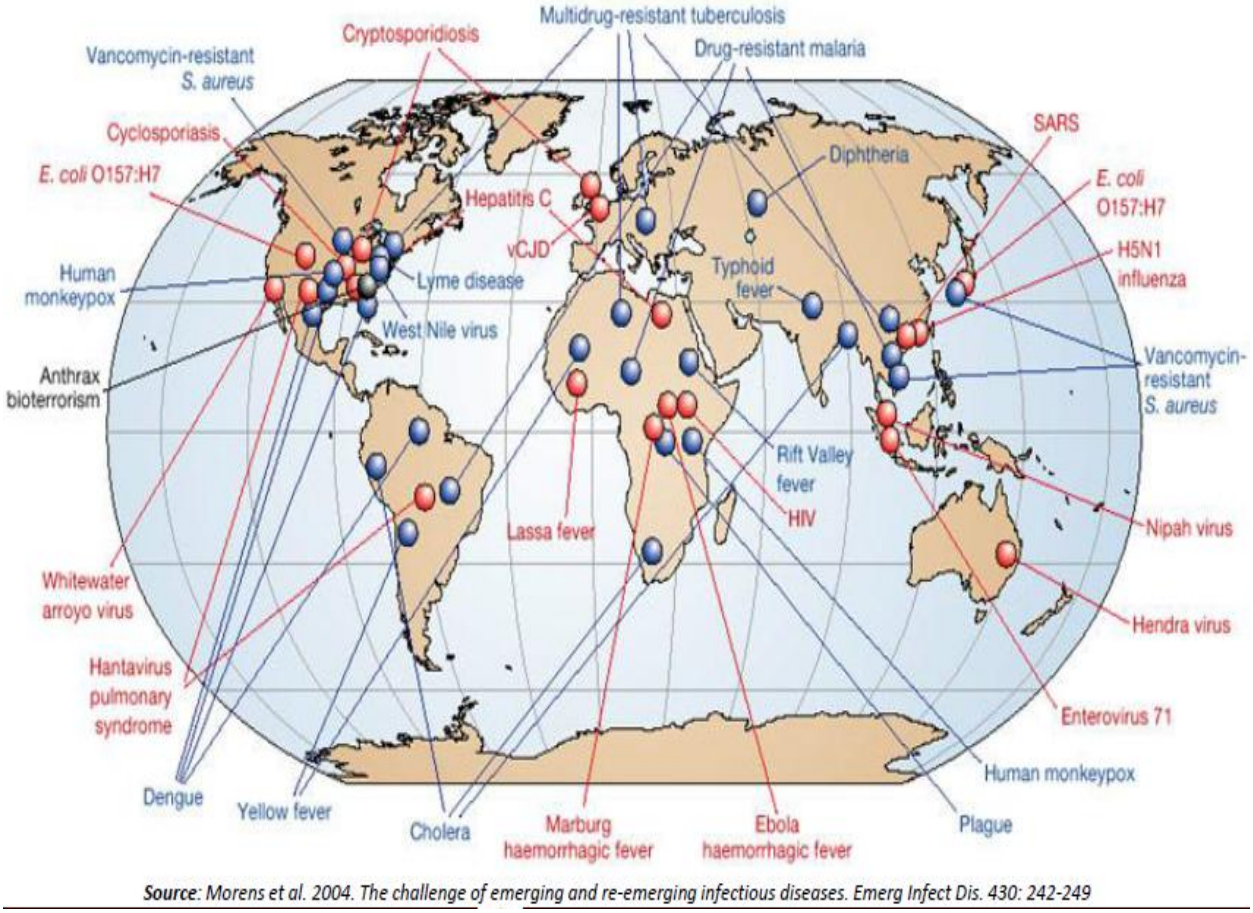
**CONTENTS** **PAGE**



### 1.0 INTRODUCTION

Diseases are caused by various infectious and non-infectious agents. The infectious agents include bacteria, viruses, fungi, protozoa and parasites. Emerging diseases are those diseases that have recently become important chiefly due to genetic mutations in pathogens, changing environmental conditions and new methods of farming animals. Generally, an **emerging infectious disease** (EID) is one that has appeared and infected a population for the first time, or has existed previously but is rapidly increasing, either in terms of the number of new cases within population, or its spread to new geographical areas. Other diseases that have affected a given area in the past, declined or were controlled, but are again being reported in increasing numbers are also grouped as emerging infectious diseases. Sometimes an old disease may manifest in a new form that may be more sever or fatal and is termed **re-emerging diseases** (ReIDs). Many of these emerging and re-emerging diseases are **zoonotic,** meaning that the diseases can cross species barrier to infect humans, thereby putting the general public or the farmer to risk when this happens in a farming environment.

The 21st century has ushered in an era when globalization of infectious diseases is occurring frequently and at an unprecedented speed. In this "globalized" environment of interdependent trade, travel, migration, and international economic markets, many factors now play an important role in the rise, emergence, and reemergence of infectious disease, which necessitates a coordinated, global response. Of note, zoonotic diseases(i.e., those infectious diseases that can be transmitted from an animal to humans) account for the majority of emerging and reemerging infectious diseases occurring due to increased contact between humans and animals as a by-product of development, industrialization, and encroachment on wildlife habitats, resulting in a dynamic upward trajectory of these diseases. Yet many of these emerging and re-emerging infectious diseases are also "neglected," meaning they impact the world's poorest and lack adequate funding and innovation for prevention and treatment, with some not adequately identified or studied. Figure II shows the global distribution of major emerging and re-emerging infectious diseases




Source: Morens et al. 2004. The challenge of emerging and re-emerging infectious diseases. Emerg Infect Dis. 430: 242-249

Fig II: Global distribution of emerging and re-emerging infectious diseases

Emerging and re-emerging infectious diseases can arise due to a multitude of factors and influences and must be addressed dynamically by diverse sectors of society, including public health, medicine, environmental science, animal health, food safety, economics, and public policy stakeholders. A host of human-sourced and environmental factors complicate these actions, such as societal influences, human susceptibility to infection, demographics, availability of health care, food production, human behavior, trade and travel, environmental and ecological changes, economic development, war and famine, adequacy of public health infrastructures, man-made events with intent to harm, and pathogen adaptation or evolution.

## 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- Define emerging and re-emerging diseases
- Know the emerging and re-emerging viral zoonotic diseases
- Know the emerging and re-emerging bacterial and parasitic zoonotic diseases

## 3.0 MAIN CONTENT

### 3.1 Factors of emergence and re-emergence of diseases

The numerous factors that enable infectious agents to evolve into new ecological niches, to reach and adapt to new hosts, and to spread more easily among new hosts precipitate the emergence of new diseases. These factors include urbanization and destruction of natural habitats, leading to animals and humans living in close

proximity; climate change and changing ecosystems; changes in population of reservoir hosts or intermediate insect vectors; and microbial genetic mutations (Figure III).

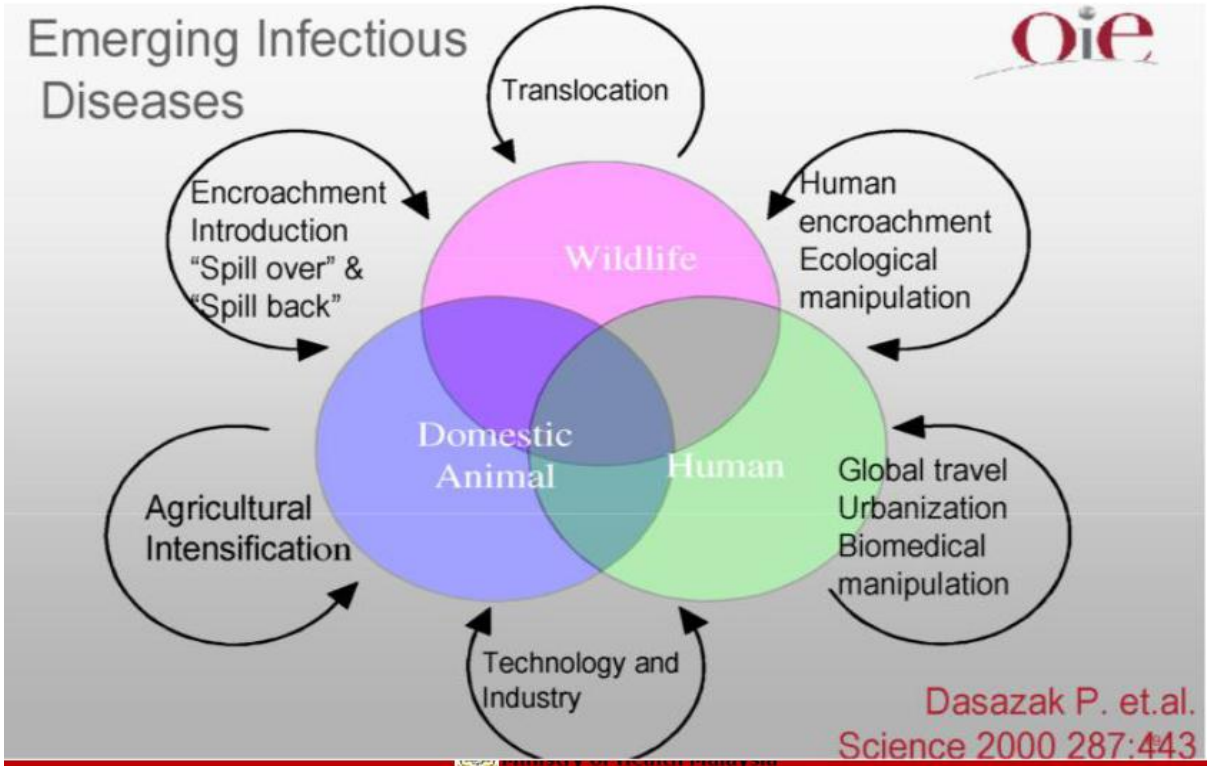



Fig. III: Factors of emergence of infectious diseases

***Zoonosis:*** Examples of EID events have been recorded throughout history, with the majority originating from zoonotic pathogens from wildlife. These include the black plague of the 14th century, caused by *Yersinia pestis*, largely attributable to regional trade and societal influences, with overcrowding, poor hygiene, and destruction of the predator of the animal reservoir being leading causes for the rapid transmission of the illness. The ability of pathogens to cross species and infect multiple hosts is an ingenious adaptation that also favors their survival. It is estimated that up to 60% of human pathogens are found in multiple species and, perhaps, up to 80% of animal pathogens are capable of infecting other species of animals. As our human populations grow and domestic and wildlife populations increase, the interactions among them also increase; thus, we are likely to experience more pathogens crossing species lines.

***Human behavior****:* Human behavior and mobility can further be implicated in sexually transmitted diseases such as HIV disease (also originally caused by cross-species transmission), hepatitis, gonorrhea, syphilis, and others, including those in the context of rural and low-income settings. Immunosuppression due to HIV/AIDS coincided with the rise of opportunistic EIDs and ReIDs in the 1980s.

***Drug resistance****:* The invention of new drugs to fight cancer or autoimmune disease have also led to immunosuppression. This, along with the development of antimicrobial resistance, has resulted in the emergence of diseases that were otherwise rare. Most notably, the development of antimicrobial resistance with new pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *S.*

*aureus* (VRSA), extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli*, multidrug-resistant (MDR) and extensively drug-resistant (XDR) *Mycobacterium tuberculosis*, and a multitude of other microbial pathogens that were once easily treated is now leading to new infectious disease threats.

***Climate change****:* Extremes of weather and natural disasters have also influenced vector-borne infectious disease spread, suggesting a role for climate change in these events. Weather and climate can influence host defenses, vectors, pathogens, and habitats. There is a growing body of data that demonstrates the impact of weather on infectious disease. Malaria and dengue fever are two mosquito-borne diseases that are likely to spread dramatically with global warming. Global warming may help expand the distribution of other vector- and water-borne diseases such as yellow fever and cholera. Small rodent and tick populations are sensitive to climatic changes. Leptospirosis and Rift Valley fever are pathogens sensitive to weather and climate changes and they have been found in a variety of epidemics worldwide over recent decades.

***Changing ecosystems:***Ecological and environmental conditions also help determine the epidemic potential of emerging diseases. Environmental changes such as the introduction of a new insect or plant vector into a region or population have led to rapid transmission of diseases that were not previously prevalent, such as in the case of Rift Valley fever, dengue, and malaria. When environmental conditions are favorable, rodent populations, as well as the associated prevalence of human diseases, can increase dramatically. Since the mid-1970s more than 20 tick-borne infectious diseases have been newly identified in humans. These emerging diseases have animal reservoirs and, for a variety of reasons, people are increasingly becoming exposed to tick vectors and associated pathogens. The emergence of Lyme disease in the United States of America is primarily because of favorable ecological conditions that have greatly increased deer populations, especially where farmland in the Northeast and Midwest United States of America has been reforested. Temperature, vegetation, and rodent populations also play a key role in the ecology and dynamics of this disease.

***Food processing****:* Food-borne illnesses are another area of emergence, with outbreaks of *Salmonella*, *E. coli*, and bovine spongiform encephalitis all occurring due to poor food processing practices.

***Globalization:*** Increasing globalization is linked to recent seminal infectious disease events as well as future concerns for global health emanating from large-scale population movement and migration. For example, the 2002 severe acute respiratory syndrome (SARS) outbreak and the 2009 H1N1 influenza pandemic were considered to be directly related to globalization and international travel. Large-scale international gatherings such as the Hajj in Saudi Arabia may also represent newly recognized social mechanisms for rapid spread of infectious diseases, such as the emergence of Middle Eastern respiratory syndrome (MERS), caused by the second novel coronavirus that has been identified in just the past decade.

***Population growth:*** The world's population quadrupled in the last century and increases by 80 to 100 million people each year. At the same time, the global population is aging at an unprecedented rate. In addition, there has been a mass

relocation of rural populations to urban areas, which has been one of the most important demographic trends in the latter part of the 20th century. According to the United Nations, the world's urban population was 2.9 billion in 2000 and is expected to reach 5 billion by 2030. The interactions of these changing and growing populations with animals and animal products are also increasing in an unprecedented manner, and the prospect of the appearance of emerging and reemerging zoonoses continues to be an outcome.

***Host susceptibility:*** As human populations increase, two groups of hosts with impaired immune systems are emerging. In developed countries, advances in medicine, science, and technology have led to an increase in the number of people who are immunocompromised. Cancer patients and transplant patients are examples. The staggering increase in AIDS1 and HIV2 infections worldwide has led to increases in zoonoses and re-emergence of latent infections. Concurrently, in a number of these countries, the fastest-growing cohort of the population are individuals over the age of 60 years. This population will likely have increasing susceptibility to food- and water-borne pathogens and zoonoses, and will possibly endure a resurgence of childhood diseases. Because the world population growth will grow disproportionately more rapidly in less developed countries, infectious disease agents will continue to take their toll. Host susceptibility to infection is aggravated by malnutrition. In parts of the world where livestock and poultry production systems are growing rapidly, a progressively larger number of animals are confined closer together, which favors pathogen dissemination. In production systems where animals have been reared for maximal production performance, huge pristine populations of genetically similar animals are especially susceptible to introductions of novel pathogens.

***Wildlife:*** Wildlife can be an important source in the transmission of infectious diseases to both domestic animals and humans. With expanding human populations, recreational interests, and changes in our ecosystems and wildlife habitat, there is a greater interface among these groups; yet, there also seems to be a lack of knowledge about diseases in wildlife populations and often a lack of disease prevention and management strategies for wildlife. Several trends in the wild are also contributing to the growing occurrence and importance of zoonotic diseases. The spectrum of infectious diseases affecting wildlife today is greater than at any time during the last century. Infectious diseases are also causing major outbreaks and losses in wildlife as opposed to the sporadic or self-limited outbreaks often seen in the past. Disease emergence has occurred on a global scale in a broad spectrum of wildlife species and habitats. Wildlife may provide a ‘zoonotic pool’ from which previously unknown pathogens may emerge. For example, Hendra, Menangle, and Nipah viruses have involved fruit bats as carriers and/or hosts of this high-profile group of emerging diseases.

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***Public health emergency of international concern:*** Worrisome disease outbreak events occur worldwide. This includes the first reported cases of infection with the highly contagious Ebola virus (with its estimated mortality rate as high as 90%) that was reported in Guinea in March 2014) and later spread to other countries in West Africa, with close to 2,000 cases and approximately 1,000 deaths by August 2014, and has was declared a “public health emergency of international concern” by the World Health Organization (WHO).

***Neglected tropical diseases*:** Historically neglected tropical diseases that currently infect more than 1 billion people and that have a high combined global burden of disease, estimated at 56.6 disability-adjusted life years are also major factors. Despite their deleterious social, economic, and health impact, these "neglected" diseases continue to be an impediment to human development and progress. The majority of these neglected diseases are zoonotic and impacted by factors similar to those associated with other emerging and re-emerging infectious diseases. However, some of these neglected tropical diseases are also classified as emerging and re-emerging, added to their unique threats to global public health.

### 3.2 Emerging and Re-emerging Zoonotic Viral Diseases

**Recent emerging viral zoonoses**

Approximately 60% of recognized human pathogens are zoonotic, so it is not surprising that many of the relatively recent emerging infections can also be traced back to animals. Approximately 75% of the diseases that have emerged over the past two decades have a wildlife source. These include the Simian immunodeficiency viruses and human immunodeficiency virus/acquired immune deficiency syndrome, Ebola virus, Hantavirus, Nipah virus, Hendra virus, Menangle virus infection, Severe acute respiratory syndrome, West Nile virus infection, Avian influenza (Influenza A), Monkey poxvirus infection. Table 1 shows a list some emergent zoonotic viral diseases, their year and locations of occurrence in animal hosts.

Table 1: Emergent zoonotic viral diseases

| Year of isolation | Place of isolation | Virus | Reservoir/spillover host |
|---|---|---|---|
| 1991 | Venezuela | Guanarito virus[20] | Rodents |
| 1992 | Slovenia | Dobrava virus[21] | Rodents |
| 1993 | United States | Sin Nombre virus[22] | Rodents (*Peromyscus maniculatus*) |
| 1994 | Brisbane, Australia | Hendra virus[23] | Fruit bats (*Pteropus sp.*)/horses* |
| | Sao Paolo, Brazil | Sabia virus[24] | Rodents |
| 1995 | Florida, USA | Black Creek Canal virus[25] | Rodents |
| 1996 | Ballina, Australia | Australian bat lyssavirus[26] | Fruit and insectivorous bats |
| | Argentina | Andes virus[27] | Rodents |
| 1997 | Hong Kong (China) | Influenza H5N1[28] | Wild birds/domestic poultry* |
| | Menangle, Australia | Menangle virus[29] | Fruit bats |
| | Saudi Arabia | Alkhurma virus[30,31] | Camels and sheep† |
| 1999 | Peninsular Malaysia | Nipah virus[32,33] | Fruit bats/pigs* |
| 2000 | Peninsular Malaysia | Tioman virus[34] | Fruit bats |
| 2002–2003 | China, Hong Kong (China) | SARS coronovirus[35-38] | Bats/civets?* |
| 2003–2004 | Viet Nam, China | Influenza H5N1[39,40] | Wild birds/domestic poultry* |
| 2007 | Melbourne, Australia | Dandenong arenavirus[41] | Rodents? |
| | Peninsular Malaysia | Melaka virus[42] | Fruit bats? |
| | Uganda | Bundibugyo ebolavirus[43] | Fruit bats?/various animals (bush meat)* |
| 2008 | Lukasa, Zambia | Lujo virus[44] | Unidentified rodents |
| | Perak, Malaysia | Kampar virus[45] | Fruit bats? |

***Simian immunodeficiency viruses and human immunodeficiency virus/acquired immune deficiency syndrome:***Human immunodeficiency virus/AIDS is caused by two of the 26 simian immunodeficiency virus (SIV) strains known to occur in African primates. The HIV-1 and HIV-2 viruses have evolved from a chimpanzee (*Pan troglodytes*) strain and a Sooty mangabey (*Cercocebustorquatus*) strain, respectively. The available evidence and genetic analysis suggest that transmission of these SIV strains to humans was a rare event, but one that has occurred on at least seven separate

occasions over the past century. These initial transmissions in equatorial Africa appear to be linked to hunting apes and using them for food. From these transmission events, virus strains which were both highly adapted to humans and contagious among humans evolved as HIV-1 and HIV-2, and these are now maintained and spread in human populations, independent of their simian origin.

The emergence of HIV-AIDS in the twentieth century appears to be the result of a complex set of largely ecological and sociological changes in Africa, including the following:
– expanding human populations
– deforestation
– rural displacement (people moving from rural areas to urban areas to seek employment, education or new social relationships)
– urbanization and its attendant poverty
– sexual behavior
– parenteral drug use
– increased local and international travel.

The HIV infection is probably becoming one of the biggest zoonotic pandemics in recent human history. At the end of 2003, the United Nations (UN) estimated that 40 million people were infected worldwide, with more than three million HIV-associated deaths during that year. Sub-Saharan Africa was the region most severely affected. International public health initiatives have not yet been successful in reducing the impact of this zoonosis; its prevalence and geographic distribution around the world are rising and its full impact on human well-being, economies and security has yet to be experienced.

***Ebola virus:*** Ebola virus infection of humans was first described in Central Africa in 1976, in the southwestern Sudan and the northern region of the Democratic Republic of the Congo with high mortality. From 1992 to 1999, further lethal outbreaks were recorded in Gabon, the Republic of the Congo and the Democratic Republic of the Congo. Also in 1994, human cases were linked to high mortality in chimpanzee colonies in Côte d'Ivoire, and the virus was isolated from a chimpanzee. Several human and animal Ebola outbreaks have occurred over the past four years in Gabon and the Republic of the Congo and West Africa. The human outbreaks consisted of multiple simultaneous epidemics caused by different sub-types of the virus. Each human epidemic has been linked to the handling of a distinct gorilla (*Gorilla sp.*), chimpanzee or duiker (*Sylvicapragrimmia*) carcass, themselves incidental victims of infection.

***Avian influenza (Influenza A):*** Influenza A viruses are responsible for highly contagious acute illness in humans, pigs, horses, marine mammals and birds, occasionally resulting in devastating epidemics and pandemics. Phylogenetic studies suggest that aquatic birds could be the original source of the genetic material of all influenza A virus in other species. The influenza A virus strains isolated from wild birds have generally been weak pathogens that cause little or no disease in the natural host or in a range of other species that have been experimentally infected. However, through genetic mutation or recombination, these strains may become both pathogenic

and well adapted to host species such as poultry, pigs and humans. There is evidence that both pigs and poultry may act as ‘mixing vessels’ for different influenza A strains, facilitating genetic re-assortment, and serving as sources for newly evolved virus strains, which have resulted in pandemics of severe disease in people.

***West Nile virus (WNV) infection:*** West Nile virus, a flavivirus of the Japanese encephalitis complex, is a well-known virus of Europe, western Asia and Africa, which is maintained in a wide species range of wild birds and bird-feeding mosquitoes. This virus can cause febrile disease and encephalitis in a number of mammal species, including humans, although these are ‘dead-end ‘hosts that play no role in the maintenance of the virus. The 2002 and 2003 WNV epidemics was the largest recognized arbovirus meningo-encephalitis epidemics in the western hemisphere, with more than 500 deaths. During these two years, a total of 13,278 human cases of WNV infection were reported in the USA, with a mortality rate of between 2% and 7%. Infection was also detected in more than 4,000 horses, of which some 20% developed
neurological disease. Clinical disease and death have been documented in 155 resident avian species in North America, with morbidity and mortality most frequently observed among Corvids, which are now used as a confirmed in more than 11,000 dead birds in 2003.

West Nile virus serves as an important case study of the capacity for introduced alien pathogens to spread widely through the biota of an entire continent, establishing firm ‘footholds’ or bases, imposing new long-term costs and strains on public health systems, and potentially altering ecological relationships, as well as menacing rare species. WNV has become firmly established in North America, it has the potential to move southwards in migratory birds and establish itself in the Caribbean, and in Central and South America.

***Severe acute respiratory syndrome (SARS):*** During 2002 and 2003, a novel viral respiratory disease emerged in humans in Southeast Asia. The disease presented as a severe, acute, sometimes life-threatening respiratory syndrome, which gave rise to its name: severe acute respiratory syndrome or SARS. This disease was found to be caused by a novel coronavirus, unrelated to coronaviruses that were commonly associated with human infections, or known to infect livestock. The disease was directly contagious between people, especially from so called ‘super spreaders’, and became rapidly disseminated by international travel. Infections of humans occurred first in the southern region of the People’s Republic of China, and caused by a virus subsequently isolated in masked palm civets (*Pagumalarvata*) in that area. This small carnivore is intensively farmed for health food and other products in that region, which may have increased opportunities for close contact with humans.

Most evidence points to an epidemiological linkage between the emergence of SARS and the expanding commercial trade in live wild or pseudo-domesticated animals in southern Asia. These wild animal or ‘wet’ markets of Southeast Asia, where humans, livestock and wild animals are gathered together in an intensive milieu, may offer an ideal setting for pathogens to cross over between species.

**Re-emerging viral zoonoses**

The re-emergence of well-documented zoonotic diseases appears to be driven by climatic, habitat and population density factors that affect hosts, pathogens or vectors –

frequently causing natural increases and decreases in disease activity in different geographical areas and over various periods of time.

***Rabies and related Lyssavirus infections:*** Rabies is an ancient disease that can affect most mammals and is endemic in many parts of the world, with sporadic epidemics. There are a large number of different host adapted strains of the rabies virus and these are maintained in nature, exclusively within specific host species. Occasionally spillover occurs into other sympatric species (species occurring in the same or overlapping geographical areas), especially during epidemics in the host species, but perpetuation through time occurs only within the specific host species. Epidemics are usually associated with climatic or environmental events which increase numbers and densities of regional wildlife hosts or domestic dogs, and are frequently described as 're-emergences'. There is great regional variation as to which strains of the rabies virus predominate in which animal host, as well as which strains pose significant risks to human health.

Dogs, however, remain the major maintenance host and source of human infection in the developing world. Bats, which represent approximately 24% of all known mammalian species, are frequently the maintenance hosts for many strains of rabies viruses. It is important to note that, as of June 2004, commercial rabies vaccines developed for classical genotype 1 rabies provide little if any protection against genotypes 2 (Lagos) and 3 (Makola), and the immune response conferred by these vaccines against genotype 5 (EBL 1) is weak. This need is currently being addressed.

The highest risk for rabies incidence occurs in the poor in regions such as Africa, Asia, and Latin America, although rabies is distributed globally in high-income and resource-poor countries alike and is endemic on all continents except Antarctica. In addition, international travelers are the largest population group to receive pre-exposure prophylaxis, though it has also been recommended for use in vulnerable populations such as children who live in countries where rabies is endemic and are at increased risk for exposure. Large social events, such as the FIFA World Cup hosted in South Africa in 2010, also raised concerns about rabies due to large population movements and tourism and led to increased education and travel advisories on how to prevent exposure. Negative economic consequences can also occur due to loss of livestock from canine rabies exposure, especially in Asia.

***Rift Valley fever:*** Rift Valley fever (RVF) is a per-acute or acute mosquito-borne viral disease of domestic and some wild ruminants in Africa. The disease is characterized by abortions, necrotic hepatitis and a hemorrhagic state, although many infections are inapparent or mild. Humans become infected by contact with infected tissue or by mosquito bites. Infection in humans is usually associated with influenza-like symptoms, but severe complications, including ocular sequelae, encephalitis and hemorrhagic disease, occur in a small proportion of patients.

Rift Valley fever activity is related to climatic conditions that favour the mosquito vectors. Following some of the heaviest (ENSO-associated) rainfalls ever recorded in East Africa, an exceptionally severe outbreak of RVF in both domestic livestock and humans commenced in Kenya in 1997, and spread rapidly into Somalia and Tanzania. The number of human cases was estimated to be 89,000.

***Monkey pox virus infection:*** Historically, monkey pox virus infection of humans occurred as isolated or, at the most, focal clusters of cases in West and Central Africa. The virus reservoir is among tree squirrels and other rodents in these African tropical rain forests, and humans became infected by hunting and handling these animals. Horizontal human transmission has been documented, but appears inefficient, and transmission chains beyond secondary are rare. In addition, smallpox vaccination imparts cross immunity to monkey pox.

The main interest in monkey pox was related to the global discontinuation of smallpox vaccination in the 1980s, and concern whether this would create an immunological void which may be exploited by other related pox viruses. The endemic monkey pox cases in Africa increased slightly in the 1980s and 1990s as a result of many years of war, when people relied heavily on subsistence hunting, and also as a result of increased susceptibility after small pox vaccination had been discontinued.

During June and July 2003, 71 suspected cases of monkey pox were reported in the states of Illinois, Indiana,Kansas, Missouri, Ohio and Wisconsin in the USA. A total of 35 cases were confirmed by laboratory tests. Most of these people became infected by contact with pet prairie dogs (rodents of the genus *Cynomys*), sourced from a commercial pet trade distributor. The prairie dogs were probably caught in the wild, and apparently became infected through contact with Gambian giant rats (*Cricetomys*spp.) and dormice (*Graphiurus*spp.) that had been shipped in from Ghana. This disease outbreak in humans and pet prairie dogs therefore occurred because of the international trade and transport of non-domesticated animals, and the growing trend of private exotic animal and captive wildlife ownership in the USA.

***Dengue.***Dengue, also known as “breakbone fever,” is an acute febrile disease caused by one of five serotypes of arthropod-borne dengue viruses and is characterized as an “old” disease that has reemerged in the last half of the 20th century. Its arthropod vector is the *Aedesaegypti*mosquito, with transmission resulting in symptoms that become more pathognomonic as the disease progresses. Infection can lead to dengue hemorrhagic fever (DHF) and in some severe cases, such as in those who suffer from dengue shock syndrome (DSS), can lead to death. Common symptoms are high fever, headache, abdominal pain, myalgia, arthralgia, and rash; in severe cases of DHF and DSS, symptoms are accompanied by thrombocytopenia, vascular leakage, and hypotension. Dengue and its clinical and social manifestations are a tremendous public health concern, and due to its undifferentiated presentation at early onset in roughly half of cases, it may be difficult to diagnose.

Dengue virus infects between 50 million and 100 million people globally, has a geographic distribution in more than 125 countries, has increased in incidence 30-fold in the past 50 years, represents a leading cause of childhood hospitalization and

mortality, and is endemic in all WHO regions except Europe. Hence, it is one of the most widespread flaviviruses globally. Dengue flourishes in tropical and subtropical regions, and it is estimated that 40% of the world's population inhabit areas where transmission occurs. It is especially prevalent in environments that have limited or no public health water management systems, leading to uncontrolled mosquito breeding of the arthropod vector.

According to WHO, dengue outbreaks are increasing in frequency and expanding geographically, even given underreporting, which would tend to significantly underestimate the actual severity and impact. WHO has hence identified dengue as an international public health priority. Recent disease surveillance modeling has estimated that the annual global incidence could be closer to 390 million, approximately three times higher than current WHO estimates. Dengue resurgenceor emergence is occurring in many poorer regions with no previous experience in preventingcombatting, or controlling it or in regions that have not had a reported case in greater than 20 years. As an example, Latin America has experienced a constant increase in dengue and DHF cases since 2003.

Specific factors that lead to increased local outbreaks echo some of the challenges of other neglected tropical diseases as well as its own contextual vector and transmission mechanisms, and these include rapid urbanization, global warming/climate change, lack of vector control, fundamental public health and social infrastructure failures (e.g., in waste management and disposal), and poor hygienic household water storage. These factors and individual country resource challenges have created social vulnerabilities for those regions with limited clinical or disease surveillance capacity. The fact that dengue is often left under prioritized in comparison to the push for economic development may also create enabling conditions.

Outbreaks and related seasonality-based transmission have led to dengue's spread internationally, particularly to vector friendly habitats such as heavily urbanized regions. Indeed, outbreaks in the U.S. states of Texas, Hawaii, and Florida and other areas where it is not endemic highlight the growing global health risk of disease transmission. It has been estimated that dengue accounts for 2% of all travel-related illness of those returning from regions of endemicity, especially Southeast Asia. Risk factors include length of stay, season of travel, and prevalence of dengue at the destination country. Early diagnosis and appropriate clinical management/treatment are
viewed as crucial prevention and treatment responses to limit international spread.

### 3.3 Emerging and re-emerging bacterial and parasitic zoonotic diseases

#### Emerging Bacterial/rickettsial zoonoses

***Lyme borreliosis:*** Lyme borreliosis has become the most common vector borne infection in the northern hemisphere. This disease is caused by spirochaetes belonging to the *Borreliaburgdorferi*complex. The sylvatic maintenance hosts and reservoirs are a range of small and medium-sized mammals and ground-feeding birds in the endemic areas. In Europe, the vector of infection is the tick, *Ixodesricinus*, whereas, in North America, two primary tick vectors exist, namely *I. scapularis*and *I. pacificus*. The spirochaetes cause a multi-systemic disease, affecting the skin, nervous system, heart

and joints. Treatment of human cases in the early stages of the disease is usually uncomplicated, involving a slightly prolonged course of appropriate antibiotics. In cases which are not detected and treated early, multi-systemic pathology may occur, and the
disease appears to become more resistant to treatment.

The emergence of Lyme borreliosis in North America in the 1970s is an example of new patterns of disease occurring as emergent properties of complex ecological changes. In this instance, changes in land-use practices, such as the abandonment of less productive farmlands, deforestation and a massive expansion of suburban human settlement resulted in dense populations of white-tailed deer (*Odocoileusvirginianus*), and an increase in wild rodent reservoirs (*Peromyscus*spp. and *Tamias*spp.) of the bacterium. The increased number of preferred hosts supported high tick-vector populations in close proximity to outdoor environments which were near to suburban areas and heavily used by people.

***Ehrlichiosis:****Ehrlichia*and *Anaplasma*spp. are obligate intracellular tick transmitted bacteria in the order Rickettsiales. Each organism exhibits tropism for a specific host blood cell in which it forms characteristic clusters known as morulae. Three of these rickettsial agents, *E. chaffeensis*, *E. ewingii*and *A. phagocytophilum*, cause human disease. Human infection with these bacteria commonly presents as a flu-like illness, but may be asymptomatic. Rarely, it may even cause fatal disease. Laboratory findings include leukopenia, thrombocytopenia and elevation of liver enzymes.

*Ehrlichiachaffeensis*, recognized as the causative agent of human monocyticehrlichiosis, is primarily maintained in nature by white-tailed deer (*O. virginianus*) and the lone-star tick (*Amblyommaamericanum*) as host and vector, respectively. *Ehrlichiaewingii*is the causative agent of both canine and human granulocytic ehrlichiosis. *E. ewingii*is also vectored by *A. americanum*, but other tick species may play a role. Molecular evidence of the bacteria has been demonstrated in wild white-tailed deer.

*Anaplasma (Ehrlichia) phagocytophilum*, the causative agent of human granulocytic anaplasmosis, was first detected as a human pathogen in 1994. In North America, the white-footed mouse (*Peromyscusleucopus*) is the mammalian host, while the ticks *I. scapularis*and *I. pacificus*are the primary vectors. Molecular evidence of infection has been demonstrated in a variety of wild rodents, as well as in medium-sized and large mammals, such as white-tailed deer. This is the same ecological complex that maintains Lyme borreliosis, and the emergence of *A. phagocytophilum*as a human pathogen may
relate to the same complex of ecological factors.

**Re-emerging bacterial zoonoses**

***Bovine tuberculosis:****Mycobacterium bovis*is a bacterium, which causes chronic debilitating disease in cattle, many wild animal species and humans. It is a bacterium of ancient lineage with a separate evolutionary trajectory from that of human-maintained

*M. tuberculosis*. In Africa, *M. bovis*has become established in certain populations of the following species:
– buffalo (*Synceruscaffer*)
– lechwe (*Kobus leche*)
– warthog (*Phacochoerusafricanus*)
– kudu (*Tragelaphusstrepsiceros*).

Bovine TB in wild animals is important because of its zoonotic potential and, indeed, wild animals can and do serve as reservoirs of infection and may pose a direct health risk to consumers of infected wildlife products. However, it is the indirect risk path, whereby wildlife reservoirs may infect livestock, that is the greatest cause for concern, because it is the bovine link which poses the greatest risk for human infection. This is especially relevant in developing countries with high human HIV prevalence, particularly in communities where human consumption of raw (unpasteurised) milk is normal practice, and meat inspection is, at most, rudimentary.

Over the past two decades, *M. bovis*infection has achieved new prominence, as populations of free-range and farmed wild ungulates, formerly believed to be free of the disease, have been discovered with high prevalence of infection, particularly in North America, Europe and parts of Africa. At least some of these new occurrences in the northern hemisphere appear linked to ecological changes and changes in land-use practices, resulting in high population densities of susceptible wild species.

***Brucella species in wild animals:*** Several species of *Brucella*infect wild animals. Infection of livestock by any of these species, whether or not the infection results in disease, may cause the animals to test 'positive' in standard screening tests used to identify and eliminate infected domestic animals or herds. *Brucellaabortus*and *B. melitensis*are the species most regularly transmitted between wild and domestic ungulates, and are most frequently associated with the risk of human disease. Each species can cause significant disease in livestock (*B. abortus*in cattle and *B. melitensis*in sheep and goats), and both can cause serious disease in humans. Human health risks are generally associated with the handling or consumption of infected animals or products.

A number of incompletely characterized species of *Brucella*have been isolated from whales and seals of various species, and also from rare human infections and are collectively referred to as marine *Brucella*.The effects of *Brucella*infections on wildlife can result in abortion, lameness and sterility on the individual level, but many infections appear to be sub-clinical.

***Leptospirosis:*** Leptospirosis is the disease caused by clinical infection with any one of the many serovars of the bacterium *Leptospirainterrogans*. Each serovar of the bacterium is maintained in nature by non-clinical persistent infection of one or more wild or domestic mammals. These mammals are the maintenance hosts. Leptospirosis as a clinical disease occurs when mammals of other susceptible species, such as humans, become infected. The disease is associated with septicaemia, haemolyticanaemia, hepatitis, nephritis, jaundice, abortion and still births. The bacteria persist in the kidneys

of the maintenance hosts, are shed (excreted) in the urine, and can survive for some time in aquatic and moist environments. Infection can occur through the following ways:
– ingestion of contaminated water
– handling or ingesting infected milk or tissues
– transplacental invasion
– sexual contact
– social grooming.

In humans, farm and abattoir workers, hunters and trappers, wildlife handlers and zoo-keepers have traditionally been the high-risk groups. Epidemic outbreaks may be associated with periods of high rainfall, particularly in habitats with poor drainage and a high density of carrier animals.There have been increasing reports of leptospirosis diagnosed in emergency rooms in urban settings in the Americas, with the source of infection thought to be rodents. Thus, while leptospirosis has been an acknowledged zoonosis for many years, recently it appears to be gaining new importance as a public health threat.

***Other re-emerging bacterial zoonosis***include Tularemia, a bacterial disease caused by strains of the bacterium *Francisellatularensis*. This bacterium appears to have co-evolved with lagomorphs and rodents in the northern hemisphere, where it occurs on most continents. Also, plague, caused by *Yersinia pestis*, was a disease of great historical impact on human populations, and continues to re-emerge as a zoonotic disease on a reduced scale. The establishment of endemic foci of plague in many parts of the world during the twentieth century has made *Y. pestis*a much more widespread and available zoonotic threat than in the past.

**Re-emerging parasitic zoonosis**

***Human African trypanosomiasis (HAT):***Human African trypanosomiasis (HAT), also known as the "sleeping sickness," is a complex vector-borne parasitic infection caused by the *Trypanosomabrucei*protozoan transmitted to humans via bites from blood-feeding tsetse flies (genus *Glossina*) that have previously acquired an earlier stage of the infection from a human. There are two related geographically distinct *Trypanosoma*
*brucei*subspecies: *T. b. gambiense*and *T. b. rhodesiense*. *T. b. gambiense*is responsible for the majority of cases and occurs in West and Central Africa, with the transmission cycle involving humans as the reservoir for the parasite and the tsetse fly acting as both a disease host and a vector for human-human transmission, though direct zoonotic transmission can occasionally occur. Specifically, domestic and wild animals can become infected with both parasitic subspecies and act as carriers or reservoirs for the tsetse fly vector. *T. b. rhodesiense*infection involves a number of wildlife and domestic animal species (such as livestock) as reservoirs in eastern and southern Africa and involves zoonotic transmission and outbreaks often involving cattle. Vertical transmission from mother to child can also occur for HAT.

The disease is restricted to sub-Saharan Africa, where the tsetse vector resides, and is especially prevalent in remote rural sub-Saharan African regions which lack health system capacity. It is endemic in many of these countries and has a wide range of

infection areas, from as small as the village level to as large as an entire district. The vast majority (approximately 90%) of cases occur in Africa, with the remaining reported cases occurring in the eastern Mediterranean region. Reported cases of HAT have experienced global declines of an estimated 76% from 1999 to 2012, and since 2009 fewer than 10,000 new cases have been reported per year. However, it has also been estimated that 70 million people may continue to be at risk for contracting HAT, reflecting its potential for re-emergence, similar to its large increase in incidence in the 1980s and 1990s.

Common symptoms after transmission include fever, headache, pain and weakness in joints, and, as the parasite migrates to the central nervous system, severe neurological and psychiatric disorders that if left untreated can result in death. The disease can also cause amenorrhea, sterility, and abortion and can be contracted congenitally, all of which impact maternal-child health outcomes in resource-poor populations. The negative socioeconomic impact of HAT is particularly severe due to the devastating physical and mental disabilities associated with disease progression, particularly in the late stage, that can also lead to stigmatization of affected individuals. This can result in a significant direct and indirect economic burden to households and communities when an infected person becomes incapacitated and can no longer work, especially given that rural populations engaged in agriculture, fishing, animal husbandry and hunting activities for livelihood are at particular risk of exposure.

Children engaged in activities that lead to increased exposure to the disease vector can also experience problems in growth and intellectual development that can lead to learning retardation and loss of future labor resources. Additionally, livestock and agricultural production in rural communities are at risk of exposure to “nagana,” the animal form of HAT. This and other factors have contributed to stagnation in economic
development in Africa, with an estimated US$1.5 billion in agricultural income loses annually as a result of the disease reported by the Food and Agriculture Organization.

Treatment of HAT depends on the subspecies and stage of the disease but is largely characterized by the use of older drugs that carry concerns of toxicity, poor efficacy, possible drug resistance, and inconvenient route of administration (e.g., Suramin, Melarsoprol, Pentamidine, and Eflornithine). Second line treatments are associated with potential fatal adverse patient safety events and complex and lengthy treatment regimens and administration, and they can come at a prohibitively high cost. Fortunately, access to therapy has been aided by international coordination and medicine donations by pharmaceutical firms.

***Chagas disease:***Chagas disease, also known as American trypanosomiasis, is caused by the protozoan parasite *Trypanosomacruzi*. It is a common chronic, systemic infection, impacting approximately 7 to 8 million people worldwide, and has an annual mortality rate of approximately 10,000. New cases arise primarily in the poor, within areas of Latin America where it is endemic, although it is spreading now outside regions of endemicity. Chagas disease can also lead to significant economic losses due to reduced productivity from early-age mortality and disability. The parasite can infect a number of wildlife and domestic animal species reservoirs and is

spread to humans generally through contact with *T. cruzi*-containing fecal matter deposited by the triatomine insect near the site of its bite or mucous membranes. This insect vector often infests poorly constructed or substandard housing. Chagas disease can also be transmitted in the blood through congenital exposure, transfusion, organ transplantation, and reactivation due to immunosuppression and through oral transmission after ingesting contaminated food or liquids. Chronic infection is seen in fewer than 10% of infections but can result in severe organ damage leading to malnutrition or sudden cardiac death, with approximately 30 to 40% of cases developing into digestive mega-syndromes, cardiomyopathy, or both.

Chagas disease, like dengue, is being transmitted beyond its endemic presence in Latin America. Usually through vector migration occurring through population movement, travel, and trade, Chagas disease has spread to areas where it is not endemic, including high-income countries such as Australia, Canada, Europe, Japan, and the United States. Transmission is also facilitated by socioeconomic factors, including immigration, urbanization, factors leading to poor prenatal care and vertical transmission from mother to child, and potentially through tainted blood and/or organ tissue use. Illustrating the potential risk for disease migration across borders, approximately 14 million persons have migrated from countries where Chagas disease is endemic to areas where it is not.

***Taeniasis/cysticercosis:***Human cysticercosis is an infectious disease caused by the ingestion of eggs of the pork tapeworm, *Taeniasolium*, through fecal-oral transmission. This typically occurs through a 2-host life cycle where the intermediate host (pigs) ingests food or water contaminated by eggs that are excreted in the feces of humans infected with the adult tapeworm, which then disseminate and mature into the larval stage in the tissue of pigs and develop into cysts. The cycle is completed with the definitive host (humans) ingesting eggs (typically transmitted from contaminated hands, food, or water) or possibly through autoinfection. The completion of this life cycle leads to human cysticercus tissue infections and neuro-cysticercosis when the larvae invade the central nervous system.

The estimated prevalence of cysticercosis is very large, with estimates generally greater than 50 million people possibly infected worldwide and 50,000 deaths annually. These
figures establish cysticercosis as one of the most common causes of acquired epilepsy in developing countries. Indeed, clinical infection with cysticerci can lead to cysts in neural tissue, resulting in untreated outcomes including epileptic seizures, convulsions,
learning difficulties, and possible death. Even with appropriate diagnosis of cysticercosis, treatment regimens can be complex, including possible drug intervention, surgery, or simply observation, depending on the location, size, stage, and number of parasites/cysts as well as the clinical symptoms of each case.

The disease is particularly a problem in areas of endemicity, including many countries in Latin America and Southeast Asia, India, Haiti, and parts of China. However, it is most recognized as a public health crisis in sub-Saharan Africa. As well, poor strategies for interrupting transmission are the rule rather than the exception, with the

primary enabling factor associated with human activities of food preparation and animal husbandry practices. Socioeconomic considerations are also significant as it has been associated with poverty in populations within high-income countries and poorer populations in areas of endemicity that may lack access to important diagnostic tests needed to refer patients for appropriate treatment.

In addition, subsistence farmers in developing countries are tremendously affected by the disease due to loss of livestock. Cysticercosis creates economic chaos in agricultural systems dependent on pig/porcine production if and when infected pig carcasses are condemned for public health purposes. Further, due to the increasing popularity of pork consumption and flow of international workers from large cross-border migration, it may be imported into regions where it is not endemic and then spread locally. Reflecting this risk, cysticercosis transmission has been detected in high-income countries such as the United States and Canada through migration of agricultural workers and travel of these workers to and from regions of endemicity.

Strategies to increase awareness of the need to improve animal husbandry practices may also aid in reducing transmission. For example, providing pig handlers with oxfendazole, an anthelmintic benzimidazole that prevents the parasitic worm's glucose
uptake by binding to tubulin proteins in microtubules, can effectively treat porcine *Taeniasolium*infections and likely lead to decreased incidences of taeniasis and cysticercosis in both pig and human populations.

## 4.0 CONCLUSION

In this unit you learnt the definitions of emerging, re-emerging and zoonotic diseases. In the present "globalized" environment of interdependent trade, travel, migration, and international economic markets, many factors interact to cause the rise, emergence, and re-emergence of infectious disease, which necessitates a coordinated, global response. These factors include urbanization and destruction of natural habitats, leading to animals and humans living in close proximity; climate change and changing ecosystems; changes in population of reservoir hosts or intermediate insect vectors; and microbial genetic mutations.

Approximately 60% of recognized human pathogens are zoonotic, so it is not surprising that many of the relatively recent emerging infections can also be traced back to animals. These viral bacterial/rickettsial and parasitic diseases, with some being neglected tropical diseases that currently infect more than 1 billion people and that have a high combined global burden of disease.

## 5.0 SUMMARY

In this unit you were informed that an emerging infectious disease is one that has appeared and infected a population for the first time, or has existed previously but is rapidly increasing, either in terms of the number of new cases within population, or its spread to new geographical areas, while an old disease that has manifest in a new form that may be more sever or fatal and is termed re-emerging diseases.Zoonotic diseases

are those that can cross animal species barrier to infect humans, thereby putting the general public to risk.

Zoonotic diseases account for the majority of emerging and re-emerging infectious diseases occurring due to increased contact between humans and animals as a by-product of development, industrialization, and encroachment on wildlife habitats, resulting in a dynamic upward trajectory of these diseases. A host of human-sourced and environmental factors such as societal influences, human susceptibility to infection, demographics, availability of health care, food production, human behavior, trade and travel, environmental and ecological changes, economic development, war and famine, adequacy of public health infrastructures, man-made events with intent to harm, and pathogen adaptation or evolution complicate emergence of diseases.

Approximately 75% of the diseases that have emerged over the past two decades have a wildlife source, are mostly of viral origin and include the human immunodeficiency virus/acquired immune deficiency syndrome, Ebola virus, Hantavirus, Nipah virus, Hendra virus, Menangle virus infection, Severe acute respiratory syndrome, West Nile virus infection, Avian influenza (Influenza A), Monkey poxvirus infection.

Neglected tropical diseases (NTDs) are historically overlooked diseases that have been neglected at the community, national, and international levels and are endemic in many resource-poor populations and developing countries. Seven of the 17 NTDs are identified as targeted zoonotic diseases by WHO and include rabies, human African trypanosomiasis, leishmaniasis, taeniasis/cysticercosis, echinococcosis, foodborne trematodiases, and schistosomiasis.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. Define emerging, re-emerging and zoonotic diseases
2. Discuss the factors of emergence of diseases.
3. Discuss the important re-emerging parasitic diseases

## 7.0 REFERENCES/FURTHER READING

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# MODULE 3 INTRODUCTION TO NON-COMMUNICABLE DISEASES (NCDs) AND DISORDERS

Unit 1. Introduction to non-communicable diseases
Unit 2: Prevention and control of NCDs and disorders
Unit 3: NCDs and non-disease chronic conditions

## UNIT 1. INTRODUCTION TO NON-COMMUNICABLE DISEASES

**CONTENTS** **PAGE**



## 1.0 INTRODUCTION

This unit on introduction to non-communicable diseases (NCDs) defines, describes and classifies NCDs. You will learn the characteristics of these diseases and their different classes. The epidemiological patterns and risk factors will also be discussed. This will help you in identifying appropriate measures for the prevention of NCDs that you, as an Environmental Health Practitioner, and other health workers will put into place in your community.

## 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- Define, describe and classify non- communicable diseases
- Understand the epidemiological patterns of the NCDs
- Enumerate the risk factors, signs and symptoms of NCDs

## 3.0 MAIN CONTENT

### 3.1 Definitions, Description and Classification

**Definition and description:** Non-communicable diseases are chronic conditions that do not result from an (acute) infectious process and hence are "not communicable." They can also be defined as diseases that have prolonged course, that do not resolve spontaneously, and for which a complete cure is rarely achieved. Therefore, their characteristics include;

- Complex etiology (causes)
- Multiple risk factors
- Long latency period

- Non-contagious origin (non-communicable)
- Prolonged course of illness
- Functional impairment or disability

Traditionally, diseases characterized as non-infectious and of chronic nature are grouped together as NCDs. NCDs include diseases such as diabetes, cardiovascular diseases, mental disorders, neuro-degenerative disorders and injuries. However, some cancers have an infectious origin and many infectious diseases such as tuberculosis and HIV have a chronic nature. The four types of NCDs, cardiovascular diseases, cancers, chronic respiratory diseases and diabetes make the largest contribution to mortality in the majority of developing countries and economies such as Nigeria. Currently, diabetes, cardiovascular diseases, cancers and chronic respiratory diseases are the largest killers accounting for 68% of deaths worldwide. Nearly 80% of NCD deaths (30 million) occur in low, middle and few high income countries, where NCDs are fast replacing infectious diseases and malnutrition as the leading causes of disease and premature death. According to WHO, it is estimated that the global NCD burden will increase by 17% in the next ten years, and in the African region by 27%. Almost half of all deaths in Asia are now attributable to NCDs, accounting for 47% of global burden of disease. Over 80% of cardiovascular and diabetes deaths and two thirds of all cancer deaths occur in developing countries. Figure I shows the projected global trends causes of death by NCDs in 2008 and 2030.

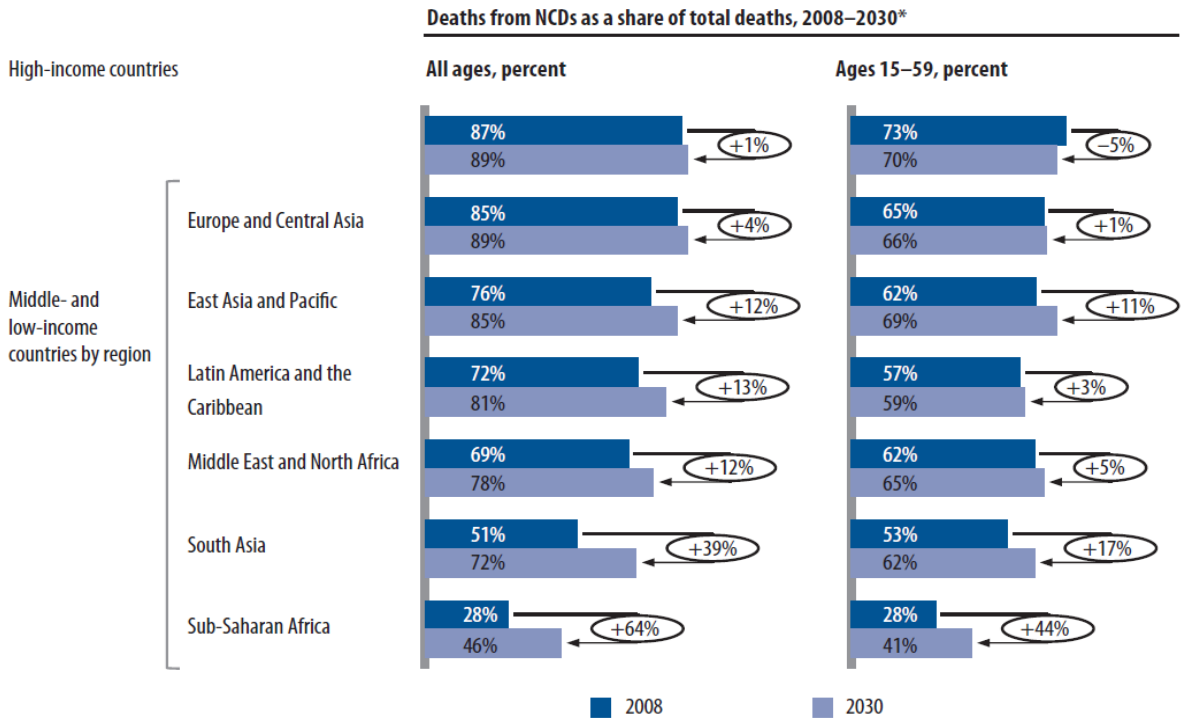


Fig. I: The rising NCD challenge in developing regions includes younger populations (*Sources*: World Bank analysis based on the WHO Global Burden of Disease database estimates and projections 2011)

Apart from their obvious threat to the health of individuals, NCDs result in loss of productivity and income. NCDs are therefore a serious threat to the global development agenda. Many low and middle-income countries face a "double burden" of disease,

dealing with the problems of infectious disease and under-nutrition, and at the same time experiencing a rapid increase in non-communicable disease and risk factors such as obesity and overweight, particularly in urban settings. It is now common to find under-nutrition and obesity existing side-by-side within the same country, the same community and even in the same household.

The social determinants that affect NCDs and the care processes involved in managing such diseases and their preventions therefore requires integrated and inter-sectorial approaches that includes the health sector as well as other sectors. Appropriate policies are needed to minimize and mitigate risk factors. Although the health sector remains the major organ for the management of NCDs, it has very little control over their root causes. Economic development, trade liberalization and foreign direct investments in food industry leads to export of energy dense foods and sweetened beverages even to the poorest countries, as well as increased use of health compromising beverages.

**Classification of non-communicable diseases:** Even as infections and nutritional deficiencies are receding as leading contributors to death and disability, cardiovascular diseases (CVDs), cancers, diabetes, neuropsychiatric ailments, and other chronic diseases are becoming major contributors to the burden of disease. The major categories of these NCDs are;

***Cardiovascular disorders and conditions of the heart:*** Cardiovascular disease (CVD) is a group of disorders of the heart and blood vessels, and may include coronary heart disease, stroke, congestive heart disorder, rheumatic heart disorder, hypertension etc.

***Rheumatoid disorders (anemia):***Examples include iron deficiency anemia, pernicious anemia, anemia of chronic diseases, hereditary hemolytic disorder (sickle cell anemia).

***Respiratory, renal and genitourinary problems:***Leading cause of death, high under-diagnoses rates and 90% of deaths occur in low-income countries. Examples include acute renal failure, chronic renal failure, asthma

***Gastric and endocrines disorders:***These include peptic ulcer, diabetes mellitus,diabetes insipidus, cirrhosis of the liver, intestinal obstruction. Diabetes is a disorder of metabolism. There are 4 types: Type 1, Type 2, Gestational, and Pre-Diabetes (Impaired Glucose Tolerance). Type 2 is caused by modifiable risk factors and is the most common worldwide.

***Benign and malignant tumors:*** This is the generic term for a large group of diseases that can affect any part of the body. They are known for rapid creation of abnormal cells that grow beyond their usual boundaries, and which can then invade adjoining parts of the body and spread to other organs. They are divided into benign tumors and malignant tumors. Examples are lung cancer, breast cancer liver cancer, colon and rectal cancer, leukemia

***Chronic neurologic disorders****:* Examples include Alzheimer's, dementias

***Unintentional injuries****:* Example are those from traffic crashes, sports injuries

***Arthritis/Musculoskeletal diseases:*** Examples are muscles wasting and joint diseases. However, the four types of non-communicable diseases (NCDs), cardiovascular diseases, cancers, chronic respiratory diseases and diabetes make the largest contribution to mortality in the majority of developing countries and economies in transition. Again, it has been shown that there are many cases of interactions between NCDs and infectious disease. Examples include;

*Diabetes, TB and maternal health:* People with diabetes are three times more likely to develop active tuberculosis (TB). Gestational diabetes (GDM), maternal under-nutrition and obesity can lead to retarded intra-uterine growth and small babies.

*HIV and metabolic syndrome:* Chronic inflammatory state in HIV adversely affects body fat composition. Anti-retroviral therapy increases the risk of metabolic syndrome and related NCDs.

*Childhood malnutrition and later obesity:* Preterm, large & small babies: independent risk factors for diabetes in adult life (due to epigenetic changes that are potentially reversible). Nutritional stunting (childhood under-nutrition) is a risk factor for obesity in later life

*Cancer and infectious disease:* Hepatitis B (HBV), hepatitis C virus (HCV) and some types of Human Papilloma Virus (HPV) increase the risk for liver and cervical cancer respectively. HIV-infection substantially increases the risk of cancer such as cervical cancer.

### 3.2 Risk factors

In Unit 2 of Module 2A risk factor was generally defined as any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury. Under this unit, risk factors will be defined and treated with special reference to NCDs. In this context, risk factor is an aspect of personal behavior or lifestyle, an environmental exposure, or a hereditary characteristic that is associated with an increase in the occurrence of a particular disease, injury, or other health condition.

***Major non-communicable diseases (NCD) risk factors:***The second half of the twentieth century witnessed major health transitions in the world, propelled by socio-economic and technological changes which profoundly altered life expectancy and ways of living, while creating an unprecedented human capacity to use science to both prolong and enhance life. Among these health transitions, the most globally pervasive change has been the rising burden of NCDs. Simultaneously, urbanization, industrialization, and globalization are often accompanied by several undesirable lifestyle alterations in the form of a diet rich in saturated fat, salt, and excess calories, decreased physical activity, addictions like tobacco and alcohol, and augmentation of psychosocial stress.

***Tobacco use:***Tobacco kills both users and those exposed to second-hand smoke. Alarming global trends include early initiation of smoking, increased smoking among women and shift to other forms like e-cigarettes as a potential fashion accessory or harm reduction strategy. Worldwide, tobacco use is a major public health problem that kills 6 million people annually. Smoking cigarettes causes approximately 71 percent of all lung cancer deaths, 42 percent of chronic respiratory disease, and 10 percent of heart disease. When people begin to use tobacco at an early age, addictions are especially hard to overcome later in life. Studies from the United States and LAC attest to widespread tobacco use among girls and boys.

***Unhealthy diet:***Convincing evidence links NCDs with specific dietary components: salt, free sugars (especially through use of sugar-sweetened beverages), fats, mainly trans-fats and saturated fats and low fruit and vegetable consumption. Salt, sugar and fat consumption in high-income countries is mainly from processed food, requiring strong policy measures. In many low and middle income countries, the source is still home-cooked food, requiring an understanding of food decision processes and multi-level contextualized interventions.

***Physical inactivity:***Current recommendations advocate moderate intensity physical activity of 150 minutes per week or 30 minutes per day for five days. In addition, sitting time should be restricted to less than 2 hours at a stretch. Insufficient physical activity and unhealthy diet can lead to high blood pressure and overweight/obesity and are widely associated with Type 2 diabetes, hypertension, and heart disease. As countries become wealthier and individuals grow older, physical activity levels decrease, especially among women.

***Unhealthy use of alcohol:***The harmful use of alcohol includes the volume of alcohol drunk over time; the pattern of drinking to intoxication; the drinking context and its public health risks; and the quality or contamination of alcoholic beverages. Excessive alcohol consumption is another risk behavior for NCDs and is associated with heart disease and some cancers. Drinking also contributes to increased risk of road traffic accidents, unprotected sex, intentional and unintentional injuries, poor mental health, and gender-based violence.

Some of these risk factors are uncontrollable and include;

1. Stress that makes the body unable to activate the immune defense, as a result the body produces a hormone which suppresses the immune system functions
2. Stress that slows down pro-inflammatory chemicals which are essential for wound healing
3. Immune disorders that make the body to over-react/become hypersensitive to a substance in the environment or diets and so trigger allergies.
4. Production of an antigen to pathogens by active immunity or by passive immunity such as injection of gamma globulin from other persons or animals that have developed antibodies to a disease. Others include bird flu vaccine, BCG vaccine, anti-malarial vaccine or tablets.

The four main risk factors defined by WHO are alcohol, unhealthy diets, physical inactivity, and tobacco use. While environmental risk factors of NCDs have not been

given adequate attention by WHO, a growing number of health, medical and scientific associations are increasingly highlighting the link in environmental risk factors such as air quality, chemicals, including mercury, climate and energy.

Risk factors could be modifiable or non-modifiable factors. **Modifiable risk factor** is a behavioral risk factor that can be reduced or controlled by intervention, thereby reducing the probability of disease. WHO has prioritized physical inactivity, tobacco use, alcohol use, and unhealthy diets (increased fat and sodium, with low fruit and vegetable intake) as modifiable risk factors. Some modifiable risk factors are shared among different NCDs as shown in figure II. Such shared risk factors make it possible to address NCDs through common preventive strategies.

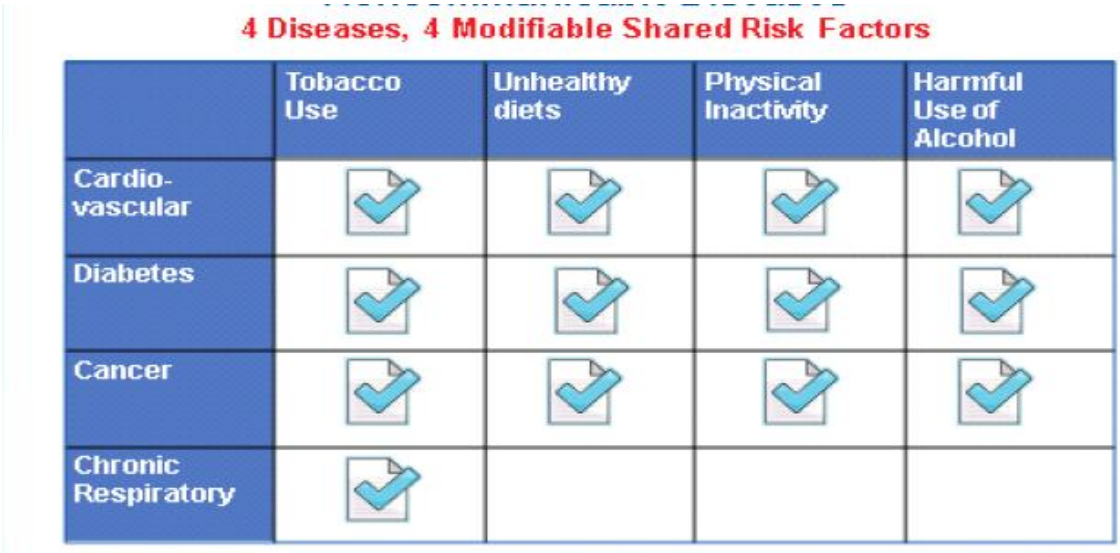


Figure II: Modifiable shared risk factors (Source: Center for Disease Control and Prevention 2013)

Much of the rise in NCDs in developing countries is attributable to modifiable risk factors such as physical inactivity, malnutrition in the first thousand days of life and later an unhealthy diet (including excessive salt, fat, and sugar intake), tobacco use, alcohol abuse, and exposure to environmental pollution. Country evidence suggests that more than half of the NCD burden could be avoided through effective health promotion
and disease prevention programs that tackle such risk factors. Particularly effective at very low costs are measures to curb tobacco, such as taxes, as indicated in the "*WHO Framework Convention on Tobacco Control*", and to reduce salt in processed and semi processed foods.

**Non-modifiable risk factor**is a risk factor that cannot be reduced or controlled by intervention; for example, age, gender, race, and family history (genetics). **Metabolic risk factors**are risk factors related to the metabolic or the biochemical processes involved in the body's normal functioning. Behaviors (modifiable risk factors) can lead to metabolic/physiologic changes. WHO has prioritized the following four metabolic risk factors: raised blood pressure; raised total cholesterol; elevated glucose; overweight and obesity.

***Determinants of health transition:*** Health transition, whereby NCDs become the dominant contributor to the burden of disease, is principally due to a combination of demographic and lifestyle changes that result from socio-economic development. Demographic transition is characterized by a decline in mortality, followed by a drop in fertility. During this transition, the age structure of the population changes from a pyramidal shape to a more columnar shape, as fertility declines and the population ages. This is then reflected in the profile of the causes of death. As industrialization and urbanization occur, there is a decline in the mortality attributable to infectious diseases and nutritional disorders. As more individuals survive to enter the middle ages, the years of exposure to the risk factors of chronic disease increase.

Simultaneously, urbanization, industrialization, and globalization are often accompanied by several undesirable lifestyle alterations in the form of a diet rich in saturated fat, salt, and excess calories, decreased physical activity, addictions like tobacco and alcohol, and augmentation of psychosocial stress. Thus the dose and duration of risk factor exposure both increase, resulting in large numbers manifesting lifestyle related diseases and their consequences. Health transition is characterized by a demographic transition in the age profile and an epidemiologic transition marked by the shift in the cause of death profile with the increasing dominance of NCDs. In addition, recent evidence suggests that impaired foetal nutrition, reflected in small birth size, results in programmed susceptibility adult cardiovascular disease, diabetes, and some cancers. Migrant Indians have also been shown to have excess rates of coronary heart disease (CHD) and diabetes in comparison to other ethnic groups, indicating a magnified response to environmental change. These factors will adversely impact on the future burden of NCDs, as India experiences health transition.

### 3.3 Epidemiological patterns

NCD prevalence is rising in the low and middle income countries of the world, where the burden of communicable diseases is largely on the retreat, populations are aging rapidly, and development and lifestyle changes due to social and economic globalization are increasing exposure to risk factors such as obesity, smoking, and pollution. The rise of NCDs in middle- and lower-income countries, especially in Africa, including amongst younger, working-age populations, present certain epidemiological patterns that warrants global attention.

***NCDs and gender:***Available studies suggest statistically significant gender differences in morbidity and mortality as well as hospital admissions. Females are more likely to suffer morbidity than males while men are more likely to die from NCDs than women. Females are more likely to be hospitalized for NCDs than males. An association has also been observed between obesity and female sex, advancing age, non-manual work, urbanity and diastolic hypertension. Usually, most women in the urban environments are housewives, traders or sedentary workers, and are poorly educated with little or no dietary awareness. In many African cultures/societies, being robust or fat is seen as an evidence of affluence or good living or absence of chronic infectious disease such as HIV/AIDS and TB. Hence, this underscores the need for appropriate health education from all disciplines involved in the delivery of health services.

***Increasing life expectancy:*** Many African countries are in the early phase of nutritional and demographic transition, with the resultant effect on chronic NCDs epidemiology. Nigeria like other African countries has been experiencing increasing life expectancy. One of the possible reasons for this increasing life expectancy in many African countries is the progress being made in some healthcare delivery and social services such as reduction in perinatal, infant and maternal mortalities; poverty reduction as seen in the increments in GNI per capita witnessed in the last 2-3 decades; improvement in literacy level, particularly female education, and nutritional disorders, specifically under-nutrition. This resultant longevity is an independent risk factor for most chronic non-communicable diseases, and also increases the duration of exposure to risk factors of NCDs. Though, the gains (increasing life expectancy) of the mid-20th century were threatened by HIV/AIDS and tuberculosis.

***Increased investment on health:*** There has also been increased investment on health by governments and from external sources, i.e., international aids and donors, even though these funding are sub-optimal to effectively address the double burden of diseases being experienced in Africa. However, this has impacted in some ways (slight decline) particularly in the areas of infectious disease control.

***Nutritional transition:*** The nutritional transition has been associated with a rapid development of the precursor of many chronic non-communicable diseases, i.e., obesity. Obesity and its associated morbidities (cardiovascular diseases, cancers, arthritis, psychological distress and depression, diabetes and other metabolic disorders) are now common health problems in Africa and other developing countries. The emergence of these NCDs is not unexpected as empirical observation shows that an average African diet, particularly among the poor, is starchy (both complex and simple carbohydrate) with excessive oil component, low protein and little vegetable content, predisposing to obesity, and obesity in turn is a risk factor to a number of chronic diseases. This is in addition to the increasing availability of processed (salted), sweetened and fatty food and high calorie drink, especially in the urban environments.

***Lifestyle changes:***Non-Communicable diseases and its major ingredient have been referred to, by scholars as diseases of modernity, civilization or affluences. The quest for modernity or civilization or better still affluence in Africa and the developing world has been associated with significant economic growth and development in the past 50 years. This has impacted positively in improving the GNI per capita, reducing poverty and under-nutrition. Unintentionally, these changes have led to rural-urban migration, as young people are more inclined to undertaking service-based jobs deserting agrarian life. Consequently, they become sedentary and adopt western lifestyles which are associated with significant risky health behaviors (chronic disease risk factors). Such unhealthy lifestyles and behaviors include smoking and tobacco use, increased and/or excessive alcohol consumption, increased consumption of highly processed fatty, salted food or high energy drinks.

***Globalization:*** The upsurge of tourism and trade liberalization, increased investment and capital flow across Africa and globally, and increased access to education and international aids are also responsible for the increasing urbanity and rural-urban migration in Africa. All these elements are entangled within the concepts of globalization, which is being felt around the world. Furthermore, the globalization of

food and drink marketing as well as trade liberalization is a major driver of the nutritional transition. Many imported food and drink items are relatively cheap and are low in fiber and micro nutrients. Though not as cheap as obtained in developed world, they are becoming more accessible and attractive to both urban and rural inhabitants in Africa.

This globalization waves are not limited to food and drinks alone, the tobacco companies have moved production facilities from Europe and America to Africa where governments are more receptive in view of the benefits from tax revenues and employment opportunities for indigenes, thereby inadvertently endangering the life of the populace.The tobacco companies also embark on innovative and aggressive marketing, targeting the young people. This development is targeted at increasing the consumption of tobacco in Africa and many other developing countries, which is a sharp contrast to the declining trends being observed in the developed nations.

***Increasing NCD-related mortality and ill-health:*** Overall, deaths from NCDs as a share of total deaths are projected to rise by over 50 percent in middle- and lower-income countries by 2030. The change will be particularly substantial in Sub-Saharan Africa, where NCDs will account for 46 percent of all deaths by 2030, up from 28 percent in 2008, and in South Asia, which will see the share of deaths from NCDs increase from 51 to 72 percent during the same period. Data on ill health paint a similar picture. By 2030, cancer incidence is projected to increase by 70 percent in middle-income countries and 82 percent in lower-income countries. While increases in NCD-related mortality and ill-health in part reflect countries' successes in extending lives and
curbing communicable diseases, a significant part of the increase is a result of modifiable risk factors, many of which are linked to modernization, urbanization, and lifestyle changes.

***The rise of NCDs amongst younger populations:*** The rise of NCDs amongst younger populations is altering many countries' "demographic dividend", including the economic benefits expected to be generated during the period when a relatively larger part of the population is of working age. Instead, these countries will have to contend with the costs associated with populations that are living with longer episodes of ill health. For example, a recent study found that one in four people in Ukraine between the ages of 18 and 65 has an NCD, and that a growing number of young adults are being affected, prompting the conclusion that the country could "lose the next generation to chronic disease". Cardiovascular disease is already a major cause of death and disability in South Asia, where the average age of first-time heart attack sufferers is 53 compared
to 59 in the rest of the world. In the Middle East and North Africa, NCD prevalence is increasing amongst women and adolescents, driven by factors unrelated to age, such as growing rates of obesity and smoking.

***Effect on development:***NCDs also present daunting development challenges for middle- and lower-income countries because of the magnitude of the burden relative to their level of economic development. The projected rise of NCDs in these countries will occur on a compressed timeline, compared to high-income countries, and often in

the context of competing priorities and a restricted capacity to respond. In fact, NCDs are already exacting a significant toll in terms of the human and economic cost in these countries, as measured in healthy years of life lost (a sum of productive life years lost due to premature mortality and disability). This toll will become even higher over the next two decades, as the share of the disease burden attributable to NCDs in middle-income countries approaches that found in high income countries and rises even more rapidly in lower income countries to come close to the levels found in middle-income countries today.

***The "double burden" of disease: A***s NCDs become an increasing challenge, many lower-income countries will continue to face a substantial burden of communicable diseases. As a result, they will contend with a "double burden" of disease, further compounding the overall health and development challenge. For poorer populations in particular, the greater likelihood of exposure to multiple risk factors for NCDs, combined with inadequate preventive health care and education, can help constitute a clustering of risk factors that makes the health consequences and costs associated with NCDs more likely to weigh most heavily on those already most vulnerable.

**Intervention strategies**

The burden of NCDs is likely to increase tremendously over the coming decades unless there is appropriate action taken to address the risk factors. Since NCD risk factors are largely preventable and modifiable, the early identification of risk factors is recognized as a primary strategy in the prevention of NCDs. Furthermore, although early detection is an absolute necessity, it's only a necessity if early treatment actually helps, and this depends on both the existence of effective treatments and a health care system that can deliver them to the right people. In the absence of early detection, many people are diagnosed at advanced stages of cancer, cardiovascular diseases and diabetes complications. It is estimated that eliminating key risk factors such as poor diet, physical inactivity and smoking would prevent 80% of heart disease, strokes and type 2 diabetes and over 40% of cancer cases.

Experts have recommended three-pronged intervention strategies-epidemiological surveillance, primary prevention (preventing diseases in healthy populations) and secondary prevention (preventing complications and improving quality of life in affected communities). As regards epidemiological surveillance, very limited data are available on the prevalence and/or risk factors for chronic diseases or general health with direct consequences on chronic diseases in Africa. However, the health ministries in many African countries, acknowledges the presence and devastating impacts of NCDs.

The social determinants that affects NCDs and the care processes involved in managing disease and preventing complications calls for integrated and inter-sectorial approaches that includes the health sector as well as other sectors. Health systems in many African countries are geared for short-term care of acute conditions related to infectious diseases, maternal and child health conditions. Malnutrition is often tackled through vertically run state or donor funded programmes. With the current situation, when countries increasingly face a double burden of disease, there is a need to develop innovative and integrated system-wide approaches to prevention and disease management.

For example, infectious diseases, maternal and child health conditions and under-nutrition often have clear causal link with NCDs, and health care systems need to address them simultaneously. Sometimes the interactions are complex. For example, there is a growing understanding of alcohol as an underlying risk factor for unsafe sex and intimate partner violence, contributing to the spread of HIV and other sexually transmitted infections. Integrating policies to reduce harmful drinking, gender-based violence and HIV will probably give better results on all three areas compared to addressing them in isolation.

The global NCD epidemic and climate change are two current critical challenges in the new development agenda. Therefore, inter-sectorial and integrated approaches that include energy, agriculture, retail, nutrition, transport and urban planning to promote local and small scale farming; retail practices that reduce carbon footprint and promote healthy choices for consumers; reliable public transport; and green spaces that are safe and promote physical activity will impact both the environment as well as NCD patterns positively.

## 4.0 CONCLUSION

You have been introduced to the definitions, classification, risk factors and epidemiological patterns of non-communicable diseases (NCDs). Cardiovascular diseases, cancers, chronic respiratory diseases and diabetes are the major NCDs that contribution to mortality in developing countries and economies such as Nigeria. Urbanization, industrialization, and globalization, often accompanied by several undesirable lifestyle alterations in the form of a diet rich in saturated fat, salt, and excess calories, decreased physical activity, addictions like tobacco and alcohol, and augmentation of psychosocial stress are the major risk factors of NCDs in middle- and lower-income countries. The rise of NCDs in these countries, especially in Africa, including amongst younger, working-age populations, has presented certain epidemiological patterns that warrants global attention.

## 5.0 SUMMARY

In this unit, NCDs have been defined as chronic conditions that do not result from an infectious process and hence are “not communicable”, and are characterized by complex etiology, multiple risk factors, long latency period, non-contagious origin, prolonged course of illness and functional impairment or disability. The four main risk factors of NCDs are alcohol, unhealthy diets, physical inactivity, and tobacco use and these are behavioral risk factor that can be reduced or controlled by intervention, thereby reducing the probability of disease.

NCD prevalence is rising in the low and middle income countries of the world, where the burden of communicable diseases is largely on the retreat, populations are aging rapidly, and development and lifestyle changes due to social and economic globalization are increasing exposure to risk factors such as obesity, smoking, and pollution.

Since NCD risk factors are largely preventable and modifiable, the early identification of risk factors is recognized as a primary strategy in the prevention of NCDs. Experts

have recommended epidemiological surveillance, primary prevention and secondary prevention as the three-pronged intervention strategies for mitigating the global increase the incidence and prevalence of NCDs.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. Define and classify non-communicable diseases
2. What are the major non-communicable diseases risk factors?
3. Discuss the intervention strategiesfor reducing the burden of NCDs

## 7.0 REFERENCES/FURTHER READING

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## UNIT 2: PREVENTION AND CONTROL OF NCDS AND DISORDERS

**CONTENTS** **PAGE**



### 3.0 INTRODUCTION

In this unit on prevention and control of NCDs and disorders you will become acquainted with issues of behavior medication, enforcements and engineering measures needed to prevent and control NCDs at societal and individual levels. Generally, the focus of relevant health agencies is to work to prevent deaths from NCDs through reducing major risk factors such as tobacco use, physical inactivity, unhealthy diet and the harmful use of alcohol. The general objectives as stated by WHO has been;

1. To raise the priority accorded to non-communicable disease in development work at global and national levels, and to integrate prevention and control of such diseases into policies across all government departments
2. To establish and strengthen national policies and plans for the prevention and control of non-communicable diseases
3. To promote interventions to reduce the main shared modifiable risk factors for non-communicable diseases: tobacco use, unhealthy diets, physical inactivity and harmful use of alcohol
4. To promote research for the prevention and control of non-communicable diseases
5. To promote partnerships for the prevention and control of non-communicable diseases
6. To monitor non-communicable diseases and their determinants and evaluate progress at the national, regional and global levels

Again, the knowledge you will gain from this unit will help you in identifying appropriate measures for the prevention and control of NCDs that you, as an Environmental Health Practitioner, and other health workers will put into place in your community.

### 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- Understand the issues associated with behavior medication
- Appreciate the proven methods of NCDs prevention and control enforcements
- Describe the engineering measures used in the prevention and control of NCDs

## 3.0 MAIN CONTENT

Effective interventions for NCD prevention and control are tedious since they involve early diagnoses. Moreover, the prevalence of these diseases has continued to increase due to demographic changes, and changes in lifestyle and the environment. Approaches that promote lifestyles through the prevention and early diagnosis of NCDs will therefore usually be inter-disciplinary and may include those that deal with behavioral change, legal policies and innovative technologies. Indeed, health care is interdisciplinary and should not be confused with medical care, which is a part of health care and deals only with treatment of illness. On the other hand, health services provide only the curative medical services.

### 3.1 Behavior medication

In 1982, Prochaska proposed the trans theoretical model of behavior change. The basis of this model is that not all individuals are prepared to take action to change their behavior at any given time and hence focuses on stages of behavior change. These stages are considered in six monthly time periods as researchers have found that this is the optimum period that most subjects are prepared to change. The stages of change are as follows:

- Pre-contemplation stage (no intention to change)
- Contemplation (actively thinking of changing a behavior, considering pros and cons)
- Preparation (currently exercising but not regularly)
- Action (currently exercising but have only just started)
- Maintenance (change has taken place)

The progression from one stage to another is not always linear; a subject may frequently relapse to the pre-contemplation stage or from one stage to another. The trans theoretical model described above helps both prediction and explanation of different people's behavior towards health related activities.

The health education authority in UK has suggested that the stages of change may be most useful for healthcare professionals to use because it is now possible to identify at which stage of change the patient is on the model's spectrum. This in turn would allow the healthcare practitioner to adopt different strategies for that particular stage in order to encourage adoption and maintenance of non-drug measures. Behavioral models provide a sound theoretical basis for all intervention programs planned to enhance compliance and form an important aspect of behavioral counseling for family and other significant people in the patient's life.

**Understanding compliance behavior**

Compliance or adherence forms a central concept in most psychological research aimed at improving patients' health. It refers to the extent to which a person's behavior, in terms of following advice on medication, diet, regular exercise or executing lifestyle changes coincides with the medical or health advice actually given by the clinician or any other health advisor. It is important to look at multiple aspects of compliance, as it is not a unitary construct. For example, one individual could be compliant with drugs or stress management but not necessarily with diet and exercise. Therefore, it is important to examine compliance across several behaviors.

In order to ensure compliance to nondrug measures, health advisors first need to be sensitized to the existing problems of patients, understand their barriers to non-compliance and then help them overcome them (Table 1). Recent research findings identified professional advice on healthier living as a key component of the national contract on health. According to this study, health advisors are ideally placed for this work. However, previous research has reported a gap between the patient's expectations of the lifestyle advice and their receipt of the same.

Table 1: How to improve patient's compliance to non-drug measures

| Category | What the FP can do? |
|---|---|
| Physical activity | • Organize and facilitate structured programs<br>• Help patients set realistic goals<br>• Initiate walks on occasions like world health day/world diabetes or heart day<br>• Reinforce importance of exercise at every visit<br>• Outline and specify exercise prescription clearly to the patient |
| Medical Nutrition Therapy (MNT) | • A trained Nutritionist/dietitian should be the one giving MNT<br>• MNT should be tailor made for the patient<br>• Reinforce the importance of meal timings and following a healthy diet plan at every visit |
| Stress management | • Help patients identify and assess their stress<br>• Suggest simple ways to cope<br>• Refer to specialists/counselors when required |
| Overall | • Help patients identify barriers to noncompliance<br>• Regularly counsel and motivate patients to comply to non-drug measures |

FP = Family physician. Source: Ranjani and Mohan, 2009.

Studies have tried to assess the health advisor's attitudes towards health promotion and lifestyle counseling through surveys. It has been reported that health advisors may feel most effective in changing the patient's drugs rather than changing lifestyle habits, as they are more trained in the former. Hence, more training and support concerning lifestyle intervention is required by health advisors in order for them to contribute more effectively in modifying patients' lifestyle. Other studies reported on the attitudes to cardiovascular health promotion among health advisors and showed that health promotion involves more than the provision of simple information and advice and the advisors lack confidence in lifestyle counselling.

Although much attention has been focused on the risky behaviors among youths, far less attention is paid to the protective factors that help explain why some young people are able to make healthy decisions despite adversity. Protective factors include a positive sense of self; strong life and decision making skills that promote school attendance; engagement in sports or religious institutions; and the facilitation of close, positive relationships with peers and family. School and family bonds have been

associated with significantly lower levels of alcohol and tobacco use, as well as less frequent involvement in violence and sexual activity. Strengthening adolescents' relationship with their family, school, and community promotes resilience and protective behaviors—enabling them to make healthy and informed decisions about sex, food, and substance use. Advancing the rights of adolescents should foster an array of protective factors, such as education.

**Stress management**

Most 20th century illnesses have been shown to have a strong relation to psychosocial factors such as stress, anxiety or depression. It has been estimated that 75% of all medical complaints are stress related. Thus, one way of reducing public and individual healthcare costs is to prevent stress by helping people to adopt health-promoting behaviors.

Stress management programs should aim to help the patient achieve maximum well-being and enjoy a richer and more rewarding tension-free lifestyle. There is conflicting evidence regarding the utility of stress management training in the treatment of NCDs such as diabetes. Many studies have shown therapeutic effects of stress management when time-intensive individual therapy was used. This requires the help of a professional psychologist or counselor, however other health advisors can help patients in identifying and assessing their stress and can then suggest ways of coping with them.

Coping strategies are many and these include exercise, dietary changes, yoga and meditation, relaxation techniques or stress management courses, counseling, where indicated in the treatment of NCDs. It is crucial to involve health professionals in this. Such health education results in more informed choices and encouraging changes in behavior that in turn improves clinical outcomes. Thus, patients need to be made aware of their condition; simple basic information about the disease, causes, treatment, management or how to avoid complications. All can be included as part of an education program where a trained educator imparts this information in the form of an interactive lecture. Books, tapes or CDs, pamphlets or posters can also be effectively used to supplement these lectures or in one to one counseling.

The Health advisors needs to regularly counsel and motivate their patients about diet, exercise, stress management and other lifestyle measures just like they would about medicines. This can be done with the help of nutritionist/dietitians, diabetic educators, counselors, behavioral specialists, podiatrists, fitness experts and yoga therapists. If the health advisor is backed with a motivated team he/she will be able to give comprehensive care to the patient and in that process enhance patient compliance to nondrug measures, especially diet and exercise. This could go a long way in the prevention and control of NCDs.

**3.2 Enforcement of prevention and control measures**

While death and disability from NCDs continues to increase, this trend could be slowed by paying more attention to the four key modifiable risk behaviors: tobacco use, excessive use of alcohol, unhealthy diet, and insufficient physical activity. These behaviors can lead to overweight and obesity, high blood pressure, and high cholesterol—all directly related to NCDs. The prevalence of NCDs is related to

unhealthy behaviors and practices typically initiated in adolescence. Therefore, building a healthier future depends on effective interventions during this critical window of opportunity.

Valuable lessons can be learned from local and global efforts to prevent tobacco use, such as country-level bans on smoking in public places and advertising aimed at young people. Restrictions and taxation have also been common strategies in tobacco control, as well as educational programs that encourage people to adopt healthy behaviors. Collecting better and more uniform data on NCD risk factors will help inform policies and programs and allow comparisons throughout the region. The following recommendations reflect current and emerging efforts to enforce reductions in these poor health behaviors.

***Tobacco usage:***Tobacco is the single greatest preventable cause of death in the world today. It kills 5.4 million people a year and if left unchecked that number will increase to more than 8 million a year by 2030. It contains the highly addictive psychoactive ingredient, nicotine. In industrialized countries, where smoking has been common for decades, it is estimated to cause over 90% of lung cancer in men and about 70% of lung
cancer among women, and about 22% of all cardiovascular disease.

In May 2003, the 192 WHO Member States adopted the WHO Framework Convention on Tobacco Control (WHO FCTC), the first coordinated global effort to reduce tobacco use and became the WHO's first public health treaty. The WHO FCTC entered into force on 27 February 2005 and requires countries that have ratified it to implement comprehensive measures, covering both the demand for and supply of tobacco products, as well as counteracting the tobacco industry and promoting international cooperation for global action. It has since become one of the most widely embraced treaties in UN history and, already has 164 Parties as of 21 April 2009.
The treaty commits countries to:
1. Ban or restrict tobacco advertising, promotion and sponsorship
2. Place large, graphic health warnings on cigarette packs and prohibit the use of false and misleading terms such as “light” and “low-tar”
3. Implement measures to protect non-smokers from secondhand smoke
4. Increase the price of tobacco products, particularly through taxation, to discourage tobacco use
5. Eliminate the illicit trade of tobacco products
6. Regulate the content of tobacco products and require public disclosure of ingredients
7. Provide cessation assistance and treatment for tobacco dependence
8. Prevent sales of tobacco products to minors
9. Protect tobacco control policies from commercial and other vested interests of the tobacco industry
10. Promote economically viable alternatives to tobacco growing and trade in tobacco products
11. Co-operate internationally including through transfer of knowledge and technology between the parties

To help countries meet their commitments to the WHO FCTC, and its' guidelines, WHO developed a technical assistance package called MPOWER– a package of six tools to support demand reduction policies that when implemented are proven to drive down tobacco use and save lives. The six demand reduction policies are:
**M**onitor tobacco use and prevention policies
**P**rotect people from tobacco smoke
**O**ffer help to quit tobacco use
**W**arn about the dangers of tobacco use
**E**nforce bans on tobacco advertising

***Harmful use of alcohol:*** Harmful use of alcohol is one of the main factors contributing to premature deaths and disability and has a major impact on public health. The harmful use of alcohol encompasses several aspects of drinking such as the volume of alcohol drunk over time; the pattern of drinking that includes occasional or regular drinking to intoxication; the drinking context if it increases the public health risks; and the quality or contamination of alcoholic beverages. Alcohol can damage nearly every organ and system in the body. Its use contributes to more than 60 diseases and conditions. In 2002, the harmful use of alcohol was estimated to cause about 2.3 million premature deaths worldwide (3.7% of global deaths). It is the fifth leading contributor to the global disease burden.

The World Health Organization developed a draft global strategy to reduce the harmful use of alcohol, as mandated by the World Health Assembly resolution adopted in 2008. The strategy includes a set of measures recommended for states to implement at the national level, taking into account the national circumstances in each country. To be effective, strategies and policy options to reduce alcohol-related harm should address levels, patterns and context of alcohol consumption through a combination of measures that target the population at large, vulnerable groups, such as young people and pregnant women, affected individuals and particular problems such as drink driving and alcohol-related violence.

Understanding the harmful use of alcohol's importance in relation to socioeconomic development needs to be better taken into account in policy formulation. Various strategies and policy options can be chosen depending on regional circumstances, public health problems and needs of individual countries. Target policy areas include:
• Raising awareness and political commitment
• Health-sector response
• Community action to reduce the harmful use of alcohol
• Drink-driving policies and countermeasures
• Addressing the availability of alcohol
• Addressing marketing of alcoholic beverages
• Pricing policies
• Harm reduction
• Reducing the public health impact of illegally and informally produced alcohol

***Diet, physical activity and health:***Eating a healthy diet, increasing physical activity and avoiding tobacco use can prevent 80% of premature heart disease, 80% of type 2 diabetes cases, and 40% of cancers. However, improving dietary and physical activity

habits are societal problem. They require a population-based, multi-sectoral and culturally relevant approach. Recognizing this and the heavy and growing burden of NCD, the WHO Global Strategy on Diet, Physical Activity and Health was endorsed by the World Health Assembly in May 2004.

To reduce the risk of these diseases, the WHO Global Strategy on Diet, Physical Activity and Health recommends developing and implementing national policies which aim to facilitate the:
• reduction of salt consumption
• elimination of industrially produced trans fatty acids
• reduction of saturated fat consumption
• limit intake of free sugars
• increase consumption of fruits and vegetables
• achievement of a healthy weight
• practice of adequate levels of physical activity.

Interventions to prevent and control the growing burden exist, and many are simple, cheap and cost effective. These can be implemented through settings based on approaches that promote healthy diets and physical activity in schools, workplaces andcommunities.

Policies to promote physical activity should;
• ensure that physical environments for walking, cycling and other forms of physical activity is accessible to and safe for all
• introduce transport policies that promote active and safe methods of traveling to schools and workplaces, such as walking or cycling
• improve sports, recreation and leisure facilities
• increase the number of safe spaces available for active play

***Cardiovascular diseases:*** Globally, cardiovascular diseases are the number one cause of death and they are projected to remain so. An estimated 17 million people died from cardiovascular disease in 2005, representing 30% of all global deaths. Of these deaths, 7.2 million were due to heart attacks and 5.7 million due to stroke. About 80% of these deaths occurred in low- and middle-income countries. If current trends are allowed to continue, by 2030 an estimated 23.6 million people will die from cardiovascular disease
(mainly from heart attacks and strokes). Cardiovascular disease deaths occur almost equally in men and women. Cardiovascular diseases place a heavy burden on the economies of countries. For example, it was estimated that during the 10 years (2006 - 2015), China lost $558 billion in foregone national income due to the combination of heartdisease, stroke and diabetes.

Risk factors include;
• Tobacco use, an unhealthy diet, and physical inactivity increase the risk of heart attacks and strokes
• High blood pressure has no symptoms, but can cause a sudden stroke or heart attack
• Diabetes increases the risk of heart attacks and stroke
• Being overweight increases the risk of heart attacks and strokes

• Low socioeconomic status increases the chances of exposure to risk factors and increases the vulnerability to develop CVD

At least 80% of premature deaths from heart disease and stroke could be avoided through healthy diet, regular physical activity and avoiding tobacco smoke. Therefore, a set of comprehensive and integrated actions could be used to prevent and control CVDs: This requires combining approaches to reduce the risks throughout the entire population and by targeting individuals at high risk or with established disease. Examples of population-wide interventions that can be implemented include:
• Comprehensive tobacco control policies,
• Taxation to reduce the intake of foods that are high in fat, sugar and salt
• Building walking and cycle ways to increase physical activity
• Providing healthy school meals to children

In addition, effective and inexpensive medication is available to treat nearly all cardiovascular diseases. After a heart attack or stroke, the risk of a recurrence or death can be substantially lowered with a combination of life style changes and drugs – statins to lower cholesterol, drugs to lower blood pressure, and aspirin. There is a need for increased government investment through national programmes aimed at prevention and control of CVDs and other chronic diseases.

***Chronic respiratory diseases (CRDs):*** These are diseases of the airways and the other structures of the lungs including asthma and respiratory allergies, chronic obstructive pulmonary disease (COPD), occupational lung diseases, sleep apnea syndrome and pulmonary hypertension. They account for four million deaths a year and many are preventable. The prevalence of these diseases is increasing everywhere, particularly among children and elderly people. The prevalence of asthma is particularly increasing in low and middle income countries where they are under recognized, under diagnosed, under-treated and insufficiently prevented. Currently COPD represents the 4th leading cause of death worldwide. Preventable chronic respiratory diseases cause premature deaths and disabilities. They also have large adverse and underappreciated economic effects on families, communities and societies in general.

Many chronic respiratory diseases are preventable. Some focus areas include:
*Tobacco prevention:* Avoidance of direct and indirect exposure to tobacco smoke is of primary importance not only for healthier lungs, but also as a preventative measure for all major NCDs: cardiovascular disease, cancer, and diabetes. Tobacco control policies aim to reduce tobacco consumption, exposure to tobacco smoke, and prevent tobacco uptake by the lungs

*Occupational health:* Early detection of lung diseases associated with occupational exposure is vital. Once the diagnosis is established, complete avoidance of the relevant exposure is the ideal prevention. Reduction of exposure could be an alternative approach.

*Diet and nutrition:* Associations have been reported between chronic respiratory disease
and diet. Obesity has also been associated with an increased risk of asthma and reduced lung function. It is therefore feasible that dietary strategies compatible with

those already existing for the control of coronary heart disease, diabetes and cancer could be developed for the primary and secondary prevention of CRDs as well.

*Indoor and outdoor air quality:*There is emerging evidence on the effects of chronic exposure to pollutants on the development and maintenance of lung function and the exacerbation of asthmatic symptoms. Control of exposure is largely through control of sources of emissions from domestic heating, traffic and industrial sources.

*Early life*: Evidence shows that a child's health in the first year of life affects the subsequent respiratory health. Although the precise nature of these associations is still unclear, children who have lower respiratory tract infections in the first year of life or who have low body weight at one year also have low lung function and a higher risk of developing asthma or COPD in later life. Maternal smoking during pregnancy adversely affects the lung function of the child at birth.

***Cancer***: Cancer is a leading cause of death group worldwide and accounted for 7.4 million deaths (around 13% of all deaths) in 2004. More than 70% of all cancer deaths occurred in low- and middle-income countries. Deaths from cancer worldwide are projected to continue rising, with an estimated 11.5 million deaths in 2030. Risk factors for cancers include tobacco and alcohol use, dietary factors, including insufficient fruit and vegetable intake, overweight and obesity, physical inactivity, chronic infections from helicobacter pylori, hepatitis B virus (HBV), hepatitis C virus (HCV) and some types of human papilloma virus (HPV) and environmental and occupational risks including ionizing and non-ionizing radiation.

More than 30% of cancers are caused by several leading behavioral and environmental risks that are potentially modifiable. Tobacco use is the single largest preventable cause of cancer in the world today. It is responsible for up to 1.5 million cancer deaths a year.
Key preventive strategies include:

- *Tobacco control*by implementing the WHO Framework Convention on Tobacco Control (see the WHO MPOWER package, a set of six key tobacco control measures)
- *Promotion of healthy diet and physical activity*(see the WHO Global Strategy on Diet and Physical Activity for a comprehensive set of policy recommendations)
- *Preventing harmful use of alcohol*by means of national alcohol policies aimed at reducing overall level of alcohol consumption
- *Reduce exposure and promote protection against infectious agentsassociated with cancer,* including vaccinationagainst Hepatitis B Virus and Human Papilloma Virus
- *Reduce exposure*and promote protective actions, to carcinogens in the environment and workplace, including ionizing and non-ionizing radiation

*Early detection:*Cancer mortality can be reduced if cases were detected and treated early.
*Treatment:*Treatment is the series of interventions, including psychosocial support, surgery, radiotherapy, chemotherapy that is aimed at curing the disease or prolonging life considerably while improving the patient's quality of life.

***Diabetes:*** Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin (a hormone that regulates blood sugar) or alternatively, when

the body cannot effectively use the insulin it produces. The overall risk of dying among people with diabetes is at least double the risk of their peers without diabetes. More than 220 million people worldwide had diabetes in 2004. WHO projectedthat diabetes deaths willdouble between 2005 and 2030. Almost half of diabetes deaths occur in people under the age of 70 years. Almost 80% of diabetes deaths occur in low and middle-income countries.

Elevated blood sugar is a common effect of uncontrolled diabetes, and over time can damage the heart, blood vessels, eyes, kidneys, and nerves. Some health complications from diabetes.For example, diabetic retinopathy is a significant cause of blindness, and occurs as a result of long term accumulated damage to the small blood vessels in the retina. After 15 years of diabetes about 10% of patients develop severe visual impairment. Diabetic neuropathy is damage to the nerves as a result of diabetes, and affects up to 50% of people with diabetes.Diabetes is among the leading causes of kidney failure; 10-20% of people with diabetes die of kidney failure. Diabetes increases the risk of heart disease and stroke; 50% of people with diabetes die of cardiovascular disease (primarily heart disease and stroke).

Without urgent action, diabetes-related deaths will increase by more than 50% in the coming decades. To help prevent type 2 diabetes and its complications, people should:
• Achieve and maintain healthy body weight.
• Be physically active - at least 30 minutes of regular, moderate-intensity activity on most days.
• Early diagnosis can be accomplished through relatively inexpensive blood testing.
• Treatment of diabetes involves lowering blood sugar and the levels of other known risk factors that damage blood vessels.
• Tobacco cessation is also important to avoidcomplications.

To control of diabetes;
• People with type 1 diabetes require insulin; people with type 2 diabetes can be treated
with oral medication, but may also require insulin.
• Blood pressure control
• Foot care

Other cost saving interventions include:
• Screening and treatment for retinopathy (which causes blindness)
• Blood lipid control (to regulate cholesterol levels)
• Screening for early signs of diabetes-related kidney disease and treatment

These measures should be supported by a healthy, regular physical activity, maintaining a normal body weight and avoiding tobacco diet use.

### 3.3 Engineering approaches in NCDs prevention and control

There have been several approaches to the reduction or elimination of risk factors that drive many NCDs prevalence. Some of these approaches, especially in the area of limiting tobacco use have resulted in the development of new products that claim to

reduce or even eliminate the harmful effects of tobacco. Organizations such as Truth Initiative have also sprung-up to support regulation that encourages the development of consistently less harmful nicotine delivery alternatives that allow smokers to quit tobacco altogether, or switch completely to a much less harmful product.

The healthcare is the dynamic research area which requires the usage of several fields like data mining, web mining, artificial Intelligence, machine learning, natural language processing, web personalization, recommender system and security. Tackling NCDs is a concern for the United Nations, which has included the reduction of premature mortality from NCDs as one of their Sustainable Development Goals. This situation calls for innovative approaches that improve the quality of healthcare, while reducing total costs. According to World Health Organization, "A good health system should deliver quality services to all individuals, when and where needed." The nature of service differs from country to country, but in all cases oblige an improved health care efficiency, reliable information on which base to take decisions and policies, safety and social benefits.

**Smokeless tobacco products:** Electronic nicotine delivery systems go by many names. The most common name is "e-cigarettes," but others such as e-cigs, vapes, vape pens, mods and tanks are also common terms. Most recently, new products, such as JUUL, have created brand-centric terms for product use ("JUULing"). However, the entire category is referred to as "e-cigarettes." E-cigarettes are devices that operate by heating a liquid solution to a high enough temperature so that it produces an aerosol that is inhaled. Solutions, sometimes called e-liquids, typically include nicotine, flavoring and a humectant, such as propylene glycol, to retain moisture and create an aerosol when heated. Many of the flavorings and humectants used in e-liquids have been approved by the Food and Drug Administration for oral consumption, but not for inhalation, due to the lack of research regarding the safety of these compounds when inhaled.

Some newer e-cigarettes on the market have nicotine salts in e-liquids — prompting questions about the use, purpose and safety of this novel form of nicotine. The makers of JUUL claim that their nicotine salt formulation increases the rate and amount of nicotine delivered into the blood, compared with other formulations. While using an e-cigarette is often called "vaping," the devices produce an aerosol, not a vapor. Unlike vapor, which is simply a substance in gas form, the aerosol from an e-cigarette can contain tiny chemical particles from both the liquid solution and the device (e.g., metals from the heating coil).

Some e-cigarettes are designed to resemble regular cigarettes, while others look more like cigars, pipes, pens and even USB flash drives. To account for the diversity in product design, some researchers have classified e-cigarettes as first, second or third generation devices (Figure III).A first generation e-cigarette is one that closely resembles a cigarette and is disposable.A second generation e-cigarette is a larger, usually pen-shaped device that can be recharged. A third generation e-cigarette refers to devices that do not resemble a combustible cigarette and often have very large and sometimes customizable batteries. Some parts may be replaceable, which is why they are sometimes called "mods." These devices are refillable.

More recently, e-cigarettes that have a sleek, high-tech design and easily rechargeable batteries have entered the market. One device, JUUL, emerged in 2016 and quickly established itself as a leading e-cigarette product by early 2018. There has also been an emergence of copycat products, such as Suorin Drop and myblu™, that follow JUUL's blueprint of a high-tech look and high nicotine delivery through the use of nicotine salt e-liquid formulations.

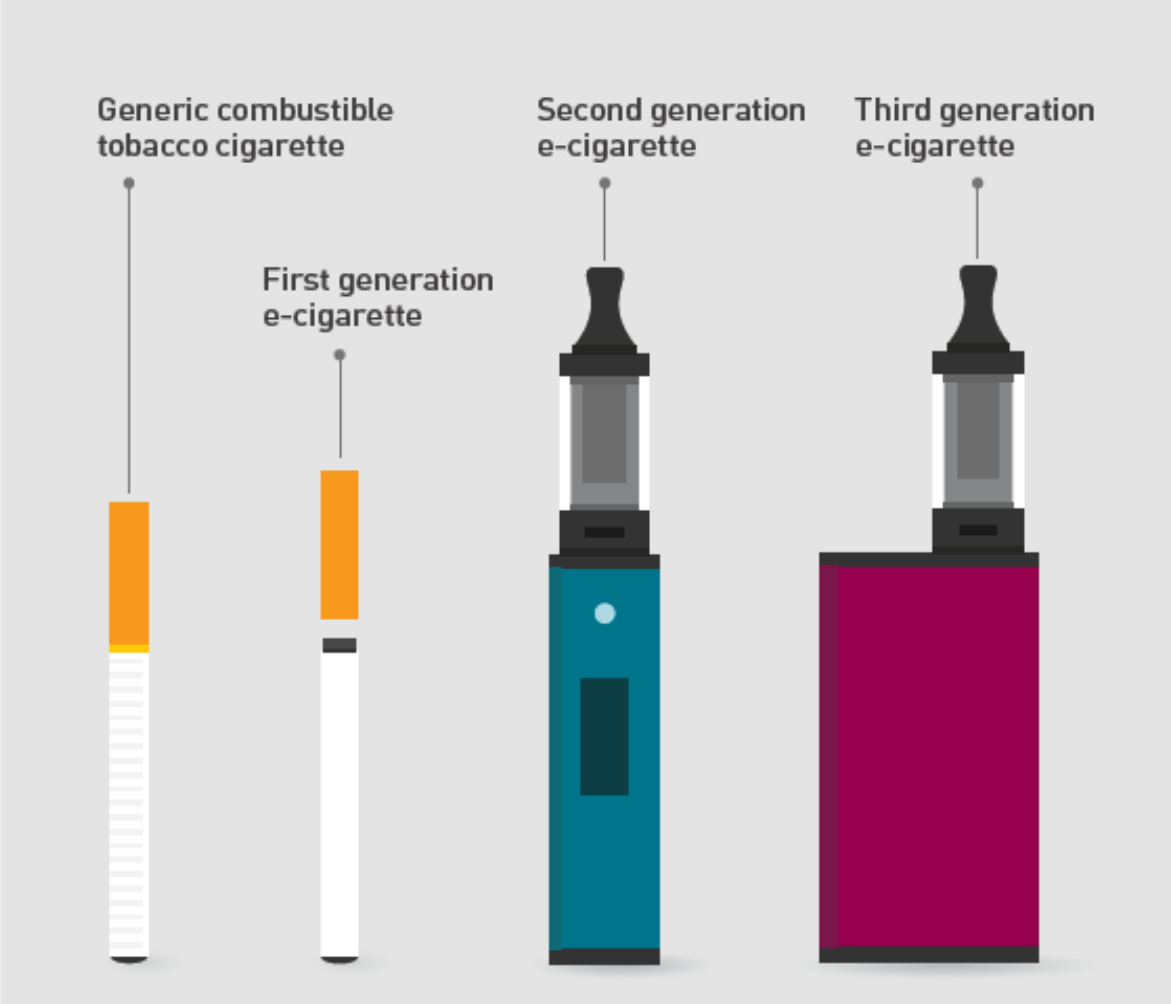


Fig. III: Evolution of the e-cigarette**. (**Source: National Academies of Sciences, Engineering and Medicine, Public Health Consequences of E-Cigarettes)

Among all age groups, e-cigarettes are most commonly used by those who also use other tobacco products, such as combustible cigarettes. This pattern is commonly referred to as "dual use" or "poly tobacco use." Among adult users, dual use is a troubling pattern because it suggests that some e-cigarette use may be supplementing smoking instead of replacing it. Because there is no safe level of smoking, there are concerns that this behavior represses efforts to completely quit smoking (i.e., people choose to "cut down" instead of quitting smoking entirely). This issue is somewhat complicated because some individuals who use e-cigarettes to quit may experience a period of dual use as they change products.

Some e-cigarette products deliver nicotine almost as efficiently as a cigarette. For example, the maker of JUUL e-cigarettes claims the product has a nicotine content like traditional cigarettes, and that it delivers the nicotine up to 2.7 times faster than other e-cigarettes. While that may make them more attractive to smokers as an alternative to cigarettes, it increases the potential for youth addiction and suggests such products should be carefully regulated to reduce youth access and use. A recently published Truth Initiative study found that among current youth and young adult JUUL users, only 37 percent knew that the product always contains nicotine.

Using e-cigarettes is substantially less harmful to individual health than inhaling smoke from combustible tobacco, such as cigarettes and cigars. However, while e-cigarettes contain far fewer toxins than combustible cigarettes, they are not free of toxins and still deliver harmful chemicals. While the basic technology behind e-cigarettes is consistent, there is an enormous variability within the product category and there is no typical e-cigarette. The products have different ingredients and different hardware, and deliver highly variable amounts of nicotine and potentially toxic chemicals. This variation makes it difficult to make overall public health recommendations about e-cigarettes and is a driver for the need for regulation. Consumers need to consistently know what they are getting — particularly from a product designed to deliver chemicals by frequent inhalation.

While some e-cigarettes may be an effective resource for quitting smoking, the variation in product quality and the lack of regulation make determining the potential of any particular product as a quit aid difficult. Although there is limited research currently supporting e-cigarette use for quitting, a smoker who switches completely to e-cigarettes from combustible cigarettes will substantially reduce exposure to toxic chemicals and health risks.Some smokers have switched to e-cigarettes or used them to quit tobacco completely.

At least 60 chemical compounds have been found in e-liquids, and more are present in the aerosol produced by e-cigarettes.Researchers have identified several substances which are either harmful or potentially harmful to e-cigarette users, including delivery solvents and propylene glycol, which can cause dry mouth and upper respiratory infections. Even e-cigarette flavors approved for ingestion have not been studied for toxicity if inhaled over long periods of time. Many e-cigarette flavorings contain chemicals that are known to be respiratory irritants,and research has found that some flavors are potentially more toxic than others. For example, researchers found that exposure to increased cinnamon flavoring caused significant cell death, compared with other flavors. Additionally, mixing multiple flavors can be more toxic to cells than exposure to just one flavor at a time.The repercussions of long-term exposure to the chemicals found in e-liquids and produced by e-cigarettes are not yet known, since products have not been on the market long enough to conclusively study their effects.

Accidental exposure to or ingestion of e-liquids can be very dangerous and, in the case of accidental swallowing or injection, even fatal.Defective, poorly manufactured and improperly modified e-cigarettes have been known to explode and cause injury. The rate of explosions is unknown, but both hospitals and burn centers in USA have reported injuries from e-cigarettes.Exposure to aerosol from e-cigarettes may expose non-users to nicotine, but research indicates that secondhand aerosol results in

substantially lower exposure to toxicants and carcinogens than secondhand cigarette smoke. However, exposure among vulnerable populations, including pregnant women and children, could still be dangerous.

**Water pipes**: A water-pipe is a smoking device also known as *nargila, argileh, hubble bubble, hookah, shisha* and *goza.* It is made up of four parts: the head, body, bowl and hose. A smoker breathes in through the mouthpiece in the hose. Smoke is drawn from the head, down the body, through water in the bowl and into the mouth. In its most common form nowadays, the water pipe involves the passage of charcoal-heated air through a perforated aluminum foil and across the flavored tobacco (a.k.a. Maassel) to become smoke that bubbles through the water before inhalation by the smoker (Figure IV).

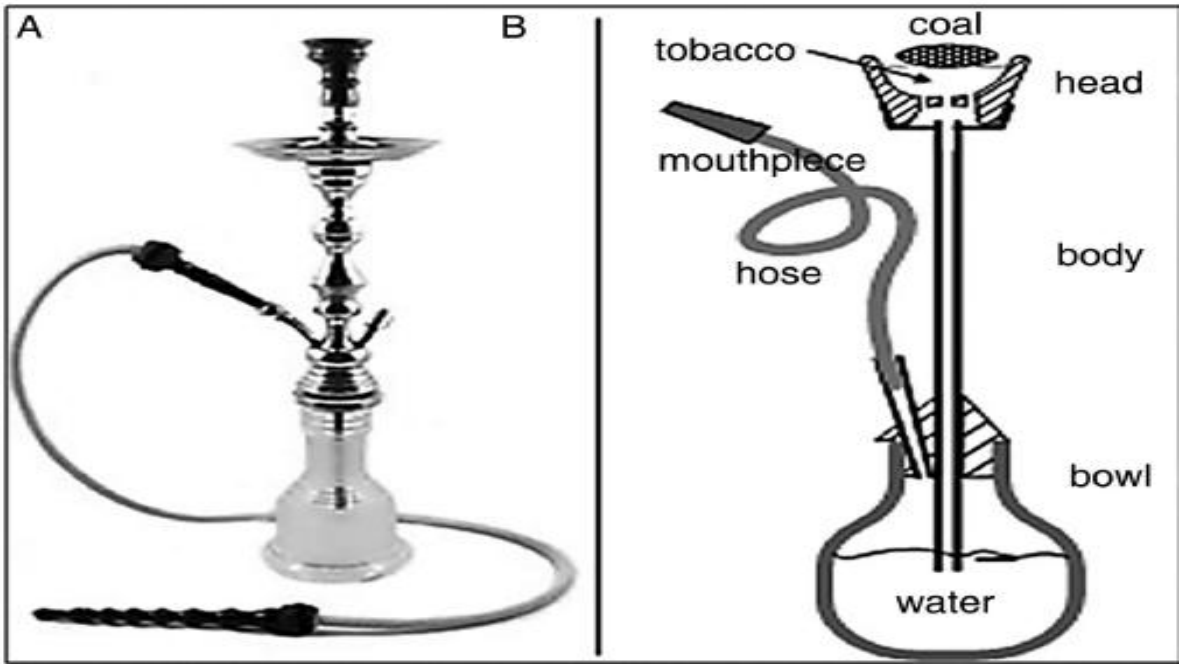


Fig. IV: (A) Water pipe device, (B) with presentation of its main parts. (Source: Maziak*et al.*, 2015)

In the Middle East, the water pipe has quickly replaced cigarettes as the most popular method of tobacco use among youth, and in several other parts of the world, it is becoming second only to cigarettes. Water-pipe smoke still contains high levels of toxic substances, even after it has been bubbled through water. Since most water-pipe smoking sessions last longer than smoking a cigarette, water-pipe smokers can absorb a larger amount of toxins. A water-pipe smoker may breathe in as much smoke during a typical one-hour session as a cigarette smoker would inhale from 100-200 cigarettes. The wood cinders or charcoal used to burn water pipe tobacco also increase health risks and add harmful substances to water-pipe smoke including carbon monoxide, metals and cancer-causing chemical.

Water-pipe smokers face the same health risks as cigarette smokers, including cancers, heart disease, lung disease and problems in pregnancy such as low birth weight. Infectious diseases can also be spread through sharing water-pipes. While some water-pipe cafés provide new pipe mouth pieces for each patron, the hose is still

shared and can transmit infection. Water pipes are therefore not a safe alternative to cigarette smoking since these smokers and second-hand smokers are at risk for the same diseases as cigarette smokers such as cancer, heart disease, respiratory diseases and adverse effects during pregnancy. Therefore, laws on the sale of tobacco and smoking in public buildings and outdoor areas apply to water pipe.

**Healthcare system and data mining:** In the recent year's healthcare industries have witnessed a momentous growth with the aim to impart good-quality health care services at the lowest cost. An effective healthcare system should also be easy to use and understand. Hence it is necessary to ensure and evaluate the effectiveness of such system. The healthcare is the dynamic research area which requires the usage of several research areas like data mining, web mining, machine learning, natural language processing, web personalization, recommender system and security. Indeed, healthcare analytics is a huge and rapidly growing market, recently predicted to reach $8 billion by 2017.

Machine learning is capable of crunching enormous amounts of electronic health records and identifying patterns, which can convey clinically relevant, prominent data for real time analysis. Machine learning classification techniques provides support for the decision making process in many areas of healthcare. High prediction accuracy is important for the diagnosis of medical application.

**mHealth:** mHealth uses mobile-based technologies to promote healthy behavioral changes in populations. The joint initiative, between the World Health Organization and the International Telecommunications Union (ITU), provides toolkits and technical advice to countries to roll-outmHealth based NCD prevention programmes.

The mHealth initiative is aiming to harness mobile phone use as a channel for improving other healthy habits relating to the prevention and reduction of NCDs. The joint initiative helps governments take advantage of this new access channel provided by mobile phones, whilst avoiding the endless cycle of small-scale, low-impact mHealth projects. This is achieved through the creation of global toolkits for each NCD area, containing technical content, design, set-up and management for each programme. Each country then adapts this global version to suit national requirements and context.

The initiative currently works in 9 countries: Costa Rica (mTobaccoCessation), Senegal (mDiabetes), Zambia (mCervicalCancer), Norway (mCOPD), the UK (mHypertension), the Philippines (mTobaccoCessation), Tunisia (mTobaccoCessation), India (mTobaccoCessation&mDiabetes) and Egypt (mDiabetes). Toolkits are available for TB/Tobacco, hypertension, COPD, ageing, cervical cancer, tobacco control and diabetes.

**Casalud NCD care model:** Perhaps one of the best examples of engineering approaches to NCDs prevention and control is the Casalud comprehensive NCD care model, which began its pilot phase in 2009 in seven Mexican states. Carlos Slim Foundation (FCS) that has been addressing many health issues facing the most vulnerable populations by finding innovative, sustainable and replicable solutions that improve people's

health across Mexico,designed the MIDO Mobile Cart. The Mobile Cart is an all-in-one system used in the primary care setting that includes medical equipment to measure weight, height, waist circumference, blood pressure, and glucose on site. After obtaining positive preliminary results, FCS and the Mexican Ministry of Health formed an alliance in December 2012 to implement Casalud in primary health clinics (PHCs) nationwide, and to incorporate the care model as a component of the National Strategy for the Prevention and Control of Pre-obesity, Obesity and Diabetes. As of 2016, Casalud has been implemented in 130 primary health clinics (PHCs) in 25 out of the 32 Mexican states through a public–private partnership between FCS and federal and state governments.

Casalud, strives to re-engineer primary healthcare services, centering its model on proactive prevention and detection of risk factors and NCDs, as well as evidence-based disease management. As a holistic model, its operation relies on the use of digital tools to connect households and primary care clinics, enhance patient-centered care by healthcare providers, detect diseases in a timely manner, and improve data reporting and management and, the availability of medicines and lab supplies. The model operates through a five-pillar intervention, with each pillar having specific technologies that allow its implementation in PHCs.

The first pillar is the proactive prevention and detection of chronic diseases, and includes two tools: the MIDO™ Mobile Cart and the MIDO™ Backpack. The MIDO Backpack is a portable version of the MIDO system, and includes a tablet, glucometer, blood pressure cuff, and measuring tape to screen for diabetes, hypertension, and abdominal obesity. The second pillar is the management of chronic diseases based on evidence, and includes the Chronic Disease Information System (SIC for its initials in Spanish), and a Digital Portfolio for healthcare professionals (HCPs). SIC is a hybrid (online/offline) database where physicians can capture patient data on NCD care, thereby improving care quality by standardizing healthcare protocols and implementing continuous monitoring. The Digital Portfolio is also a tool for HCPs and comprises applications and reference materials, including health calculators to estimate body mass
index as well as cardiovascular and other health risks, and a digital library with national clinical practice guidelines.

The third pillar, continuous monitoring of medication supply chain, is carried out through AbastoNET. AbastoNET is an online information system that standardizes metrics for stock management at PHCs. Pharmacists use AbastoNET to register supply levels of medicines and lab tests, as well as stock outs of specific medicines. The fourth pillar, capacity building through continuous medical education, is executed through the Online Interactive Platform for Health Education (PIEENSO in Spanish). PIEENSO is a hybrid (online/offline) platform that confers two degrees with academic endorsement from national and foreign universities.

The fifth pillar is patient engagement and empowerment, the practical tools of which are still in the design phase. The patient engagement measures will include assessment of the knowledge, confidence and skills to prevent and manage chronic disease, plus tools to implement related behaviors. One of the first pilots of a practical tool to

promote these components of patient engagement included two different mobile applications that could be used with smartphones or through text messages. The apps help patients understand their health, begin to self-monitor and interpret their own results, and implement lifestyle changes; aspecific app for patients with diabetes allows patients to
schedule medicine and appointment reminders, input measurements like glucose and weight, and receive immediate personalized feedback and educational messages.

## 5.0 CONCLUSION

In this unit, you have been introduced to the concepts of behavior medication, policy enforcement and technological or engineering approaches to the prevention and control of NCDs. The healthcare is the dynamic research area which requires the usage of several fields like data mining, web mining, artificial intelligence, machine learning, natural language processing, web personalization, recommender system and security. Approaches that promote lifestyles through the prevention and early diagnosis of NCDs will therefore usually be inter-disciplinary and may include those that deal with behavioral change, legal policies and innovative technologies.

The extent to which a person's behavior, in terms of following advice on medication, diet, regular exercise or executing lifestyle changes coincides with the medical or health advice given by the clinician or any other health advisor is a critical component of NCDs prevention and control. Valuable lessons can be learned from local and global efforts to prevent tobacco and excessive alcohol use, such as country-level bans on smoking in public places and advertising aimed at young people. However, the nature of healthcare service differs from country to country, but in all cases, oblige an improved health care efficiency, reliable information on which bases decisions and policies are made for safety and social benefits.

## SUMMARY

In this unit, it has been shown that in order to ensure compliance to non-drug measures or behavior medication, health advisors first need to be sensitized to the existing problems of patients, understand their barriers to non-compliance and then help them overcome them. Specifically, a strong relation to psychosocial factors such as stress, anxiety or depression and most illnesses, with 75% of all medical complaints being stress related, indicating that one way of reducing public and individual healthcare costs is to prevent stress by helping people to adopt health-promoting behaviors.

Restrictions, taxation and educational programs that encourage people to adopt healthy behaviors are common strategies in tobacco control, which could be added to better and more uniform data collection and risk factors determination to help in the development, inform policies and programs that could have global applications across different NCDs prevention and control efforts.

Since healthcare is the dynamic research area which requires the usage of several fields, tackling NCDs calls for innovative approaches that improve the quality of healthcare, while reducing total costs. Innovative initiatives such as the mHealthinitiative which aims at harnessing mobile phone use as a channel for

improving healthy habits relating to the prevention and reduction of NCDs are imperative. Specifically, engineering approaches to NCDs prevention such as Casalud, a comprehensive NCD care model based on the use of patient-centered technologies is playing integral role in the transformation of current healthcare approach.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. What do you understand by the term behavior medication?
2. Discuss the components of the WHO coordinated global effort to reduce tobacco use
3. Explain the concept of mHealth?

## 7.0 REFERENCES/FURTHER READING

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## UNIT 3: NCDS AND NON-DISEASE CHRONIC CONDITIONS IN NIGERIA

**CONTENTS** **PAGE**



### 1.0 INTRODUCTION

This unit on NCDs and non-disease chronic conditions in Nigeria informs you in greater details about the NCD situations in Nigeria. As a brief review, you should recall our definition that NCDs are chronic, non-contagious diseases capable of causing long term debilitation and disability if not prevented or properly controlled. Currently, NCDs affect the highly productive populations in Nigeria, thereby posing a heavy socio-economic burden and consequently undermining national development. In 2012, a total of 56 million deaths were recorded and 38 million of these deaths were caused by NCDs (mainly cardiovascular diseases, cancer and chronic respiratory diseases) globally. WHO NCD Country Profile of 2012showed that NCDs accounted for 27% of the total deaths in Nigeria in 2008.

According to the Federal Ministry of Health Abuja, Nigeria,the prevention and control of NCDs do not lie within the health system alone, however a whole-of-government, a whole-of-society and a multi-sectoral approach is needed to tackle NCDs. Therefore, relevant stakeholders such as the Ministries of Transport, Urban Planning, Finance, Agriculture, Information Education, National Sports Commission as well as the civil society organizations were involved in the development of the national strategic plan of action on prevention and control of non-communicable diseases in order to create a sense of ownership. Information derived from this unit will therefore enable you as an Environmental Health Practitioner, to play active role with other stakeholders in the prevention and control of NCDs in Nigeria

### 2.0 OBJECTIVES

By the end of this unit, you will be able to:

- know the important cardiovascular diseases and chronic respiratory conditions in Nigeria
- understand cancers; diabetes mellitus and sickle cell disease situations in Nigeria
- understand the mental, violence and oral health situations in Nigeria

Major NCDs in Nigeria include cardiovascular diseases (such as hypertension, coronary heart diseases and stroke); cancer; diabetes mellitus; sickle cell disease;

chronic respiratory diseases (CRDs); mental, neurological and substance use disorders (MNSDs); violence and road traffic injuries; and oral health disorders (OHDs).

## 3.0 MAIN CONTENT

### 3.1 Cardiovascular diseases and chronic respiratory diseases

***Cardiovascular diseases CVD):***Cardiac is the medical term that refers to the heart. The heart muscle (myocardium) is nourished by blood from the coronary arteries, which arise from the aorta. Vascular system refers to the blood vessels, which consist of a vast circuit of closed tubes connected to the muscular pump- the heart. The component units of the vascular system are the arteries, the capillaries and the veins. Cardiovascular diseases are therefore disruptions or impairments of the functions of the cardiac, coronary and vascular system brought about by degeneration of the components of the system. Cardiovascular diseases therefore include: coronary or ischaemic heart disease (heart attacks), cerebrovascular disease (stroke), raised blood pressure (hypertension), peripheral artery disease, rheumatic heart disease, congenital heart disease, and heart failure. The major causes of CVD are tobacco use, physical inactivity and an unhealthy diet.

The heart owns an electrical system that produces an evenly timed regular beat. When relaxed, adult heart rate is between 60 to 80 beats per minute. The beat is slower if the heart is in good physical condition. Under strenuous activity, or stress the heart beats faster. The heart may skip a beat or experience premature heartbeats. Very fast heart rate, greater than 100 beats per minute is known as tachycardia, while very slow rate less than 60 beats per minute is referred to as bradycardia. When the heart's pumping power is below normal capacity, it is referred to as congestive heart failure. Blood fluid accumulates in the lungs, hand, and feet and gives rise to the condition known as pulmonary congestion and congestive heart failure. This may be due to myocardial infarction, rheumatic fever, hypertension atherosclerosis or birth defects.

*Heart Attack:*Heart attacks and stroke are caused mainly by a blockage that prevents blood from flowing to the heart or brain. The most common cause is a buildup of fatty deposits on the inner wall of the blood vessels that that supply the heart or brain. The blood vessels can become narrow and less flexible, also known as atherosclerosis. The blood vessels are then more likely to become blocked by blood clots. When this happens, the blocked vessels cannot supply blood to the heart and brain, which then become damaged.

Myocardial infarction is the medical name for heart attack. Fresh and plentiful supply of blood is delivered to the muscle of the heart through a system of coronary arteries. If the arterial blood supply to the myocardium is blocked by a clot or plaque or a spasm, the myocardial cells do not get sufficient oxygen and the portion deprived of oxygen begins to die. This deprivation of blood is called infarction, while the whole turn of event is called myocardial infarction. Within the first few hours after the deprivation of blood, the dead area in the wall of the heart becomes soft and liable to rupture, causing sudden death of the victim.

One of the cardinal symptoms of heart attack is extreme pain which is not always felt around the heart area. In some cases, symptoms are manifest in form of severe pain in

the upper part of the abdomen, which is sometimes confused with the pain of acute indigestion. Frequently the pain appears from the middle of the chest and very often to the left arm and even into the forearm. Often, there are no symptoms of underlying diseases of blood vessels. A heart attack or stroke may therefore be the first warning of underlying disease. Symptoms of heart attack include pain or discomfort in the center of the chest, pain or discomfort in the arms, the left shoulder, elbow, jaw, or back. In addition, the person may experience difficulty in breathing or shortness of breath; feeling sick or vomiting; feeling light-headed or faint; breaking into a cold sweat; and becoming pale. Women are more likely to have shortness of breath, nausea, vomiting and back or jaw pain.

*Stroke:* A stroke is an interruption in normal circulation of blood through the brain, leading to a sudden loss of consciousness and some degree of paralysis, which may be temporary or permanent depending on the severity of oxygen deprivation of the brain cell. About 80% of deaths from stoke occur in people 65 years old or more.

The most common symptom of a stokeis sudden weakness of the face, arm or leg, most often on one side of the body. Other symptoms are sudden unset of numbness of the face, arm, or leg, especially on one side of the body; confusion, difficulty speaking or understanding speech; difficulty seeing with one or both eyes; difficulty walking, dizziness, loss of balance or coordination; severe headaches with no known cause; fainting or unconsciousness. People experiencing these symptoms should seek medical care immediately.

Symptoms of stoke may develop instantly or over a period of several minutes. Paralysis from stoke may cripple the muscle of one side of the body, face and limb, causing the mouth to be pulled to the strong side. Minor or little stroke may produce dizzy spells, feeling of confusion, lapse of memory, handwriting change and numbness of arm or leg. It could occur during sleep, on awakening, while driving or in the office.

*Hypertension:* Hypertension or high blood pressure (HBP) is the commonest of the diseases affecting the heart and blood vessels. HBP is a condition in which a person's blood pressure is higher than it should normally be when all variables including age and health condition are taken into account. Blood pressure is the force exerted against the walls by blood flowing through them. It usually refers to the pressure of blood flowing in the arteries. There are three broad types of hypertension, namely;

- Essential hypertension or a persistently elevated blood pressure in which no primary cause can be found. It is a reading in which diastolic pressure persistently exceeds 95 mmHg that cannot be attributed to any specified organic causes. Approximately 95% of all hypertension fall within this definition.
- Secondary hypertension or organic hypertension, which is the type commonly caused by detectable diseases of the heart and arteries
- Eclampsia or hypertension during pregnancy. Which is due to hormonal changes during pregnancy and which calls for special attention by attending physician.

Essential hypertension can be caused by any or a combination of risk factors such as

- hereditary or racial background
- overeating with resultant obesity
- abnormal irritability of the central nervous system often found in individuals who are easily tensed and highly strong
- persistent overreaction to unpleasant situations or mental or emotional stress
- use of tobacco

Uncontrolled hypertension can force the heart to work harder and result in

- atherosclerosis,
- kidney disease or obstruction of normal flow of blood to the kidney,
- glandular disturbances such as over-activity of the thyroid or pituitary glands
- heart failure
- Damage and progressive impairment of kidney function
- Increase in risks of heart attack and stroke
- Chest pain resulting in temporary difficulty in coronary arteries
- Temporary blindness
- Speech loss
- Mortality due to a relationship between HBP and coronary heart disease

Many victims of essential hypertension may not often manifest symptoms before the age of thirty-five years. During its early stage it seldom produces any symptoms perceptible to the person who has it. Only medical signs of elevated blood pressure may be the evidence of the condition at this early stage. Signs and symptoms of hypertension may vary widely and include headaches and dizziness, apparent robust heart, especially among persons who are fifty or sixty years of age. There may also be ringing in the ear and other disagreeable sensations. Hypertension is the commonest known CVD in Nigeria. Extrapolated data from the last national survey conducted in 1991/92 put the prevalence of hypertension at >20%, while hospital records estimate the prevalence at about 25%.

Any form of HBP is dangerous if not properly treated. The higher the diastolic pressure, the greater the risk of heart attack, stroke and kidney failure. As people become older, diastolic pressure will typically begin to decrease, and systolic pressure starts to rise. Systolic hypertension also increases the danger of heart attack, stroke, and kidney failure, as well as kidney damage, blindness and other conditions.

Beta-blockers and diuretics are recommended as first line treatment for hypertension, but newer drugs such as angiotensin-converting enzyme (ACE) inhibitors and calcium channel blockers are becoming increasingly popular. No single drug works well for everybody; clinicians have to rely on clinical judgement to find the best possible medication for an individual patient. Treating obstructive sleep apnea also improves essential hypertension.

***Chronic respiratory diseases (CRDs):*** Chronic respiratory diseases, such as bronchial asthma, chronic bronchitis, emphysema, chronic occupational lung diseases affecting both children and adults are common in Nigeria. There are no reliable data on the national prevalence on CRDs. However, at the global level, they account for four million deaths a year and many are preventable; are increasing everywhere,

particularly among children and elderly people; also the prevalence of asthma in increasing in low and middle income countries. There is a strong association with house dust, mites, fungi, exposure to tobacco smoke and smoke from domestic sources as well as industrial and environmental pollutants (fumes from solid fuels, airborne allergens, diesel exhaust gases, asbestos dust etc.).

*Chronic obstructive pulmonary disease (COPD):* The two major chronic respiratory diseases are Chronic obstructive pulmonary disease (COPD) and asthma. COPD is a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases. A diagnosis of COPD should be considered in any patient who has symptoms of cough, sputum production, or dyspnea, and/or a history of exposure to risk factors for the disease.

The main risk factors of COPD is tobacco smoke. This includes smoke from cigarettes, pipes, cigars and environmental tobacco smoke. A second risk factor is prolonged exposure to occupational chemicals and dusts in the form of fume, irritants and vapors. A third risk factor, although contributing less to COPD, is outdoor air pollution. Other factors that can contribute to the development of COPD are low birth weight and respiratory infections as they may affect lung growth. Genetic risk factors for COPD have also been reported as several genes are implicated in the pathogenesis of COPD.

*Asthma:* Bronchial asthma is a chronic condition involving the respiratory system in which the airways is occasionally constrict, become inflamed and lined with excessive amount of mucus, often in response to one or more triggers. The cause of asthma is not known but what triggers asthma are such things as environmental stimulants like an allergen, tobacco smoke, cold or warm air, moist air, perfume exertion or emotional stress. In children the most common trigger are viral illnesses such as those that cause the common cold.

The airway narrowing causes symptoms such as wheezing, shortness of breath, chest tightness and coughing the airway constriction responds to bronchodilators. Coughing usually happens at night or early in the morning. Between episodes, most patients feel well but can have mild symptoms and they may remain short of breath after exercise for long periods of time than the unaffected individual. The symptoms of asthma which can range from mild to life threatening can usually be controlled with a combination of drugs and environmental changes.

### 3.2 Cancer; diabetes mellitus and sickle cell disease

***Cancers:*** Malignant neoplasms are different types of cancer. Cancer is not one disease but a group of over 100 diseases that have in common the uncontrolled multiplication of abnormal cells. The human body is made up of billions of cells of many types. In a particular cancer there will be a particular type of abnormal cell. Usually cancers start with a localized tumor or swelling consisting of abnormal cells, which increases in size and spreads. Furthermore, tumors can appear away from the original site; these are called metastases.

Most untreated cancers cause death within months or a few years of diagnosis. Treatment is sometimes completely successful (when there are no live cancers cells remaining), sometimes prolongs life by a number of years, sometimes just eases particular symptoms (which may be its purpose), or sometimes turns out to be ineffective in a particular case. There is often a much better chance of successful treatment if treatment is started when a cancer is still small and before it has spread anywhere (no metastases).

In developed countries, smoking causes over 80% of lung cancers and generally, heavy smoking increases the risk by around 30-fold making lung cancer a major problem in developing countries where the consumption of tobacco is flourishing. Breast cancer is assumed to be mainly related to dietary factors which account to up to 80% of the between-country differences in rates. Substantial evidence suggests that stomach cancer risk is increased by high intakes of some traditionally preserved salted food and that risk is decreased by high intakes of fruit and vegetables.

In developing countries, ingestion of contaminated food is an important liver cancer risk factor together with active hepatitis virus infection, whereas, alcohol consumption is the main diet-related risk factor in the world. In developed countries, oral cavity, pharynx and esophagus cancers are mainly correlated to alcohol and tobacco (up to 75% of such cancers are attributable to these two lifestyle factors). Between 80 and 90 % of esophagus, larynx and oral cavity cancers are caused by tobacco and alcohol. In developing countries, an estimated one-third of all cancer deaths was attributable to smoking.

In developing countries, around 60% of esophageal cancers are thought to be a result of micronutrient deficiencies related to a restricted diet that is low in fruit and vegetables and animal products. There is also consistent evidence that consuming drinks and foods at a very high temperature increases the risk for these cancers. Pancreatic, endometrial, prostate and kidney cancers are more common in industrialized countries. However, the fact that overweight/obesity is an established risk factor, their incidence is expected to increase in developing countries engaged in the socio-economic transition. One-third of cancers could be avoided by eating healthily, maintaining normal weight, and exercising throughout life.

Cancers are major contributors of morbidity and mortality in Nigeria and are closely linked to tobacco use, excessive consumption of alcohol, unhealthy diet, obesity, physical inactivity, chronic infections, exposure to radiation, chemical agents and family history. The prevalence of cancer is on the increase. About 100,000 incident cases of cancers are currently reported annually and in earlier estimates it was stated that by the year 2015 the burden would have increased fivefold if nothing is done. The problem is further compounded by the lack of integration of routine screening into the primary health care. Majority of cancers in Nigeria are diagnosed at a very late stage and there are very few centers offering radiotherapy and other oncology services.

Data from the 11 hospital-based cancer registries located in Abuja, Calabar, Enugu, Ile- Ife, Ilorin, Ido-Ekiti, Maiduguri, Nnewi, Port Harcourt, Zaria, Lagos, show that the 5 commonest cancers in Nigeria are as follows:

*In females;*
1. Breast (40%)
2. Uterine cervix (17.9%)
3. Ovary (3.7%)
4. Lymphomas (3.1%)
5. Skin excluding malignant melanomas (2.3%)

*In males;*
1. Prostate (27.2%)
2. Colorectal (7.1%)
3. Lymphomas (6.6%)
4. Liver (4.2%)
5. Skin excluding malignant melanomas 4.2%)

***Diabetes mellitus:*** Diabetes is a chronic (lifelong) disease marked by high levels of glucose in the blood. It is the inability to control the amount of glucose in the blood such that the level can go too high (hyperglycemia). This makes one pass more urine (with glucose in it), thirsty and drowsy. At very high levels of blood glucose one can become unconscious (coma). Diabetes is associated with a hormone called insulin which is produced by the pancreas to control blood glucose. Diabetes can be caused by too little insulin and insulin resistance.

There various types of diabetes, including:
- *Type 1 diabetes:* Type 1 diabetes mellitus is usually diagnosed in early childhood. Most patients are diagnosed when they are less than age of 20. With this disease, the pancreas makes little or no insulin. Daily injections are needed. The exact cause is variable. Genetic, viral infection and autoimmune problem may play a role.
- *Type 2 diabetes:* Type 2 diabetes is far more common than type 1. It makes up most diabetes cases. It usually occurs in adulthood, but young people are increasingly being diagnosed with this disease. In this case, the pancreas does not make sufficient or enough insulin to keep blood glucose levels normal, often because the body does not respond well to insulin.
- *Gestational diabetes:* This is temporary diabetes that first comes only during pregnancy. It increases the risk problems for the foetus, and even if it resolves after pregnancy, it hugely increases the risk of T2 diabetes mellitus in later life. Although our knowledge of its epidemiology is not good, it varies greatly between populations. It is estimated that gestational diabetes affects two to four per cent of all pregnancies and involves an increased risk of developing diabetes for both mother and child. Gestational diabetes means diabetes mellitus (high blood glucose) first found during pregnancy. In most cases, gestational diabetes is managed by diet and exercise and goes away after the baby is born. It is also called glucose intolerance of pregnancy.
- *Pediatric diabetes* is a type of diabetes that is commonly found in children or young adolescents. Young people with high blood glucose levels usually have either type 1 or type 2 diabetes.

Weight loss is an early symptom of diabetes. Since the diabetic cannot draw on previously stored glycogen, the patient must call on the fats stored in the body. Other prominent signs are persistent hunger, thirst, frequent urination, vision problems itching and slow healing of cuts and bruises. Although the afore mentioned signs are immediate consequences of faulty carbohydrate metabolism, the involvement of protein and fat metabolism gives rise to changes in the diabetic's blood vessel, kidney, eyes, nerves and muscles.

Some complications also emerge as by-products of fat metabolism, such as ketones, which when in excess leads to diabetic acidosis that may result in fatal diabetic coma. Also, when there is too much insulin in the body as a result of too much intravenous injection of insulin, it may cause the level of blood sugar to fall below normal level, thereby giving rise to a condition known as hypoglycemia or insulin shock. When this happens, the brain is deprived of an essential energy source.

The rising prevalence of diabetes in the developing countries is attributed to risk factors such as: changes in lifestyle, rapid cultural changes, increased aging populations, urbanization (which result in greater levels of obesity – eating patterns, decreased physical inactivity – changes in modes of work and transport) and other changes in behavioral patterns. For instance, up to 90% of cases of types 2 diabetes, could potentially be avoided through changing lifestyle factors. In developing countries, the prevailing poverty, ignorance, illiteracy and poor health consciousness further adds to the problem. These risk factors must be addressed. Without effective prevention and control programmes, the incidence of diabetes is likely to continue rising globally and at fastest rate in developing countries.

The prevalence of diabetes in Nigeria is estimated at 2.8%. The prevalence is higher in the urban than rural areas (Lagos metropolitan - 7.2%, semi-urban area of Port Harcourt - 6.8% and rural Mangu in Plateau state - 0.65%). According to a recent report, diabetes complications among patients managed in Nigerian Tertiary Hospitals are peripheral neuropathy (59.2%), retinopathy (35.5%), cataracts (25.2%), diabetic foot ulcers (16.0%), cerebrovascular disease (4.7%), and nephropathy (3.2%). This clearly shows that diabetes care in terms of glycaemic control, control to goal of other cardiovascular risk factors, management practices as well as prevention of complications are below standard.

Today, doctors use a variety of treatments to control diabetes. These include;

1. Insulin injection, which is by all means the best treatment for diabetes and is administered by subcutaneous injection
2. Self-treatment of diabetes- since day-to-day treatment of diabetes cannot be left solely in the hands of doctors, victims and their families are educated on all aspects of treatment so that they can administer therapy as at when necessary.
3. Instructions to diabetics to carry sugar or packaged sweet as safe guard to insulin shock or hypoglycemia.
4. Wearing of identification tag to indicate their condition
5. Carrying of card in their wallets which gives detailed information about their medication and the name of their doctor.

6. Oral therapy – Administration of oral hypoglycemic drugs which stimulate the release of insulin from the pancreas and foster insulin activity.
7. Dietary therapy- Individualized diet prescription by a doctor. If the diabetic is thirsty, reduction in calories is prescribed. Non-obese diabetics are advised to eliminate sweets, soft drinks and sugar from their diet.
8. Routine medical checkups are necessary in minimizing diabetic complications and enabling victims to live normal life

***Sickle Cell Disease:*** Sickle Cell Disease (SCD) is an inherited hemoglobin disorder that affects mainly the black population. Nigeria, being the most populous black nation, has the highest burden of SCD. About 150,000 - 200,000 babies are born each year in Nigeria with SCD and more than half of them die before their fifth birthday, 90% before attaining adulthood if poorly managed in childhood.

Approximately 24% of Nigerians have the sickle cell trait (SCT) and can pass the gene to their off-springs. It is estimated that where prevalence of SCT is above 20%, SCD can be as high as 2%. This implies that over 3.4 million Nigerians currently have SCD. In addition, SCD patients experience different degrees of stigmatization and discrimination in the society.

The disease is genetically determined and the offspring of two parents who carry the trait have a 25% chance of being born with the disease. Sickle-cell hemoglobin is peculiarly sensitive to lowered oxygen supply such as occurs when climbing a high mountain, taking an automobile trip through a high mountain pass or when suffering from pneumonia.

Symptom include sudden severe abdominal pain followed by the appearance of dark colored urine. There may also be sever leg cramps, acute pain in the left side and yellowish discoloration of the eye (jaundice). The chronic anemia is accompanied by severe pain, and the blockage of circulation because of clotting which eventually involves the heart, lungs and kidneys.

Genetic counselling program is necessary, especially for intending marriage partners. If both are carriers, they should be discouraged, since the chances of their offspring having the disease is one in-four.

### 3.3 Mental, violence and oral health disorders

***Mental, neurological and substance use disorders:*** Although mental health conditions are not considered one of the four main non-communicable diseases (NCDs), they represent an important part of the shift from communicable diseases to NCDs as well as the shift from premature death to longer lives lived with a disability. Mental health disorders are also closely linked to key NCD-risk behaviors such as alcohol use, and can also affect adherence to medication for chronic diseases (potentially leading to serious consequences for health and survival). Population growth and aging have driven a 38 percent increase in the worldwide burden of mental health and substance use disorders between 1990 and 2010. These conditions represent the leading cause of years lived with a disability, well above the burden imposed by HIV/AIDS or infectious diseases. Mental health conditions pose an

increasing burden in Africa and represent an area where working with young people can make a big difference. Many mental health conditions emerge during adolescence and can trap people in a cycle of poor educational
and professional achievement, limiting their productivity and wage-earning potential.

Mental, neurological and substance use disorders (MNS) together contribute 25% to years of potential life lost due to premature mortality and the years of productive life lost due to disability (DALYs) in Nigeria. Mental health has a major impact on quality of life as well as social and economic viability of families, communities and the nation. A community study in Nigeria estimates around 1 in 5 persons would experience a significant mental health problem in their lifetime requiring long-term commitment to treatment. The proportion receiving any treatment, orthodox or otherwise, within the previous 12 months is about 10%. As a result of the high prevalence, relatively low mortality rate, low identification rate and poor utilization of treatment, the MNS disorders are the largest single group, among NCDs contributing to disability.

Psychotic disorders, the most easily identifiable form of mental illness which include the schizophrenias, manic illness and organic psychosis, affect about 1% of the general population. Depression, anxieties and somatoform disorders are far more prevalent. At least 10% of the population will be suffering from those poorly identifiable disorders. These conditions run a chronic course and are responsible for more morbidity. There is evidence that depression is particularly common among Nigerian elderly, with over 7% reporting major depressive disorder in a 12-month period and over 25% reporting same in the course of a lifetime.

In Africa, as in most low- to middle-income regions, mental health policies and interventions receive low priority and limited resources. Stigma also hampers progress. In a survey of 45 African countries, fewer than one-half reported having a dedicated mental health policy and only one-quarter reported having manuals available for the management and treatment of mental health disorders in the majority of primary health-care settings. Mental health services for young people, however, can play a key role in reducing the burden of mental health disorders and help curb the rise of NCDs.

***Road Traffic Injuries and Violence:*** Not all risks to health come from disease. Many of the biggest threats to people come from unintentional injuries and violence. For example, road traffic injuries are the leading cause of death among young people ages 15 to 29, and 80 percent of these deaths occur in middle-income countries. Pedestrians and cyclists account for over a third of road traffic deaths in low- and middle-income countries, but less than 35 percent have policies that protect them. Annual reports of the Federal Road Safety Corps (FRSC) from 2008 to 2011, showed a total of 6,661, 5,693, 4,065, 4,372 deaths and 27,980, 27,270, 18,095, 17,464 injuries respectively. There is an observed reduction over the 4 years' period probably as a result of the awareness campaign by the FRSC and FMOH.

Intentional injuries resulting from violence are another public health problem that account for a high loss of life and disability among young people in the region. Data from the Nigeria Police showed that the prevalence of interpersonal violence is 31%,

intimate partner violence - 18%, sexual violence - 7%, domestic violence - 28%, female genital mutilation - 29.7%, emotional violence (spousal) - 18%.

Youthful years may bring generally good health, but also bring risks to life and well-being. Excessive alcohol consumption is a key link associated with NCD risks as well as road traffic injuries and violence. To mitigate risk, policies and communities can play a role by providing safer roads and neighborhoods, preventing driving under the influence of alcohol, and supporting interventions for domestic violence.

***Oral health disorders:***The oral cavity is the entrance to the digestive tract and the respiratory system. In addition to the teeth, the other structures that aid chewing of food are the lips, cheek muscles, tongue, the roof of the mouth (hard palate), the soft palate and the uvula. The tonsils are small organs in the throat, containing white blood cells, which help to prevent infection entering the body through the mouth.

Oral hygiene is the practice of keeping the oral cavity(lips, tongue, teeth, throat and surrounding structures, clean and healthy to prevent tooth decay and gum disease. A healthy oral cavity has smooth, unbroken lips without any sores. The teeth are not broken or cracked; they are clean and without signs of decay. The tongue and gums are clean and pink, without any greyish coating, bleeding, sores or swelling. The saliva that keeps the mouth moist should be a clear fluid, not thick or colored white or greenish, which is a sign of infection. The breath emerging from the mouth should be without any smell.

*Mouth infections:* Neglecting dental and oral hygiene, eating a high-fat high-sugar diet, smoking or chewing tobacco, and excessive alcohol consumption are the main causes of mouth, tooth and gum diseases. In an unhealthy person, the tongue is often coated with a whitish or yellowish deposit that has a fur-like appearance. This may be caused by bacteria, viruses or a fungal infection (‘thrush’) growing on the tongue, which may be due to inadequate oral hygiene. Up to 50% of people who are HIV-positive have fungal, bacterial or viral infections in the mouth, which often occur early in the course of HIV infection. Mouth infections such as thrush are very common as the person approaches closer to death.

Mouth infections may be treated by good oral hygiene and by salt water mouth washes. Dissolve a large spoonful of salt in a cup of water which has been boiled and then allowed to cool. The patient should take a mouthful of the salt solution and hold it in his or her mouth for at least two minutes, using their tongue to move the solution around all parts of the mouth. Spit out the solution and repeat one or two more times. This should be carried out two or three times per day until the mouth remains clean

*Tooth decay:* Bacteria constantly multiply in food particles in the mouth, particularly on the teeth and trapped between the teeth. When bacteria build up, they form a sticky, colorless substance called plaque, which is the main cause of tooth decay and gum disease. Bacteria produce acids that destroy tooth enamel, enabling the bacteria to penetrate into the internal structure of the tooth and cause decay. When plaque is not removed by brushing, it hardens into tartar (or *calculus*), which is very difficult to

remove. The growing layer of tartar pushes the gums away from the tooth and in time it may become loose and fall out.

Certain foods contribute to plaque formation. For example, a diet high in sugar and starch will eventually result in tooth decay. Today, in most parts of Nigeria, sugar appears to play a key role in the increasing rates of tooth decay. Sugar cane, soft drinks, biscuits, candy, other sweets and refined sugars are readily available in every corner of the country, and the use of sugar as a sweetener in tea and coffee is now universal in both urban and rural Nigeria. This has a negative impact on the dental health of the population. Using tobacco also increases the risk of developing gum disease. Smoking and chewing tobacco contribute to plaque and tartar build up, as well as causing oral cancer.

*Fluorosis:* Fluoride is a substance found in nature that strengthens teeth and helps prevent tooth decay. Most water systems naturally contain some fluoride, but the amounts must be 'just right' to promote oral health. Not getting enough fluoride in the diet or water supply increases the risk of tooth decay. Some communities in Nigeria may have water supplies low in fluoride, so they are prone to faster rates of tooth decay than elsewhere. However, very high concentrations of fluoride are even more damaging to the teeth. Water sources high fluoride levels, cause dental fluorosis (yellowish discoloration of the teeth. A high intake of fluoride during childhood, especially in the first six to seven years of life, leads to severe fluorisis later in life. This is associated with cracking and 'pitting' (tiny holes in the surface) of the teeth, which create cavities for bacteria to grow and cause tooth decay. The teeth become very weak and can easily break.

*Eroded or broken teeth:* Cracked or broken teeth can be caused by personal habits such as biting pens or chewing hard items likehard grains and nuts. Using the teeth as a heavy duty tool (e.g. for wire cutting or opening bottles) can damage the enamel and crack or break the tooth. This makes tooth decay more likely to occur.

*Oral cancer:*Oral cancer in the mouth is a less common cause of disability and death, which is often neglected because the signs and symptoms are not recognized, or are thought to be due to infection in the mouth. The signs are white and red patches inside the mouth or lips swelling, blisters and ulcers, difficulty in swallowing, ear pain, loose teeth, and bleeding from the mouth. Two known causes of oral cancer are tobacco and alcohol. Eighty to 90% of oral cancers come from smoking cigarettes, cigars or pipes, chewing tobacco. The longer a person has uses tobacco, the higher is their risk of developing cancers, including oral cancer, as well as lung and other cancers. People who use a pipe for smoking tobacco are especially prone to cancer of the lip. Strong alcoholic drinks ('spirits' like whisky and brandy) are damaging to the delicate membranes in the mouth, and prolonged use over several years increases the risk of developing oral cancers.

*Cleft lip and cleft palate:*Birth defects such as cleft lip and palate are conditions that occur in around one per 500 to 700 of all births, but the rate varies substantially between different ethnic groups and in different countries. The clefts can be repaired surgically, but many affected children in poor communities are left without surgery. A

cleft lip may result in the child being stigmatized and rejected as it grows up. A cleft palate can allow infection to get into the brain through the gap in the roof of the mouth; this rapidly leads to death unless urgent medical attention is received.

The World Health Organization (WHO) estimates that 60–90% of school children worldwide have dental cavities, and severe gum disease is found in 5–20% of middle-aged adults. These figures are probably much higher for Nigeria and other sub-Saharan countries. With the exception of birth defects (which have a genetic basis), all oral conditions share common risk factors with the four leading chronic diseases – cardiovascular diseases, diabetes mellitus, cancers, and chronic obstructive pulmonary disease (COPD). They include unhealthy diet, tobacco use and excessive use of alcohol. Poor oral hygiene is also a risk factor for oral diseases. Intervention against oral diseases and non-communicable diseases must therefore be integrated. In addition, oral health problems are more severe among people with diabetes, and HIV infected people often have oral lesions that affect their quality of life because of dry mouth, impaired and sugar-rich dietary habits, and poor nutrition. Prevention of oral cancer should be incorporated into national cancer programmes and include early detection and referral for specialist care.

**Efforts to reduce the burden of NCDs**

Concerted efforts have been made by the Federal Ministry of Health since 1988 to reduce the burden of NCDs in Nigeria. The Non-Communicable Disease Control Programme, now a Division, was established in 1989 with the mandate to serve as the arrowhead of the response to NCDs in Nigeria. This was followed shortly by the establishment of an expert committee on NCDs to guide and advise the government on the implementation of policies and programmes for the prevention and control of NCDs. In addition, a national survey on NCDs was carried out in 1990-1992 to determine the prevalence of major NCDs in Nigeria, their risk factors and health determinants. Documents for health professionals on management of NCDs and health education materials were also developed. Attempts to integrate NCDs into the Primary Health Care (PHC) have also been made but with minimal success. The annual commemoration of NCDs related Global Days with a wide range of activities such as press briefing, awareness campaign rallies, sensitization workshops/seminars for the general public, school children etc. have contributed greatly to awareness creation on NCDs and their risk factors among the general public.

Following the political declaration of the high level meeting of the 66th UN General Assembly on Prevention and Control of NCDs in September 2011, more steps have so far been taken to add impetus to the already existing efforts for the prevention and control of NCDs in Nigeria. These include:

- Approval for the establishment of a national task force on NCDs prevention and control to replace the existing expert committee on NCDs which was established in 1989. The membership of the task force, unlike the expert committee, will not only comprise of experts on NCDs but stakeholders from other sectors.
- Flagging off of the National Stroke Prevention Programme in October 2013 by the former President of Nigeria. The programme is aimed at encouraging

Nigerians to live healthy and to regularly carry out medical check-ups in order to reduce the risk of having stroke.

- Intensified efforts to effectively control tobacco in Nigeria in line with the WHO FCTC by the Federal Ministry of Health and stakeholders. This culminated into signing of the National Tobacco Control Bill into law on 26th May, 2015 by the former President. Prior to this, the Global Adult Tobacco Survey (GATS) was successfully conducted in Nigeria in 2012 and the report was released in 2013. This made Nigeria the first country in sub-Sahara Africa to successfully conduct GATS.
- Development of the National Nutrition Guideline on Prevention and Control of NCDs and the National Guideline for the Control and Management of SCD which were subsequently approved by the 56th National Council on Health (the highest decision making body on health related matters in Nigeria) in August 2013.
- Domestication of WHO Mental Health Gap Action Programme (mhGAP) and finalization of Mental Health Policy and Legislation.
- Establishment of six (6) Sickle Cell Disease centers in Federal Medical Centers in the 6 geopolitical zones in the country between 2011 and 2012.

## 4.0 CONCLUSION

In this unit on NCDs and non-disease chronic conditions in Nigeria, you were informed that the relevant stakeholders involved in the prevention and control of non-communicable diseases in Nigeria include Ministries of Transport, Urban Planning, Finance, Agriculture, Information Education, National Sports Commission as well as the civil society organizations. Cardiovascular diseases include coronary or ischaemic heart disease (heart attacks), cerebrovascular disease (stroke), raised blood pressure (hypertension), peripheral artery disease, rheumatic heart disease, congenital heart disease, and heart failure. However, hypertension is the commonest of the diseases affecting the heart and blood vessels. Asthma and diabetes prevalence have also gained public health significance in the country.

Neglecting dental and oral hygiene, eating a high-fat high-sugar diet, smoking or chewing tobacco, and excessive alcohol consumption are the main causes of mouth, tooth and gum diseases. Interventions against oral diseases be integrated with non-communicable diseases such diabetes, and HIV infection because often sufferer have oral lesions that affect their quality of life because of dry mouth, impaired and sugar-rich dietary habits, and poor nutrition.

Concerted efforts have been made by the Nigerian government to reduce the burden of NCDs in Nigeria. A key effort in this direction was the creation of the Non-Communicable Disease Control Programme, now a Division, was established, with the mandate to serve as the arrowhead of the response to NCDs in Nigeria. The Nigerian government has also taken steps add impetus to the already existing efforts for the prevention and control of NCDs in the country in line with the political declaration of the high level meeting of the UN General Assembly on Prevention and Control of NCD.

## 5.0 SUMMARY

Heart attack, stroke and hypertension are the commonest cardiovascular diseases in Nigeria. Heart attacks and stroke are caused mainly by a blockage that prevents blood from flowing to the heart or brain, with the most common cause is a buildup of fatty deposits on the inner wall of the blood vessels that that supply the heart or brain. Hypertension on the other hand is a condition in which a person's blood pressure is higher than it should normally be when all variables including age and health condition are taken into account.

Chronic respiratory diseases such as bronchial asthma, chronic bronchitis, emphysema, chronic occupational lung diseases affecting both children and adults are common in Nigeria. However, the two major chronic respiratory diseases are chronic obstructive pulmonary disease (COPD) and asthma.Bronchial asthma is a chronic condition involving the respiratory system in which the airways is occasionally constrict, become inflamed and lined with excessive amount of mucus, often in response to one or more triggers.

Cancer is a group of over diseases that have in common the uncontrolled multiplication of abnormal cells are also prevalent cancers in Nigeria, with the commonest types being breast, uterine cervix, ovary, lymphomas and skin excluding malignant melanomas among females, and prostate, colorectal, lymphomas, liver and skin excluding malignant melanomas among males.

Diabetes, another important NCD in Nigeria is a chronic disease marked by high levels of glucose in the blood and associated with a hormone called insulin which is produced by the pancreas to control blood glucose. The rising prevalence of diabetes in the country is attributed to changes in lifestyle, rapid cultural changes, increased aging populations, urbanization, which result in greater levels of obesity, decreased physical inactivity and other changes in behavioral patterns.

Good oral hygiene, which is the practice of keeping the lips, tongue, teeth, throat and surrounding structures, clean and healthy is important since neglecting dental and oral hygiene, eating a high-fat high-sugar diet, smoking or chewing tobacco, and excessive alcohol consumption are the main causes of mouth, tooth and gum diseases.

## 6.0 TUTOR-MARKED ASSIGNMENT

1. What are the causes and symptoms of heart attack?
2. Discuss the various types of diabetes
3. List the major risk factors of oral health disorders and how they are linked to the major NCDs

## 7.0 REFERENCES/FURTHER READING

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