Fig 5: Showing make shift housing in a flooded area of Yenagoa. The scenario may facilitate the transmission of infectious/communicable diseases within the neighborhood.

Figure 6: Meat being shared on a slaughter slab in an abattoir in Oji River, Enugu State. Butcher are seen dancing the meet with or without foot wear. This may lead to contamination of the meet making it unacceptable for human consumption.

Fig 7: Showing improperly and insanitary slaughter slab in Oji River, Enugu State.
Figures 8. Immediate sides of a slaughter slab showing drainage and the overall sanitary condition of the slab. The situation is about the same in all our abattoirs in most cities in Nigeria.

Figure 9. Showing heap of animal dung accumulated over a long period. This can predispose to infections.
Figure 10: Shows the use of old tyres in processing meat parts (the skin and head of the cattle). This condition may predispose the consumer of such meat to dioxins and other toxic chemicals from used tyres. (Source: Amadi and Abonyi from Oji River, Enugu State, Nigeria 5/6/2010).

Figure 11. Showing littered faeces in cellophanes near a VIP Latrine in a public school in an urban area (Source: Amadi and Abonyi, 2010).
1. WEB OF CAUSATION
This model of disease believes in the assumption that all predisposing factors and their complex interactions combine to cause disease in man. It was developed by MacMalon and Pugh for the study of chronic diseases where the etiologic agents (causes) which are usually multiple factors are not known. In effect the web of causation does not really mean that disease cannot be controlled unless the chains of events or various factors leading to the disease are checked or eliminated. Sometimes, removal of only one link could break the chain of disease, if that link is playing a significant role in the transmission process. But in a disease situation involving multiple factors, each is considered important to the overall effect. Thus, the relative importance of these factors may be expressed as relative risk (Park 2007).

A simple illustration of the web of causation can be seen below

![Diagram of Web of Causation for Myocardial Infarction](image)

*Fig 16: Web of Causation of Myocardial Infarction*

*Source: Park (2007)*
CRITERIA FOR ASSESSING CAUSAL RELATIONSHIPS IN DISEASE TRANSMISSION

It is generally well known that epidemiological studies are rarely done in the laboratory. Thus, results often become difficult to interpret because of the uncontrollable variations in the cases. To overcome these challenges, the criteria developed by Robert Koch and Bradford Hill were adopted for assessing the strength of the relationship between the disease agent and the disease. Unfortunately, Koch's postulates or criteria first developed for the determination of causal associations between pathogen and disease only works for highly infectious bacteria/toxins. They are no longer applicable in modern epidemiological studies. Bradford Hill criteria are the current standards for assessing epidemiological relationships, due to their proven success and additional values in measurement and evaluation of scientific theories and public health concepts, including the social sciences. It comprises of nine (9) items:

i. Temporal relationship
ii. Strength
iii. Dose-responses relationship
iv. Consistently
v. Plausibility
vi. Consideration of alternative explanations
vii. Experiment
viii. Specificity
ix. Coherence

1. Temporal Relationship: Exposure always precedes the outcome or effect (occurrence of disease).
2. Strength: A small association does not mean that there is no causal effect. The stronger the association means the more likely the causal effect, i.e., disease occurrence.
3. Dose-Response Relationship: The greater the exposure, the greater effect or risk of disease occurrence. However, the mere presence of the factor can trigger the effect. (disease incidence). In other cases, an inverse proportion is observed in which greater exposure leads to lower incidence or risk.
4. Consistency: Consistent findings observed by different persons in different places with different samples indicate the strength of
the likelihood of an effect (disease occurrence).

5. **Plausibility.** A plausible mechanism between cause and effect is helpful, but this may be limited by current knowledge. A theoretical basis is necessary for establishing an association between exposure and outcome or disease occurrence e.g. vector and disease.

6. **Consideration of Alternative Explanations (Analogy).** The effect of similar factors may be considered. In other words, it is always necessary to take into account multiple hypotheses before concluding that a causal relationship exist between any two items under investigation.

7. **Experiment.** The condition can be altered (prevented or minimised) by an appropriate experimental require.

8. **Specificity.** Causation is likely in a specific population at a specific site and disease with no other likely explanation. This implies that the more specific an association between a factor and an effect is, the bigger or more the probability of a causal relationship.

9. **Coherence.** Coherence between epidemiological and laboratory findings increases the likelihood of an effect. The association should be compatible with existing theory and knowledge. Nevertheless, lack of such laboratory knowledge cannot nullify the epidemiological effect on associations.

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**TIME RELATIONSHIP IN DISEASE CAUSATION**

Disease is caused by the complex interaction between the agent, host (man) and environment. The knowledge of the time in which development of disease and transmission processes are completed is important for prompt prevention and control. Also, it shows the different stages in the natural history of disease.

1) **Natural History of Disease**

   The natural history of disease refers to the chain of events that result in disease occurrence in man. It is an epidemiologic concept defined as the progression of a disease process (illness) in an individual over a period of time in the absence of treatment or prevention (Park 2006).

   Each disease has its own natural history of disease which
comprises three specific stages:

i. Time of exposure before the onset of disease (illness)

ii. Time of sub clinical disease or Diagnosis (Incubation period).

iii. Time of clinical disease or incidence.

ii) TIME OF EXPOSURE BEFORE ONSET OF DISEASE
This period marks the beginning of disease transmission when the individual is exposed to etiologic agent(s) or accumulation of the factors causing the disease. In communicable disease transmission, the exposure or causative factor (agent) is the microorganism. For non-communicable diseases, the factor that initiates the process may be toxic chemicals (e.g., asbestos in cancer) or one which acts as catalyst to promote the disease process such as estrogen.

ii) TIME OF SUBCLINICAL DISEASE OR DIAGNOSIS (INCUBATION PERIOD)
The time of subclinical disease is the interval between exposure of the individual to the etiologic agent(s) and appearance of clinical signs and symptoms of disease. During the period, early pathological changes occur in the body, but the individual may not know. In diseases classified as communicable or infectious, this stage of subclinical disease is called "incubation period" and "latency period" for non-communicable diseases. Although the individual at this time does not perceive or experience the symptoms of disease, except by laboratory screening, or testing, diagnosis can be done since early prevention and intervention work better. Thus, this time of subclinical disease is also termed "time of diagnosis". In some diseases the period lasts for a few seconds, as in hypersensitivity or toxic reaction. But for chronic diseases, it may be years (e.g., hepatitis).

iii) TIME OF CLINICAL DISEASE OR INCIDENCE
The clinical stage is the period when the individual develops the signs and symptoms of disease. In most individuals, the manifestation of symptoms may not progress to apparent illness following invasion by the etiologic agent. However, the process results in illness, ranging from mild to
severe (fatal) illness and finally terminating in recovery, disability or death. The range of progressive development of disease process is known as the spectrum of disease. The entire cycle of events is shown in the simplified diagram below.

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Pathological changes</th>
<th>Onset of symptoms</th>
<th>Unusual time of diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage of susceptibility</td>
<td>Stage of clinical disease</td>
<td>Stage of recovery, disability or death</td>
<td></td>
</tr>
</tbody>
</table>

Fig 17: Natural history of disease time  
*Source: U.S Department of Health and Human Services, 2006.*

1. **MODES OF DISEASE TRANSMISSION**

Communicable diseases are spread from a reservoir to a susceptible host in different ways and these occur directly or indirectly.

1. **DIRECT TRANSMISSION:**

Direct transmission occurs when an infectious agent passes from the reservoir or source to a susceptible host without intervention by another agent. Close contact is a necessary factor for transmission to succeed.

**Types of Direct Transmission:**

i. Direct contact

ii. Droplet infection (spray/aerosol)

iii. Contact with soil

iv. Animal bite

v. Through placenta.

i) **Direct Contact:**

This is the transfer of an infectious agent from the reservoir or source to susceptible host through direct body contact without an intervening agent. Common examples of direct contact...
transmission of diseases occur in STDs and AIDS by sexual intercourse, scabies and pediculosis (lice borne infections) by skin contact.

ii) **Droplet Infection:**
Direct transmission by droplet infection involves the transfer of infectious agent (infection) to a susceptible host through droplet spray or aerosols of saliva from the mouth or nasal secretions from the nostrils directly during coughing, sneezing or talking. The droplet spray or aerosols are transmitted within close range because of size of the particles about 5 microns. Diseases such as meningitis, TB, diphtheria, whooping cough (pertussis) etc. are transmitted by droplet spray.

iii) **Contact with soil:**
Direct contact with contaminated soil is an important route by which disease or infectious agents can get to a susceptible host e.g. tetanus, hookworm, mycosis etc.

iv) **Through placenta:**
This is mother to child transmission in which disease passes through blood circulation and via the placenta to the unborn child (foetus) in the womb. It is very common with syphilis, AIDS, German measles, hepatitis B infections etc.

v) **Animal bite:**
Direct transmission also occurs when a susceptible host is bitten by animals which are the reservoir (source) of infection as in the case of rabies by dog, fox or jackal, rat bite by rats or rickettsial pox by mice etc.

1. **INDIRECT TRANSMISSION:**
Unlike direct transmission, diseases are also transmitted indirectly. This involves the transfer of an infectious agent from the reservoir/source to a susceptible host through an intervening agent. It requires that the infectious agent must be able to survive until it arrives the host body.

**Types of indirect transmission**

i. Vehicles

ii. Vectors

iii. Air

iv. Formites
v. Hand/Fingers

I) Vehicles:
Inanimate materials or substances can help convey diseases (infectious agents) from the reservoir to the susceptible host, e.g. water, food, milk, milk products, blood, serum, plasma, and other biological materials. Of these, water and food are the most important vehicles for the spread of both communicable and non-communicable diseases, such as cholera, typhoid, dysentery, various intestinal parasites, including chemical toxicants.

ii) Vectors:
In epidemiology, vector refers to an arthropod or other living organism which carries an infectious agent to a susceptible host. There are two classes of vectors: Invertebrate and vertebrate vectors. Invertebrate vectors are mainly arthropods (e.g. housefly, mosquito, blackfly, sandfly, tsetsefly etc.), Cyclops, snail, flea, ticks, mites etc. Vertebrate vectors include rats and mice, dog, fox, bat, fish etc.

Types of Vector Transmission
- Mechanical transmission
- Biological transmission

In mechanical transmission, the pathogen is conveyed on the hair or legs, or mouth parts, or other parts of the body of the vector and deposited on food. This is the method by which the housefly transmits diseases, such as cholera, typhoid, dysentery, diarrhoea from human faeces to man.

Biological transmission usually entails development of the pathogen (infectious agent) in the body of the vector before transmission to a susceptible host. In some cases, the pathogen undergoes asexual development during its larval stage in the vector, while others allow complete development to full maturity. Thus, vectors act as intermediate host, as well as definitive host or reservoir host e.g. mosquito in malaria transmission (Mutha 2010, and CDC 2009).
iii) **By Air:**
Disease transmission through the air may occur in two specific ways:
- Droplet nuclei and
- Dust

**Droplet Nuclei:**
Droplet nuclei are tiny particles of less than 2 microns in size formed from sputum or saliva and secretions from the nose which dry off and remain suspended in air for long periods. In this state, they can be carried by air currents to other places. In crowded and poorly ventilated environment where people are in close contact, disease can spread fast by droplet nuclei e.g. tuberculosis, chicken pox, influenza, measles, and a host of other respiratory infections.

**Dust:**
Larger droplets up to 5 microns in size easily fall to the ground when released during coughing, sneezing or talking and get mixed with dust. During sweeping, and cleaning operations, these droplet containing the pathogens may be inhaled by susceptible individuals or settle on food consumed by man. Hospital acquired infections (nosocomial) and transmitted in this way. Dust borne diseases include tuberculosis streptococcal infections etc. (Muthu 2010).

iv) **Formites:**
Inanimate objects other than food, water or milk also provide suitable means for disease transmission. These include soiled clothes, handkerchiefs, towels, cups, spoons, knives, toys, door handles, cups, syringes/needles. Common examples of diseases spread through such articles are typhoid, dysentery, eye and skin infections.

v) **Hands and fingers:**
Hands and fingers act as vehicles of disease transmission when they are dirty or contaminated with infectious agents, due to lack of personal hygiene. (hand washing and cleaning) after using the toilet, handshake or touching dirty objects. Faeco-oral infections
(from excreta) e.g. diarrhoea, typhoid, cholera, dysentery, hepatitis, intestinal parasite, food poisoning etc. and various respiratory infections can be transmitted through dirty fingers. (Muthu 2010, Sanders, Adarsh and Panek 2009, Lucas & Gills 2003; Salvato 2002, CDC 2009, Park 2007)

2. CYCLICITY OF DISEASE OCCurrence
(Seccular vs Seasonality)
Cyclical patterns of disease prevalence or transmission is a common phenomenon in nature, but the causes are often not well known. Many diseases may be affected by cyclical and seasonal changes due to environmental factors, as well as host susceptibility. These include measles, malaria, meningitis, upper respiratory infections etc. including non infectious diseases.

A study conducted by Lass and Ebert (2003) of the Royal Society, Biological Science, Switzerland suggests the effect of seasonal / environmental changes on cyclic prevalence pattern of transmission of diseases. Findings from various studies in different countries over a four year period demonstrated regular increase in prevalence patterns during summer and a decrease in winter when the host was in diapause (dormant). Further experiments revealed that environmental factors influenced diapause in magna host transmitting the *Microsporidium*, *Octopousa bayeri* (parasite).

However, apart from environmental changes seasonal fluctuations in disease prevalence are also traced to a number of other factors such as:
- Actual increase or decrease in disease frequency
- Changes in sensitivity and or specificity of the surveillance systems
- Emergence or introduction of new disease agents (pathogens) in an area.
- Decline in efficacy of control measures
- Environmental changes due to climatic factors etc.
- Poor data collection, organization and reporting
- Societal dynamics and changes in public perception etc. (CDC 1998).
Types of cyclical changes in disease prevalence patterns

Two forms of fluctuations in disease prevalence patterns are well recognized are:

1. Periodic fluctuation
2. Long term fluctuations or secular trends

1) PERIODIC FLUCTUATIONS

Periodic fluctuations comprise:
a. Seasonal trends and
b. Cyclic trends

a. Seasonal fluctuations in disease prevalence patterns.
Most communicable diseases affected by seasonal changes are usually caused by environmental conditions such as temperature, humidity and rainfall. For example, measles, malaria, meningoccocal meningitis, upper respiratory infections etc; respond positively to seasonal trends.

b. Cyclic fluctuations in disease prevalence patterns.
The transmission of most diseases occur in circles over a short period of time which may be days, weeks, months or a few years. Measles is a typical example. It occurs in circles with peaks in every 2 to 3 years. Also, non infectious diseases show similar periodic fluctuations as in accidents which often have high rates of occurrence during festive periods e.g Xmas (Park 2007).

2) LONG TERM FLUCTUATIONS IN DISEASE PREVALENCE OR SECULAR TRENDS

The term secular trends means progressive increase or disease changes in disease occurrence over long periods, say several years or decades.

Secular trends or long term fluctuation in disease prevalence are usually constant in a particular direction or follow a definite pattern in one direction. For example, diabetes, lung cancer, coronary heart disease follow an up and down trend, while typhoid, polio, T.B, diphtheria etc, show a down ward /up trend (CDC 1998).The knowledge of cyclicity of disease is essential for futuristic planning of prevention and control programs (Park 2007).
3. TIME INCIDENCE FUNCTION OF DISEASE

Monitoring time trends is very important, especially when investigating disease outbreak. **Epidemic period** is an example and it is defined as the time when the number of cases of a disease increases more than the expected number.

Time period is usually measured in hours, days, weeks or months. A special graph or histogram is used to plot cases according to the time of onset of symptoms. This is called the **“epidemic curve”** it shows the trends or patterns of prevalence of disease according to time of onset of the disease following exposure. The epidemic curve is made up of the following features:

- X-axis equal time interval
- The time interval which is hours, days, weeks and months corresponds with the disease.
- The Y-axis is the number of cases
- Each case is represented by one square and all squares are equal in size.
- There are no spaces between the columns
- There may or may not be longitudinal lines between the squares.

A frequency polygon may be used to produce the epidemic curve instead of histogram (CDC 1998).

**ENDEMIC COMMUNICABLE DISEASES IN NIGERIA**

The following diseases/conditions are directly related to Environmental Health and Sanitation: Malaria, Gastroenteritis Diarrhea, Salmonellosis and Typhoid fever, Anthrax, Ascariasis - Roundworm Infection, Botulism, Brucellosis, Cholera Food Poisoning e.g. *Bacillus Cereus, Clostridium perfringens, E. coli*, Staphylococcosis, Hepatitis A., Hepatitis E., Listeriosis, Measles Poliomyelitis, , Rabies Scabies, Schistosomiasis - Bilharzia, Shigellosis - Dysentery, Taeniasis - Beef Tapeworm, Taeniasis - Pork Tapeworm, Toxoplasmosis, Trichinellois, Yellow Fever, etc.

**MALARIA:**

Although malaria is not prevalent in the Cape Town area, some cases
have been reported by people who have returned from endemic regions. Malaria is prevalent mostly in the northern regions of South Africa. Malaria is a preventable infection that can be fatal if left untreated. The most serious of human malarias is the *P. falciparum* malaria because of its lytic preference for both adult and foetal haemoglobin. Symptoms include fever, chills, sweats, increased temperature, headache, and may include shock, renal and liver failure, and eventually coma if not treated in time. Once a person has had malaria, relapses may occur from time to time.

Transmission of plasmodiasis is by the bite of an infective haematophagous female *Anopheles* mosquito notably *A. gambiae* in Nigeria. Most mosquitoes feed at dusk and during early night hours. When a female *Anopheles* mosquito ingests blood from an infected person, that contains the sexual stages (macro and micro gametocytes) of the *Plasmodium*, the male and female gametocytes unite in the mosquito’s stomach to form an oocyst in which thousands of spores (sporozoites) develop. These infective sporozoites migrate to the salivary glands of the mosquito and are, in turn, injected into the next victim as the insect takes a blood meal for survival. Roughly 12 days after the infectious bite, the symptoms begin, depending on several factors such as age, immune status, species of parasite, level of environmental condition, etc. As long as you have malaria and an *Anopheles* mosquito bites you, the infection can be spread to other susceptible hosts.

**Prevention**

i. Avoid endemic malaria areas if possible.

ii. Regular use of prophylaxes (using sulphurdioxide and pyremethamine) and chemotherapy mostly the current treatment modality of combined arthesamine camoquin therapy (CAT).

iii. Destroy mosquito breeding grounds by reducing the amount of stagnant water, by filling in and draining areas of impounded water.

iv. Apply mosquito repellent to exposed skin and spray residual insecticide on the internal wall surfaces of dwellings.

v. • Mosquito screens on doors and windows and mosquito nets over
sleeping areas mostly the insecticide treated bed nets (ITBN).

DIARRHOEA

Gastroenteritis is an acute illness characterized by three or more watery or loose stools, cramps, nausea, urgency, bloating, fever, and malaise, usually lasting 3 to 7 days, sometimes longer. Diarrhea is seldom life-threatening. Outbreaks are common in areas with poor sanitation. Most of the time, diarrhea is self-limiting and requires replacement of fluids and electrolytes (body salts) lost in loose stools. Sufferers should begin treatment by oral rehydration by drinking large amounts of bottled or fruit juices, caffeine-free soft drinks, and sports drinks. Avoid drinking iced or non-carbonated bottled fluids made from water of uncertain quality and dairy products. When in doubt of water purity use boiled or bottled water. Foods easily digested such as rice, bananas, gelatin, dry toast, and salty crackers can also be consumed to aid in rehydration.

Sufferers should always consult a doctor rather than attempt self-medication, if the diarrhea is severe or does not improve within several days, if there is blood and/or mucus in the stool; if fever occurs with shaking chills, or if there is dehydration with persistent diarrhea.

Gastroenteritis is usually contracted through ingestion of food or water contaminated by Bacillus cereus bacteria, or other disease pathogens transmitted through the faecal oral route.

Prevention

i. Sanitary disposal of human faeces.
ii. Good personal hygiene.
iii. Maintenance of fly control.
iv. Regular hand washing.
v. Only drink from safe water supplies that are regularly chlorinated, or alternatively, boiled.
vi. A simple rule of thumb "Boil it, cook it, peel it or forget it."
vii. By not eating cooked foods that have been stored at room temperature for several hours.
SALMONELLOSIS
This is the commonest and most serious cause of bacterial food-borne diseases. The disease is caused by viable cells of *Salmonella enteritidis*, * choleraesuis* or *Serotype typhimurium*. The incubation is from twelve to twenty four hours. Salmonella morbidity may last for one to seven days.
Salmonellosis is a bacterial disease commonly manifested by sudden onset of headache, chills, fever, abdominal pain, diarrhea, enteritis, nausea, watery, greenish, foul-smelling stool, vomiting and dehydration. Dehydration in infants is often severe. Salmonellosis is acquired by the ingestion of the *Salmonella* bacteria in food derived from infected food, animals or contaminated by *faeces* of an infected animal or person. This includes raw (especially cracked) eggs and egg products, raw milk and milk products, meat and meat products and poultry and poultry products. Infections may also be spread by animal feeds and fertilisers prepared from contaminated meat scraps, fish meal and bones. The faecal oral route of transmission from person to person is an important mode of transmission when diarrhea is present (infants pose a greater risk). Usually, a great number of *Salmonella* bacteria need to be ingested before illness develops. Epidemics of *Salmonella* infection can usually be traced back to foods such as commercially processed meat products, inadequately cooked poultry products, raw sausage, lightly cooked foods containing eggs or egg products, unpasteurised milk, or foods contaminated by an infected person. The infection often starts with contaminated food and continues by person-to-person transmission via the hands of food handlers.

Prevention
i. Avoid all cooked foods that have been prepared several hours before serving.

ii. Avoid cooked food that has been stored at room temperature for extended periods of time.

iii. Avoid inadequately cooked foods, especially poultry products.

iv. Strict personal hygiene.
v. Washing of the hands, especially after using the toilet.
vi. Always cook poultry products thoroughly.
vii. Avoid reheating poultry product leftovers.
viii. Avoid unpasteurised milk and milk products.

**TYPHOID FEVER AND PARATYPHOID**

Typhoid Fever is a severe systemic bacterial infection and is characterized by the onset of high and continued fever, headache, malaise, vomiting, diarrhea, bleeding from the body, anorexia, rose spots on the trunk, non-productive cough, constipation more commonly than diarrhea. The infectious agent is *Salmonella typhi*. Its incubation period is about fourteen days. Illness may last for one to eight weeks. The mode of transmission are by vehicle transmission through contaminated milk and water, direct contact through hands that are contaminated and vector by house flies (*Musca domestica*) and others.

Paratyphoid fever is often caused by *Salmonella enteritidis*, serotype Paratyphi A, B, and C. Incubation period is 1 to 15 days. The illness may last for one to three weeks (mode of transmission as in typhoid fever)

Infection is by food or water contaminated by faeces or urine of an infected person or carrier during the food preparation process. Shellfish taken from sewerage contaminated beds and raw fruits, vegetables, milk and milk products contaminated by the hands of infected persons or carriers.

**Prevention**

i. Sanitary disposal of human faeces.
ii. Regular hand-washing.
iii. Only drink from safe water supplies that are regularly chlorinated, or alternatively, boiled.
iv. Wash fruit and vegetables in clean chlorinated water or water that has been boiled.
v. If uncertain of sanitary practices when buying food, then select food that is cooked and hot.
vi. Fly control.
vii. Typhoid vaccine is currently available.
viii. It is important to follow food and water precautions.
ix. Immunization is recommended for all persons living in areas where sanitation is inadequate or under developed.
x. A simple rule of thumb "Boil it, cook it, peel it or forget it".

ASCARIASIS - ROUNDWORM INFECTION

It is an infection of the small intestine by the helminthic worm Ascariis lumbricoides generally associated with few or no symptoms. Live worms, passed in stools or occasionally from the mouth or nose, are often the first recognized sign of infection. Heavy infestation may aggravate nutritional deficiency. Other symptoms include bowel obstruction or obstruction of the bile duct, pancreatic duct or appendix. Ascaris is transmitted by ingestion of infective eggs from soil contaminated with human faeces or uncooked produce contaminated with soil containing infective eggs, but not directly from person to person. Eggs reach the soil in the faeces and then undergo development; at summer temperatures, they become infective after 2 weeks. The ingested eggs hatch in the intestine, with the larvae reaching the lungs via the bloodstream. The larvae will mature and grow in the lungs, and after 9-10 days after infection they pass into the alveoli of the lungs, ascend the trachea, and are swallowed to reach the small intestine, where they grow to full maturity.

Prevention

a. Provide adequate facilities for the proper disposal of faeces and prevent soil contamination in and around areas adjacent to dwellings and, especially, children's play areas.
b. Always wash your hands after using the toilet, before eating and handling food.
c. Health education with particular emphasis on personal hygiene and toilet habits.

BACILLOSIS

A gastrointestinal disorder characterised in some cases by sudden onset of nausea and vomiting and in others by colic and diarrhea. Symptoms
tend to occur 1 - 6 hours after infection. The infectious agent is the *Bacillus cereus* bacterium, an aerobic spore former. The poisoning generally persists for no longer than 24 hours and is rarely fatal.

Transmission is by the ingestion of food that has been kept at room temperature after cooking, allowing multiplication of the bacteria. Fried rice, vegetables and meat dishes mishandled after cooking are often responsible for the poisoning. Commonly found in raw, dried and processed foods.

**Prevention**

i. Avoid cooked food items that have been standing at room temperature for some time.

ii. Serve food dishes as soon as they are cooked, or cool them rapidly until serving time.

iii. Promptly refrigerate leftover foods.

iv. Avoid inadequately cooked foods.

v. Thorough reheating should be performed rapidly to avoid multiplication of bacteria.

**CLOSTRIDIUM PERFRINGENS**

An intestinal disorder characterised by the sudden onset of colic, diarrhea and nausea, but seldom vomiting or fever; generally, it presents as mild disease with short duration. It is caused by the toxins elaborated by *Clostridium perfringens* or *Clostridium welchii* bacteria.

Transmission is through ingestion of food contaminated by soil or faeces that contain *Clostridium perfringens*. Almost all cases are associated with inadequately heated or reheated meats, usually stews, pies or gravies made of beef or chicken. The spores survive normal cooking temperatures, germinate and multiply during slow cooling, storage at ambient temperatures, or inadequate reheating. Often traced back to food catering firms and restaurants, which have inadequate cooking and refrigeration facilities for large-scale service, especially if foods are cooked several hours before serving.

**Prevention**

i. Serve meat dishes as soon as they are cooked, or cool them
rapidly until serving time.

ii. Reheating, if necessary, should be thorough (with an internal temperature of no less than 75 degrees C) and rapid, otherwise avoid reheating leftover foods.

iii. Large cuts of meat should be thoroughly cooked.

iv. Avoid cooked food items that have been standing at room temperature for some time.

v. A simple rule of thumb "Boil it, cook it, peel it or forget it".

ESCHERICIA COLI

The organism can be found on a small number of cattle farms and can live in the intestines of healthy cattle. Meat can become contaminated during slaughter, and organisms can be thoroughly mixed into beef when it is ground. Bacteria present on the cow's udders or on equipment may get into raw milk. Although the bacterium, Escherichia coli, is a normal inhabitant of the intestinal flora of man and animals, many strains are enteropathogenic and give rise to acute diarrhea in infants. E. coli is considered to be responsible for a proportion of incidents described as "travellers' diarrhea". Eating meat, especially ground beef, that has not been cooked sufficiently to kill E. coli, can cause infection. Contaminated meat looks and smells normal. Although the number of organisms required to cause disease is not known, it is suspected to be very small.

The E. coli bacterium and its toxins have been found in the following:-

i. Undercooked or raw beef hamburgers.

ii. Salami.

iii. Lettuce (unwashed).

iv. Unpasteurised milk, apple juice, and apple cider.

v. Contaminated well water.

vi. Unsuspecting swimmers have been infected by accidentally swallowing swimming pool water that has not been chlorinated and contaminated by human faeces. People also can get infected by swimming in sewerage-contaminated water.
Bacteria in diarrheal stools of infected persons can be passed from one person to another if hygiene or hand-washing habits are inadequate. This case is particularly likely among toddlers who are not yet adequately toilet trained. Family members and playmates of these children are at high risk of becoming infected.

**Prevention**

i. Cook beef meat patties thoroughly.
ii. Keep raw meat separate from cooked meat.
iii. Avoid unpasteurised juices.
iv. Drink only pasteurised milk and milk products.
v. Wash fresh fruits and vegetables thoroughly with clean, fresh treated water before eating raw or cooking.
vi. Eat only thoroughly cooked meat and meat products.
vii. Wash hands thoroughly, especially after using the toilet.

**STAPHYLOCOCCOSIS**

Staphylococcal food poisoning is intoxication (not an infection) of abrupt and sometimes violent onset, with severe nausea, cramps, vomiting and diarrhea. The illness does not last longer than a day or two. The onset of symptoms is usually soon after eating contaminated food, between 30 minutes and 4 hours. Infection is caused by the enterotoxins of *Staphylococcus aureus*.

It is transmitted by ingestion of a food product containing *Staphylococcus enterotoxin*. Foods involved are usually those, which are in contact with food handler's hands either without subsequent cooking or with inadequate heating or refrigeration, such as pastries, custards, salad dressings, sandwiches and cold meat. When these food items remain at room temperature for several hours before being eaten, toxin producing *Staphylococci* multiply and elaborate the toxin. The bacteria may be from an infected cut on the hand of a food handler or from their nose or eyes.

**Prevention**

i. Strict food-handling and hygiene.
ii. Strict cleanliness of kitchens.

iii. Strict personal hygiene of food handlers.

iv. A simple rule of thumb "Boil it, cook it, peel it or forget it".

HEPATITIS A

Hepatitis A is a highly contagious viral disease that attacks the liver. Although hepatitis A is found throughout the world, its incidence is highest in developing countries, such as South Africa. Within 3 to 5 weeks after infection, an onset of symptoms that range from mild to severe fever, vomiting, abdominal pain, fatigue, jaundice, and lack of appetite, may occur. All people who have not had hepatitis A infection or vaccination for hepatitis A are at risk of developing the infection. Outbreaks commonly occur in institutions, day care centers, sub-economic housing projects and rural areas, where environmental sanitation is poor or lacking. Infection is common and may occur at an early age.

Hepatitis A is most commonly spread from person to person and through food and water contaminated with the Hepatitis A virus, or by the faecal oral route.

Prevention

i. Good personal hygiene.

ii. Good sanitation hygiene.

iii. Regular and careful hand-washing, especially after going to the toilet.

iv. Prophylactics.

v. Do not allow infected persons to prepare or handle food.

vi. Avoid inadequately cooked foods.

vii. Avoid eating shellfish from sewerage contaminated sea water.

viii. A simple rule of thumb "Boil it, cook it, peel it or forget it".

HEPATITIS E

Hepatitis E is very similar to Hepatitis A, and is clinically
indistinguishable from Hepatitis A. HEV is an viral transmitted disease that can be distinguished from other forms of acute viral hepatitis only by using specific serological testing. This disease is most often seen in young to middle age adults, and pregnant women appear to be exceptionally susceptible to severe symptoms and mortality. Symptoms include malaise, anorexia, abdominal pain and fever.

HEV is usually associated with fecal contaminated drinking water. The potential for HEV transmission from contaminated food is still under investigation, and there is no evidence of transmission by sexual exposure. There is no vaccine to prevent HEV.

Prevention
i. Good sanitation practices.
ii. Good personal hygiene practices.
iii. The best prevention of infection is to avoid potentially contaminated water (and food), as with hepatitis A and other enteric infections.

LISTERIOSIS

Listeriosis is a serious infection caused by consumption of food contaminated with the bacterium Listeria monocytogenes. The disease affects primarily pregnant women, the newborn, and adults with weakened immune systems. Listeria infection is not usually dangerous for healthy adults and children. Pregnant women are 20 times more likely than other healthy adults to get Listeriosis. In pregnancy, listeria bacteria can cross the placenta and cause serious illness for the fetus or newborn and may lead to miscarriage, premature birth or stillbirth. In the newborn, listeriosis can cause breathing problems, chest infections or meningitis, an inflammation of the lining of the brain. Listeriosis can be easily missed as it often presents itself with vague symptoms such as headache, nausea, vomiting, sudden fever, muscle and joint aches and pains or loss of balance. Severity of the symptoms varies. These symptoms usually appear within 2 to 30 days but can take up to 90 days after consumption of contaminated food. Symptoms vary from person to person, and the diagnosis is confirmed by a blood test. Listeria can be safely treated during pregnancy with antibiotics. Such treatment
prevents infection of the fetus or newborn. The infected newborn are also treated with antibiotics.

*Listeria monocytogenes* is found naturally in soil, dust, ground water and animal feces (including those from pets), and may also be on unwashed raw produce, raw meat, processed foods, prepared meat (i.e., hot dogs, deli meats, etc.)

**Prevention**

i. Use pasteurised milk and dairy products only.

ii. Cook raw foods from animal sources thoroughly (i.e., beef, pork, poultry).

iii. Be sure to wash all produce thoroughly under running water before eating.

iv. Wash hands, knives and cutting boards with hot soapy water after handling uncooked foods.

v. Store raw meat separate from cooked and ready-to-eat foods.

vi. Make sure your refrigerator always stays at 5°C or below (Listeria can grow at refrigeration temperatures).

vii. Use all perishable foods that are precooked or ready-to-eat as soon as you can.

viii. Be sure to clean refrigerators on a regular basis.

ix. Try to eat freshly cooked or freshly prepared foods only.

x. A simple rule of thumb "Boil it, cook it, peel it or forget it".

**BOTULISM**

Botulism is the most severe of all the food borne illnesses, but also the most uncommon. Botulism has a case fatality rate of between 15% and 20%. It usually occurs where food products are prepared or preserved by methods which do not destroy the spores and which permit toxin formation. Botulism is usually associated with an incorrect handling of post production canned foods and inadequate heat processing. Botulism is characterised by blurred or double vision, dry mouth, sore throat and vomiting and diarrhea, with eventual paralysis of the throat muscles and respiratory system. Unless it is adequately treated, about one third of
patients may die within 3 to 7 days after the onset of symptoms.

The mode of transmission in botulism occurs from the ingestion of toxin, produced by the bacteria called *Clostridium botulinum*, preformed in contaminated food. It occurs predominantly after inadequate heating during the process canning.

**Prevention**

i. Effective control of processing and preparation of commercially canned and preserved foods.

ii. Avoid rusted, blown, damaged or unlabelled canned foods.

iii. Always inspect canned foods carefully.

iv. If one is uncertain of the quality of canned foods, boil the contents thoroughly.

v. Avoid eating raw and fermented fish.

**BRUCELLOSIS**

Brucellosis is a systemic bacterial disease with an sudden onset, which is characterised by continued, intermittent or irregular fever, headache, weakness, profuse sweating, chills, depression, weight loss and generalised aching. The disease may last a few days, months or occasionally for a year. Brucellosis is an occupational disease and is usually associated with people who have contact with infected animals or their tissues, such as abattoir workers, vets and farm workers. However, cases have occurred among consumers of unpasteurised (raw) milk or milk products (especially cheese) from cows, sheep and goats that are infected with brucellosis. The infectious bacteria are called *Brucella abortus*.

**Prevention**

i. Avoid all milk and milk products from cows, sheep or goats that have not been pasteurised.

ii. Avoid consuming milk or milk products in the raw state.

iii. If pasteurisation is not possible, boiling the milk is essential.
CHOLERA

Cholera is an acute diarrheal illness caused by infection of the intestine with the bacterium *Vibrio cholerae*. The infection is often mild or without symptoms, but may be severe. Symptoms include watery diarrhea, vomiting, and rapid dehydration. Without treatment a person may die within hours. Often confined to impoverished areas that have poor sanitation, and areas with inadequate treatment of sewerage and drinking water as in Nigeria.

A person may contract cholera by drinking water or eating food contaminated with the cholera bacterium, via faeces, soiled hands or flies. Raw sea foods and shellfish may also be contaminated if from polluted waters. The infection is not likely to spread directly from one person to another.

**Prevention**

i. Drink only water that is treated with chlorine or that you have boiled.

ii. Eat only foods that have been thoroughly cooked and are still hot, or fruit that you have peeled yourself.

iii. Avoid raw or uncooked sea food.

iv. Avoid sea food that has come from sewerage contaminated sea water.

v. A simple rule of thumb: "Boil it, cook it, peel it or forget it".

vi. Avoid using night soil as fertiliser.

vii. Active immunisation.

**TABLE 5: CAUSES OF DEATH WORLDWIDE: ESTIMATES FOR 1999 (IN THOUSANDS)**

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Diseases</td>
<td>17,380 (31%)</td>
</tr>
<tr>
<td>Non-Communicable Diseases</td>
<td>33,484 (59.8%)</td>
</tr>
<tr>
<td>Injuries</td>
<td>5,101 (9.1%)</td>
</tr>
<tr>
<td>Cardiovascular Diseases</td>
<td>16,970 (30.3%)</td>
</tr>
<tr>
<td>Cancers</td>
<td>7,065 (12.6%)</td>
</tr>
<tr>
<td>Respiratory Diseases</td>
<td>3,575 (6.4%)</td>
</tr>
<tr>
<td>Digestive Diseases</td>
<td>2,409 (3.7%)</td>
</tr>
<tr>
<td>Neuropsychiatric Disorders</td>
<td>911 (1.6%)</td>
</tr>
<tr>
<td>Genitourinary Diseases</td>
<td>900 (1.6%)</td>
</tr>
</tbody>
</table>

In addition, these diseases cause pain, disability, loss of income, disruption of family stability, and an impaired quality of life.

A disability-adjusted life year (DALY) constitutes one means of assessing the effect of disease, as shown in Table 6. (DALYs form a measure accounting for years of life spent with diminished function resulting from health conditions of varying severity.) Over the past century, dynamic changes have occurred in the worldwide prevalence of non-communicable diseases, and even more rapid transitions are expected in the twenty-first century. These changes have been driven by social, economic, and public health progress and the strategies for change have been illuminated by research.

**ASCENDENCY OF NON-COMMUNICABLE DISEASES**

In 1900, the average life expectancy globally was about forty-seven years, and there were few differences among different countries. The leading causes of death in Nigeria, like the United States, etc., were communicable diseases and nutritionally related conditions (see Tables 5 and 6). Infant and childhood mortality was high because of infections and poor nutrition; the short average life span mainly reflected high mortality in the early years of life. During the first half of the twentieth century, the high-income, industrialized countries of the world made major advances against infectious and childhood diseases through improved public health measures, nutrition, vaccines, and, to a lesser degree, antibiotics.

**TABLE 6: BURDEN OF DISEASE WORLDWIDE: ESTIMATES FOR 1999 (IN THOUSANDS)**

<table>
<thead>
<tr>
<th>Health Condition</th>
<th>Disability-Adjusted Life Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total DALYs</td>
<td>1,438,154</td>
</tr>
<tr>
<td>Communicable Diseases</td>
<td>615,105 (42.8%)</td>
</tr>
<tr>
<td>Non-Communicable Diseases</td>
<td>621,742 (43.2%)</td>
</tr>
<tr>
<td>Injuries</td>
<td>201,307 (13.9%)</td>
</tr>
<tr>
<td>Cardiovascular Diseases</td>
<td>157,185 (10.9%)</td>
</tr>
<tr>
<td>Neuropsychiatric Disorders</td>
<td>158,721 (11.0%)</td>
</tr>
<tr>
<td>Cancers</td>
<td>84,500 (5.9%)</td>
</tr>
<tr>
<td>Respiratory Diseases</td>
<td>70,017 (4.9%)</td>
</tr>
<tr>
<td>Congenital Abnormalities</td>
<td>36,557 (2.5%)</td>
</tr>
</tbody>
</table>

In the developed world, childhood mortality declined in these countries, survival to middle and late adult life increased, and non-communicable diseases emerged in the middle of the twentieth century as the major threat to health. This epidemiologic transition from communicable to non-communicable diseases as the major threats to health did not begin in low-and middle-income countries (LMICs) until the latter half of the twentieth century. In many countries, with rapidly developing economies, such as Malaysia and Korea, the transition was rapid in the latter half of the century. The public health experience of high-income countries was applied successfully by these countries.

Currently, many middle-income countries have health profiles that resemble those of high-income countries. But this epidemiologic transition to non-communicable diseases not only differs across countries but has been interrupted by recent events.

Unfortunately, the trend in many countries have been impacted by a new epidemic plague HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome). Many countries in Africa and southern Asia have high infection rates for HIV, and the disease principally affects young adults and newborn infants in these areas. From 1980 onward, the rapid transmission of this fatal disease has not been preventable except by behavioural change; there is no vaccine for prevention, and affordable treatment has not been available in low-income countries. This leaves many countries with a double burden of health problems—a new epidemic of infectious disease and unresolved infectious conditions, as well as a growing set of non-communicable diseases.

The state of the epidemiologic transition varies around the world, reflecting the social, cultural, economic, and health resource factors in various countries. The health status of the nations of the world is reported by the World Health Organization. According to estimates of the burden of disease, high-income countries in 1990 experienced a preponderance of non-communicable diseases compared to the burden worldwide, as measured by disability-adjusted life years (DALYs), a measure that portrays years of life lost owing to disabling conditions, and thus represents the impact of these conditions. Worldwide in 1990, infectious diseases and perinatal conditions top the list. However, by the year 2020, the worldwide burden is projected to shift to non-communicable diseases, as indicated in the right column. There is an important dimension not
obvious from these tables. High-income countries contain 15 percent of the world's population but account for only 8 percent of the disease burden. Comparisons of high-income countries and LMICs indicate that non-communicable diseases rates were similar across the two levels of economic income in 1990. A major burden of non-communicable diseases does exist in LMICs, but is overwhelmed by the burden of communicable diseases. If the communicable diseases are controlled successfully, there will be a new worldwide "epidemic" of non-communicable diseases. Already, many middle-income countries that are managing the epidemic of HIV/AIDS are experiencing increased survival to middle adult life and increasing rates of chronic disease and injuries. This change in disease patterns is useful to the health planner who needs to evaluate resource needs, and to the economist who links health, productivity, and economic development as an argument to allocate resources to health services.

There was an alarming rise in chronic diseases and injuries in high-income countries (the United States, Canada, Australia, European nations, and Japan) during the middle of the twentieth century. This increase was especially striking for ischemic heart disease, which became the leading cause of death in these countries in the 1950s and 1960s. This disease results from the formation of plaques containing cholesterol and blood clots in the arteries that supply oxygen and nutrients to the heart muscle. The concerns about this epidemic prompted studies that explored the causes and prevention of the plaques and resultant disease. From 1960 to the present there has been a striking decline in ischemic heart disease deaths in the high-income countries, representing another epidemiologic transition to prevention and management of chronic diseases and increasing survival. Life expectancy has increased in these countries, principally from adding to the years of life after the age of fifty. Somewhat later, in the 1990s, cancer deaths began to decline. This "post-industrialization" improvement in health and survival has important implications beyond the increased life expectancy for these countries. First, non-communicable diseases can be controlled with prevention and treatment when the modifiable environmental causes are identified and controlled and effective health services are available. Second, research studies can identify the risks and the means to modify them. This information can be applied to individuals and to groups to improve health. Third, the lessons learned
from high-income countries might be applied to low-income countries to stanch the anticipated epidemic of non-communicable diseases and non-modifiable factors, although these distinctions are blurring with greater knowledge (Encyclopaedia of Public Health/ NCDs 2011).

**CAUSES AND PREVENTION**

**Modifiable Causes.** The causes of non-communicable diseases are often divided into modifiable causes.

**TABLE 7: BURDEN OF DISEASES (1999)**
**MEASURED IN DISABILITY-ADJUSTED LIFE YEARS**

<table>
<thead>
<tr>
<th>High Income Countries 1999</th>
<th>Worldwide 1999</th>
<th>Worldwide 2020 (Projected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic Heart Disease</td>
<td>Lower Respiratory Infection</td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>Malignant Malignant</td>
<td>Malignant Conditions</td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>Cerebrovascular Disease</td>
<td>Diarrheal Diseases</td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>Cancer</td>
<td>HIV AIDS</td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>Motor Vehicle Accidents</td>
<td>Malignant Malignant Depression</td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>Chronic Obstructive</td>
<td>Cerebrovascular Disease</td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>Pulmonary Disease</td>
<td></td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>Pneumonia</td>
<td></td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td>Lower Respiratory Infections</td>
<td></td>
<td>Ischemic Heart Disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ischemic Heart Disease</td>
</tr>
</tbody>
</table>


Chronic diseases result from genetic, behavioural, and environmental factors and the interactions between them. These factors, generally termed "risk factors," produce molecular and structural changes in organs and tissues but produce few if any early symptoms or signs of disease. After relatively long periods of time, usually decades, disease manifestations and impairment of health result. Risk factors place an individual at a greater likelihood of developing disease, but do not predict disease with absolute certainty. For most chronic diseases, several risk factors contribute.

At the population level, a high prevalence of risk factors can put
populations or communities at greater risk and result in more disease. Risk factors for future disease development and early structural changes may be found during the "silent" period before disease becomes manifest.

The prevention of non-communicable diseases entails a definition of the risk factors and application of interventions to favourably alter risks before overt symptoms or signs develop. At an even earlier level, it may be possible to prevent the development of risk factors through changes in the environment and personal health behaviours. Primary prevention of chronic disease is therefore an important goal, as morbidity and mortality may be averted or forestalled, and promotion of health, or "primordial prevention," is perhaps the foremost goal. Prevention research seeks to identify risks and to test interventions that modify risk and, thereby, prevent disease. Chronic diseases result from multiple factors that often interact in an additive or multiplicative fashion to increase risk, but there are also factors that can obviate or decrease disease risk. Because most chronic diseases take years to develop, with overt manifestations occurring in middle to late adult life, there is considerable potential for early identification and modification of risk in childhood, adolescence, and early adulthood.

Injuries include trauma from unintentional causes, such as vehicular and occupational injuries, as well as intentional injuries, such as interpersonal violence and self-inflicted trauma. With increased industrialization and the growth of vehicular traffic, injuries are a major cause of death and DALYs (see Tables 1 and 2), and the estimated worldwide burden in 2020 suggests an even greater increase (see Table 3). Homicides, suicides, and wars are also regrettable important sources of injury-related mortality and morbidity.

The prevention of vehicular injuries has focused on improved vehicular engineering for safety, better road design and traffic regulation, and improved driver training and enforcement of impaired driver laws. Occupational hazards are addressed with regulations related to the workplace. Homicidal actions, either individual or national, continue to pose a threat, particularly with the development of weapons that pose a threat to non-combatants. The principal casualties of wars continue to be civilian populations, and the advent of chemical and biological weapons increase further the potential for mass civilian deaths, even in the
Non-modifiable Causes. A major non-modifiable individual risk for disease is genetic susceptibility. This has a very important influence on disease development, but does not confer an absolute certainty that a disease will occur. In the overwhelming majority of diseases, inherited susceptibility interacts either adversely or beneficially with environmental exposures and personal behaviours to alter molecular or metabolic processes that increase the likelihood of disease development or to mitigate such changes if the susceptibilities or the exposures are beneficial. For example, smoking and tobacco use are risks for cancer the risk of smokers getting lung cancer is ten to forty times that of non-smokers. However, not all smokers will develop lung cancer at the same exposure levels, as measured by the number of cigarettes smoked and the duration of smoking. There is an individual difference in susceptibility, attributable in part to genetic differences or to environmental exposure to substances such as asbestos, which increases the risk further.

The delineation of the human genome will accelerate the description of genetic susceptibilities to disease and clarify the interactions between genetic differences and environmental risks. However, discovery of the individual genetic susceptibility will only provide an alert that an increased risk exists. There is no current safe means of changing the genetic make-up of individuals, and multiple changes might be required. Nevertheless, it might be possible in the future to identify those genetically at risk and have them avoid certain environmental exposures, thereby decreasing the risk for disease. The current preventive strategy, however, is to identify and eliminate or minimize damaging exposures and not to seek out and change the genetic component.

In some instances, a single gene abnormality will predominate over environmental influences. For example, familial hypercholesterolemia is a disorder resulting from a single abnormal gene that results in blood cholesterol levels two to four times above normal, depending on whether one or two alleles are inherited. Ischemic heart disease develops in middle or early adult life. The usual modifiers of blood cholesterol levels, diet and physical activity, have little influence on cholesterol levels or disease development. The genetic risk overwhelms the environmental influences. However, the use of potent new drugs that decrease internal
cholesterol synthesis in the body can lower blood cholesterol and the risk for heart disease. However, for the overwhelming majority of people, and for the majority of chronic diseases, alteration of personal and environmental exposures are the most important strategy.

Age represents a non-modifiable factor in the development of chronic disease. The mechanism is assumed to be the cumulative, long-term exposure to factors that alter function and structure, including DNA. However, increasing genetic information suggests that there are individual differences in genetic-environmental damage related to exposure.

**GENERAL ENVIRONMENTAL EXPOSURES**

Environmental exposures can be categorized into general environmental exposures and personal environmental exposures (see Table 4). The general environment encompasses the social, cultural, and public health aspects of life over which individuals can exert little or no personal control. For example, the quality of air and of drinking water or the exposures in the workplace environment are managed or regulated by public health or industrial organizations. If toxic exposures exist, the only personal option would be to change location or employment, but this is often not feasible. The public generally depends on public health organizations to monitor and manage the ambient environment and to make and enforce regulations in the public interest. Through public action, however, individuals can express preferences if the health risks are known.

Vehicular accidents and injuries result from increased traffic and speed of traffic, but public regulation of vehicular design, highway engineering, and regulation of driver behaviour represent social policy changes that can decrease fatalities and injuries. Occupational exposures to silica, asbestos, and heavy metals can lead to lung disease, cancer, and death, and regulation and monitoring
Table 8: Modifiable Risk Factors for Non-Communicable Diseases

<table>
<thead>
<tr>
<th>General Environmental Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical environment:</td>
</tr>
<tr>
<td>ambient air quality</td>
</tr>
<tr>
<td>water quality</td>
</tr>
<tr>
<td>occupational and work site</td>
</tr>
<tr>
<td>food safety and availability</td>
</tr>
<tr>
<td>Social environment:</td>
</tr>
<tr>
<td>income</td>
</tr>
<tr>
<td>cognitive education</td>
</tr>
<tr>
<td>cultural education</td>
</tr>
<tr>
<td>access to health services</td>
</tr>
<tr>
<td>availability of public health and community services</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personal Environmental Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking (and tobacco use)</td>
</tr>
<tr>
<td>Nutrition and Obesity</td>
</tr>
<tr>
<td>dietary intake</td>
</tr>
<tr>
<td>macronutrient adequacy</td>
</tr>
<tr>
<td>caloric balance</td>
</tr>
<tr>
<td>Physical Activity</td>
</tr>
<tr>
<td>Alcohol Drug Abuse</td>
</tr>
<tr>
<td>Genetic endowment</td>
</tr>
<tr>
<td>monogenic</td>
</tr>
<tr>
<td>gene-environment interactions</td>
</tr>
</tbody>
</table>


of the workplace can minimize or eliminate the risk. Environmental aspects can also facilitate healthful behaviours. The community environment can be made more conducive to personal behaviours that decrease the risk of chronic disease. For example, provision of safe and pleasant community venues for walking or other physical activity can
help individuals to develop and maintain personal commitments to increasing physical activity. Similarly, the availability of fresh fruits and vegetables at reasonable prices in local markets can foster healthful purchases and eating behaviours.

Other social and environmental characteristics can have a major influence on health, particularly that of populations. Throughout the world, groups with higher personal income and greater education have better health, less disease, and live longer. This observation was substantiated throughout the twentieth century and remains a fundamental factor for both communicable and non-communicable diseases. The reasons for health disparities by income are not completely understood, but include access to health services, knowledge about and resources to act on health-promoting behaviours, and homes and workplaces that have fewer hazardous exposures. Differences in health status among countries can be explained in part by differences in per capita income, but there are exceptions: some countries that have low income levels have relatively good health status (e.g., Chile, China, and Sri Lanka). Attention to public health measures and availability of basic health services in low-income countries may account for some of the favourable differences. Within a country like the United States, which has a high prevalence of chronic disease, this income and educational gradient is also present. Three times as many people in low-income families report activity limitations as those in high-income families, and individuals in high-income families can expect to live three years longer than those in low-income families.

Disparities in health across racial and ethnic groups are not fully explained, but require study because of the major differences that exist and the need to address risks in groups with the poorest health. Important elements in such disparities include social, economic, and educational factors, as well as access to care, and the affordability of care. These factors tend to be confounding and have made it difficult to sort out the quantitative contribution of each. Some countries have provided more equitable distribution of public health and personal health care despite overall limitations in financial resources. These investments have been associated with improved health for the entire country. Considerable speculation has focused on the role of genetic differences across populations and groups as an explanation of health differences. However, this seems less important than environmental differences, as
evidenced by the many instances of rapid change in disease patterns within a generation. This could not be explained by changes in the genetic pool.

**PERSONAL ENVIRONMENTAL FACTORS**

Personal environmental factors include behavioural choices that are made every day, though many behaviours are habitual. These personal behaviours are extraordinarily important and have been termed the underlying or true causes of chronic disease. They are outlined in Table 4. The use of tobacco, particularly smoking, is the number one preventable cause of death and disability. It directly contributes to ischemic heart disease, stroke, chronic lung disease, and several common cancers, especially lung cancer. These are the leading causes of death in industrialized countries and will be the leading causes worldwide during the coming century. Even exposure of non-smokers to second-hand smoking increases risk. The prohibition of smoking in public places is an example of a public health regulation that decreases the risk for non-smokers.

Dietary intake, which includes both the quantity and quality of foods, is highly important in the development of chronic diseases. An intake of calories in excess of what is expended during daily activity leads to obesity and an increased risk of diabetes, high blood pressure, heart disease, and some cancers. Increased physical activity can offset some excess caloric intake and may have additional healthful benefits as well. Since much of the industrialized world now has a predominance of inexpensive, caloricly dense food and too little requirement for physical activity, it is not surprising that an epidemic of obesity, and the corresponding increased risk for disease, has occurred. As low-income countries move toward economic development and industrialization, there are similar pressures toward high caloric intake and decreased physical activity. Dietary patterns have important influences aside from the caloric content. Fruits and vegetables and whole grain products have beneficial effects on health, as does a limitation of fat intake to no more than 30 percent of calories.

Other personal behaviours and circumstances contribute to non-communicable disease development. Alcohol use has both adverse and beneficial effects. Non pregnant individuals and groups consuming small
amounts of alcohol (about one drink per day) experience less ischemic heart disease. However, large amounts (about four or more drinks per day) contribute to chronic liver disease, depression and suicide, and injuries, especially motor vehicular injuries. Any alcohol use during pregnancy carries a risk for impaired foetal development. Illicit drugs are addictive and impair social and occupational functioning and are associated with impaired mental health, notably depression. Both alcohol and illicit drugs can have long-term effects on intellect.

There is evidence that behavioural risk factors are influenced by the availability and affordability of tobacco, foods, and alcohol. When people immigrate to an industrialized country from an area where chronic diseases are less common, their patterns of disease change to resemble the resident country over several decades of exposure. There has been no genetic change, but the risk factors and disease patterns change as the lifestyle changes. The influence of the new environment is especially marked in younger individuals. While genetic susceptibility is important, the factors of environment and personal behaviour are robust, modifiable, and when changed effectively, can reduce disease.

The burden of non-communicable diseases in Nigeria is rising greatly both in rural communities and urban settings. Disproportionately, NCDs affect poor people living in urban settings. This situation has resulted in an increase in the demand for care for chronic diseases such as hypertension, diabetes mellitus, kidney pathologies, etc. The rising burden of non-communicable diseases is shown by an increasing number of deaths from diabetes, chronic kidney disease, and cancer of the prostate and cervix, breast, colon, mouth, liver and by the increasing proportion of disability-adjusted life years (DALYs) attributed to neuropsychiatric disorders. The number of deaths attributable to stroke, chronic obstructive airways disease, and lung cancer has fallen in the past 2 years. We need to understand the reasons for these trends, with a view to informing prevention efforts. The rising demand for chronic care for communicable and non-communicable diseases needs an integrated model of care at all levels of the health system, supported by a robust surveillance system.

NCDs may be discussed under the following:
a. **Endocrine Diseases**

The endocrine system is a complex group of glands that helps control reproduction, metabolism, growth and development through substances called hormones. It also controls the way an individual responds to his surroundings and provides the proper amount of energy his body needs to function. Sometimes, the glands of the endocrine system are impaired and can cause a hormone imbalance. This hormone imbalance (or endocrine disease/condition) can affect the individual's health in many ways, and some endocrine system diseases/conditions are more serious than others. In Nigeria the common endocrine disease are Diabetes, hypertension, growth disorders, hormone abuse, menopause, osteoporosis, pituitary disorders, polycystic ovary syndrome, reproductive endocrinology, thyroid conditions/disorders, etc.

**HYPERTENSION**

Hypertension is defined as blood pressure of 140/90 mmHg based on at least two readings on separate occasions in an adult. Hypertension is a chronic medical condition in which the blood pressure is elevated. High blood pressure (HBP), or hypertension, means high pressure (tension) in the arteries. Arteries are vessels that carry blood from the pumping heart to all the tissues and organs of the body. High blood pressure does not mean excessive emotional tension, although emotional tension and stress can temporarily increase blood pressure. Normal blood pressure is below 120/80; blood pressure between 120/80 and 139/89 is called "pre-hypertension", and a blood pressure of 140/90 or above is considered high. The top number, the systolic blood pressure, corresponds to the pressure in the arteries as the heart contracts and pumps blood forward into the arteries. The bottom number, the diastolic pressure, represents the pressure in the arteries as the heart relaxes after the contraction. The diastolic pressure reflects the lowest pressure to which the arteries are exposed.

It is also referred to as high blood pressure. The word "hypertension", by itself, normally refers to systemic, arterial hypertension. Hypertension can be classified as either primary (essential) or secondary. Essential, or primary, hypertension means that no medical cause can be found to explain the raised blood pressure and represents about 90-95 per cent of
hypertension cases. Secondary hypertension indicates that the high blood pressure is a result of another condition, such as kidney disease. Persistent hypertension is one of the risk factors for stroke, heart attack, heart failure and arterial aneurysm and a leading cause of chronic renal failure. Even moderate elevation of arterial blood pressure leads to shortened life expectancy. At severely high pressures, defined as mean arterial pressures, 50 per cent or more above average, a person can expect to live no more than a few years unless appropriately treated.

The American Heart Association estimates high blood pressure affects approximately one in three adults in the United States - 73 million people. High blood pressure is also estimated to affect about two million American teens and children, and the Journal of the American Medical Association reports that many are under-diagnosed. Hypertension is clearly a major public health problem.

In Nigeria, hypertension is the commonest non-communicable disease with a prevalence of about 20-25 per cent in adult Nigerians. The prevalence is higher in the Southern Nigeria, compared to the North. In 90-95 per cent of cases, no cause can be found and this is termed essential hypertension. In 5-10 per cent, a cause can be found and this is termed secondary hypertension. Hypertension is a disorder to which both environmental and genetic factors contribute.

Risk factors for essential hypertension include age greater than 40 years, male sex, family history of hypertension, high salt diet in predisposed individuals, overweight/obesity, physical inactivity, and excessive alcohol consumption, inadequate intake of vegetables and fruits, diets high in 'salty' fats. An elevation of the systolic and/or diastolic blood pressure increases the risk of developing heart (cardiac) disease, kidney (renal) disease, hardening of the arteries (atherosclerosis or arteriosclerosis), eye damage, and stroke (brain damage). These complications of hypertension are often referred to as end-organ damage because damage to these organs is the end result of chronic (long duration) high blood pressure. For that reason, the diagnosis of high blood pressure is important so efforts can be made to normalize blood pressure and prevent complications.

It was previously thought that rises in diastolic blood pressure were a more important risk factor than systolic elevations, but it is now known
that in people 50 years or older systolic hypertension represents a greater risk. Hypertension affects many organs of the body. In the heart, it ultimately causes heart failure; in the brain, it causes stroke; in the kidneys, it causes chronic kidney disease; peripheral arterial disease in the vasculature and blindness in the eyes.

**Prevention**

i. Check your blood pressure regularly

ii. Lifestyle modifications are the cornerstone of anti-hypertensive therapy.

iii. Treatment must be to target (<140/90 mmHg; <130/80 mmHg in patients with diabetes or chronic kidney disease)

iv. Combinations of drugs are usually required to achieve blood pressure targets.

v. What are the lifestyle recommendations for the treatment of hypertension?

vi. Healthy diets; High in fresh fruits, vegetables and low fat dairy products, low in spicy fat and salt.

vii. Regular physical activity; Optimum 30-60 minutes of moderate activity 4-7 times/week.

viii. Low risk alcohol consumption; = 2 standard drinks/day and less than 14/week for men and less than 7/week for women.


x. Waist circumference <94 cm for men and <80 cm for women.

xi. Low salt intake (restriction of salt intake to less than 100 mmol/day).

xii. Smoke-free environment.

**DIABETES MELITUS**

Diabetes mellitus (DM) is a set of related diseases in which the body cannot regulate the amount of sugar (specifically, glucose) in the blood. Diabetes mellitus is a chronic disease caused by the inability of the pancreas to produce insulin or to use the insulin produced in the proper
way. Diabetes is the 7th leading cause of death among Americans; over 15 million Americans suffer from one form or another of this disease. In Nigeria, the exact prevalence of the disease is not known, just like other health challenges.

Glucose in the blood gives you energy to perform your daily activities. From the foods you eat, glucose in the blood is produced by the liver. In a healthy person, the blood glucose level is regulated by several hormones, including insulin. Insulin is produced by the pancreas, a small organ between the stomach and liver. The pancreas secretes other important enzymes that help to digest food. Insulin allows glucose to move from the blood into the liver, muscle, and fat cells, where it is used for fuel. People with diabetes either do not produce enough insulin (type 1 diabetes) or cannot use insulin properly (type 2 diabetes), or both (which occurs with several forms of diabetes). In diabetes, glucose in the blood cannot move into cells, so it stays in the blood. This not only harms the cells that need the glucose for fuel, but also harms certain organs and tissues exposed to the high glucose levels.

**Type 1 diabetes:**

The body stops producing insulin or produces too little insulin to regulate blood glucose level. Type 1 diabetes comprises about 10% of total cases of diabetes in the United States. Type 1 diabetes is typically recognized in childhood or adolescence. It used to be known as juvenile-onset diabetes or insulin-dependent diabetes mellitus. Type 1 diabetes can occur in an older individual owing to destruction of pancreas by alcohol, disease, or removal by surgery. It also results from progressive failure of the pancreatic beta cells, which produce insulin. People with type 1 diabetes require daily insulin treatment to sustain life.

**Type 2 diabetes:**

The pancreas secretes insulin, but the body is partially or completely unable to use the insulin. This case is sometimes referred to as insulin resistance. The body tries to overcome this resistance by secreting more and more insulin. People with insulin resistance develop type 2 diabetes when they do not continue to secrete enough insulin to cope with the higher demands. At least 90% of patients with diabetes have type 2 diabetes. Type 2 diabetes is typically recognized in adulthood, usually after age 45 years. It used to be called adult-onset diabetes mellitus, or
non-insulin-dependent diabetes mellitus. These names are no longer used because type 2 diabetes does occur in younger people, and some people with type 2 diabetes need to use insulin. Type 2 diabetes is usually controlled with diet, weight loss, exercise, and oral medications. More than half of all people with type 2 diabetes require insulin to control their blood sugar levels at some point in the course of their illness.

**Gestational diabetes** is a form of diabetes that occurs during the second half of pregnancy. Although gestational diabetes typically goes away after delivery of the baby, women who have gestational diabetes are more likely than other women to develop type 2 diabetes later in life. Women with gestational diabetes are more likely to have large babies.

**Metabolic syndrome** (also referred to as syndrome X) is a set of abnormalities in which insulin-resistant diabetes (type 2 diabetes) is almost always present along with hypertension, high fat levels in the blood (increased serum lipids, predominant elevation of LDL cholesterol, decreased HDL cholesterol, and elevated triglycerides), central obesity, and abnormalities in blood clotting and inflammatory responses. A high rate of cardiovascular disease is associated with the metabolic syndrome.

**Pre-diabetes** is a common condition related to diabetes. In people with pre-diabetes, the blood sugar level is higher than normal but not high enough to be considered diabetic. Pre-diabetes increases an individual's risk of developing type 2 diabetes and of heart disease or stroke. Pre-diabetes can typically be reversed without insulin or medication by losing a modest amount of weight and increasing his physical activity. This weight loss can prevent, or at least delay, the onset of type 2 diabetes. The incidence of diabetes is increasing rapidly in Nigeria. Some independent studies have recorded a rate of 10 to 18% in Nigeria. This increase is due to many factors, but the most significant are the increasing incidence of obesity and the prevalence of sedentary lifestyles.

**Complications of diabetes**

Both forms of diabetes ultimately lead to high blood sugar levels, a condition called hyperglycemia. Over a long period of time, hyperglycemia damages the retina of the eye, the kidneys, the nerves, and the blood vessels.
i. Damage to the kidneys from diabetes (diabetic nephropathy) is a leading cause of kidney failure.

ii. Diabetes accelerates atherosclerosis (the formation of fatty plaques inside the arteries), which can lead to blockages or a clot (thrombus). Such changes can then lead to heart attack, stroke, and decreased circulation in the arms and legs (peripheral vascular disease).

iii. Damage to the nerves from diabetes (diabetic neuropathy) is a leading cause of foot wounds and ulcers, which frequently lead to foot and leg amputations.

iv. Damage to the retina from diabetes (diabetic retinopathy) is a leading cause of blindness.

v. Damage to the nerves in the autonomic nervous system can lead to paralysis of the stomach (gastroparesis), chronic diarrhea, and an inability to control heart rate and blood pressure during postural changes.

vi. Diabetes predisposes people to high blood pressure and high cholesterol and triglyceride levels. These conditions independently and together with hyperglycemia increase the risk of heart disease, kidney disease, and other blood vessel complications.

In the short run, diabetes can contribute to a number of acute (short-lived) medical problems.

Many infections are associated with diabetes, and infections are frequently more dangerous in someone with diabetes because the body's normal ability to fight infections is impaired. To compound the problem, infections may worsen glucose control, which further delays recovery from the infections.

Hypoglycemia, or low blood sugar, occurs from time to time in most people with diabetes. It results from taking too much diabetes medication or insulin (sometimes called an insulin reaction), missing a meal, doing more exercise than usual, drinking too much alcohol, or taking certain medications for other conditions. It is very important to recognize hypoglycemia and be prepared to treat it at all times.
Headache, feeling dizzy, poor concentration, tremors of hands, and sweating are common symptoms of hypoglycemia. The individual can faint or have a seizure if blood sugar level gets too low.

**Diabetic ketoacidosis** is a serious condition in which uncontrolled hyperglycemia (usually due to complete lack of insulin or a relative deficiency of insulin) over time creates a buildup in the blood of acidic waste products called ketones. High levels of ketones can be very harmful. This typically happens to people with type 1 diabetes who do not have good blood glucose control. Diabetic ketoacidosis can be precipitated by infection, stress, trauma, missing medications like insulin, or medical emergencies like stroke and heart attack.

**Hyperosmolar hyperglycemic nonketotic syndrome** is a serious condition in which the blood sugar level gets very high. The body tries to get rid of the excess blood sugar by eliminating it in the urine. This increases the amount of urine significantly and often leads to dehydration so severe that it can cause seizures, coma, and even death. This syndrome typically occurs in people with type 2 diabetes who are not controlling their blood sugar levels, who have become dehydrated, or who have stress, injury, stroke, or are taking certain medications, like steroids.

**PREVENTION**

There is no foolproof way to prevent diabetes, but steps can be taken to improve the chances of avoiding it:

i. **Exercise.** Studies of both men and women have shown that vigorous exercise, even if done only once a week, has a protective effect against diabetes. Exercise not only promotes weight loss, but also lowers blood sugar as well.

ii. **Lose weight.** There is evidence that both men and women who gain weight in adulthood increase their risk of diabetes. A study conducted at Harvard showed that adult women who gained 11 to 17 pounds since the age of 18 doubled their risk of diabetes; those who gained between 18 and 24 pounds almost tripled their risk. Fact: 90 percent of diabetics are overweight.

iii. **Diet.** The use of a diet low in calories and in saturated fat is an ideal strategy for preventing Type II diabetes.

    **Stop smoking.** Smoking is especially dangerous for people with diabetes who are at risk for heart and blood vessel diseases.
Use alcohol in moderation. Moderation for men means no more than two drinks a day; for women, one drink is the limit. Choose drinks that are low in alcohol and sugar such as dry wines and light beers. If mixers are used, one that is sugar free should be selected for example, diet drinks, club soda, seltzer or water. If diabetic pills or insulin is taken, alcohol can drop blood glucose levels too far. A drink with a meal or snack should be had (HEALTH ENCYCLOPEDIA).

MAJOR CHALLENGES IN ACHIEVING SANITATION
In 2010, a Capacity Gap Analysis was conducted from March to May, 2010, in 34 Health Technology Schools and Colleges and two Universities training Environmental Health Personnel in Nigeria. The exercise involved active participation of relevant stakeholders, e.g., Provosts/Principals of Schools of Health Technology, Heads of Departments of Environmental Health, other academic staff, students and practicing Environmental Health Officers (EHOs).

The objectives of the Capacity Gap Analysis were...

i. To assess the institutional capacity of Schools/Colleges of Health Technology training Environmental Health personnel.

ii. To identify challenges militating the training of Environmental Health personnel in the institutions

iii. To appraise the roles of the government, academia and EHORECON (the Regulatory body) in the capacity building of EHOs.

iv. To make recommendations on how best to achieve effective/qualitative training of EHOs for efficient service delivery.

The major findings were lack of skilled, trained manpower in the seventeen core sub-specialties of environmental health. The results from the CGA show that out of 558 EHOs studied, 7 (1%) had Doctor of Philosophy Degree, 199 (36%) had Master of Science, and 341 (61%) had Bachelor's Degrees in various fields (i.e., Health Education, Sociology, Law, etc.), while others 11 (2%) had Diplomas. Furthermore, 75% of the Bachelors and Higher Degree holders were not in core Environmental Health discipline. The reason for the above may be the fact that only the Federal University of Technology Owerri is training Environmental
Health Officers/practitioners at both graduate and undergraduate levels in Nigeria as of date. The University College Hospital, Ibadan, and Abia State University, Uturu, are engaged in the training of EHOs at the postgraduate level.

By way of comparison, 19 Institutions were considered in the Northern part of the country and 15 in the Southern States of the country. The institutions in the North have a total of 87 (38%) first-degree holders, and 17 (8%) second-degree holders with none having a Doctor of Philosophy Degree, while the schools in the Southern part of the country recorded 107 (78%), 49 (36%) and 3 for first (B. Sc.), second (M. Sc.) and third degrees (Ph.D.), respectively. One hundred and forty (62%) of the EHOs in the North had lower qualification as against 31 (23%) in the Southern part of the country.

The observed gap in availability of qualified EHOs may adversely affect the quality of environmental health and sanitation services. The major mitigating factor in the capacity and capability of EHOs in Nigeria are as follows:

i. Gross inadequacy of specialized human resources in Environmental Health.

ii. Lack of basic infrastructures/equipment useful in the training of environmental health personnel viz environmental monitoring laboratories, basic science laboratories, office accommodation, library services (especially e-library) classrooms and staff, and students' residence, ICTs, laboratory equipment and supplies.

iii. Lack of national policy on environmental health training.

iv. General lack of public and environmental health laboratories in all the schools, colleges and ministries

v. Poor library facilities

vi. Poor conditions of lecture halls

vii. Lack of ICT facilities

viii. Lack of demonstration ground and practical sites

ix. Inadequate student accommodation

The implications of infrastructural decay as identified from this study are a clear evidence of the obvious neglect of the subsector by various governments. This situation may have contributed to the limited
exposure of EHOs in the country in the past three decades and corresponding environmental decay in the country.

**STRATEGIES IN DISEASE CONTROL AND PREVENTION**

The aim of disease control and prevention is to provide guidelines for public health officers to predict the occurrence of communicable diseases and health events and initiate prevention and control measures on time and to participate in integrated disease surveillance & response (IDS). The basic disease control strategies include the following:

1. **Establish Early Warning Systems for Disease Prevention**
   i. Assess environmental factors determinant of disease occurrence (extreme temperature, high humidity, dust, fume, etc.)
   ii. Assess human behaviour that may trigger off disease occurrence indiscriminate solid waste disposal, overcrowding, lack of proper hand washing, poor personal hygiene, lack of exercises open defecation, poor planning of layout, poor design and poorly built building, etc.
   iii. Review health records in health facilities, develop models for disease prevention, determine alert and epidemic thresholds to prevent disease outbreaks and establish control measures.
   iv. Assess the movement of people, animals and animal products and plants and plant products into and outside Nigeria, and therefore participate in Port Health services.

2. **Establish Disease Preventive Measures**
   i. Ensure waste segregation at source.
   ii. Ensure proper waste collection and storage.
   iii. Ensure proper disposal of solid waste, faeces and waste water (see solid waste and excreta disposal).
   iv. Ensure protection of sources of water.
   v. Ensure hygienic storage and the use of water.
   vi. Ensure drinking water sanitation from doubtful sources (see NSDRQ 2007).
   vii. Ensure that banned and dangerous chemicals are not used for planting, nursing and preservation of food crops.
   viii. Ensure proper storage of food items.
   ix. Ensure food preparation and serving when hot (see NEHPR 2007 and National Guidelines on EHP in Nigeria).
x. Control the activities of food vendors and hawkers.
xi. Control the quality of food exposed for sale.
xii. Ensure effective pest and vector control.
xiii. Ensure proper designs and construction of buildings.
xiv. Control emission and fume levels.
 xv. Control noise level within residential and commercial areas (noise level should not be above 90 decibels).
xvi. Ensure proper handling and storage of chemicals, radiation materials and their proper disposal.
xvii. Educate the public on environmental factors and behavioural pattern predict posing to disease occurrence and possible outbreaks.
xviii. Carry out mass vaccination against epidemic prone diseases and ensure routine immunization of all children under 5 years.

1. **Integrated Disease Surveillance and Response (IDSR)**
   There are currently forty (40) diseases in the IDSR in Nigeria and are classified as follow:
   - Health officers should educate community members, using standard case definitions on signs and symptoms of prevailing communicable diseases in the community, to report to the nearest health facility or designated point in the community. (see IDSR Guidelines)
   - Describe health facility or designated reporting points to community members.
   - Ensure that ill health or health events are promptly reported to such facilities or designated reporting points.
   - Train identified and designated community members or health facility staff to collect and collate health data into appropriate IDSR forms:

<table>
<thead>
<tr>
<th>IDSR</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>001A</td>
<td>Immediate/case-based Reporting Form</td>
</tr>
<tr>
<td>001B</td>
<td>Lab Reporting Form</td>
</tr>
<tr>
<td>001C</td>
<td>Line List</td>
</tr>
<tr>
<td>002</td>
<td>Weekly notification</td>
</tr>
<tr>
<td>003</td>
<td>Monthly</td>
</tr>
</tbody>
</table>
### Revised List Nigeria IDSR Priority Diseases, conditions and events

#### Epidemic-Prone and IHR recommended Diseases, conditions and events

<table>
<thead>
<tr>
<th>Epidemic prone</th>
<th>IHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cholera</td>
<td>8. SARS</td>
</tr>
<tr>
<td>2. Diarrhoea with blood</td>
<td>9. Smallpox</td>
</tr>
<tr>
<td>3. Tuberculosis</td>
<td>10. Denge</td>
</tr>
<tr>
<td>5. Meningitis</td>
<td>11. Anthrax</td>
</tr>
<tr>
<td>6. Hepatitis A</td>
<td>12. SARI</td>
</tr>
</tbody>
</table>

#### Diseases Targeted for Eradication and Elimination

<table>
<thead>
<tr>
<th>Disease</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Poliomelitis</td>
<td>4. Lymphoma</td>
</tr>
<tr>
<td>2. Diarrhoea</td>
<td>Lymphatic filariasis</td>
</tr>
<tr>
<td>3. Leprosy</td>
<td>Tuberculosis</td>
</tr>
</tbody>
</table>

#### Other Diseases of Public Health Importance

<table>
<thead>
<tr>
<th>Disease</th>
<th>Other Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diarrhoea in children less than 5 years of age</td>
<td>9. Asthma</td>
</tr>
<tr>
<td>2. Polio in children less than 5 years of age</td>
<td>10. Diabetes mellitus</td>
</tr>
<tr>
<td>3. HIV/AIDS</td>
<td>11. Epilepsy</td>
</tr>
<tr>
<td>4. Malaria</td>
<td>12. High blood pressure</td>
</tr>
<tr>
<td>5. Onchocerciasis</td>
<td>13. Sickle cell disease</td>
</tr>
<tr>
<td>6. Sexually transmitted infections (STIs)</td>
<td>14. Malnutrition</td>
</tr>
<tr>
<td>7. Trypanosomiasis</td>
<td>15. Plague</td>
</tr>
<tr>
<td>8. Buruli ulcer</td>
<td>16. Trichoma</td>
</tr>
<tr>
<td></td>
<td>17. Typhoid</td>
</tr>
<tr>
<td></td>
<td>18. Hepatitis B</td>
</tr>
<tr>
<td></td>
<td>19. Pertussis</td>
</tr>
<tr>
<td></td>
<td>20. Human Rabies</td>
</tr>
<tr>
<td></td>
<td>21. Schistosomiasis</td>
</tr>
<tr>
<td></td>
<td>22. Noma</td>
</tr>
</tbody>
</table>

- They should note that all epidemic prone IHR recommended disease are for immediate notification (see pg 90 using standard case definition; see IDSR revised Guidelines).
- Ensure that all completed IDSR are returned to the LGA DSNO for collation, analysis and reporting to the state epidemiologist. (See surveillance data flow in Nigeria below):
4. Measures to Control Communicable and Non-Communicable Diseases
When a communicable disease occurs in a community, it can easily be controlled if it is promptly reported, diagnosed and treated. When these steps are not taken, the disease may spread to many persons resulting into an outbreak. Therefore, the health officer shall:
i. Educate community members to report promptly every occurrence of communicable disease in their community to the
nearest health facility or reporting centre. In event that the person suffering from the disease or health event is unable to report, the person in care or the nearest relative of such a person shall take the responsibility to report the occurrence of the communicable disease to the nearest health facility or reporting centre.

ii. Enforce prompt reporting of occurrences of communicable diseases in every community.

iii. Report the occurrences of communicable diseases, which in his/her judgment is epidemic prone, to the LGA health Department/DSNO for onward transmission to the state Ministry of Health/SE for collation, analysis and onward reporting.

iv. Initiate measures to control the spread of communicable diseases including:

v. Conducting special investigation/inspection.

vi. Seizing for disinfection or destruction any contaminated material, article including food, water, clothing, etc, that is suspected to be a source of infection or may be a source of continuous spread of communicable diseases.

vii. Conduct reactive vaccination against epidemic prone diseases.

viii. Stop vehicles for the purpose of screening passengers during epidemics, and taking all suspected cases and carriers for treatment or quarantine or whatever other measures that may deem fit in accordance with IHR.

Environmental Sanitation Problems and Constraints in Nigeria

i. Climatic and other Ecological Factors

ii. Underdevelopment and prevailing socio-economic conditions (infrastructural limitations/settlement patterns/living standards)

iii. Illiteracy, poor public enlightenment and lack of community involvement

i. Limited/Poor planning and organization of environmental sanitation programmes (inadequate advice/limited competence and poor operational mechanisms/machinery)

ii. Poor funding and lack of co-ordination of environmental sanitation programmes
iii. Inadequate background data, limited projections and lack of dependable policy back-up
iv. lack of community participation

RECOMMENDATION
1. Develop policies, plans, and also assist governments at all levels in implementing plans of action towards accelerating progress for achieving sanitation.
2. The government should invest more on environmental sanitation and encourage states and LGAs to do so.
3. The government may need to consider the use or appointment of a supervisory councilor for environmental health and sanitation in all the LGAs.
4. Human capacity building in environmental health and sanitation is urgently required.
5. Environmental sanitation desk officers for all government ministries, agencies and parastatals to oversee the day-to-day sanitation issues may be experimented. Every major market should have a resident EHO or sanitation officer.
6. Available Environmental Health laws and policies should be vigorously enforced.
7. The National Assembly may consider new laws to replace the obsolete regional Environmental Health laws.
8. Sanitation offenders may need to pay heavily as a way to discourage them.

CONCLUSION
Environmental sanitation is the set of principles and practices of effecting healthful and hygienic conditions in the environment to promote public health and welfare, improve quality of life and ensure a sustainable environment. The essential components of environmental sanitation are solid waste and medical waste management, excreta and sewage management, food sanitation, sanitary inspection of premises, market and abattoir sanitation, pest and vector control, management of urban drainage, control of reared and stray animals, disposal of the dead, weed and vegetation control, hygiene education and promotion. Environmental sanitation is important for the protection and
preservation of lives and life-forms; healthy conservation of natural environments (terrestrial/aquatic/aerial); organized and safe evacuation of wastes (nitrogenous/organic/industrial/chemical/agricultural, etc.); controlled exploitation; spoilage and/or pollution of the environment and promotion of healthy living, growth and survival.

According to the WHO/UNICEF (2010) Joint report on the progress on sanitation and drinking water, 2.6 billion people do not use improved sanitation, although 1.3 billion people have gained access to improved sanitation since 1990. The world is likely to miss the MDG sanitation target by a billion people. However, open defecation rates have decreased from 25% in 1990 to 17% in 2008. Globally, 1.1 billion people practice open defecation, which has been a decline of 167 million since 1990. In the rural areas only, about 45% have improved sanitation, while the urban ones have 75% coverage. The rural population lags far behind in the achievement of sanitation globally.

In Nigeria, poor environmental quality is responsible for up to 75% of all preventable diseases. Diseases related to inadequate sanitation, mostly water, sanitation and hygiene, are huge burdens in most countries in Africa and other development countries. It is estimated that 88% of diarrhoea disease is caused by unsafe water supply, and inadequate sanitation and hygiene. Most often, people who live in rural areas or urban slums, completely lack appropriate sanitation facilities such as drinking water and hand-washing facilities; or where such facilities exist, they are often inadequate in quantity and quality.

Environmental Health and sanitation diseases range from communicable (bacteria, protozoa, helminthes, viruses, fungi, etc.) and non-communicable (anaemia, diabetes, hypertension, etc.) diseases. The following organs/systems may be involved: gastrointestinal, renal, hepatic, reproductive, central nervous, haematological, nutritional/metabolic, etc., depending on the specificity or target site of the pathogen or chemical involved.

Poor sanitation may lead to high morbidity and mortality in children, pregnant mothers, geriatrics or people with compromised immunity. Good environmental sanitation reduces the transmission dynamics of
pathogens, thereby promoting good health and longevity, and attracts investors. It has an economic cost advantage in that people spend less to treat clinical diseases. Good sanitation encourages international trade, thereby generating revenues for the nation. Furthermore, it creates room for cross fertilization of resources, since most foreigners would settle in the place, introducing their economic strategies which will boast the existing economy inter-alia.

Obviously, the environment in which people live influences their health. A healthy population is dependent upon a healthy environment. It shows that health, productivity and national development are all dependent on the level of sanitation, which in turn is dependent on the per capita income, poverty and levels of social consciousness.

In conclusion, environmental sanitation is a collective responsibility of the individual, the community and the government. This view requires that all hands be on deck to ensure the maintenance of a clean and safe environment for our health and survival. Good environmental sanitation is basic for protection, promotion and preservation of good health. Finally, the roles of individuals, communities, governments and NGOs will be highlighted.
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APPENDIX 1

TRAINING AND FUNCTIONS OF EHP/EHO
The training of an EHO/EHP is rigorous, like in medicine and surgery, pharmacy, medical laboratory sciences, etc. The overall objective of the B.Sc. /B. Tech. (Environmental Health) Degree Programme is to contribute towards the improvement of the health of the Nigerian population and its quality of life. It is, therefore, expected that at the end of the course, an environmental health graduate should have acquired knowledge, skills and attitudes to achieve the following specific objectives (averagely, the training of an EHO takes average of seven years, comprising five years of training in university one year of internship and one year of youth services):

General Objectives
Upon satisfactory completion of the programme in Environmental Health, graduates will be able to...

(i). Characterize major sources of chemical or microbial contamination of environmental media, viz, water, air, soil and food;

(ii). Identify current regulatory programmes and legislative authorities directed at prevention and control of contamination of environmental media including water, air, soil and food;

(iii). Describe major processes in human and natural environments that affect transport, dispersion, transformation, and accumulation of hazardous agents and identify characteristics of the agent, the environment and the conditions of release that influence the environment and distinguish key factors in a given scenario;

(iv). Characterize mechanisms and processes by which toxic or infectious hazards reach target populations and predict the most significant exposure pathways in a given scenario;

(v). Describe and apply means by which exposures of target populations to toxic or infectious hazards can be measured and/or modelled; indicate how these approaches would depend upon the properties of specific
contaminants; and identify sources and magnitudes of uncertainties associated with these characterizations;

(vi). Describe and apply means of preventing or controlling adverse effects of contamination of environmental media (water, air, soil and food) on public health that are available to local, state and federal regulatory agencies or the private sector; and

(vii). Communicate effectively with the public and professionals regarding potential public health impacts, mitigation strategies and associated uncertainties related to chemical, or microbial contamination of environmental media (water, air, soil and food).

Cognitive Objectives
i. To describe and apply the scientific principles involved in the identification, analysists and in providing solution to Environmental health problems.
ii. To identify the communication and group dynamic processes necessary to effect changes.
iii. To describe the investigative or monitoring processes necessary to identify the environmental health problems in a community.
iv. To describe in detail the steps in planning and implementing an appropriate environmental health programme aimed at solving those problems.
v. To describe the basic knowledge of physical, sociological and biological theories, concepts and principles and application of these in the practice of environmental health.
vi. To describe in detail the list of the commonest communicable diseases in the country, their mode of transmission and indicate methods of controlling the biological and physical environment so as to prevent them.
vii. To list the Public and Environmental Health Laws of the country and explain their rational application so as to encourage citizen to voluntary compliance.

Psychomotor Objectives
i. To perform accurately, standard laboratory tests employed in the monitoring of the physical environment, water supply,
sewage disposal and food sanitation and hygiene.

ii. To design a satisfactory graphic representation of the water treatment plant of:
   a. a rural community;
   b. an urban community.

iii. To design a satisfactory graphic representation of the sewage disposal and treatment plant of an urban community.

iv. To initiate and undertake actions capable of preventing diseases and prolonging lives.

v. To identify an ill person within the community and make appropriate referral after initial first aid management.

vi. To assume leadership role during times of emergency within the community.

vii. To manage resources adequately and perform required administrative functions.

viii. To be able to recognize an epidemic and design management strategy for its control.

**Affective Objectives**

1. To demonstrate an attitude that places premium on team work, accepting and performing leadership and followership role with equal effectiveness.

2. To demonstrate an attitude of pride in the contribution of his profession to the health of the nation and hence continually seek self-education and improved effectiveness.

3. To demonstrate an attitude of scientific enquiry in relation to every aspect of his professional activity, never taking anything for granted nor prematurely jumping to conclusions.

**Employment Opportunities**

A career in Environmental health is both rewarding and challenging. Thus graduates of the discipline will be very suitably equipped to take on gainful employment in the following areas.

i. Public health related agencies and environmental sanitation Parastatals.

ii. Pollution monitoring and control outfits.

iii. Diseases surveillance units/establishments.

iv. Research institutions.
v. Public health department of State and Federal Ministries of Health, public utilities, etc.

vi. Agencies concerned with food inspection, standards, disease control vis-a-vis immunization programmes, etc.

vii. Private establishments and independently operated laboratories/and referrals units for the analysis of environmental samples such as polluted water, food (cooked), confectionaries/bakeries, etc.

viii. Establish private outfits in different areas of environmental health management

The Roles and Functions of Graduates of Environmental Health

Graduate employment opportunities will be varied and would include, among others, employment by international organizations, government agencies as well as non-government organizations. Graduates of the B.Sc. / B. Tech Environmental Health Programme will be adequately prepared to perform the following roles and functions:

i. Monitoring and management of environmental safety and protection at higher level of practice.

ii. Initiation, implementation and evaluation of environmental health services

iii. Involvement in designing and inspecting of all types of premises and situations for environmental, occupational and sanitation requirements and compliance.

iv. Provision of technical advice in the enactment and enforcement of laws, regulations and by-laws relevant to public and environmental health.

v. Conducting research activities on communities and the environmental health problems and suggesting solutions to the problems.

vi. Participating in the surveillance and control of communicable diseases at local, state, national and international levels.

vii. Participating as members of health teams in preventive and promotive health care at all levels.

viii. Participation in the formulation and development of health policies for the management and improvement of public health and its sustainability.

ix. Facilitation of change towards positive health and its
x. Production of ICT in the relevant areas of public health.

xi. Planning teaching and training programmes for environmental health personnel, and other related health workers and community members.

xii. Using appropriate intervention measures to educate the community on issues that relate to environmental and public health.

SUMMARY OF THE BASIC MINIMUM ACADEMIC STANDARD FOR THE TRAINING OF B. TECH./ B. SC/B. EH IN ENVIRONMENTAL HEALTH IN NIGERIA (EHORECON, 2010).

ADMISSION REQUIREMENTS
Candidates intending to enter the B.Sc. (EH) or B. Tech. (EH) programme must satisfy the individual university's admission requirements. In addition to this, two modes of admission are open to candidates intending to study Environmental Health in any Nigerian university. A candidate may enter the programme at either Part I/100 levels (through UME/JAMB) or by direct entry at Part II/200 levels.

Admission to Part I.
Candidates may be considered for admission to Part I B.Sc. (EH) or B. Tech (EH) Degree course after passing at the required level, the UME Examination of the Joint Admission and Matriculation Board (JAMB), provided they obtain the West African School Certificate (WASC), National Examination Council (NECO) or the General Certificate of Education (SSCE/GCE) at credit level in five subjects including English Language, Mathematics, Physics, Chemistry and Biology/Health or Agricultural Science, taken and passed at not more than two sittings.

(b) Part II: Direct Admission.
In addition to 'O' Level requirements, candidates may be admitted through JAMB direct entry into Part II of the programme provided they have any of the following qualifications:

i. good pass at Advanced Level of the General Certificate of Education or its equivalent in any two of Biology (or Zoology), Chemistry and Physics

ii. The Public Health Inspector’s Diploma of the Royal Society of Health Dip RSJ) or West Africa Health Examination Board (WAHEB) Diploma for Public Health Superintendents/Health Technologists.

iii. National Diploma (ND) (Upper Credit) in Environmental Health Sciences, Community Health, or such other relevant qualifications as the host University or relevant regulatory bodies may prescribe from time to time.
Duration of the Programme
The programme is designed to run for a minimum of 10 semesters for
UME candidates and pro rata for direct entry students depending on
point of entry. Other requirements shall be as specified by the host
University.

Degree Structure
The first year of the programme introduces students to the basic
scientific concepts upon which environmental health is based. This level
is essentially a faculty of science-based programme as obtained in similar
health sciences and science based degree programmes. Courses of
instruction would include among others Chemistry, Biology/Zoology,
Mathematics, Physics and Communication & Laboratory Skills.

In the second year, students are introduced to the Biological science,
microbiology and bacteriology, food and nutrition science, and
environmental planning and construction. Specific environmental
health/health sciences are introduced at this level. The courses at this
level should incorporate both classroom teaching, laboratory practical
and field trips.

Core Environmental health subjects are introduced in the third year as
well as basic epidemiology and biochemistry. Transferable skills in
research methods, entrepreneurship, data interpretation, analysis and
problem solving are developed.

The fourth year shall comprise of core environmental health subjects
and professional exposure, the latter being field experience based.
Students during their industrial attachment shall be required to undergo
supervised field experience in different Environmental Health settings
in order to provide appropriate exposure to the practice of components of
environmental health. This field experience shall include but not limited
to rural and urban sanitation, industrial sanitation, occupational health
programme, disease/vector control, environmental health
administration and practice to mention a few.

The final year of the programme builds on the experience gained above
and introduces contemporary issues in the practice and application of Environmental health. Students shall undertake a research project to be examined by an external examiner.

At the end of the programme, the Council shall administer two courses during the final examination of the students. These courses shall cover all aspects of the job of an Environmental health officer as stated in courses - EHS 510 Environmental Health Practice 1; and EHS 512 Council paper 11.

OUTLINE OF COURSES

COURSE CODES:
For uniformity, courses are broadly classified into Core Environmental Health courses and others. The core Environmental Health Courses must be offered as described by this minimum standard in the Department of Environmental Health, while the others may be offered in other Departments and faculties where such or similar courses exist. The core Environmental Health courses must retain the EHS (Environmental Health Science) code, while the others may retain the code or carry another code of a similar course offered in another department or faculty.

LIST OF CORE COURSES IN ENVIRONMENTAL HEALTH IN NIGERIA

YEAR ONE - FIRST SEMESTER

Basic 1st year courses as may be applicable to the host faculty in addition to workshop practice and Engineering Drawing.

YEAR ONE - SECOND SEMESTER

As may be applicable to the host faculty/school.
### YEAR TWO - FIRST SEMESTER

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YEAR FOUR - SECOND SEMESTER

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Each student should be exposed to environmental health facilities in rural and urban settings during the period of industrial training. In the urban setting, students are required to visit environmental firms, industries, and laboratories to acquire the skills in Environmental Health Sciences.

YEAR FIVE - FIRST SEMESTER

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## FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
### LIST OF PREVIOUS PUBLIC LECTURES AND LECTURERS

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<td>“University of Technology in Modern Nigeria: Society: An outlook for the future”.</td>
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<td>3</td>
<td>Dr. C. N. Ogbo</td>
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<td>Prof. S. A. Okecha</td>
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<td>Prof. G. Oyibo</td>
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<td>E.I. Oyia</td>
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<td>Prof. (Mrs) E. Onyejekwe</td>
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<td>Dr. Goddv Chuma Okove</td>
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<td>Prof. Christopher Okoro</td>
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