

# Pathophysiology

Dr. Yasser Mufid

Lecture **1**  
2018-2019

## Introduction

### Learning Objectives

Upon completing this Lecture, the students should be able to:

1. Define pathophysiology.
2. Understand the differences between Anatomical pathology & pathophysiology.
3. Comprehend disease and its pathophysiological aspects.
4. Know the various categories of the causes of diseases.
5. Know the course, outcome of diseases.

### **Pathophysiology or physiopathology:** -

*I*s the physiology of altered health.

It combines:

- 1- **Pathology:** -Greek meaning of disease, literally the study (logos) of suffering (pathos). More specifically, it is abridging discipline involving both **basic science** and **clinical practice** and is devoted to the study of the structural and functional changes in cells, tissues, and organs that underlie disease. By the use of molecular, microbiologic, immunologic, and morphologic techniques, pathology attempts to explain the whys and wherefores of the signs and symptoms manifested by patients while providing a sound foundation for rational clinical care and therapy.
- 2- **Physiology:** - Is a biological discipline that describes mechanisms and processes operating within an organism.

That's to say pathophysiology is the functional changes occurring or associated with disease or injury.

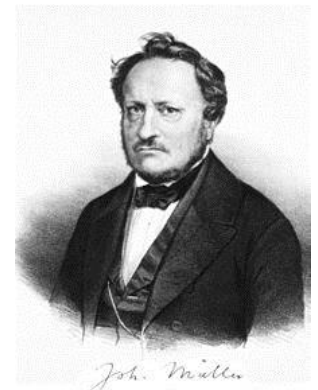
Dr. Johannes Peter Müller 1830's from Germany was the first to combine Physiology with medicine.

Pathophysiology is a biomedical science on the mechanisms related to development and elimination of pathological processes and diseases.

Thus Pathophysiology is the study of the biologic and physical manifestations of disease as they correlate with the underlying abnormalities and physiologic disturbances.

In other words, it's simply understanding the mechanics of disease.

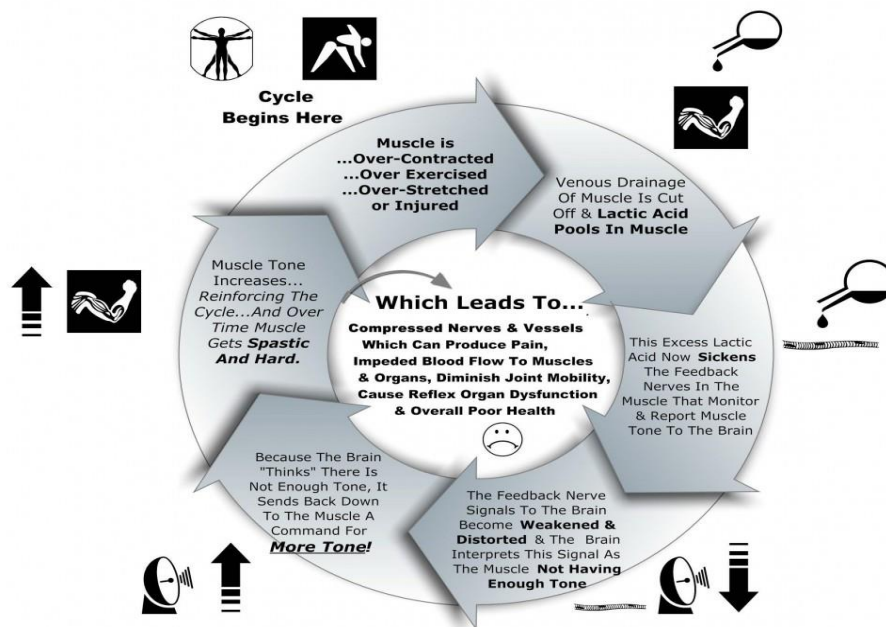
Anatomic Pathology is more related to anatomy "*The anatomic changes in the body that cause disease*" while pathophysiology is more related to physiology "*The cellular mechanics that allow a disease to progress*".



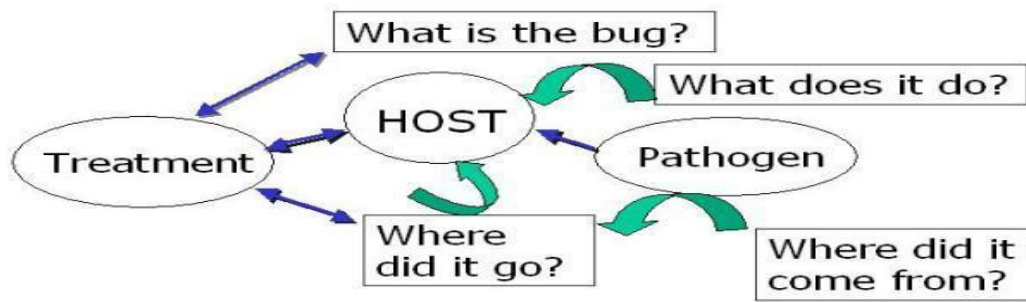
	Pathophysiology	Anatomic Pathology
1.	A vital study of pathological processes	A study of a pathological process in post-mortem objects or fixed biopsy.
2.	Based on testing object in artificially organized situations (experiments) or on a clinical observations of a live sick organism.	No experiments, only observing the natural picture caused by the disease.
3.	Applies not only morphological, but physiological, biochemical, biophysical, immunological, informational & bio-cybernetical techniques.	Accent on morphological methods only.
4.	In clinics, physicians involved in functional diagnostic tests, lab diagnostic studies and results interpretations.	In clinics, dissectors & biopsy/ smear test analyzers.
5.	Controlled clinical experiments on human patients in course of treatment and diagnosis processes are called “functional and lab. Tests” e.g. glucose tolerance test for endocrinology.	Work with autopsy material, from live patients like biopsies, smears or aspirate.

**Example:** The pathophysiology of muscle spasm:

## The Muscle Spasm Cycle



# ID Pathophysiology Summary



(c) 2004, Susan Hadley, M.D.

Pathophysiology does not deal directly with the treatment of disease. Rather, it explains the processes within the body that result in the signs and symptoms of a disease.

**A pathologist** is a specialist in pathology; a physician who practices, evaluates, supervises diagnostic tests, using materials removed from living or dead patients, and functions as a laboratory consultant to clinicians, also conducts experiments and other investigations to determine the causes or nature of disease changes.

A pathologist is either

1- **Surgical pathologist:** The study of disease by the analysis of tissue specimens obtained during surgery. The surgical pathologist often examines specimens during surgery to determine how the operation should be modified or completed. The appearance of the specimen is noted. Then, slices of the tissue are prepared by the paraffin or frozen section method and microscopically examined by a physician trained in pathology.

2- **Clinical pathologist:** The laboratory study of disease by a pathologist using techniques appropriate to the specimen being studied. Among the many branches of clinical pathology are hematology, bacteriology, chemistry, and serology.

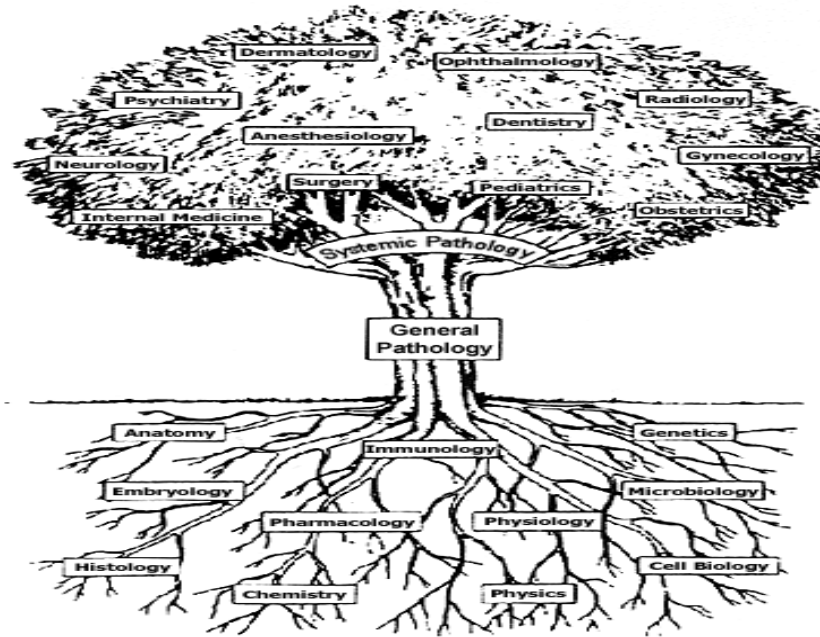
Pathology is divided into

- 1- General Pathology.
- 2- Systemic Pathology.

**General Pathology** is concerned with the basic reactions of cells and tissues to abnormal stimuli that underlie all diseases (i.e.) studies inflammation, cell injury adaptation and death, tissue repair, Hemodynamic disorders, diseases of immunity, Neoplasia, genetic and pediatric diseases, environmental diseases and infectious diseases... all in general.

**Systemic Pathology** is the study of the specific responses of specialized organs and tissues to more or less well defined stimuli.

## THE TREE OF MEDICINE



**Disease definition according to the godfather of pathology Rudolf Virchow (1821-1902) is:**  
*A life of an organism under abnormal conditions... relation of physiology to pathology is the same as the relation of smooth runner to steeplechase.*

*In other words, cell organelles behave differently in a state of health and in a state of disease.*



**For example:** - Antidiuretic hormone (vasopressin) in normal healthy individual induces reabsorption of water from the collecting tubules of the kidney, decreases diuresis & induce vasoconstriction, but in a state of hypovolemic shock as a result of sever blood loss its level increases ( $\times 1000$  to  $\times 10000$ ) times the normal level which will influence the endothelial cells of the blood vessel to secrete Von Willebrand factor VIII inducing clotting and even Disseminated intravascular coagulation(DIC). While in Ultra high levels induces coronary artery spasm and myocardial ischemia.

**Disease** is a term for any condition that impairs the normal functioning of an organism or body.

Three aspects of a **disease** form the **core of pathophysiology**:

1- **Etiology**: -

*Doctrine of causative factors, causes and conditions of diseases and pathological processes, which constitute them.*

The cause of disease; **genetic vs acquired** e.g. (infectious, nutritional chemical, physical. etc.). Many diseases are multifactorial; combination of inherited susceptibility & external influence.

2- **Pathogenesis**: - *Doctrine of mechanism of diseases, development, course and outcome.*

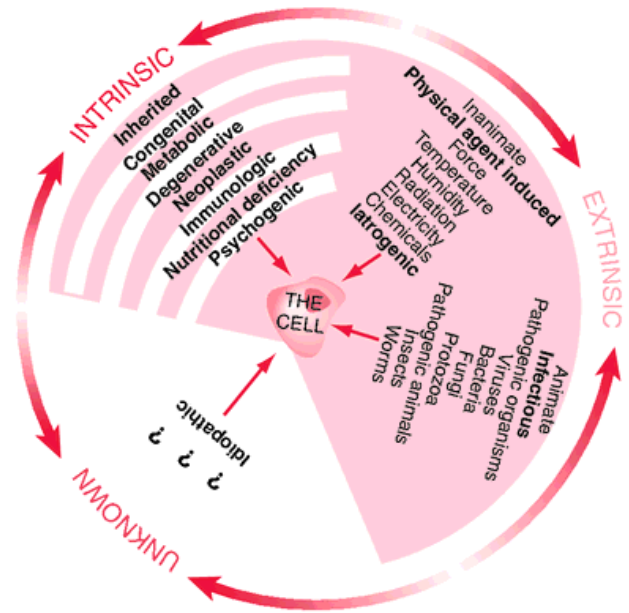
It refers to the sequence of events in the response of cells or tissues to the etiologic agent, from the initial stimulus to the ultimate expression of the disease.

3- **Models**: - Modelling of diseases and their elements.

Which is either experimental or clinical modellings.

Modelling of disease or their elements is the key of the disease progress.

A disease model is an animal or cells displaying all or some of the pathological processes that are observed in the actual human or animal disease. Studying disease models aids understanding of how the disease develops and testing potential treatment approaches. Modelling always starts with a clinical observation by the physician to a disease and giving a combination of signs and symptoms that in different patients having the same similarity.



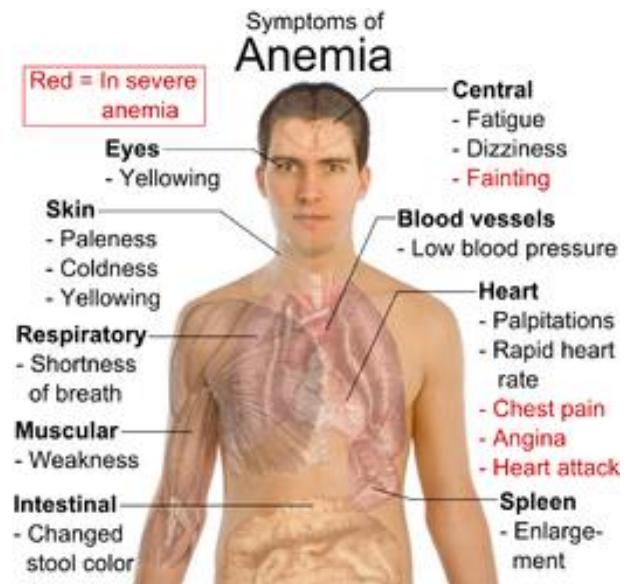
**Diagnosis**

In general, diagnosis (plural diagnoses) has two distinct dictionary definitions.

The first definition is: "**the recognition of a disease or condition by its outward signs and symptoms**",

while

The second definition is "**the analysis of the underlying physiological/biochemical cause(s) of a disease or condition**".



e.g. Iron deficiency anemia

	Normal	Fe deficiency without anemia	Fe deficiency with mild anemia	Fe deficiency with severe anemia
<b>Serum Iron</b>	60-150	60-150	<60	<40
<b>Iron Binding capacity</b>	300-360	300-390	350-400	>410
<b>Saturation</b>	20-50	30	<15	<10
<b>Hemoglobin</b>	Normal	Normal	9-12	6-7
<b>Serum Ferritin</b>	40-200	<20	<10	0-10

Another, a common disorder such as pneumonia was nevertheless used as a diagnosis before the germ theory was accepted, and the disease was defined as a complex of many symptoms consisting of cough, sputum production, fever and chills. Later, as the actual cause was assigned to micro-organisms, the term diagnosis included the causality, e.g., *Pneumococcal pneumonia*, suggesting not only a spectrum of symptoms but also a cause for the symptoms.

**1- Differential Diagnosis (“rule-outs”):**

A list of diagnoses that could account for the history, clinical signs or lesions in a case.

**2- Clinical Diagnosis:**

Diagnosis based on data obtained from the case history, clinical signs, and physical examination.

**3- Morphologic Diagnosis (lesion diagnosis):**

A diagnosis based on the predominant lesion(s) in the tissue.

It may be macroscopic (gross) or microscopic (histologic) and describes the severity, duration, distribution, location and nature (eg degenerative, inflammatory, neoplastic) of the lesion.

e.g. severe, acute, locally-extensive, fibrinous bronchopneumonia.

**4- Etiologic Diagnosis:**

A definitive diagnosis that names the specific (or general) cause of the disease. (eg parvovirus enteritis, parasitic hepatitis).

**5- Disease (Definitive) Diagnosis:**

A specific diagnosis that states the “**name of the disease**”.

eg, a 10-years old child presented to the clinic with severe neck rigidity and vomiting of 2 days duration. The child died prior to complete clinical work up and a necropsy was performed.

<u>Type of Diagnosis</u>	<u>Description</u>
<b>1. Clinical Diagnosis:</b>	<b>Acute meningitis</b>
<b>2. Morphologic Diagnosis:</b>	<b>Widespread inflammation of the pia mater &amp; arachnoid layers of the meninges</b>
<b>3. Etiologic Diagnosis:</b>	<b>Bacterial Meningitis</b>
<b>4. Disease Diagnosis:</b>	<b>Neisseria Meningitis</b>

**Clinical course** describes the evolution of the disease in other words any disease could be preclinical, acute, subacute or chronic

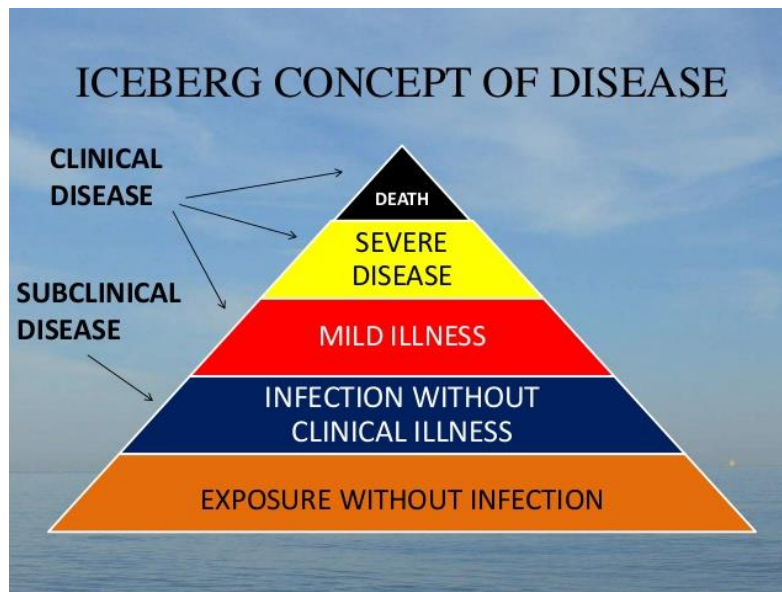
**Preclinical:** a stage in a disease when a specific diagnosis cannot be made because adequate signs and symptoms have not yet developed.

**Acute** a stage in a disease characterized by a relatively sudden onset of symptoms that are usually severe. An episode of acute disease results in **recovery** to a state comparable to the patient's condition of health and activity before the disease, in passage into a **chronic phase, or in death**.

**Subacute:** - An abnormal condition present in a person who appears to be clinically well. Between acute and chronic; denoting the course of a disease of moderate duration or severity.

**Chronic** a disease that persists over a long period. The symptoms of chronic disease are sometimes less severe than those of the acute phase of the same disease. Chronic disease may be progressive, result in complete or partial disability, or even lead to death. Examples of chronic disease include diabetes mellitus, emphysema, and arthritis.

**Carrier** one who harbors disease organisms in their body without manifest symptoms, thus acting as a distributor of infection.



### Epidemiology and pattern of disease

**Epidemiology** is the study of the patterns, causes, and effects of health and disease conditions in defined populations. It is the **cornerstone of public health**, and informs policy decisions and evidence-based medicine by identifying risk factors for disease and targets for preventive medicine.

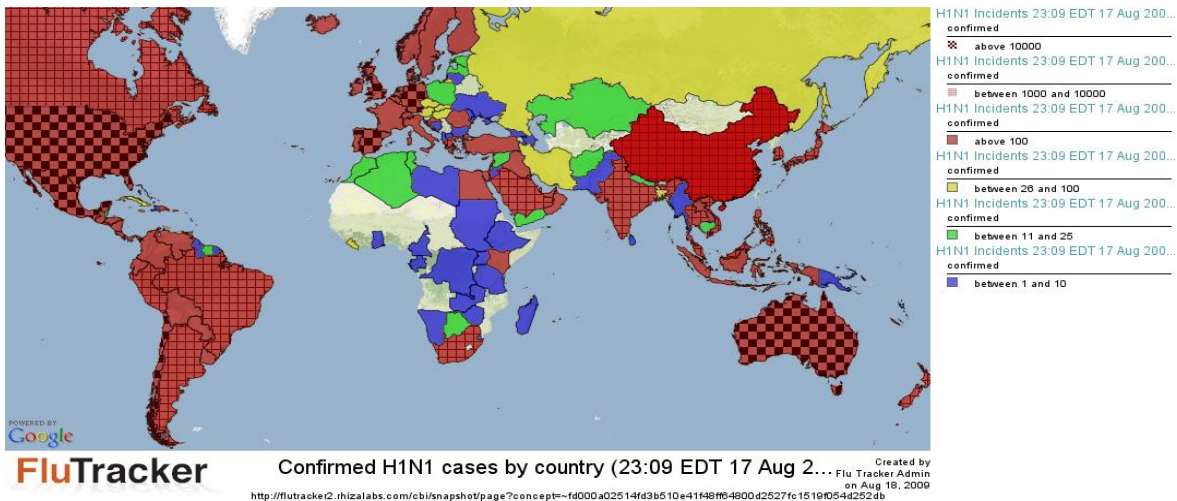
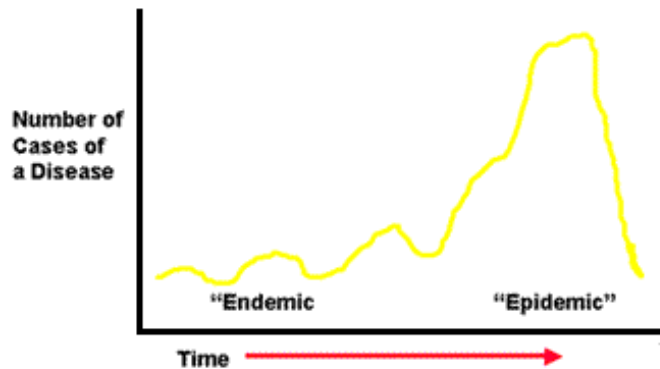
It has emerged as the science that helps to study the risk factor for **multifactorial diseases such as heart diseases and cancer**. It looks for patterns such as **age, sex, nutrition, race, habits, lifestyle .... etc.** in relation to the disease that will help doctors in their diagnosis.

**Endemic diseases** in a population when that disease is maintained in the population without the need for external inputs.

**Epidemic disease:** any new cases of a certain disease, in a given human population, and during a given period, substantially exceed what is expected based on recent experience.

**Pandemic** is an epidemic of infectious disease that has spread through human populations across a large region; for instance, multiple continents, or even worldwide. E.g. H<sub>1</sub>N<sub>1</sub> influenza virus

### “ENDEMIC” vs. “EPIDEMIC”



The godfather of Pathophysiology Jean Francois (1497-1558) said:

- Life is a week fire burning without a flame...
- There must be a special kind of physiology for life of a sick persons.

