



N4: PATHOPHYSIOLOGY

TOPIC 7: FLUID, ELECTROLYTE, AND ACID-BASE IMBALANCE

Study Guide

Description

Hello there!

We are halfway through Nursing 4 already and I hope you are all still doing great at this time!

In this topic, we shall discuss some major concepts that you need to understand in Nursing 4 – fluid, electrolyte, and acid-base imbalances. We humans have about 55% to 60% of our bodies made up of water and the proportion depends on our sex. The water or more generally, the fluids, that are found inside our bodies are important for our metabolism and it drives several cellular processes. As you have learned in Nursing 3, these fluids are found in all parts of the body – be it intracellularly, interstitially, or intravascularly. The amount of fluid found within the various compartments in the body need to be regulated carefully because changes in the amount due to fluid movement across compartment may have untoward effects.

Dissolved in these fluids are ions (or electrolytes) which are also essential for metabolism. Because of their charged nature, these ions drive cellular processes. Just like the fluids, the number of dissolved electrolytes also need to be regulated carefully, otherwise, it may cause untoward effects. Corollary to the electrolytes, there are other dissolved substances in the fluids, particularly the blood, which determines in pH. Some of these dissolved substances include oxygen, carbon dioxide, and bicarbonate ions which are important in maintaining the very rigid window of 7.35 to 7.45 which is the normal blood pH.

This topic will cover the following subtopics:

1. Alterations in fluid balance
2. Electrolyte imbalance
3. Alterations in acid and base balance

Pre-session Quiz

Before delving into the subtopics, please answer the **pre-session quiz** which has 10 items. This is non-graded, and it will help you focus yourself to the topic at hand and to serve as review of the concepts that you have previously learned in N3: Anatomy and Physiology and other subjects.



After answering the pre-session quiz, you may now proceed to the subtopics. This session will be delivered via pre-recorded lecture. You may download the slides. I will set up a forum where you can post any questions about this topic. The policies on communicating with your faculty is found at the course guide.

You can use the reference text book by Norris as your guide or you may find any pathophysiology book of your choice.

Subtopic 1. ALTERATIONS IN FLUID BALANCE

As mentioned earlier, fluid balance should be carefully regulated to prevent cardiovascular alterations, among others. You have learned in Nursing 3 how the kidneys are important regulators of fluid balance. They do this through the *nephron* which regulates the concentration of water and soluble substances like sodium by filtering blood, reabsorbing what is needed and excreting the rest as urine. By doing this, the kidneys also help in regulating blood volume and hence, blood pressure. The endocrine system is also an important regulator of fluid balance primarily through the production of *antidiuretic hormone*. You have also learned in Nursing 3 the importance of the *renin-angiotensin-aldosterone mechanism* in maintaining fluid balance. If you think that you need to review all these concepts, I encourage you to go back and review your notes in Nursing 3 because these are all essential concepts as we tackle alterations in fluid balance.

In this subtopic, we will look closer to the alterations of fluid balance. We will discuss *edema* formation which is a manifestation of expansion of the interstitial fluid volume. We will also discuss specific fluid volume disturbances which are *hypovolemia* (which is fluid volume deficit) and *hypervolemia* (which is fluid volume excess).

At the end of this subtopic, you will be able to:

1. Explain the physiologic mechanisms to maintain fluid balance.
2. Explain through a concept map the pathogenesis of edema.
3. Trace the pathogenesis of hypovolemia and hypervolemia to explain the clinical manifestations of these conditions.

Edema is a manifestation of imbalance of fluid exchange in the capillaries. In this prerecorded video entitled **Edema Formation**, you will learn the various causes of edema.



Additionally, you may read any Pathophysiology reference textbook, or you may want to refer to this paper - Kreimeier U. (2000). Pathophysiology of fluid imbalance. *Critical care (London, England)*, 4 Suppl 2(Suppl 2), S3–S7. <https://doi.org/10.1186/cc968> (Download at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3226173/>).

Subtopic 2. ELECTROLYTE IMBALANCE

Electrolytes are dissolved substances in the body fluids which help drive cellular process and maintain homeostasis. As mentioned above and like body fluid, their dissolved amount should be carefully regulated. Below is a summary of the electrolytes that we will study in this subtopic and their normal values:

Electrolyte	Normal Serum Level
1. Sodium	135-145 mEq/L
2. Potassium	3.5-5.0 mEq/L
3. Calcium	4.5-5.3 mEq/L
4. Magnesium	1.5-2.5 mEq/L

The following electrolyte imbalances will be discussed in this subtopic:

- Hypo and hypernatremia (Na⁺)
- Hypo and hyperkalemia (K⁺)
- Hypo and hypercalcemia (Ca²⁺)
- Hypo and hypermagnesemia (Mg²⁺)

At the end of this subtopic, you will be able to:

1. Explain the physiologic mechanisms to maintain electrolyte balance.
2. Discuss the etiology and pathogenesis of the electrolyte imbalances.
3. Trace the pathogenesis of the electrolyte imbalances to explain the clinical manifestations of these conditions.

Subtopic 3. ALTERATIONS IN ACID AND BASE BALANCE

An *acid* is a solution with a higher concentration of hydrogen ions than hydroxide ions. It separates into one or more hydrogen ions and one or more negative ions. A *base*, on the other hand, has higher concentration of hydroxide ions than hydrogen ions. It separates into one or



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more hydroxide ions and one or more positive ions. The concentration of hydrogen ion determines the pH of a substance. As mentioned earlier, the blood pH should be carefully maintained between 7.35 to 7.45 and there are several physiological mechanisms (called *buffer systems*) to regulate this.

There are two acid-base balance that we will learn in this subtopic – *acidosis* and *alkalosis*. Each of these imbalances can still be categorized as respiratory or metabolic depending on the etiology and pathogenesis of the imbalance.

At the end of this subtopic, you will be able to:

1. Explain the physiologic mechanisms to regulate acid-base balance.
2. Discuss the etiology and pathogenesis of the acidosis and alkalosis.
3. Trace the pathogenesis of the acidosis and alkalosis to explain the clinical manifestations of these conditions.

Post-session Quiz

After you have viewed and read all the preceding resources, you are now ready to take the **post-session quiz**. This is a graded quiz consisting of 10 items which will test the knowledge that you have acquired from the preceding subtopics.

CONGRATULATIONS for finishing Topic 7 – Fluids, Electrolytes, and Acid-Base Imbalance! You may now proceed to the next topic.