

## **CHAPTER II**

### **LITERATURE REVIEW**

#### **2.1 Suction Concept**

##### **2.1.1 Definition**

Suction is an action to clean secretions and stimulate the cough reflex. This procedure is performed to free the client's airways to optimize the process of oxygen and carbon dioxide exchange and prevent pneumonia due to accumulation of secretions (Kozier & Erb, 2012). Suction of mucus (Suction) is an action to aspirate secretions through a catheter tube connected to a suction machine. This suction is performed in the nose, oral cavity and endotracheal intubation, repeated if there are signs of accumulation of secretions. This action is performed to maintain airway patency from excessive accumulation of secretions (Lesmana, et al., 2015).

While the duration of suction is the length of time used in the process of sucking mucus or suction which is calculated in minutes or seconds. Based on the standard operating procedures of RSUD Ngudi Waluyo Wlingi regarding closed suction, the recommended suction duration is 10-15 seconds. This depends on the patient's condition and the suction technique used.

##### **2.2.2 Suction Indication**

According to the AARC (American Association for Respiratory Care) in 2010, the indication for performing mucus suction is a large amount of secretions blocking the airways, which is indicated by:

1. Ronchi/Crackles sound: when an examination is carried out with lung auscultation, it indicates the presence of mucus buildup in the trachea or

respiratory tract.

2. Gurgling or Snoring: a noisy breathing sound like someone gargling, indicating a buildup of secretions that are disturbing the airway.
3. Decreased oxygen saturation (SpO<sub>2</sub>): oxygen saturation values below 95% indicate the need for intervention to improve oxygenation status.
4. Decreased level of consciousness: patients who experience decreased level of consciousness are at risk of experiencing airway obstruction due to accumulation of secretions and may not be able to expel their own secretions and experience decreased cough reflex.
5. Changes in respiratory rate: a significant decrease in respiratory rate may indicate that the airway is blocked by a foreign body or secretions.

6. Patient request: patients who feel the need for suctioning due to discomfort resulting from the accumulation of secretions or mucus in their respiratory tract.
7. Peak pressure elevation on ventilator use: in patients who are unconscious and on a ventilator, this increase in pressure may indicate obstruction by secretions.

### 2.2.3 Types of Suction Cannula

According to (Kozier & Erb, 2012) there are two types of suction cannulas, namely:

#### 1. Open Suction

Open suction is a procedure for sucking mucus using a sterile disposable suction cannula usually placed on the edge of a vacuum system. The advantage of this type of suction is that it reduces the growth of bacteria in the catheter tube because it is always new and disposable. The disadvantage is that each time it is used it must be new and sterile so the costs incurred are quite high.

#### 2. Closed Suction

Closed suction is a cannula with a closed system that is usually connected to the ventilator circuit and its user needs to open the connector so that the incoming air flow does not come out. The advantages are preventing contamination of air from outside, preventing the loss of air supply from the lungs, preventing hypoxia and preventing a decrease in oxygen saturation. The disadvantage of this type of suction is that within 24 hours it allows significant bacterial growth on the surface

of the catheter.

#### 2.2.4 Suction Side Effects

The suction procedure is not only important for clearing the airways but can also cause various side effects, including:

##### 1. Hypoxemia

Hypoxemia is a decrease in the level or partial pressure of oxygen in the blood. Hypoxemia is the most common side effect because the suction process can remove not only mucus or secretions but also oxygen in the respiratory tract. This can cause a decrease in oxygen saturation levels in the blood. Previous research by Kai, et al. (2021) on 833 adult postoperative subjects diagnosed with respiratory system disease and given suction showed that more than one-fifth of the subjects in the study after suction experienced a decrease in

SpO<sub>2</sub> levels <90% for > 10 minutes. Hypoxemia can cause serious complications if not treated immediately, namely brain dysfunction, dysrhythmia, myocardial ischemia and death.

## 2. Airway Trauma

Suctioning can cause trauma to the tracheal and bronchial mucosa. This is a risk of injury due to the catheter entering the respiratory tract which can cause bleeding or irritation. Research conducted by Farnell, et al (2002) recommends that the number of phases in one period of mucus suction or suction is no more than 3 times, because it will potentially cause complications from suction, namely trauma to the respiratory tract mucosa.

## 3. Dyspnea

Changes in vital signs are a common side effect in some patients after being given suction. When secretions partially block the airways, there is a decrease in tidal volume which results in decreased oxygen saturation so that the body compensates by increasing the respiratory rate and increasing the heart rate (Lesmana, 2015). Research by Schell, et al (2006) showed that head injury patients who received suction experienced changes in vital signs, one of which was an increase in respiratory rate to 26-27x/minute. This is caused by irregularities in the respiratory pattern (rapid inspiration and expiration) due to cough receptor stimulation by the suction catheter touching the carina, resulting in a cough response.

## 4. Heart Rhythm Disorders

Suctioning can trigger heart rhythm disturbances such as tachycardia, bradycardia, arrhythmia and dysrhythmia which are a response to physical stress during the procedure.

#### 5. Anxiety and Dyspepsia

Patients may experience discomfort or anxiety during and after suctioning. This is due to the discomfort caused by suctioning mucus.

#### 6. Nosocomial Infection

If the suction procedure is not performed with proper aseptic technique, there is a risk of nosocomial infection. Microbial contamination can occur during the suction process, especially if the equipment used is not sterile.

## **2.2 Oxygen Saturation Concept**

### **2.2.1 Definition**

According to (Marlisa & Situmorang, 2019) oxygen saturation is the percentage of hemoglobin bound to oxygen in the arteries. Normal oxygen saturation levels are usually in the average range of 95-100%. Oxygen saturation is the ratio or actual amount of oxygen bound by hemoglobin (blood) to the total ability of blood to bind oxygen (Fadlilah, et al., 2020).

Oxygen saturation is the ability of hemoglobin to bind oxygen and is indicated as saturation (SaO<sub>2</sub>). The highest saturation (saturated) is 100%, meaning that all hemoglobin binds oxygen. Conversely, the lowest saturation is 0%, meaning that no oxygen is bound by hemoglobin. The normal oxygen saturation value is above 95% (Rupii, 2016).

### **2.2.2 Factor affecting**

Factors that influence oxygen saturation or the adequacy of circulation, ventilation and transport of respiratory gases to the tissues are:

#### **1) Physiological factors**

Any condition that affects cardiopulmonary will affect the body's ability to meet oxygen requirements. The position of the patient during suctioning can also have an effect. Certain positions can increase airflow and improve measurements, thereby increasing oxygen saturation.

#### **2) Development factors**

Developmental stage (Age) and the aging process will affect tissue oxygenation. The ability of the lungs to synthesize surfactant develops slowly during pregnancy. Ventilation and gas transfer decline with increasing age.

### 3) Activity factor

Behavior or lifestyle, either directly or indirectly, will affect oxygen needs. Some activities that can affect oxygen needs include: physical exercise, smoking, drug abuse and stress. Shivering or excessive movement can affect accurate SpO<sub>2</sub> readings.

#### 4) Suction technique

The duration and pressure of suction can affect oxygen saturation. Suction performed using too high a pressure or for too long a duration can cause decreased oxygen saturation (hypoxemia).

#### 5) Hemoglobin levels

Low hemoglobin levels can reduce the blood's capacity to bind oxygen, thus affecting oxygen saturation. Patients with anemia tend to have lower oxygen saturation.

### **2.2.3 Oxygen Saturation Measurement**

Continuous capillary oxygen saturation measurement can be done using transcutaneous oximetry. The advantages of measuring using transcutaneous oximetry include: easy to do, easy to obtain, non-invasive. This oximetry is also painless and suitable for patients with indications of or experiencing perfusion or ventilation disorders such as pneumonia, emphysema, bronchitis, etc.

The most commonly used oximeter is the pulse oximeter. Pulse oximeter helps measure the amount (percentage) of oxygen saturation in the blood through a probe (sensor) that is attached to the fingertip via a specially designed clip. The sensor will detect changes in the amount of oxygen saturated in hemoglobin by monitoring the signal produced by the light beam on the sensor. The result of the oximeter is a basic indication of oxygen saturation in hemoglobin by estimating blood pulses (blood perfusion) through the soft tissue on the side of the probe. The measurement result can be read as a percentage of oxygen saturation ( $\text{SaO}_2$ ) which is often recorded as  $\text{SpO}_2$  or  $\text{SaO}_2$ .

Tabel 2. 1 Oxygen Saturation Assessment Range

	Normal	Abnormal
Oxygen Saturation	95-100%	Mild Hypoxia 90-95% Moderate Hypoxia 85-90% Severe Hypoxia <85%

## **2.3 The Concept of Respiratory Rate**

### **2.3.1 Definition**

According to (Riki, 2018) Respiratory Rate (RR) or Respiratory Frequency is the number of complete respiratory cycles from inspiration to expiration which is calculated in a time span of one minute or equivalent to 60 seconds. In the respiratory system, there is a frequency that will determine the percentage value of the patient's respiratory system condition. The respiratory frequency is calculated in one minute to determine whether the patient's breathing is still in the normal category or not (Tarigan, 2022).

### **2.3.2 Factor affecting**

There are several factors that can affect breathing frequency according to (Riki, 2018), including:

#### 1) Age

Age is related to the aging process or the increase in the number of years of a person's life. As age increases, the possibility of decreased lung function also increases. The need for energy continues to increase until it reaches its peak after the age of 40, then decreases due to decreased physical strength. Normally, age also affects the respiratory rate and lung capacity. In adults, the respiratory rate ranges from 16-18 times per minute, while in children it is around 24 times per minute, and in infants around 30 times per minute. Although the respiratory rate in adults is lower than in children and infants, the respiratory rate value in adults is higher than in children and infants. However, under certain conditions, such as due to illness, breathing can become faster or

vice versa.

## 2) Health conditions

Systemic illness or acute conditions such as infection or pain can increase the respiratory rate as the body compensates to meet the increased oxygen demands.

## 3) Drugs

The use of sedatives or anesthetics can suppress the respiratory center in the brain which can have an impact on the patient's respiratory rate.

#### 4) Physical activity

The intensity of heavy physical activity will increase the body's oxygen needs, so that the respiratory rate will increase to meet the oxygen supply.

#### 5) Emotions and Stress

Anxiety or emotional stress can cause an increase in breathing rate as the body's physiological response to a stressful situation.

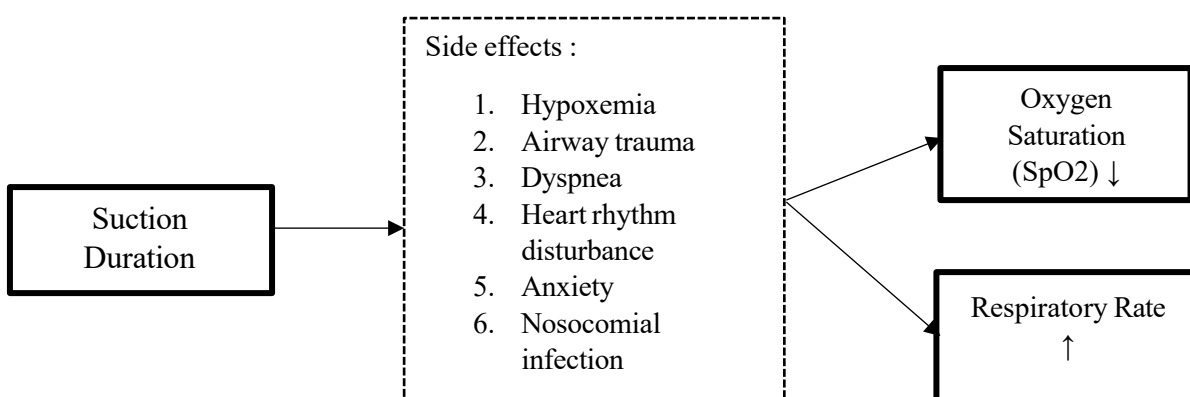
### 2.3.3 Rating Range

According to (Andarmoyo, 2012) the assessment of respiratory frequency can be calculated as follows

Tabel 2. 2 Respiratory Rate Assessment Range

Respiratory Rate	Normal	Abnormal
	16-20 x/minute	Tachypnea >20 x/minute Bradypnea <16 x/minute

### 2.4 Conceptual Framework



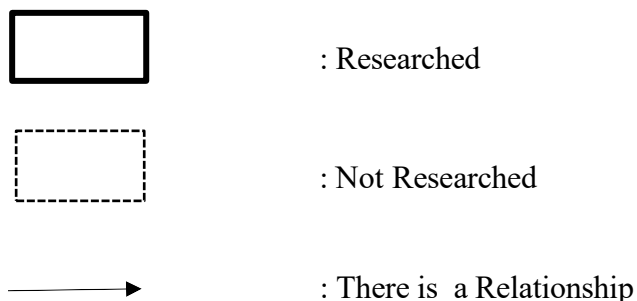
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Figure 2.1 Conceptual Framework

According to Kozier (2013), the action of suctioning mucus or suction is influenced by several factors including suction pressure, preoxygenation before suction, patient position, suction duration and the size of the suction catheter. The larger the size of the suction catheter used, the narrower the ETT lumen for atmospheric air to enter and increase the oxygen in the lungs that is sucked. Likewise, the suction pressure must be adjusted to the size of the suction, because the higher the pressure used, the higher the risk of a decrease in vital signs. The recommended suction duration is a maximum of 10 seconds, if more than that there is a risk of hypoxia. Suction action can cause a decrease in oxygen saturation and respiratory rate. This is because the stimulus of the cough receptor by the suction catheter touches the carina, resulting in irregular breathing patterns (rapid inspiration and expiration) which has an impact on decreasing oxygen saturation so that the body compensates by increasing the respiratory rate.

## **2.5 Research Hypothesis**

According to Muchsinin (2020) technically, a hypothesis is a statement about the state of a population whose truth will be tested through data obtained from research samples. The hypothesis of this study is:

There is a relationship between suction duration and oxygen saturation and respiratory rate in Intensive Care Unit (ICU) patients.