

# A QUICK GUIDE FOR FOUR CARDIAC ARREST RHYTHMS

A self-study material for supporting nursing student to recognize the life-threatening ECG rhythms during their advanced practical placements.

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## Abstract

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<p>Cardiac arrest is a medical emergency in which the heart cannot preserve an adequate blood circulation due to the loss of heart function. Failure to treat immediately may result in cardiac arrest death. As a healthcare professional, it is essential knowledge to distinguish between each cardiac arrest rhythm before treating a patient. Identifying electrocardiogram (ECG) rhythms is very difficult for the undergraduate nursing student and new graduate nurses. Rapidly interpreting these cardiac arrest rhythms is an essential skill that every nurse should master, especially in the critical care units.</p> <p>This bachelor's thesis aimed to create four flash cards, which give basic knowledge of the four cardiac arrest rhythms recognizing that are used for the nursing student without going too deep into the medical disease or physiological details. The purpose of this functional thesis was to be a contributor to the development of nursing students' professional skills on four cardiac arrest ECG strips rhythms understanding so that they can implement better professional knowledge during their advanced practical placements.</p> <p>This functional thesis consists of both theoretical part and final project output. Theoretical part includes the basics of cardiac anatomy, physiology, electric conduction, interpreting electrocardiogram rhythm strips, and the self-study material theory background of four cardiac arrest rhythms. It also includes the final output which is the streamlined report of the theoretical part, the creation of a final product is four cardiac arrest rhythms quick identification as a self-study material aimed at Lahti University of Applied Sciences nursing students.</p>		
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Cardiac arrest rhythms, Life-threatening ECG, Self-study material, VT, VF, PEA, Asystole, Nursing student.		

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<p>Tiivistelmä</p> <p>Sydänpysähdys on lääketieteellinen hätätilanne, jossa sydän ei voi säilyttää verenkiertoa, koska sydämen toiminta on menetetty. Jos potilas ei saa hoitoa välittömästi, se voi johtaa kardiaalin pysäyttämiseen. Terveystieteiden ammattilaisena on olennaisen tärkeää erottaa jokainen sydänpysähdysrytmi ennen potilaan hoitoa. EKG-rytmien tunnistaminen on erittäin vaikea perustutkinto-opiskelijalle ja uusille jatko-sairaanhoitajille. Mutta näiden sydänpysähdysten rytmien nopea tulkinta on olennainen taito, joka jokaisella sairaanhoitajalla on oltava, etenkin kriittisen hoidon yksiköissä.</p> <p>Opinnäytetyön tarkoituksena oli luoda neljä flash-korttia, jotka antavat perustaidon neljästä sydänpysähdysrytmistä, jotka tunnistavat, että niitä käytetään hoitotyön opiskelijalle menemättä liian syvälle lääketieteellisiin sairauksiin tai fysiologisiin yksityiskohtiin. Tämän opinnäytetyön tarkoituksena on edistää hoitotyön opiskelijoiden ammatillisten taitojen kehittymistä neljällä sydämenpysähdyksen EKG-rytmien käsitteillä, jotta he voivat suorittaa parempia ammattitaitoja edistyneiden käytännön harjoittelujen aikana.</p> <p>Tämä toiminnallinen opinnäytetyö koostuu sekä teoreettisesta osasta että lopullisesta projektin tuotoksesta. Teorian osa sisältää sydämen anatomian, fysiologian, sähköjohtavuuden, elektrokardiogrammin rytmiauhon tulkinnan ja neljän sydänpysähdysrytmin itsetutkimuksen teorian taustan. Se sisältää myös lopputuotannon, joka on teoreettisen osan virtaviivaistettu raportti, lopputuotteen luominen on neljä elvytysrytmiä, jotka tunnistetaan nopeasti itsenäisenä oppimateriaalina.</p>		
Asiasanat Sydänpysähdysrytmit, Hengenvaarallinen EKG, Itseopiskelumateriaali, VT, VF, PEA, Asystolia, Sairaanhoitaja opiskelija.		

## CONTENTS

1	INTRODUCTION.....	1
2	AIM, PURPOSE, AND OBJECTIVE OF THE THESIS.....	3
3	NURSES ROLE IN A CARDIAC ARREST SITUATION.....	4
4	CARDIOVASCULAR SYSTEM.....	6
4.1	Cardiac anatomy.....	6
4.2	Physiology.....	7
4.3	Electrical conduction.....	8
4.4	Electrocardiogram (ECG) waveforms.....	9
4.5	Interpreting ECG rhythm strips.....	10
5	FOUR CARDIAC ARREST RHYTHMS.....	12
5.1	Ventricular Tachycardia (VT).....	12
5.2	Ventricular Fibrillation (VF).....	14
5.3	Pulseless Electrical Activity (PEA).....	17
5.4	Asystole.....	19
6	THE PROCESS OF THE THESIS.....	22
6.1	Functional thesis.....	22
6.2	Ideas and planning.....	23
6.3	Self-study material and preparatory questionnaire.....	24
6.4	Feedback of self-study material.....	26
7	DISCUSSION.....	29
7.1	The process of developing self-study material.....	29
7.2	Ethical considerations.....	30
7.3	Reliability and validity.....	30
7.4	Further development of the self-study material.....	31
	REFERENCES.....	33
	APPENDICES.....	42

## 1 INTRODUCTION

Cardiac arrest is a serious malfunction or stop of the electrical and mechanical activity of the heart. There are four primary alterations in the electrical activity of the heart that are associated with cardiac arrest: Ventricular Tachycardia (VT), Ventricular Fibrillation (VF), Pulseless Electrical Activity (PEA) and Asystole. (Keller & Halperin 2015) Cardiac arrest is a medical emergency requiring rapid decision making. In-hospital cardiac arrest is very commonly associated with low survival rates. The survival rate decreased with increasing age, increasing the time to defibrillation, increasing duration of resuscitation and was particularly low following PEA and asystole. (Das, Ghafur, Murshed & Charkovortty 2016, 123)

The American Heart Association (AHA) and the European Resuscitation Council (ERC) state that cardiac arrest effects on the average one person in a thousand every year (Danielle 2012,1). Sudden cardiac arrest is a significant cause of mortality in Europe. In the United States, the incidence of sudden cardiac arrest is about 300,000 per year, which is the primary cause of sudden cardiac death (Marill, Kazzi, Khalil & Bright 2015). The incidence of out-of-hospital cardiac arrests was 51/100 000 inhabitants in Finland (Hiltunen, Silfvast, Rutanen, Vaahersalo & Kurola 2012, 1).

Despite advanced medical achievements in prevention and treatment of cardiovascular diseases, poor following a sudden cardiac arrest with most individuals not surviving, which is leading to half of all sudden cardiac deaths from a cardiovascular disease (Wong, Brown, Lau, Chugh, Albert, Kalman & Sanders 2018, 6) Cardiac arrest is the most life-threatening condition both in-hospital and out of hospital (Karim 2016, 6). In-hospital cardiac arrest is a common problem, with an estimated 6.65 cases per 1,000 inpatients and has a very high mortality rate. Mortality is highly correlated with the first-determined arrest rhythm. Pulseless electrical activity (PEA) and asystole are associated with survival rate to hospital discharge was about 10%, and ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT) were associated with a survival rate to hospital discharge was about 35%. (Straznitskas, Wong, KupchiK & Carbom 2015, e23)

Cardiac arrest occurs when there is no active cardiac output. Cardiac arrest care is a new challenging hospital specialty that provides specialized treatments for patients with life-threatening rhythms. The primary goals of cardiac arrest treatment are to facilitate the return of spontaneous circulation and to avoid death and any physical or neuroglial damage. Distinguishing each of the cardiac arrest rhythms and effective cardiac life support must be established before starting any specific treatment. It depends on how a cardiac arrest

rhythm was recognized and how the staff reacted to these rhythm changes. (Graham, McCoy & Schultz 2015)

As a part of his thesis, I developed a self-study material for the nursing student of Lahti University of Applied Sciences. I wanted to choose a theme for my thesis that is interesting to me and also has some tangible benefits for the nursing student. My functional thesis aimed to make self-study material. The purpose of my thesis output is to improve the knowledge of four cardiac arrest rhythms for the nursing student and helps them recognize the life-threatening ECG rhythms without delay.

## 2 AIM, PURPOSE, AND OBJECTIVES OF THE THESIS

The aim of this bachelor's thesis was to create four flash cards, which give basic information of the four cardiac arrest rhythms recognition that are used by the nursing student without going too deep into the medical disease or physiological details. The main focus was on the interpretation of four cardiac arrest rhythms electrocardiograms (ECG) that have some very unique features, such as Torsade's de Pointes which means the QRS morphology and axis continuously change. I tried to make this self- study material is easy to understanding and easy to carry, so students can always study it at any time anywhere independently.

The purpose of this functional thesis was to be a contributor to the development of nursing students' professional skills on four cardiac arrest ECG strips rhythms understanding so that they can perform better professional knowledge during their advanced practical placements. Thus, they will be able to identify the most common life-threatening ECG findings that require an immediate response, as well as perform high-quality critical care skills. All this ultimately leads to the hope that patients will receive prompt treatment too.

The objective of this thesis is to serve as a self-study material for nursing students who are undergoing advanced clinical training. These advanced placements play the most challenging learning and practicing role among pre-registration nurses. This thesis is supporting the student to learn the four cardiac rhythms and demonstrate the knowledge during the advanced practice placements, when the student sees the changing of rhythms on the monitor, the student is able to recognize the life-threatening rhythms and initiate CPR while pressing the emergency alarm button, because the arrhythmia of patients might change in any blinking time.

### 3 NURSES ROLE IN A CARDIAC ARREST SITUATION

Cardiac arrest is defined as a clinical condition characterized by a disappearing of a pulse, blood pressure or respiration, loss of consciousness and collapse, which can lead to death if a treatment is not provided quickly. Cardiac arrest can happen at any time, attack at any age, race, or gender that looks healthy and usually does not issue a warning. The survival rate depends on the first witness. (Graham et al. 2015) A crucial factor in improving survival is time. An action must be taken as early as possible to increase the recovery of satisfactory neurological function in long-term survival. (Daniele 2012, 1)

Under normal conditions, the sinus node initiates and spreads an electrical signal to the right atria and left atria, causing the atria to contract and pump blood into the ventricles. The electrical signal then travels from the atrioventricular node to the right ventricle and left ventricle, causing them to contract in a coordinated sequence and pumping blood from the heart to the lungs and the rest of the body. When the signal disappears, the ventricle relaxes, and the process begins again after a reasonable delay. Cardiac arrest results in almost momentary loss of consciousness and collapse, which will lead to death without immediate medical intervention. (Graham et al. 2015)

A nurse often witnesses in-hospital cardiac arrests, and their survival rates are related to the first witness to give Advanced Cardiac Life Support and perform defibrillation. A Singapore study (Heng, Fong, Wee & Anantharaman 2011) shows that nurse could play the following roles in the resuscitation of cardiac arrest in a hospital setting. The first role is as a member of the resuscitation team, performing a good quality cardiopulmonary resuscitation (CPR), recognizing shockable rhythms (VF and pulseless VT) and delivering defibrillation, managing airway and the effective use of a bag-mask ventilator, placing intravenous lines and tubes. Also, nurses could play other roles: They could be in charge of the resuscitation documentation. The nurse could be a resuscitation instructor. (Heng, Fong, Wee & Anantharaman 2011, 611-613)

In a study of nursing management of cardiac arrest in Cuneo's emergency departments in Italy there were 95.6% of four initial rhythms of cardiac arrest. Another 4.4% were unknown rhythm. The finding was that 3.3% of nurses were not feeling safe in the management of the cardiac arrest regarding their skills. Many factors influence a nurse's confidence, but the main factors are experience and training which can help the nurse act confidently to ensure proper care for the patient. The nurses themselves were aware of their skills shortages and needed further training. All investigated nurses had attended Basic Life Support Defibrillation and TRIAGE course. In this finding, there are 68% of the nurses participated in the Advanced Life Support (ALS) less than three years ago. Therefore,

fresh and new training with an emphasis on quality is crucial. It's also important to ensure the skills and knowledge learned are maintained and updated. (Daniele 2012, 9-10)

However, the understanding of life-threatening ECG is the most essential nursing competence, especially for the nurses who are working in the critical care units. The competency evaluation of intensive and critical care nursing education and practice is essential for the nurses' professional development (Lakanmaa 2015,1). As the study shows, nursing student's ability to manage appropriately in a life-threatening situation is the most important to practice (Shearer & Lasonen 2018, 136-137). Clinical training is paramount importance part of nursing education, where the nursing student transfer the learned theories to the clinical training settings, so that there are several tools for clinical evaluation, but the component of assessment is mainly the same, such as professional behaviors, critical situations examination, decision-making (Saied, James, Singh & Humaied 2016, 9).

As studies reveal newly graduated nurses are not prepared to enter the practice, lacking the required critical thinking and skills necessary to provide safe care. The Nursing Education Programs are implemented to ensure students are prepared for the demands of the current healthcare system. (Elizabeth 2017, 16) Numerous e-learning platforms are increasingly used in nursing education and practice development. In a Turkey study (Parlakkilic 2015), a modular course design and rapid e-learning were used together in the education of 3<sup>rd</sup> year nursing students for three months. The effectiveness of this hybrid method was educationally more effective than the traditional way when compared with previous studies. (Parlakkilic 2015, 11-14) There are many articles that studied different education methods to improve the ECG skills of undergraduate students. One study explored the differences between a videoconference and traditional classroom ECG learning for nursing students. The results show overwhelming satisfaction with a videoconference-based lecture. (Celikkan, Senuzun, Sari & Sahin 2013, 286)

## 4 CARDIOVASCULAR SYSTEM

### 4.1 Cardiac anatomy

The human heart has complex anatomy and is a continually moving dynamic organ (Pasipoularides 2010, 299). The heart consists of four hollow chambers. The two upper chambers are called atria (Figure 1) which is receiving blood returning to the heart and send into the ventricles. The other two lower chambers are called ventricles (Figure 1) which pump blood out of the heart, and they serve as the primary pumping chambers of the heart (Dyer 2014, 140). The heart contains four one-way valves separating the heart's chambers, and the valves are preventing blood from flowing backward and clogging up the atria. The opening and closing of the valves are controlled by blood pressure changes within each heart chamber (Dyer 2014, 141). In figure 1 we can see the four valves; each set of the valves operates at a different time. Two atrioventricular valves, or AV valves (the mitral and tricuspid), separate the atria and the ventricles. AV valves are open with ventricular diastole and close with ventricular systole. The other two semilunar valves (the pulmonic and aortic) separate the ventricles from the blood vessels leaving the heart, they are open with ventricular systole and close with ventricular diastole. (Elaine 2015, 385-387).

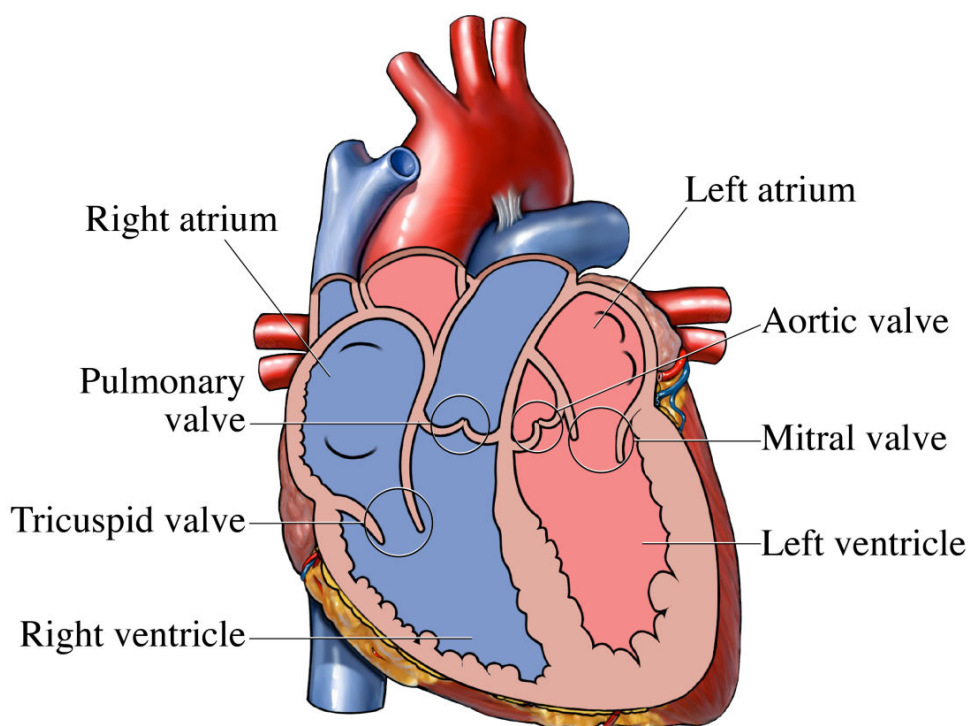


Figure 1: Valves and Chambers of Heart (Nucleus Medical Media 2018).

## 4.2 Physiology

The heart pumps the blood in order to move essential nutrients through the blood vessels to nourish and remove the potentially damaging waste products and carbon dioxide from the body (Tucker & Foulston 2015, 82). The heart, blood vessels, and blood are the three principal components that make up the cardiovascular system. This cardiovascular system brings life-sustaining oxygen and nutrients to the body's cells. (Dutton, Elliott & Sargent 2012, 108)

Blood follows a one-way path through the heart and vascular system in a certain direction under the action of the heart pump. The human circulatory system is a two-cycle closed system consisting of the pulmonary circulation and systemic circulation (Rogers & Scott 2011, 99). The pulmonary circulation carries deoxygenated blood returns to the heart from the body (Figure 2) through inferior and superior vena cava → Right Atrium → Tricuspid Valve → Right Ventricle → Pulmonary Valve → Lungs → Pulmonary System (Boyette & Burns 2019). The systemic circulation carries oxygenated blood returns to the heart from the lungs (Figure 2) through pulmonary veins → Left Atrium → Mitral Valve → Left Ventricle → Aortic Valve → Systemic Circulation (Tucker & Foulston 2015, 88).

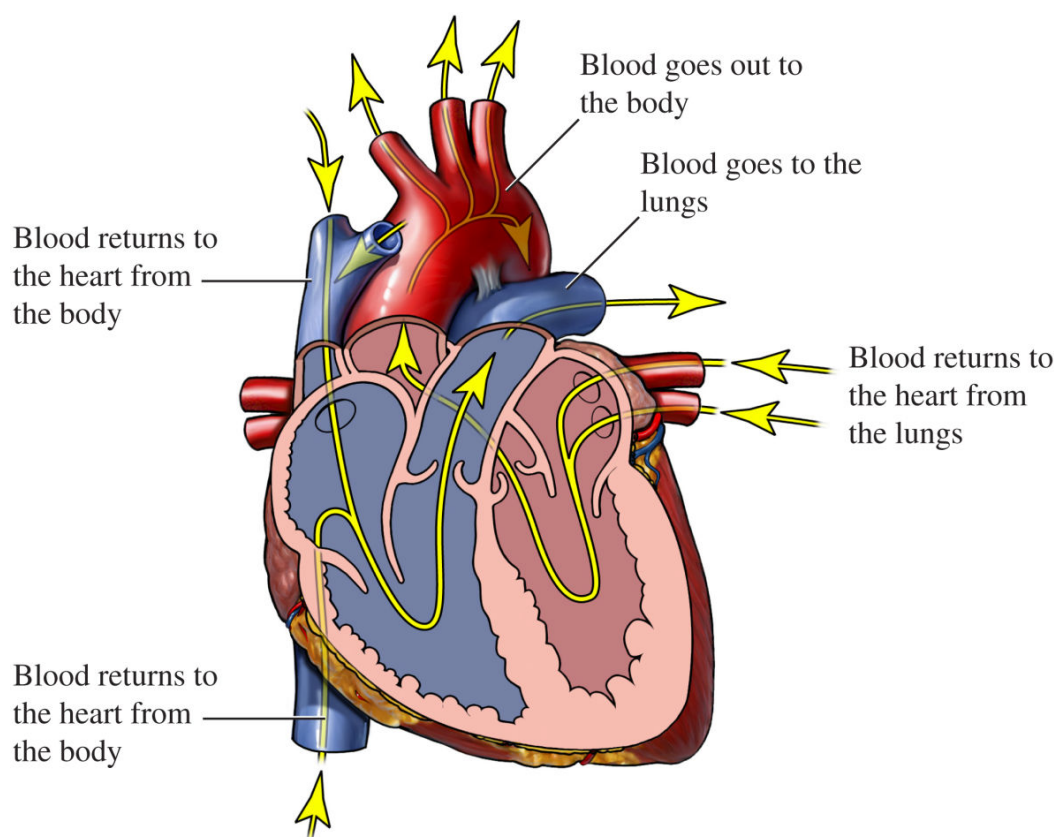


Figure 2: Cardiac Cycle- Blood flow Through the Heart (Nucleus Medical Media 2018).

The cardiac cycle represents the sequence of ventricular contraction and ventricular relaxation, that is the time from the beginning of one heartbeat to the beginning of the next (McLaughlin 2014, 17). The cardiac cycle has systole and diastole two major phases: Systole is a period of ventricular contraction whereby the heart pumps blood forward; Diastole is a period of ventricular relaxation and ventricles fill passively from the atria to 70% of blood capacity (Knapp 2015, 11). The intrinsic conduction system applies a contraction rate of approximately 60-100 beats per minute on the heart (Dutton et al. 2012, 113).

#### 4.3 Electrical conduction

In order to keep the blood circulating in the cardiovascular system, the heart has two separate but interrelated systems: an electrical system that tells the mechanical system how and when to pump; A mechanical mechanism that pumps blood (Walraven 2016, 444). Cardiac cells have the unique ability to depolarize rhythmically, they can and do contract spontaneously and independently, even if all nervous connections are severed (Elaine 2015, 388). The conduction system of the heart begins with the heart's pacemaker: the sinoatrial (SA) node (Figure 3). When an impulse leaves the SA node, it travels through the atria along with Bachmann's bundle and the intermodal track on its way to the AV node. After the impulse passes through the AV node (Figure 3), it travels to the ventricles, first down the bundle of His (Figure 3), then along the bundle branches and, finally, down the Purkinje fibers (Figure 3) (Dyer 2014, 143). This entire process takes less than a second, which is the time required for a single heartbeat (McLaughlin 2014, 17).

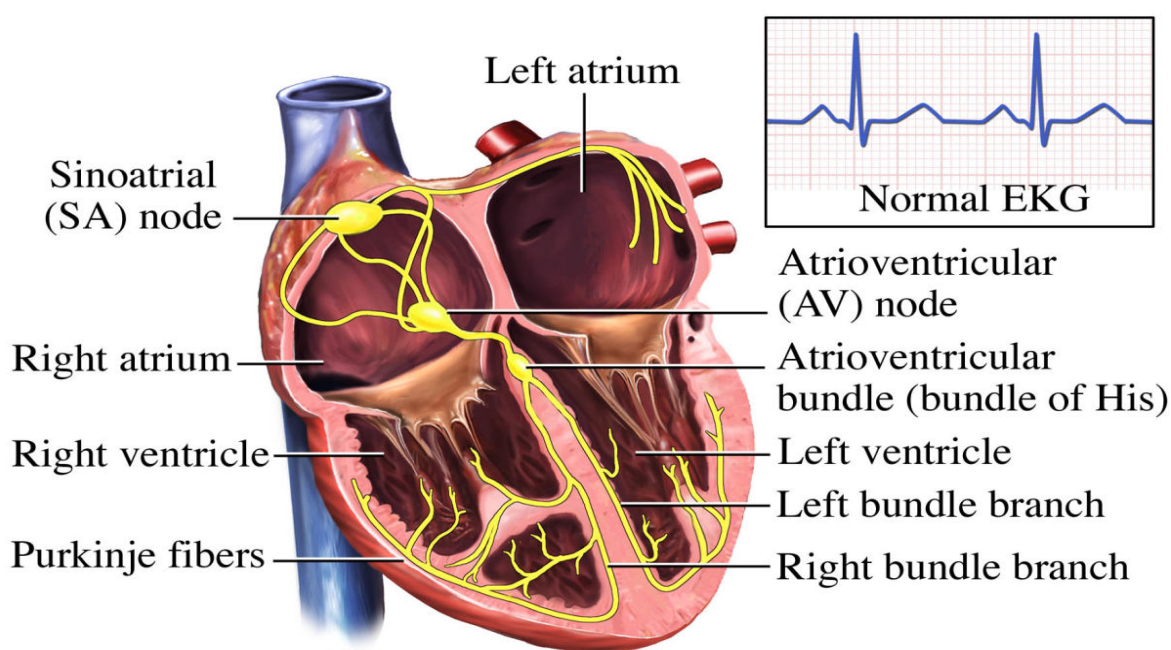


Figure 3: Electrical System of the Heart (Nucleus Medical Media 2018).

Moreover, these spontaneous contractions occur in a regular continued way. Although the cardiac muscle can beat independently, the muscle cells in different areas of the heart have different rhythms. The conduction system has two built-in safety mechanisms. If the SA node fails to fire, the AV node generates an impulse between 40 and 60 times per minute. If the SA node and the AV node fail, the ventricles can generate their own pulse between 20 and 40 times per minute. (McLaughlin 2014, 17)

#### 4.4 Electrocardiogram (ECG) waveforms

Each complete cardiac cycle is made up of three major components: P wave, QRS complex and a T wave (Figure 4) (Fiona & Helen 2010, 31). The P wave represents the atrial depolarization. A depolarization wavefront spreads down from the SA node to the right and left atrium simultaneously, the complete depolarization of the atria gives raised P wave (Figure 4) on the surface of ECG. (Kaye, Lemery & Furniss 2013, 7) The QRS complex is a larger complex which represents a depolarization of the ventricles and repolarization of atrial, which occurs as the wave of depolarization passes down the bundle of His, the right and left bundle branches and Purkinje fibers (Walraven 2016, 22). The T wave represents ventricular repolarization as the myocardial cells return to their resting charge; it's associated with the diastole (Coviello 2016, 49).

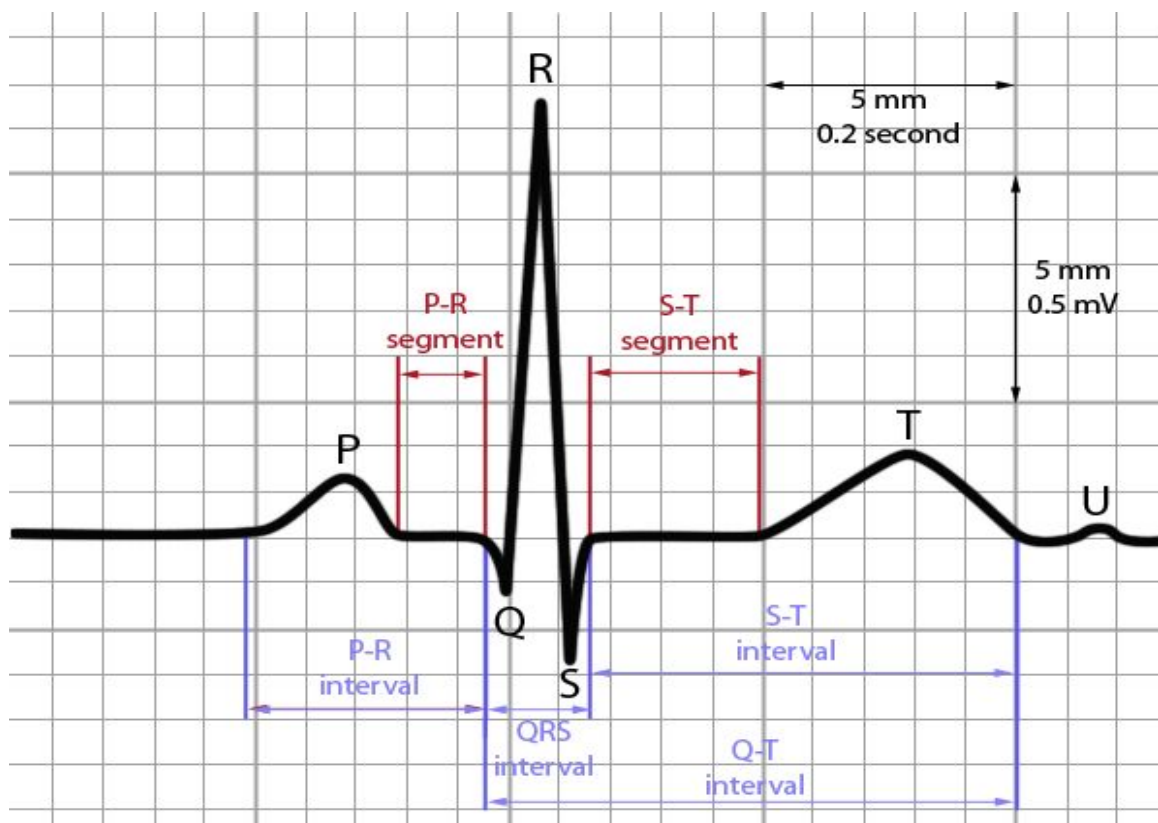


Figure 4: Electrocardiogram intervals (The McGill Physiology Virtual Lab 2019).

## 4.5 Interpreting ECG rhythm strips

When the cardiac conduction system is activated, the respective parts of the atria and ventricles contract accordingly. As the depolarized waves spread through the muscle fibers of each chamber, the exchange of positively charged ions enters and exits the muscle cells. This produces a voltage change that can be recorded on the cardiac monitor as an ECG rhythm. (Dutton et al. 2012, 108) A 12-lead ECG or 15-lead ECG are indicated for suspected clinical conditions, such as myocardial infarction (MI), angina, arrhythmias, electrolyte imbalance, pericarditis, and chronic obstructive pulmonary disease. It is used as a quick completion and non-invasive diagnostic test. (Goldworthy 2016, 101)

The waveform generated by the heart's electrical current is recorded on the graphed ECG paper by a stylus. ECG paper consists of horizontal and vertical lines forming a grid. The horizontal axis of the ECG strip represents time. Each small block is equal to 0.04 seconds, and five small blocks form a large block equal to 0.2 seconds (Figure 4). The vertical axis of the strip measures the amplitude in millimeters (mm) or the electrical voltage in millivolts (mV). Each small block represents 1 mm or 0.1 mV; each large block represents 5 mm or 0.5 mV (Figure 4). To determine the magnitude of a wave, segment, or interval, calculate the number of small blocks from the baseline to the highest or lowest point of the wave, segment, or interval. (Coviello 2016, 39)

The following five primary step approach is recommended as a systematic way to ECG interpretation, and they are a rate, rhythm, P wave, PR interval, and QRS complex (Sampson 2016, 71). It is always important to assess the patient's condition before analyzing the ECG rhythm (Goldworthy 2016, 101).

**Heart rate:** Calculate the heart rate by looking at the R waves that fall on one of the thick black lines. Use the sequence 300-150-100-75-60-50-43-37. Count from the first thick line is 300, the next thick line 150, etc. Stop the sequence at the next R wave. When the second R wave is between two lines, take the mean of the two numbers from the sequence. This method of calculating heart rate works well for impulse within the sinus node, which means there is an upright P wave before each QRS complex on the ECG paper. (Knechtel 2017, 48-50) This is just one way to calculate heart rate. I am not going to explain the other two methods because my topic is focused on four cardiac arrest rhythms.

**Heart rhythm:** A sequential beating of the heart as a result of the generation of electrical impulses. Atrial rhythm is measured by the P-P intervals for several cycles; if the P-P intervals are constantly similar, atrial rhythm is regular; if not, atrial rhythm is irregular (Coviello 2017, 28). The ventricular rhythm is measuring the intervals between R waves across

the ECG, if the QRS complexes march out at even intervals all the way across the page, the ventricular rhythm is considered to be regular; If the intervals between the R waves are variable and dissimilar, the ventricular rhythm is considered to be irregular (Knechtel 2017, 57).

**P Wave:** P wave is produced when the left and right atria depolarization, which is at the first deviation from the isoelectric line (Thaler 2014, 94). The P wave time is 0.06-0.12 seconds in duration (Fiona & Helen 2010, 33). If the P wave is upright, round, smooth, and there is a P wave before each QRS complex, it can be assumed that the electrical pulse originated in the right atrium sinus node (Coviello 2016, 43-44).

**PR Interval:** The PR interval is measured from the beginning of the P wave to the beginning of the QRS complex. Which is includes both P wave and PR segment? It measures the time interval from the beginning of an atrial contraction to the beginning of ventricular contraction. A normal PR interval is 0.12- 0.20 second. When conduction from the atria to the ventricle is blocked, it appears as an extension of the PR interval or disappearance of the ventricular wave after the P wave. (Coviello 2016, 45)

**QRS Complex:** The QRS complex presents depolarization or contraction of the ventricles. The normal duration of the QRS complex is 0.06 - 0.12 seconds (1.5 to 3 small boxes) and is measured from the beginning of Q wave to the end of the S wave (Coviello 2017,29). When there is a conduction block of the left and right branches of the heart, ventricular enlargement or hypertrophy, the QRS complex appears to be broadened, deformed, and prolonged. Deep, wide Q waves may represent myocardial infarction (Knechtel 2017, 90-108).

## 5 FOUR CARDIAC ARREST RHYTHMS

### 5.1 Ventricular Tachycardia (VT)

Ventricular tachycardia (VT), also known as wide-complex tachycardia or V-tach, refers to the rapid ventricular contraction and the ventricular rate frequency exceeding 100 beats/min. Sometimes up to 250 beats/min, when the heartbeat is this so fast that it's not able to circulate adequate oxygenated blood to the rest of the body. About 7% of patients with cardiac arrest are diagnosed with VT. (Baldizhar, Manuylova, Marchenko, Kryvalap & Carey 2016, 317-320) VT is an extremely unstable rhythm because it's of unpredictable. This arrhythmia may precede ventricular fibrillation (VF) and sudden cardiac death. It can occur brief burst of paroxysmal bursts lasting for fewer than 30 seconds and perhaps not cause any symptoms, or it can last for much longer and because symptoms require immediate treatment to prevent death, even in patients who initially able to maintain adequate cardiac output. (Coviello 2016, 151)

### ***Ventricular Tachycardias***

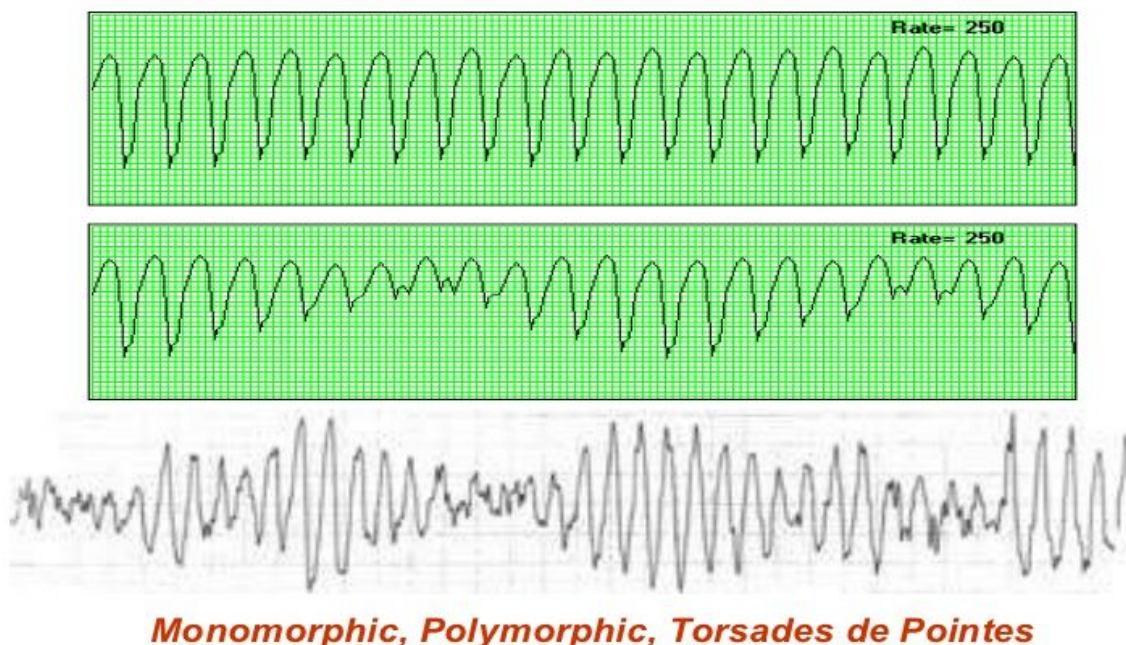


Figure 5: Monomorphic, Polymorphic, Torsades de Pointes Ventricular Tachycardias (George 2018)

When diagnosing VT with ECG, on the ECG strip (Figure 5), the atrial rhythm and rate can't be determined. The ventricular rhythm is usually regular, although it can be slightly irregular. The ventricular rate range is between 150-250 beats/ minute if the rate is below

150 beats/minute; it is considered a slow VT. If the rate greater than 250 beats/minute is considered ventricular flutter. P waves are usually absent and none P waves preceding each QRS complexes, but maybe see dissociated P waves intermittently across the strip. Retrograde P waves may be present. Since the rhythm originates in the ventricles, the PR interval won't be measured. The QRS complex will be wide and bizarre, and wide QRS complex means that the QRS complex is greater than three small boxes (0.12 second). If the T wave is visible, it is frequently in the opposite direction of the QRS complex. (Walraven 2016, 215)

VT is a broad complex tachycardia that originates in the ventricles. There are several types of VT, and the most being will be monomorphic VT. Monomorphic VT (Figure 5) has a uniform QRS complexes shape, which is all waveforms have the same morphology. But in polymorphic VT have a constantly changes QRS complexes shape. It because there are multiple foci that cause the ventricular complex to vary in shape and amplitude from beat to beat. (Burns 2017) Torsades de pointes (Figure5) is a special variant of polymorphic VT, which has a wide QRS complex with a phasic variation that seems to twist around the baseline. Typically occurs in no sustained bursts. Prolonged QT interval during breaks, QRS rates from 166-300, RR interval highly variable. (Nachimuthu, Assar & Schussler 2012)

Myocardial ischemia and infarction are significant factors of ventricular tachycardia (VT). Additional risk factors include mitral valve disease, heart failure, electrolyte imbalances such as hypokalaemia, drug intoxicant from digoxin, parathormone effects of some anti-arrhythmics. (Coviello 2016, 151) The symptoms can trigger shortness of breath because the body's tissues aren't getting enough oxygen, and it's going to breathe more. Most of the patients complained chest pain that's basically because the heart itself isn't getting enough oxygenated blood. VT can lead to angina, heart failure or significant reduction in organ perfusion. Another common symptom is feeling of palpitations, which is the sensation that the heart is beating out of the chest wall feels like a heart beating against chest wall like a drum, other symptoms can feel light-headed or dizzy, that's because the brain didn't get enough oxygen. (Baldizhar et al. 2016, 318-320)

Assessment is along with the whole process of the treatment. Evaluate the vital signs, pulse oximetry, and all physiologic systems. Administer 12-lead ECG, initiate continuous ECG monitoring and pulse oximetry, and obtain at least two channel of intravenous (IV); maintain the patient's safety, prevention of fall injury caused by dizziness, fatigue, confusion or syncope; assess the level of consciousness, low cardiac output can lead to hypotension and reduced levels of consciousness leading to no response; assess for history of

underlying structural or ischemic heart disease, particularly myocardial infection; Assess onset, duration, and severity of symptoms. (Compton 2017)

The treatment of VT is based on the patient's hemodynamic stability. In all cases, the goal of treatment is suppressed VT, because even if the patient is stable, the arrhythmia can degenerate into VF. Patients with VT who has hemodynamically stable is treated on an individual basis. For example, A hemodynamically stable patient with monomorphic VT is treated with medication amiodarone 150 mg slow iv at first, if the medication can't correct the rhythm disturbance, prepare the patient for synchronised cardioversion with 100 J. (Compton 2017) A patient with VT who is hemodynamically unstable require synchronized cardioversion, administration of IV antiarrhythmics. If the arrhythmia is associated with torsades de pointes. Administer magnesium sulfate 1-2 g diluted in 100ml D5W over 1-2 minutes. Amiodarone 150-300mg is also effective. (Nachimuthu et al. 2012)

VT is one of the shockable rhythms. Most patients with VT have weak or no pulse, if the pulse is undetectable with VT, should receive the same treatment as patients with VF, which requires immediate defibrillation and CPR (Coviello 2016,154). For example, a pulseless unstable monomorphic VT starts CPR immediately, defibrillator with 200J biphasic or 360 monophasic, resume CPR for 2 minutes, reassess the rhythm. Adrenaline 1mg, Amiodarone 300mg or Lidocaine 50-75mg and reattempt defibrillation, defibrillation can be continued as long as there is shockable rhythm. (ACLS Certification Institute 2019)

## 5.2 Ventricular Fibrillation (VF)

Ventricular fibrillation (VF) is a so-called V-fib, is a life-threatening cardiac arrhythmia which is a chaotic rhythm of electrical activity that results in uncoordinated contraction of the ventricles. As the electrical impulses arise from many different foci, which are firing in a chaotic, ineffective manner, and the heart is unable to contract in response. It does not produce effective muscular contraction and does not produce cardiac output. (Coviello 2016, 155) Untreated ventricular fibrillation is the single largest causes in up to 85% of patients in sudden cardiac death outside the hospital (Goyal & Rottman 2018). When the initial rhythm is VF rather than cardiac arrest or pulseless electrical activity (PEA), the mortality rate of cardiac arrest is lower. However, if VF occurs as a secondary rhythm after cardiac arrest or PEA, mortality will increase. (Straznitskas et al. 2015, e23)

On the ECG strip (Figure 6), the rhythm regularity, ventricular rate, P wave, PR interval, QRS complex, T wave, and QT interval can't be determined. They are chaotic with no discernible waves or complexes. As a result, there are no identifiable complexes or wave-forms; the ECG pattern of VF is simply a grossly chaotic fibrillatory pattern. (Walraven

2016, 217- 218) Fine ventricular fibrillation (Figure 6) has smaller waves, which is follows coarse ventricular fibrillation as the heart muscle depletes its metabolic stores the probability for successful defibrillation is significantly less with fine VF. Larger, or coarse fibrillatory waves are called coarse ventricular fibrillation (Figure 6), which is of recent onset and has a fairly high probability of successful defibrillation since the substrate for metabolism has not yet depleted. (Coviello 2016, 156)

## Ventricular Fibrillation

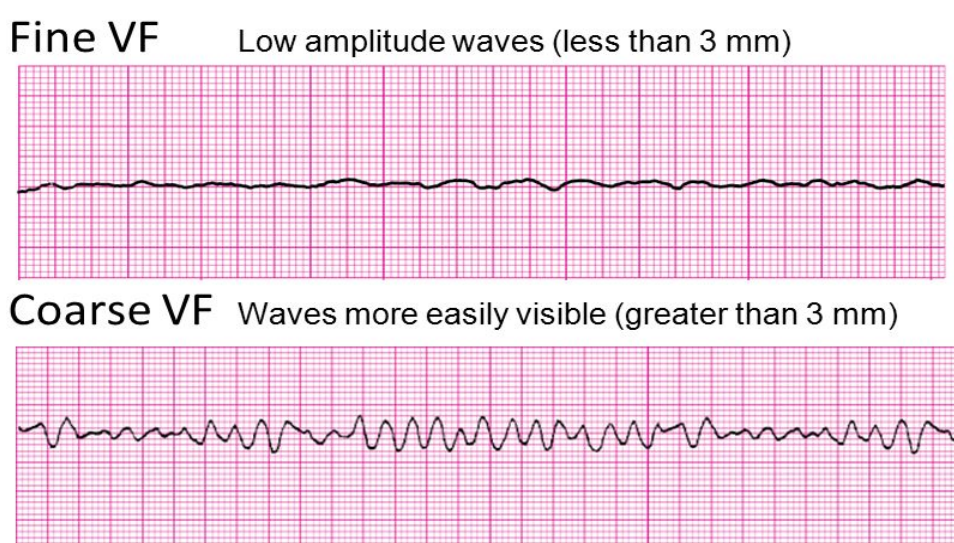


Figure 6: Fine and Coarse Ventricular Fibrillation (Silver Cross Emergency Medical Services System 2012, slide 83)

VF can be initiated by a variety of mechanisms and conditions; the most common underlying cause of VF is coronary artery disease due to myocardial ischemia and infarction (Burns 2018). Other risk factors can be untreated ventricular tachycardia, severe congenital heart disease, electrolyte imbalance, rapid changes in the levels of potassium or calcium in the blood, for example, could be electrocution severe hypoxia (Coviello 2016, 155). Before the upcoming VF, patients may exhibit signs and symptoms of myocardial ischemia, such as chest pain, difficulty breathing, fatigue, syncope. The patient in ventricular fibrillation is going to be very rapidly unconscious, no pulses, agonal breathing or no respirations, jugular venous distension, and cyanotic or mottled skin. Excessive breathing can occur initially, for example, gasping. Whenever you see a pattern resembling

ventricular fibrillation, check the patient immediately and start treatment. The priority intervention is immediate defibrillation (American Heart Association 2015, 22). Early defibrillation is critical because the likelihood of successful defibrillation decreases over time and as VF changes from a coarse VF and irregular wave pattern to a fine VF that closer to cardiac arrest (Gu & Li 2016). During defibrillation, the electrode paddles direct electric current through the heart of the patient. Current causes depolarization of the myocardium, which in turn causes the sinus node to resume normal control of the cardiac electrical activity. One paddle is placed to the right of the upper sternum, and one is placed over the fifth or sixth intercostal space at the left anterior axillary line. During cardiac surgery, internal paddles are placed directly on the myocardium. (Coviello 2016, 156-157)

It is necessary to give non-synchronous defibrillation in a short time 1- 2 minutes. Generally, 120-200J is used for electric shock. If it's ineffective, assist with endotracheal intubation, such drugs as epinephrine 1mg IV is given every 3 to 5 minutes, vasopressin 40 units IV can be used instead of the first or second dose of epinephrine. Amiodarone IV first dose 300 mg and the second dose of 150 mg. Lidocaine may replace amiodarone when is not available. (National CPR Association 2015) Defibrillation is followed by CPR (cardiopulmonary resuscitation) to maintain perfusion and medication. As a first aid treatment, CPR must be performed until the defibrillator arrives to preserve oxygen supply to the brain and other vital organs. Assess the level of responsiveness and cardiopulmonary stability, continue to alternate the delivery of shocks with a delivery of CPR, together with medications in accordance with advanced cardiac life support (ACLS) guidelines. (American Heart Association 2015, 25)

For the patient with VF, successful resuscitation requires rapid recognition of the rhythm and prompt defibrillation (Coviello 2016,144). Nurses are at the bedside, monitoring and caring for patients. Nursing intervention is at the start of treatment. When confirming VF by palpating for a carotid pulse, because there is no pulse with VF; confirm all leads are connected and correctly placed and check the rhythm in a second lead; be alert that mimic VF can be caused by muscle movement from shivering, such as electric razor is one such mimic. Checking the patient's armband whether there is DNR (Do Not Resuscitate) code before initiating CPR in a healthcare setting. The nurse also needs to provide emotional support and educate patients and families of patients were undergoing emergency treatment (Coviello 2016,158).

### 5.3 Pulseless Electrical Activity (PEA)

Pulseless electrical activity (PEA) is in a condition which the ECG shows activity that should produce a pulse, but no pulse is detectable in the patient. PEA is not a rhythm itself. It occurs in many rhythms including NSR, tachycardias, and bradycardias. (Walraven 2016, 221) PEA is precisely what it says there is no pulse, but there is still electrical activity going on in the heart, even though electrical activity is preserved, but the heart muscle loses its ability to contract. As a result, the patient goes into cardiac arrest. (Coviello 2016,160)

Most of the sudden cardiac arrest might due to ventricular fibrillation (VT), ventricular tachycardia (VT), pulseless electrical activity (PEA) or asystole. So that most efforts have been put into preventing and treating VT and VF. Asystole and PEA are more common presenting rhythm than VT/VF at the time sudden cardiac arrest in non-ischemic cardiac disease. The decreasing trend of ischemic heart disease as a cause of sudden cardiac arrest may partly explain the increasing trend of PEA and asystole. (Kauppila, Hantula, Kortelainen, Pakanen, Perkiömäki, Martikainen, Huikuri & Junttila 2018, 76-78)

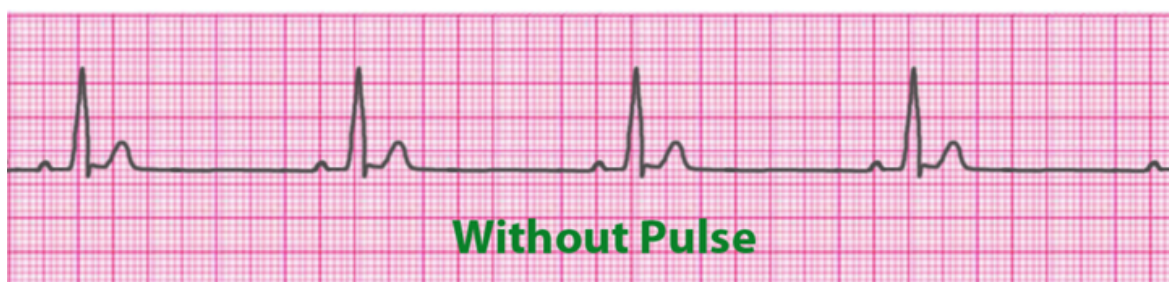


Figure 7: Pulseless Electrical Activity (United Medical Education 2018)

On an ECG, you will see evidence of organized electrical activity, but you won't be able to palpate a pulse or measure the blood pressure (Figure 7). It is important to correlate the patient's pulse with ECG tracking to identify the condition. PEA could not be detected by observing EKG alone. The patient's pulse must be accepted before making a diagnosis. (Walraven 2016, 221) This condition requires rapid identification and initiated emergency intervention. Valid CPR and airway management should immediately perform, along with epinephrine. Atropine may be given to patients with bradycardia. Subsequent treatment focuses on identifying and either treating or removing the underlying cause. (Coviello 2016,160)

Hypovolemia is one most common cause of PEA and the most treatable underlying cause (Walraven 2016, 221). The underlying cause of cardiac arrest can usually summarize by the American heart association's (AHA's) "H & T" list, which is a mnemonic used to help

recall the main factors of pulseless cardiac arrest. Table 1 and Table 2 are the list of 5H's and 5T's based on the AHA and other previous studies.

Table 1: 5H's cause PEA

Condition	Clues	Management
Hypovolemia	Carotid weak or disappear	Volume infusion with a 250ml fluid bolus
Hypoxia	Cyanosis, blood gases, airway obstruction	Mechanical ventilation, capnography monitoring.
Hydrogen ion(acidosis)	Renal failure	Sodium bicarbonate, hyperventilation.
Hyperkalaemia	History of renal failure, diabetes, recent dialysis, medication, ECG.	Calcium chloride; combination of insulin, glucose, sodium bicarbonate.
Hypothermia	History of exposure to cold, central body temperature, ECG.	Gradual warming with fluids and warming blanket.

(Oommen 2013, 419; American heart association 2015, 25)

Table 2: 5T's cause PEA

Condition	Clues	Management
Tension pneumothorax	Tracheal deviation, no pulse with CPR, history of asthma, ventilator, COPD.	Chest tube insertion or needle decompression.
Tamponade cardiac	Vein distension, no pulse with CPR, impending tamponade- tachycardia, hypotension, low pulse pressure.	Pericardiocentesis guided by echocardiography.

Toxins	Bradycardia, history of ingestion, empty bottles at the scene, pupils, neurologic examination.	Drug screens, intubation, lavage, activated charcoal, lactulose, antidotes.
Thrombosis, pulmonary	History and no pulse felt with CPR	A pulmonary arteriogram, surgical embolectomy, fibrinolytic.
Thrombosis, coronary	History, ECG, enzymes	Fibrinolytic, percutaneous coronary intervention (PCI)

(Oommen 2013, 419; American heart association 2015, 25.)

If an underlying cause cannot be determined, PEA should be treated as asystole (Walraven 2016, 221). In the hospital, nurses are usually the first witnesses and responders to cardiac arrest, and they must immediately initiate high-quality CPR (Attin, Tucker & Garey 2016, 392). In the critical care units or emergency department, the nurses are typically initiated CPR, while general ward nurses perform CPR until the ward team arrives to take over an advanced level of care. The job of the nurse is to recognize this life-threatening arrhythmia and start resuscitation right away. It should be aware that pulseless electrical activity can lead to asystole. And most patients with asystole can't be resuscitated, especially after a prolonged period of cardiac arrest. The nurse also should provide emotional support to patients and families of patients undergoing emergency treatment. (Heng et al. 201, 611)

#### 5.4 Asystole

Asystole is a cardiac standstill, which is caused by the absence of electrical activity in the heart and leads to cardiac arrest. Asystole is the result of the heart's primary and secondary pacemakers have failed, makes there is no depolarization, no contraction, no cardiac output, and no perfusion to the rest of the body. (Coviello 2016, 1598) It's extremely important to distinguish asystole from fine ventricular fibrillation, which is managed differently. Therefore, asystole should be confirmed by switching between several leads or changing the position of the defibrillation paddles (Oommen 2013, 419). Asystole is also known as the arrhythmia of death. The patient is in cardiopulmonary arrest. Without rapid initiation of CPR and appropriate treatment, death will occur within minutes. (Coviello 2016,158)

Asystole is represented on the ECG tracing looks like a nearly flatline or wave line (Figure 8), except for changes caused by chest compressions during CPR (Coviello 2016, 159). Atrial and ventricular activity is at a standstill so that no intervals can be measured. A separate form of asystole: P-wave asystole without QRS complexes (Figure 8) occurs when the atria continue to function but can't transmit impulses to ventriculus to depolarize and contract. In P-wave asystole, even though there is an atrial rate, the heart rate is zero because the patient cannot have a pulse without ventricular contraction. (Bartlam & Mohanraj 2016, 212-215)



Figure 8: Asystole and P-wave Asystole (Ceyssens 2016, slide 48)

Asystole is caused by myocardial hypoxia; severe cardiac damage that causes heart conduction system failure is the most common cause of cardiac arrest. The patient in asystole will be unresponsive with no pulse, blood pressure, or respirations; pupils are fixed and dilated; skin is cyanotic or mottled. The summarized table 1 and table 2 are the underlying cause of pulseless cardiac arrest, and it also includes asystole. (Jordan & Morrisonpoce 2019)

The goals of asystole treatment are to maintain perfusion through CPR and to identify and correct reversible causes (American Heart Association 2015, S319-S320). When asystole is cofired, immediately start CPR as soon as you determine that the patient has no pulse. Administer the first of 1 mg of epinephrine, the 1.0mg dose of epinephrine can be repeated every 3 to 5 minutes during pulse-free electrical activity (PEA) or asystole without a maximum dose limit. Prolonging the interval of administration of epinephrine may improve the prognosis of patients with cardiac arrest and the initial rhythm of PEA or asystole. (Straznitskas et al. 2015, e23)

If return of spontaneous circulation is successful, initiate post-arrest care: Maintain oxygen saturation > 94%; Manage the airway, insert an endotracheal tube if needed; Keep systolic blood pressure (SBP) > 90 mm Hg; Consider differential diagnosis for treatable causes, as above mentioned “5H’s & 5T’s” list; Perform a 12-lead EKG, whether there is ST-elevation myocardial infarction (STEMI). (American Heart Association 2015, S321-322) Early reperfusion in STEMI patients is the primary factor associated with lower mortality (Couper, Kimani, Gale, Quinn, Squire, Marshall & Perkins 2018, 56).

Be alert to the concept of cardiac monitor asystole in which patients in apparent asystole are, upon ultrasound examination, actually in unrecognized VF (Limb & Siddiqui 2015) The common non-shockable cardiac arrhythmias in-hospital cardiac arrest are pulseless electrical activity and asystole, and the timely and high-quality CPR is the primary treatment for non-shockable rhythms (Attin et al. 2016, 387). Before initiating CRP in the healthcare setting, quickly check for a DNR armband. Evaluate the patient’s pulse and respirations, confirm the validity of the asystole tracing by checking the rhythm in two different leads. Disconnected lead, artificial, incorrect lead placement, sensitivity set too low can lead to an isoelectric EKG tracing, but real asystole is synonymous with cardiac arrest with no pulse, respiration, or cardiac output. (American Heart Association 2015, S316-S317)

## 6 THE PROCESS OF THESIS

### 6.1 Functional thesis

A functional thesis is an alternative to a research-based dissertation. The functional thesis aims to guide, organize and rationalize the practice. The target group defines the way work is carried out. The functional thesis proceeds in a typical way for the project and starts with the preparation of the plan. A project organization was built for the thesis. The tasks of the members were agreed between the project organization, and the project schedule was planned. As nursing students, it was important for the authors of the thesis to identify the needs of the target group and take them into account in the design of the self-study material. The functional thesis also includes the preparation of the final report, which describes all the phases of the operational thesis, including a theoretical knowledge base with source references, an output of the development process and assessment with reflection. (Saastamoinen, Vähä, Ypyä, Alahuhta & Päätaalo 2018) This functional thesis consists of both a theoretical part and a final project output. The theoretical part includes the basic structure and function of the heart, electric conduction, interpreting electrocardiogram rhythm strips, and the four cardiac arrest rhythms. It also consists of the final output which is the report of the theoretical part, the creation of production is four cardiac arrest rhythms quick identification self-study material for Lahti University of Applied Sciences nursing students.

The Plan, Do, Study, Act (PDSA) change cycle (Figure 9) provides a pragmatic approach to the framework of this functional thesis. The PDSA cycle is shorthand that is developed to test changes(plan), perform tests(do), observing and learning from the consequences(study), and determining what modifications should be made to the tests(act). (NHS Improvement 2018, 3) I have been searching for specialized filed for making learning material about cardiac arrhythmia for a thesis topic in planning phases. When searching for data, I made the change of limitation on my topic of four cardiac rhythms. Then I studied the four cardiac rhythms and made the self-study material, modified the self-study material all the time from the evaluation and feedback and planned the next change cycle until the full implementation of the thesis. PDSA was thought out during the thesis process, the produced plan, script, and the self-study material as output were discussed, and I got guidance from the teacher in the thesis workshops. The feedback of self-study material helped the thesis process progressively and according to the plan. While working with the functional thesis, I got more experience of responsibility for practical actions in a project, a realization of the program, and evaluation work.

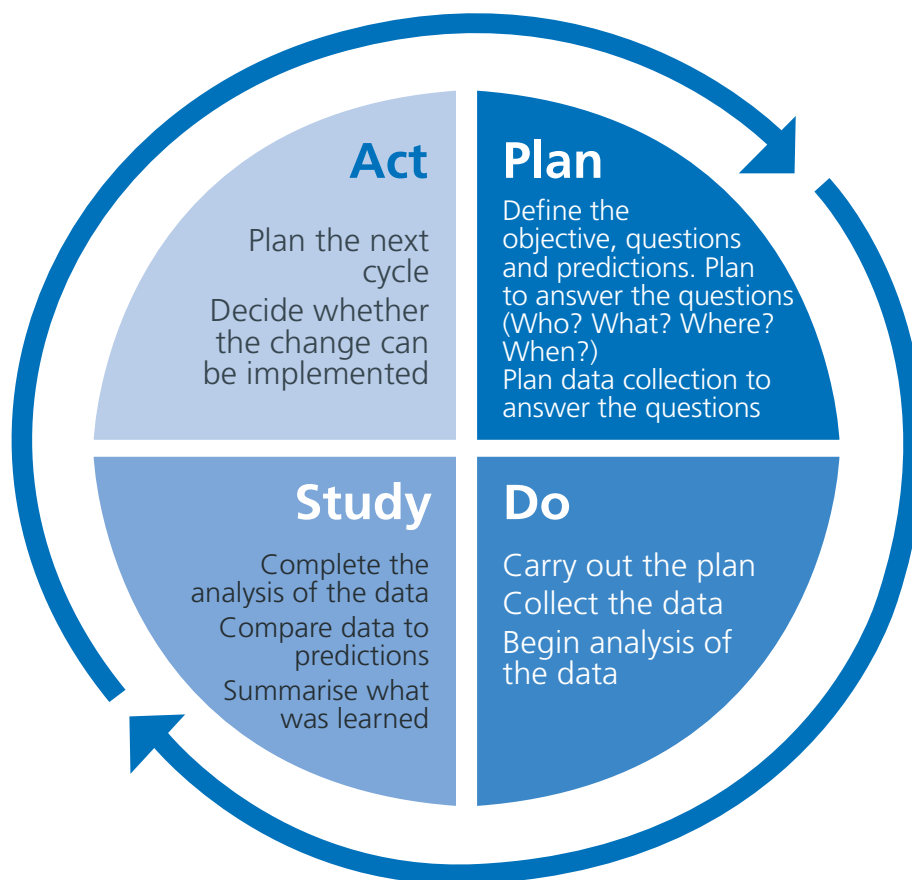


Figure 9: PDSA cycle (NHS Improvement 2018,4)

## 6.2 Ideas and planning

I studied theses from the electronic thesis of Theseus since autumn of 2017, and in the next few months, I was trying to find a suitable topic for my thesis. I found several interesting bachelor's theses in Theseus that demonstrated that students had deficiencies in their abnormal ECG understanding. At the same time, I was doing my clinical training in Malmin Sairaala Päivystys. I had discussed with several students there, and it turned out we were more desirable to practice our hand skills and how to treat the disease, as ECG understanding is improved with work experience. We evaluated our arrhythmia knowledge poorly in the emergency department to our current capabilities. My clinical training supervisor teacher also mentioned that the understanding of the four life-threatening ECG rhythms were very crucial knowledge in the emergency department because the heart rate of arrhythmia patients is might change in any blinking time.

Pre-registration nurse education includes conceptual and practical elements to help graduates prepare for a clinical practice transition (Cox & Simpson 2016, 215). In a clinical practice the students apply theoretical knowledge to real practice. Many new graduate nurses are entering the workforce with professional confidence. The best support for the confidence of newly graduated nurses is to improve undergraduate education and nursing practices (Ortiz 2016, 19). A study recommended that nurses who work in the emergency department require to update their training every two or three years. During the training it is extremely important to recognize the four initial rhythms and to complete manual defibrillation (Daniele 2012, 9-10). On this basis, I got the idea of making self-study material about life-threatening ECG understanding for nursing student during their advanced placements. When choosing the topic of the thesis, I also considered it important that the topic is both interesting and useful in future working life.

The planning continued with the preparation of the actual thesis project. In the planning phase, I collected a comprehensive knowledge base about the four cardiac arrest rhythms. The cardiac arrhythmias basics are naturally found in many different sources. After I understood the collected sources of cardiovascular system knowledge, I planned to write the background theory which supports the central content part of the four cardiac arrest rhythms. The content of four cardiac rhythms comes out smoothly with previous knowledge study. Initially, I planned to make a video of self-study material, with the progress of thesis developing. I found the video must be played with devices, and it's not practical and comfortable for nursing student to use it in the critical care clinical training. Gradually, I got the idea of making flashcards which are directly and easily carried to any placement.

### 6.3 Self-study material and preparatory questionnaire

A self-study material as prepared as any learning resource in such a way that it can be used by the distance learner without the physical presence of a teacher. This kind of distance education refers to learning situations that utilize information and communication technology, which is the student can study flexibly based on their own timetable, without the group schedule. (Ilkay & Zeynep 2014, 1285) The success and effectiveness of a distance education system depends on the learning materials. Self-study materials perform the functions of an invisible teacher who guides learners. Self-study materials with multimedia can bring versatility and openness to the learning material through images, text, audio, animation, and video. Any tests, tasks, and games that may be included in a multimedia presentation will maintain study motivation and provide feedback on the progress of the study. (Jayaram & Dorababu 2015, 21929)

It is essential to think about the type of self-study material that best suits the content being studied, as well as the needs of the target group. The content studied in learner-oriented material has been selected according to the needs of readers; for example, the nursing students. The information on self-study material is understandable and relevant to the nursing student. The content of a self-study material is depending on matching rules between learners and learning objects. The self-study material is one that students can periodically repeat. (Wan & Niu 2018, 71-86) Learning objectives can receive and transmit information between the learner and self-study material. Learner orientation is reflected in the self-study material about their looks and content. (Wan & Niu 2016, 38-39)

In this thesis, I also keep the approach practical to nursing students. The life-threatening ECG recognition is the essential knowledge for a nursing student undergoing the critical care clinical setting. The content of self-study material is helping the nursing student to accomplish the learning objectives of critical care study. I made the self-study material in the form of four flash cards or both side A4 paper, and its combined text and image of second lead ECG. The text links to the specific rules for each of the four cardiac arrest rhythms, such as regularity, rate, P wave, QRS complex. A mini-guide flash card can be two A4 paper sizes, and the students could print and fold them into a little A6 size, which is very convenient for a nursing student to use during their advanced placements or even in the future working life. The guide contains a summarized form of key rules for each of the cardiac arrest rhythms. The four flash cards are an effective method of memorizing material in a short period of time.

I wrote the content of the self-study material based on the theories as previously collected. I also considered that the appearance had to be quite simple, as the space is very limited. In the design of the self-study material, I have already used guides collected earlier on the subject and the framework for the output. When I was writing the self-study material and prepared the questionnaire, I also contacted my supervisor teacher and received feedback and correction suggestions for guidance. The layout and the final content of the output started to grow, although changes still came out.

Today, more and more questionnaires or measurement tools for assessing psychosocial characteristics and health outcomes can be used for research, clinical practice, and assessment of the health of the population. Researchers must carefully select adequate and accurate tools to ensure the quality of their results. Before using it, it's necessary to learn more about the instrument, the project, the field, the evaluation form, and especially the measurement properties. (Souza, Alexandre & Guirardello 2017, 2)

Nursing students were the target group of the self-study material and the nursing student's perspective in this material was deemed valuable. I designed six questions by using the Likert Scale and two open-end questions in Google Forms, which are attached in Appendix 2. The items are about what the nursing students think, feel, and improve as a part of self-study material. The internet questionnaire of self-study material is to collect feedback about the self-study material from all Lahti University of Applied Sciences nursing students. Its purpose is to keep improving self-study material both in terms of appearance and content in the next version. Besides, all of the answers will be anonymous to respect privacy.

#### 6.4 Feedback of the self-study material

As there are many different evaluations of different multimedia resources, and the evaluation influenced by many factors. But there are several universal evaluations of the self-study material that should be followed. The practice material should aim to help the students to become truly independent so that they can actually use it in a clinical training sitting. The self-study material should have meaningful language input so that the student knows what an offer to them is. The objective of self-study material is flexibility which is the student can easily access the material when they want to use. The feedback and advice should be available on the test of the material in the progression. The material also should have motivational factors for the student. (Tomlison 2010, 73-81)

When the self-study material was almost ready, I asked the suggestions from one of my previous tutor teachers in the clinical training place in Malmin sairaalan päivystysyksikkö through messages. She felt that the interpretation of four cardiac arrest rhythms was good and comprehensive. She also liked the treatments were included in the self-study material. The treatment of nursing intervention can be wider, but for the nursing student it is enough information.

I also asked for suggestions through WeChat at my previous working place, which is general intensive care units (ICU) of the first affiliated hospital of Chongqing medical university. The opinions I received were from one doctor and four nurses, the doctor confirmed that the information of material is necessary. According to the four nurses, a nurse knows how to recognize the life-threatening rhythms and can initiate the treatment to the patient together with the doctor promptly. The nurses also suggested mentioning more about the nurse can do in the first since, such as airway management, press the emergency button to ask for help, administer IV in the early stage. They also think the background of the layout can be more visualization. The ready output will be provided in electronic form in addition to the paper version.

Based on these suggestions I received from one doctor and five nurses' professionals. I made the necessary changes to the self-study material. The final output of the self-study material is come out with an electronic pdf version attached in Appendix 1. I have sent my self-study material by pdf version and linked the survey through email to three teachers who are in charge of clinical training student. One teacher forwards my email into two nursing student groups (NUR 16 and NUR 17) and asking them for feedback. I have waited for one month and got six responses. The most of participants evaluated that the self-study material is useful and suitable for nursing students utilize. I summarized the answer to six responders' feedback in Table 3. Otherwise, there are original assessments about self-study material content attached in appendix 3.

Table 3: The six responders' feedback of self-study material.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The material is easy to follow	0	0	2	1	3
The content is suitable for nursing student	0	0	0	4	2
The material has enough useful information	0	1	1	2	2
Material is convenient	0	0	2	3	1
The layout is comfortable	0	0	0	3	3
The content is easy to understand	0	0	2	3	1

Table 3 shows that most student agrees this self-study material is easy to follow, and suitable for the nursing student who is undergoing advanced clinical setting. The content of this self-study material has enough useful information for nursing student easy to understand the life-threatening ECGs. Turning to the appearance of self-study material, almost all the responses answered was comfortable.

The open-end question 7 and question 8 explore the target group base-needs. Generally, the output of my self-study material is including crucial information for nursing student needs and can be mainly guidance in the real clinical situation. It's quite good material which explained in shortly and clearly, and it helps the student understand the life-threatening ECG in clinical practices. However, there is some more information where the target group wants to know and add into self-study material. Such as symptoms of four cardiac rhythms, examples of the disease, normal ECG rhythms. The target group is thinking about very practical needs. Before I output my self-study material, I have been studied all these parts where demand improves and wrote in a text of this belcher's thesis. Since the purposes of the self-study material are only for recognizing the life-threatening ECG rhythms, rather than in-depth understand the four cardiac arrest rhythms. Also, for the convenience of carrying in critical clinical training sitting. One response hope has more different pictures of the ECG should be shown in the self-study material. On the other hand, she or he would like to have more images or illustrated pictures to understand more. However, images or illustrated ECG pictures must be permitted by authors and the copyright process. It was difficult for me to download a particular part of accurate education ECGs.

## 7 DISCUSSION

### 7.1 The process of developing self-study material

My intention of this bachelor's thesis was to make an output that would actually benefit nursing students and give them the necessary life-threatening ECG rhythms recognizing know-how for future work life. These four cardiac rhythms self-study materials will certainly be useful for the nursing student who are doing advanced clinical training. However, this is only the four life-threatening ECG rhythms, so hopefully, this material would also inspire nursing student for me to learn more about arrhythmia and life-threatening situations. Experience shows that the work of the joint thesis work is important.

Producing a self-study material as a finished product require a lot of effort, as it was necessary to edit the output of self-study material many times to match the target group. In this case, the six respondents naturally support and encourage this thesis progressive growth. The perspectives were different, which helped to develop and refine the thesis for the better. While working with the functional thesis, I got more experience in choosing grouping methods suitable for the target group.

In my opinion, the thesis process itself was a very enlightening experience. This was especially the case with the scheduling of work, the search for information and the definition of the necessary information. When searching for information, it was important to keep in mind what is precisely related to the subject. In particular, there was an overwhelming consideration of output content over time. Otherwise, I had been slightly overly optimistic about the time of graduation. However, the interest of the subject proved to be an important resource for moving forward.

The final method of implementing the thesis is a justified synergy between the author's own resources, the needs of the target group and the requirements of the bachelor's thesis. The Bachelor's thesis is viewed as autonomous work, and it's a method of developing the nursing professional competencies. (Roca, Gros & Canet 2018, 159) As a learning experience of the implementation of a functional thesis, a project -based thesis made it possible to perceive the whole process of the thesis. During the process of the thesis work, there were challenges at its different phases. The most challenging steps were finding suitable source material on the knowledge base and delimiting the topic. I learned how to manage the project and also how to solve the problem I met.

## 7.2 Ethical considerations

According to the Finnish Advisory Board on Research Integrity (TENK): “Ethical principles of research in the humanities and social and behavioral sciences are divided into three areas: Respecting the autonomy of research subjects, avoiding harm and privacy and data protection.” Research according to good scientific practice has been designed, implemented and reported with high quality. The study must be written accurately and honestly to allow the reader to understand the study content. The investigator must also work honestly with other researchers and their achievements. (Finnish Advisory Board on Research Integrity 2019)

The working process of the entire thesis takes into account the ethical point of view. This thesis enhances the understanding of life-threatening electrocardiograms that brings benefits to nursing students and self-evaluates the perception of four cardiac arrest rhythms. This thesis will not cause harm to the society and community. Plagiarism must be avoided in any action. Scientific published articles and books used in this thesis will be accurately quoted according to Thesis guidelines of Lahti University of Applied Sciences. This is shown as a source list and the source references.

Research must also always be respected. Participants have been informed of the purpose and approach of research evaluation and their role in it. Participation in research should be voluntary and based on informed consent. And their names may not be mentioned without their permission. (Barnett & Camfield 2016, 530-531) The feedback of self-study material was conducted anonymously and responding was voluntary. The students were also unknown to me, so they were easier to answer objectively.

## 7.3 Reliability and validity

The reliability of quantitative research refers to exact reproducibility of the processes and the results. In qualitative studies with different paradigms, such definition of reliability is challenging and epistemologically counterintuitive. The validity of qualitative research means the “appropriateness” of the tools, processes, and data. Regardless of whether the research question is valid for the desired result, the choice of methodology is appropriate for answering the research question, and the design is sufficient for the method, the sampling and data analysis is appropriate, the final results and conclusions are valid for the sample and context. (Leung 2015, 325-326)

At all the stages of the thesis, the information retrieval of the thesis I have used trustworthy information published. The most sources I used are books and peer-reviewed articles

and journals. The search engines I used were Medic, ERIC- Institute of Education Sciences, PubMed, Cochrane Library, Google Scholar, eBook Academic Collection (EBSCO), Scientific & Medical ART Imagebase (EBSCO) and CINAHL(EBSCO). All search engines through Lahti University of Applied Sciences using the Masto-Finna search server. Some database can only read the abstract of the article through EBSCO. Such as ScienceDirect, ProQuest. In addition, I used one computer which connects Helsinki university in Niemen campus library of LAMK. Figures are used from Imagebase (EBSCO) and reputable organizations, such as United Medical Education. They are stable and permanent research tools for doing research. The information I need for my thesis comes only from reliable and up-to-date sources. As a source, I tried to use less than eight years of resources to ensure updated information. All sources are listed in the reference list and cited in-text by appropriate references.

The validity of the response process is the extent to which the actions and thought processes of survey responders demonstrate that they understand the construct in the same way as the researcher defines. This type of validity is observed through observation, interviews, and feedback from respondents. (National survey of student engagement 2017, 2) I designed six questions by using the Likert Scale. Questions are the focus on the individual's point of view to the questionnaire. The questionnaire is modified many times for appropriate evaluation questions to the target group. I have been written the purpose of my survey before starting to answer the questions. The students have known about why and for what purpose the questionnaire was made and who did them.

Open-ended qualitative questions can easily be added to a standard quantitative self-report questionnaire methodology. By using open questions in self-report questionnaires significant depth can be added to quantitative results, and the service user perspective can be adequately captured. (Harland & Holey 2011, 486) The questions are standardized, and respondents are asked exactly the same questions in the same order. The questionnaire was a clear, comprehensive, and short description of the object of valuation. Both of evaluation and feedback of the self-study material are not involved in any personal health outcomes. It's only evaluated the study materials.

#### 7.4 Further development of the self-study material

In the future, it would, of course, be possible to add more information into self-study material in accordance with the nursing students' needs. I would make some tests whether students' life threatening-ECG recognition has improved after using the self-study material. In addition, students' life threatening-ECG understanding skills could be strengthened through various simulations, utilizing school simulation mode. It would also be possible to

carry out a functional thesis in which students would be offered different simulated patient-related four cardiac arrest rhythms cases. This will enable students to experiment with their life-threatening- ECG recognition know-how.

From the feedback of the open-end question 8 shows, many aspects can develop differently in the self-study material. The target group nursing students are a desire to learning more knowledge about four cardiac arrest rhythms. My self- study material is only about the recognizing of the four cardiac arrest rhythms, so that there are several other parts of the four cardiac arrest rhythms can develop in different directions of self-study material in the future. For example, the regular ECG reading, the possible disease to cause cardiac arrest rhythms, the symptoms before the four cardiac arrest rhythms happen, different ECG pictures of each cardiac arrest rhythm.

Developing self-study material is a challenging task, even though we have advanced communication technology, which can be used in self- study material through multimedia. It is relevant for you to understand the concept of self-study materials which are based on the principles of use of the means and ways of communication. In the future, I would recommend using a 3D animation to draw the different possible ECG rhythms for each of the cardiac arrest rhythms, and at the same time create a corresponding patient's situation and potential disease.

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## APPENDICES

Appendix 1: Self-study material of a quick guide to four cardiac arrest rhythms.

### *A quick guide for four cardiac arrest rhythms*

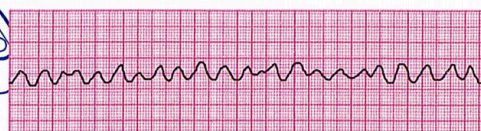
#### **Ventricular Tachycardia (VT)**



The rules of this rhythm:

- Regularity: usually regular.
- Rate: ventricular rate 100-250bpm
- P wave: absent
- PR interval: unmeasurable
- QRS complex: wide and bizarre duration > 0.12 second.
- T wave: difficult to differentiate from QRS complex.
- QT interval: unmeasurable.

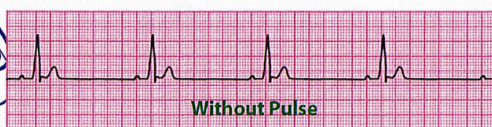
#### **Ventricular Fibrillation (VF)**



The rules of this rhythm:

- Regularity: unrecognizable, chaotic.
- Rate: ventricular rhythm rapid, undetermined.
- P waves: no visible P waves
- PR interval: unmeasurable
- QRS complex: wide & irregular
- T waves: indiscernible
- QT interval: not applicable

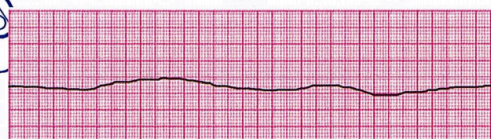
#### **Pulseless Electrical Activity (PEA)**



The rules of this rhythm:

- PEA can be seen in many rhythms: normal sinus rhythm (NSR), tachycardias, bradycardias.
- ECG has an organized electrical rhythm, but no pulse.
- Diagnosis PEA: look at the ECG while checking patient's pulse.

#### **Asystole**



The rules of this rhythm:

- Regularity:
  - Rate:
  - P waves:
  - PR interval:
  - QRS complex:
  - T waves:
  - QT interval:
- } Straight line indicates absent of electrical activity

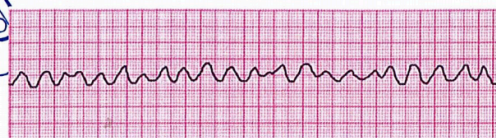
### Ventricular Tachycardia (VT)



#### What to do:

- Administer oxygen and establish IV.
- Hemodynamically unstable patient: synchronized cardioversion.
- Lidocaine 1.0-1.5 mg/kg IV
- Amiodarone 150-300mg IV
- Polymorphic VT with prolonged QT: Administer magnesium sulfate 1-2g diluted in 100ml D5W over 1-2 minutes. Treat electrolyte imbalances.
- Pulseless VT: Follow VF.

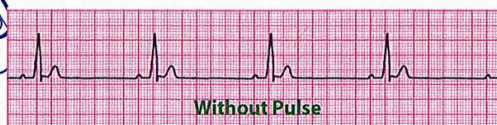
### Ventricular Fibrillation (VF)



#### What to do:

- Initiate CPR immediately.
- Defibrillate with 200J.
- Control the airway & establish IV.
- Epinephrine 1mg every 3-5 minutes.
- Consider second-line drugs: lidocaine, amiodarone, procainamide, or magnesium sulfate.

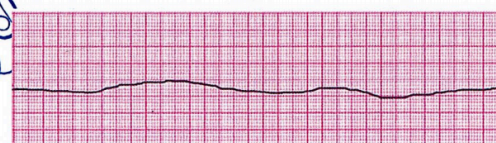
### Pulseless Electrical Activity (PEA)



#### What to do:

- CRP, oxygen, IV-line, airway.
- Epinephrine every 3-5 minutes.
- Atropine may be given bradycardia.
- Consider correctable causes.
- Return of spontaneous circulation.
- Continue resuscitation.

### Asystole



#### What to do:

- Administer CPR.
- Manage the airway: endotracheal intubation.
- Treatment of underlying cause.
- Repeated doses of epinephrine & atropine as ordered.
- Transcutaneous pacemaker.

## Reference

Zhou, L. 2019. Bachelor thesis. A quick guide for four cardiac arrest rhythms. In theseu.fi

Figure: United Medical Education. 2018. PALS Algorithms 2018(Pediatric Advanced Life Support). Available at: <https://www.acls-pals-bls.com/algorithms/pals/#shock>



5. The layout of the self-study material was comfortable. \*

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

6. The content of this self-study material for nursing student was easy to understand. \*

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

7. What is your overall assessment of this self-study material? \*

Short-answer text

.....

8. Which part of this self-study material need improve? \*

Short-answer text

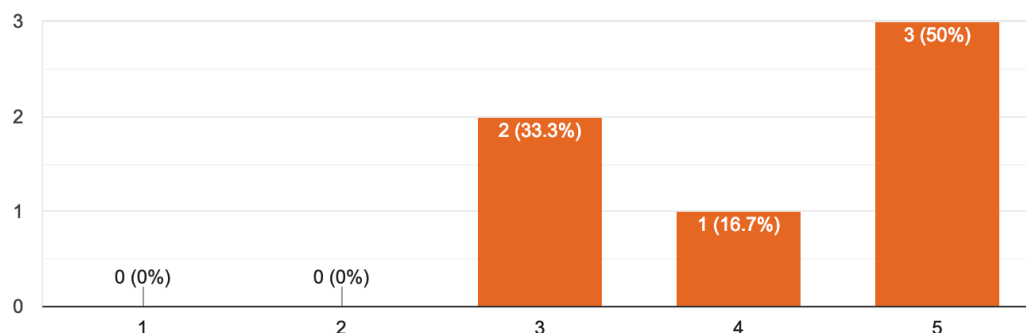
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### Appendix 3: The feedback of the self-study material.

1. I feel this self-study material is easy to follow.



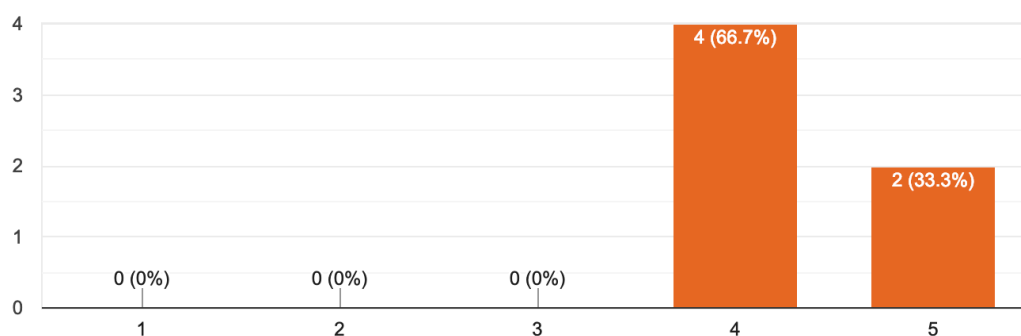
6 responses



2. I think this self-study material is suitable for nursing student who are undergoing advanced clinical training.



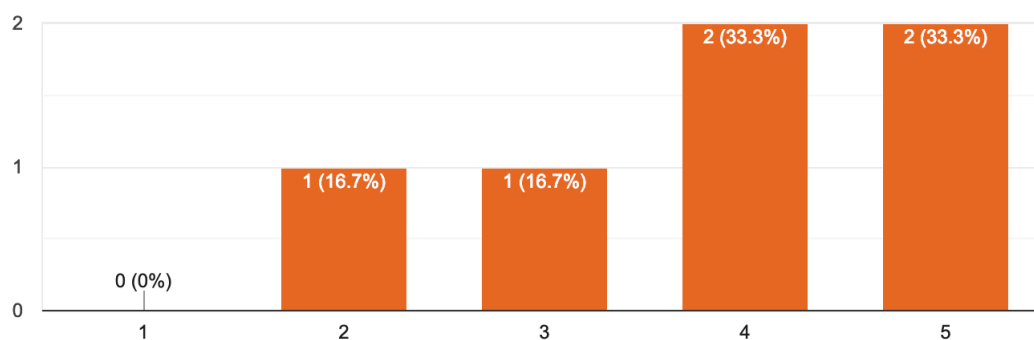
6 responses



3. I think this self-study material has enough useful information for critical care units clinical training sitting.

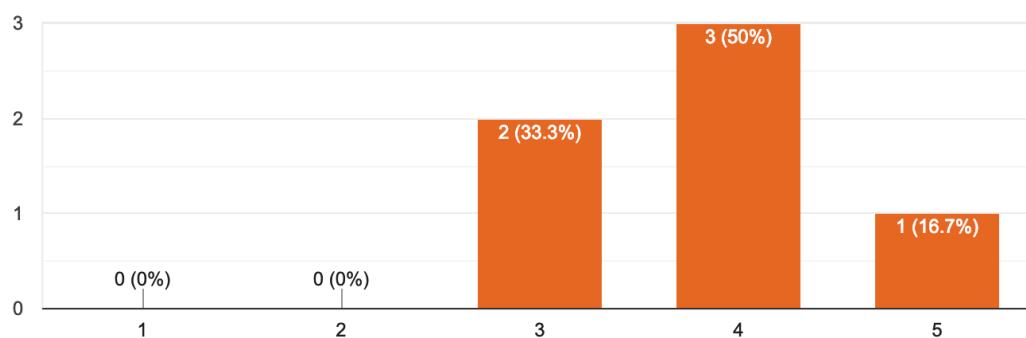


6 responses



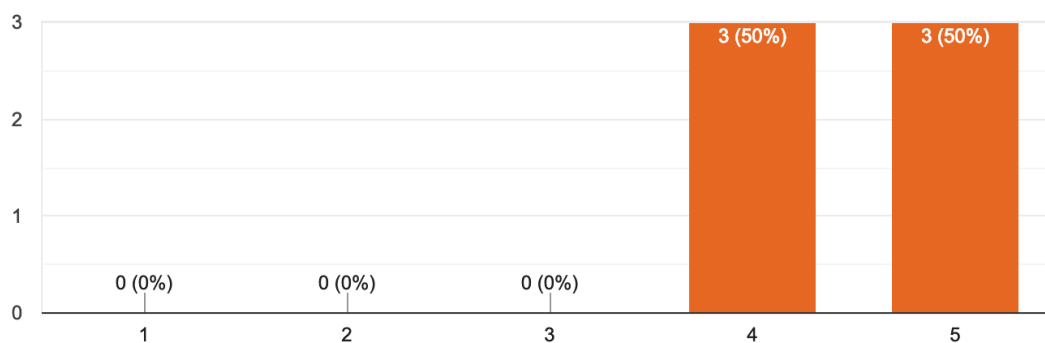
#### 4. The self-study material was convenient.

6 responses



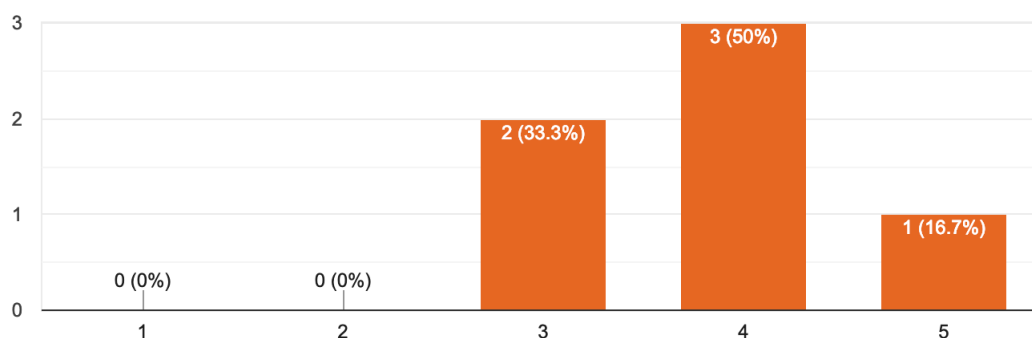
#### 5. The layout of the self-study material was comfortable.

6 responses



#### 6. The content of this self-study material for nursing student was easy to understand.

6 responses



## 7. What is your overall assessment of this self-study material?

6 responses

It is good material which showed the picture rhythm and explained in short.

Easy to understand and helpful in clinical practices

It is helpful for student to understand the basics and common of ECG.

The information is clear, easy to understand.

Useful

This self-study material content are hard part, but the author arranged them clearly and it's useful and quickly to guide clinical application. Even it depends the real clinical situation, but this self-study materials can be mainly guidance and correct direction. It's great work.

## 8. Which part of this self-study material need improve?

6 responses

May be in short example in what conditions, examples situations (patients ).

Would be nice to mention possible symptoms when these kind cardiac rhythms appear

There should more different pictures of the ECG be shown in the self-study material. It has better to give some examples about the disease.

It depends on its purpose, but it is already very good.

I think it should be more information about the use of the material.

It's quite good about this part. Just advice is it possible to add the normal ECG introduction pre these? Cause it's self-study, someone need to review the normal ECG and then recognize the unnormal.