



RAJALA NOORA, MAHLAMÄKI JASPERI

Educational Material for Taking High Quality ECG

Educational video

DEGREE PROGRAMME IN NURSING
2021

Author(s) Rajala Noora, Mahlamäki Jasperi	Type of Publication Bachelor's thesis	Date December 2021
	Number of pages 38	Language of publication: English
Educational Material for Taking High Quality ECG		
Educational video		
<p>Taking a high-quality ECG is an important part of nursing and diagnostics. In order for an ECG to be high quality, the student needs training and instruction. Mistakes often occur at the theoretical level, which can be corrected with quality teaching. The product of this thesis is made to support the teaching in Satakunta University of Applied Science (SAMK) among the English-speaking Nursing students, due to the lack of English educational material.</p> <p>The objective of this work is to provide SAMK with an educational video demonstrating and guiding how to produce a high-quality Electrocardiograph. This thesis was implemented as a functional thesis in the form of a project. The video will be directed for present and future nursing students.</p> <p>Research was conducted on the topics of ECG, taking ECG, as well as producing educational material. Based on the collected theoretical information, a transcript of the video was planned and produced. The transcript includes evidence-based theoretical background, planning and manuscript as well as instructions on graphs and other aspects of post-production. After filming the acted scenes at the SAMK campus, the video material was edited into the finished product.</p> <p>Once the final draft was approved, test screenings were conducted of the video with the goal of obtaining feedback from teachers and students, on whether there was anything to improve. The feedback was overall positive, and nothing was pointed out as requiring improvement. The feedback also included notions supporting the necessity of the product.</p> <p>The finished product will be provided to SAMK as educational material on how to take a high-quality ECG. Suggestions for further development include taking a 15-lead ECG and getting acquainted with the most common arrhythmias and their treatment.</p>		
<p><u>Key words</u> Electrocardiography, ECG, educational material, nursing</p>		

CONTENTS

1 INTRODUCTION.....	4
2 ELECTROCARDIOGRAM (ECG).....	5
2.1 ECG registration.....	5
2.1.1 Device preparation.....	6
2.1.2 Patient education.....	6
2.1.3 Location of electrodes.....	7
2.2 Interpreting ECG.....	9
2.2.1 Sinus Rhythm.....	9
2.2.2 Segments of the isoelectric line in sinus rhythm	10
2.2.3 ECG Artefacts.....	10
3 EDUCATIONAL MATERIAL	14
3.1 Video design.....	14
3.1.1 Cognitive load.....	14
3.1.2 Student engagement.....	15
3.1.3 Active learning.....	16
4 PROJECT PURPOSE AND AIMS.....	16
4.1 Purpose.....	16
4.2 Importance for own development	17
5 PROJECT PLAN	17
6 PROJECT IMPLEMENTATION	18
7 PROJECT RESULT	19
8 EVALUATION.....	19
8.1 Product evaluation.....	19
8.2 Project evaluation.....	22
9 CONCLUSION	22
9.1 Ethics and reliability	23
9.2 Follow up projects and development	24
REFERENCES	
APPENDICES	

1 INTRODUCTION

The overall lacking skill and consistence in taking high quality electrocardiogram has been apparent in clinical practice experience. Therefore, it was an important task to provide a clear guide to this specific task. This video is designed to be implemented into teaching as an additional learning tool alongside written materials and simulation practice. The video produced as a result of this thesis will be used by Satakunta University of Applied Sciences (SAMK) for teaching purposes. As need for audio-visual learning material grows, it may be difficult to find appropriate material for specific groups. Thus, we have developed a video specifically to be used in SAMK nursing courses, by request of the faculty. Audio-visual teaching material may help students achieve their learning goals. There are advantages and disadvantages to audio-visual material. The use of audio-visual teaching material facilitates the learning process. (Fuady, R., & Mutalib, A. A. 2019.)

There are over 6000 students in SAMK and has the highest ranking of graduate's employment among other universities of applied sciences outside the metropole area. There are 39 different degree programmes including e.g. nursing, communications, engineering and business administration. (Website of Satakunta university of applied sciences 2020.)

English Nursing degree programme started in 2017 in SAMK and there is a need for studying material in English. Taking high-quality ECG is one basic nursing intervention and common in medical field. Technology and medical development walks hand in hand. All the time scientists are trying to find a way to make equipment and hardware easier to use and to get more reliable results. Considering this technology development, the study material needs to be updated with the latest research.

Exploration of producing educational material will provide students' knowledge and experience with not only the subject in question, but also the details of what goes into the production, e.g., the metacognitive aspects of specific choices in scripting.

2 ELECTROCARDIOGRAM (ECG)

The pumping motion of the heart muscle is caused by the transfer of electricity from the sinus node to the tissues of the right and left atrium. Then, the atrioventricular node sends the impulse into the ventricles. This transfer of electricity is reflected in the electrocardiogram. (Hekkala, 2020.)

Electrocardiography is a test used in assessment of cardiovascular condition. Electrodes are set on the subject's body to collect information from the heart through an electrocardiogram, which will produce an electrocardiograph. It is an essential test for interpreting cardiac rhythm, conducting system abnormalities, pre-excitation, and atrial abnormalities. (Tarek, 2019.)

2.1 ECG registration

ECG registrations are taken in hospital and in health care settings. E.g., nurses and physicians with proper training can perform the examination. (Mäkijärvi, 2019.)

ECG should always be registered as high quality without any technical errors. Interpreting faulty electrocardiographs is typically unreliable and can result in misguided diagnosis and treatment. Thus, errors should be identified and eliminated during the graphing process. Adequate knowledge on how to take a high-quality ECG is essential in ensuring the most reliable information. (Mäkijärvi, 2019.)

In situations where attaining a high-quality ECG is compromised by the condition of the patient or other environmental factors, a lower quality ECG may be valid. When

consciously recording an anomalous ECG, it is essential to record the abnormalities clearly and accurately in the graph. This will vitally aid in the interpretation of said faulty graph. (Mäkijärvi, 2019.)

2.1.1 Device preparation

The condition of the ECG device should be checked before starting the measurement. There is a variety of different ECG devices in common use, and while details of their operation may differ, the essentials remain the same. It should be made sure that the device, its wires and electrodes are intact, safe and operational. (Honkanen, 2002.)

The device may require information of the patient in order to perform the ECG, this should be done after placing the electrodes. This gives the patient time to adjust for the measurement and leaves time for the electrodes to stabilize. (Honkanen, 2002.)

2.1.2 Patient education

Patient guidance is the most important part of preparing an ECG. The patient should feel calm and relaxed during the operation. The measurement does not cause any pain or discomfort to the patient. The patient's clothing should be loose to allow proper circulation. The patient must have their upper body, as well as their wrists and ankles exposed. Before the procedure, the patient should withhold consuming stimulants, such as nicotine for four hours prior, or heavy meals for two hours prior. Medication should be taken only according to the doctor's instructions. (Hoito-ohje Lepo-EKG, 2020; Honkanen, 2002.)

Small metallic jewellery, such as small rings, necklaces or piercings usually do not interfere the procedure if the jewellery is not in contact with the electrodes or moves on the skin during the measurement. Large jewellery that may affect the reading, such as larger necklaces, watches, anklets, should be removed before measurement. The patient should be instructed to settle in a relaxed supine position. The patient must not be in any contact with the metal parts of the bed or operating table to avoid misreading. (Hoito-ohje Lepo-EKG, 2020; Honkanen, 2002.)

Body hair should be shaved from the areas assigned to the electrodes before application. If the patient has a rough skin that complicates introducing the electrodes, the skin should be gently grated with a sandpaper designed for this purpose. The skin should be cleaned from dandruff or grease before the procedure with 80% denatured ethanol. In order to attain a high-quality ECG, the skin must remain undamaged. (NordLab, 2017; Honkanen, 2002.)

2.1.3 Location of electrodes

In the most used 12-lead ECG recording a total of 10 electrodes are attached to the human body, of which four are attached to the limbs and six are placed in the chest. Voltage fluctuations between the electrodes create 12 different connections that appear as graphs and from which the electrical activity of the heart can be monitored. (Mäkijärvi, 2019.)

Chest connections provide information about the functioning of the heart in a horizontal view. Chest connections V1 and V2 electrodes come between the 4th rib on both sides of the sternum. On the left side of the chest, V4 electrode is placed between the 5th rib on mid-clavicular line, from where the electrodes V5-6 are placed sideways in a horizontal segment, V5 on anterior axillary line and V6 on mid-axillary line. The V3 electrode is placed between the V2 and V4 electrodes. The connections of the wires to the electrodes go logically in order V1 to V6. The wires are numbered. This is demonstrated in Figure 1. (Mäkijärvi, 2019.)

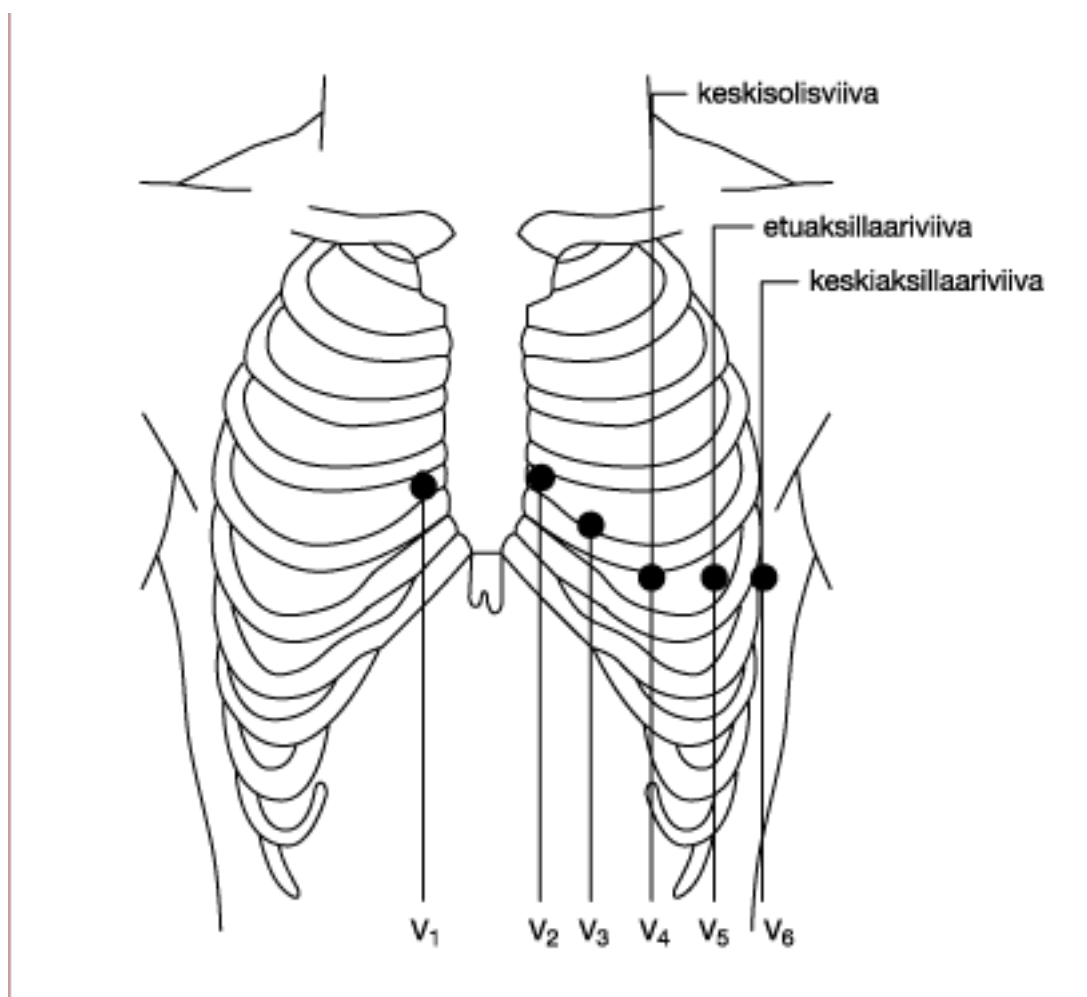


Figure 1. Wilson's Unipolar lead. (Mäkijärvi, 2019)

In limb connections, electrodes are placed on the patient's wrist and ankles on the inner side of the limb. Electrodes should be placed at the same height on the same limb. If the patient's ankles are not available for any reason, you should move electrodes from both ankles e.g., to the knees. If the wrists and/or ankles cannot be used and the electrodes are placed on the knees or elbows, the electrocardiogram may become biased. In this case, a good documentation is important. If the electrodes cannot be placed in these places, the hips and shoulders can also be used if necessary. When connecting the wires, on the left side limbs yellow wire is connected to left arm and green wire to left foot. On the right side, the red wire is connected to right arm and black wire that works as a ground wire is connected to right foot. Figure 2 shows limb electrode and lead placements when patient is in supine position. (Mäkijärvi, 2019.)

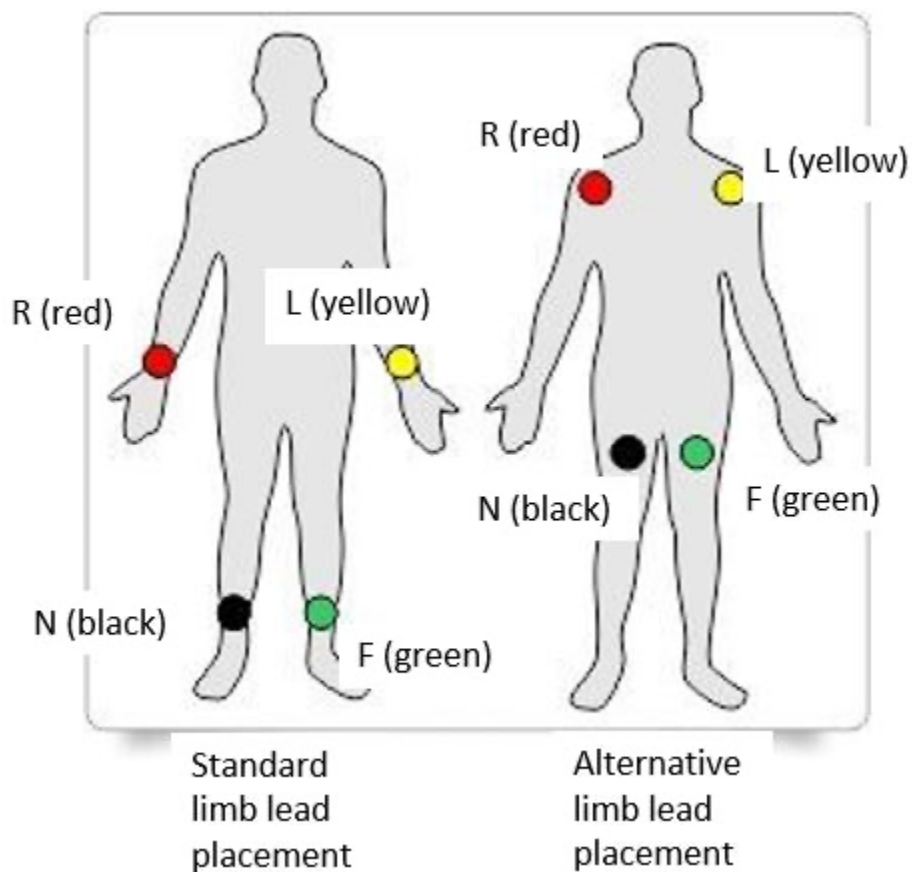


Figure 2. ECG limb lead positioning. (*Glasgow Emergency Paediatric ECG Guideline, 2021*)

2.2 Interpreting ECG

Doctor diagnoses heart-related diseases based on patient's ECG. However, The ECG registrant must be able to interpret and react to certain results orthodoxly.

2.2.1 Sinus Rhythm

The normal rhythm of the heart is called the sinus rhythm. Proper movement of the atria and ventricles are displayed as three distinct waves on electrocardiograph. These waves are labelled as the P wave, the QRS complex, and the T wave, as demonstrated in Figure 3. These three waves should be distinguishable when producing an electrocardiograph, unless an overriding artefact is detected. The three

waves are emphasized over the five apparent in the visual, because individual Q or S waves are not always visible. (The University of Nottingham, 2020.)

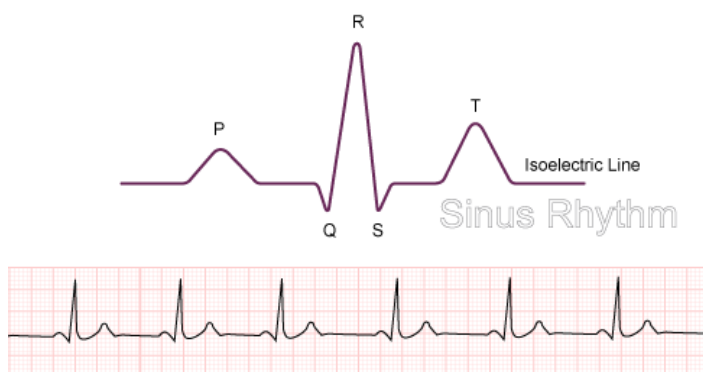


Figure 3. P, QRS & T Wave. (The University of Nottingham, 2020)

2.2.2 Segments of the isoelectric line in sinus rhythm

The P wave represents atrial depolarisation. In sinus rhythm, the P wave is followed by a short flat period preceding the uniform QRS complex. The complex consists of the Q wave, representing depolarisation in the septum, the R wave, representing ventricular depolarisation, and the S wave, representing depolarisation of the Purkinje fibres. The brief period between the S wave and the T wave is known as the ST segment, which in sinus rhythm remains flat. The following T wave represents ventricular repolarisation and is followed by another flat period before the cycle continues with another P wave. (The University of Nottingham, 2020.)

2.2.3 ECG Artefacts

Nurses do not diagnose cardiac arrhythmias from the ECG. However, it is essential for a professional to be able to recognise the most common and alarming ECG artefacts and react accordingly.

In atrial fibrillation (AF) the heart rate is irregular, and no P wave is detected in the ECG. The heart rate is usually over 100 per minute. Atrial fibrillation is not a life-threatening condition, but it increases the risk of heart failure and stroke. The

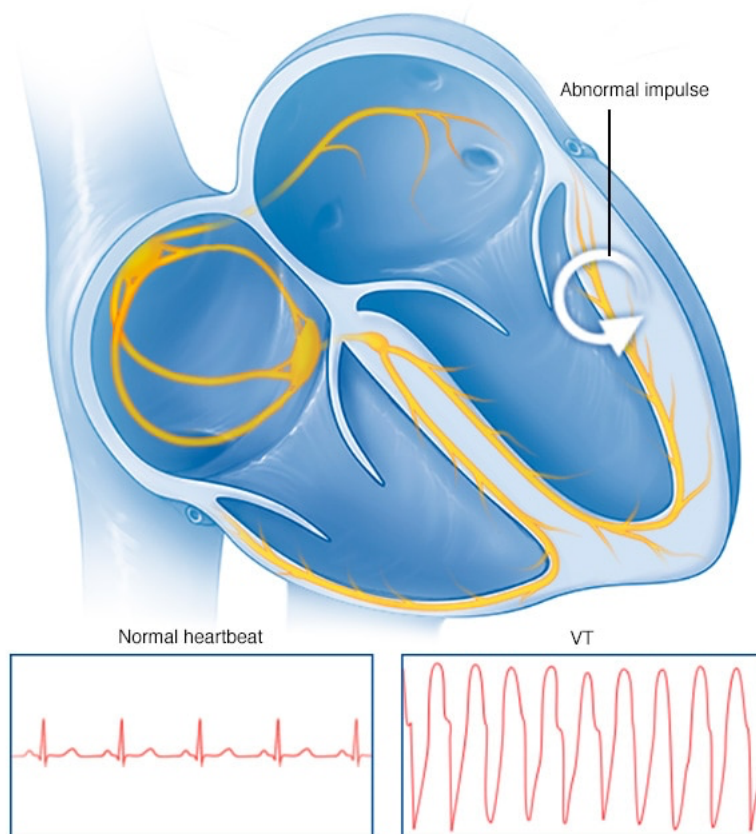
potential symptoms of AF include weakness during physical activity, dizziness and shortness of breath, but may also appear symptomless. AF occurs as paroxysmal, persistent, long-standing persistent or permanent types. In paroxysmal AF the sinus rhythm returns to itself within 7 days or medically or electrically within 48 hours. Persistent AF the sinus rhythm does not return itself, sinus rhythm is returned medically, or electronically more than 48 hours after the symptoms has started. Long-standing persistent AF lasts longer than 12 months and the patient is referred for invasive treatment. In permanent AF, the sinus rhythm cannot be restored and is typically treated with medical treatment to control the heart rate. (Käypä hoito - suositus, 2017; Hekkala, 2019.)

Figure 4 shows the ECG measurement of AF at the top and the normal sinus rhythm at the bottom gram. The arrows indicate the location of the P wave.



Figure 4. Atrial fibrillation. (J. Heuser 2005) käyttöoikeus: [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/)

Ventricular tachycardia (VT) is cardiac arrhythmia in which the lower chambers (ventricles) of the heart do not function simultaneously with the upper ventricles. The heart rate is usually more than 100 beats per minute. VT can last from few seconds to longer and it can cause symptoms like dizziness, shortness of breath, loss of consciousness and chest pain. Long lasting VT may cause cardiac arrest thus, it needs to be quickly treated into a steady sinus rhythm by electronic rhythm transmission. (Kettunen, 2020.) The electrocardiogram of VT is shown in Figure 5 on the left gram.



© MAYO FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH. ALL RIGHTS RESERVED.

Figure 5. Ventricular tachycardia. (Mayo Clinic, 2020)

Ventricular fibrillation (VF) is life threatening arrhythmia where the ventricles of the heart are in vibrating state and the heart does not pump blood into the body. In 10 to 15 minutes VF leads to a sudden cardiac arrest. In VF the patient is unconscious and cardiopulmonary resuscitation (CPR) should be started immediately. VF can only be stopped with an electronic defibrillator. (Hekkala, 2020.) Figure 6 shows that in VF the P wave and the QRS complex do not stand out in the ECG.

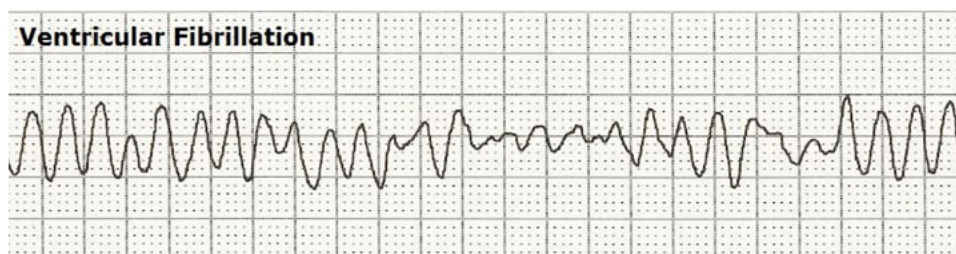


Figure 6. VF. (National CRP Association, 2020)

Pulseless electrical activity (PEA) the heart displays electronic function, but it is weak and there is no palpable pulse, the patient is unconscious. In Figure 7 there is a few electrical activities. CPR must be started immediately. Adrenalin must be administered as soon as possible and after two minutes the rhythm must be analysed again. When PEA changes to VF it is possible to use defibrillator. (Ikola, ym. 2017.)

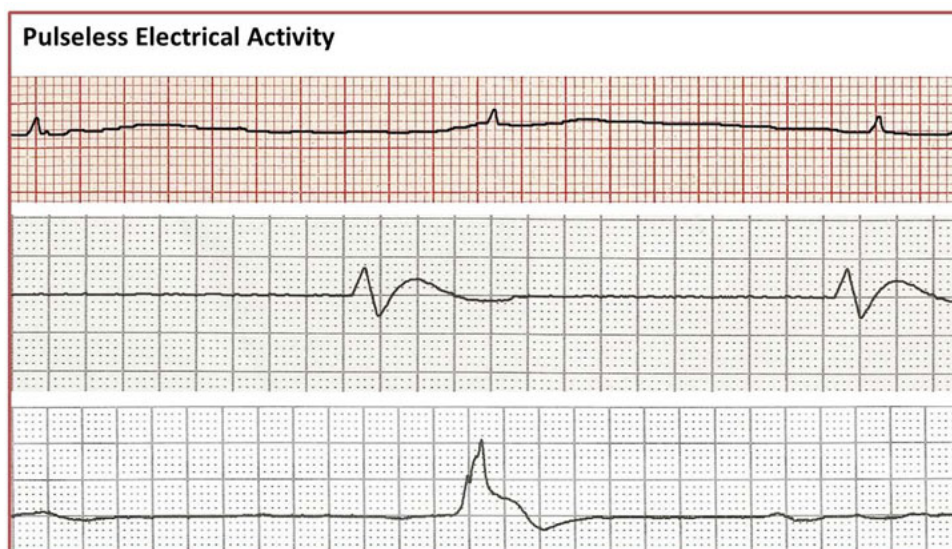


Figure 7. PEA. (National CRP Association, 2020)

Asystole is when there is no electrical function on ECG and ECG shows only straight or wavy line. There is no palpable pulse, and the patient is unconsciousness. The CPR must be started, and the procedure is the same as PEA. As the Figure 8 shows, electrical function cannot be detected from electrocardiogram. (Ikola, ym. 2017.)

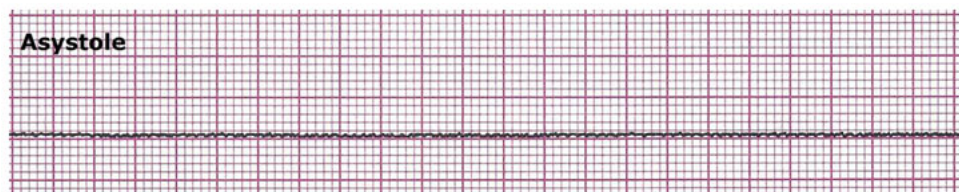


Figure 8. Asystole. (National CRP Association, 2020)

Proper ECG recording reduces the number of errors and artefacts. Artefacts caused by the patient can include muscle tension, patient movement and contact with metal. Improper placement of the electrodes as well as poor attachment also cause distortion

in the electrocardiogram. If error readings appear on the ECG, the electrode placement and patient condition must be reassessed to determine the dysfunctional factor. (Mäkijärvi, 2019.)

3 EDUCATIONAL MATERIAL

The advantages and disadvantages of making educational material must be considered. In the production of audio-visual teaching material, the benefits may be the possibility of repetition of the material, conciseness, and utilization of visualization. The material should not be too long, or too fast. These make it difficult to concentrate and lose interest. (Lähteenmäki, E., Setälä, J. 2014; Fuady, R., & Mutalib, A. A. 2019.)

3.1 Video design

An educational video in and of its own seldom suffices as the most productive educational material. Integrated as part of a more whole learning experience and supported by theoretical and concrete learning, audio-visual tools such as video are particularly effective in memorizing and internalizing the initial subject matter. When developing and using video as an assistive tool in teaching, it is expected of the instructor to understand and implement three key components of educational video material: cognitive load, student engagement, and active learning. (Brame, 2015.)

3.1.1 Cognitive load

Cognitive load pertains to the extent of information that working memory is able to hold at a given time. Since working memory has a limited capacity, instructional methods - such as educational video - should avoid overloading it with unnecessary

activities that do not deliberately contribute to the material or the learning experience. (Mind Tools Content Team, 2021.)

There are various methods and options to consider in the video making process to reduce cognitive overload. These include but are not limited to:

- **Signalling** important information with highlighted text or symbols helps the student distinguish and memorize key concepts.
- **Segmenting** information into clear distinct chunks controls the flow of information and allows the student to engage with more digestible quantities of new data.
- **Weeding** out information that may be interesting or related, but ultimately extraneous when considering the goal of the video.
- **Matching modality**, i.e., implementing both visual and verbal channels in tandem, fitting the appropriate information to the most optimal channel while complementing it with the other. (Brame, 2015.)

3.1.2 Student engagement

An effective educational video will include aspects that help promote student engagement. Students are more likely to watch and pay attention to videos whose elements are tailored towards the demographic. Keeping the video short and focused caters to the attention span. (Brame, 2015.)

Using a more conversational style over formal has a notable effect on students' learning. Speaking with relative speed and enthusiasm promotes interest. Another method of attaining and maintaining student engagement is directing the learning material to a non-specific, relatable audience. Addressing a specific group of people immediately isolates every viewer outside of the demographic, while keeping the object more common and up to interpretation will keep a wider audience more involved and susceptible to learning. (Brame, 2015.)

3.1.3 Active learning

Providing tools to help students process information and monitor understanding is important to get the most out of an educational video. This can be done within the video with guiding questions, but it is much more effective in the form of questions, tasks and simulations outside of the video provided by the teacher. (Brame, 2015.)

4 PROJECT PURPOSE AND AIMS

4.1 Purpose

The purpose of the thesis is to create reliable study material done by form of educational video for future nursing students. While the material can be used as part of a lecture, the focus will be on providing students themselves with material that is optimized to be independently studied. The contents of the material will be stripped of unnecessary facets, leaving the focus on the most important aspects of universally generating a high-quality ECG.

Nurses gain their basic essential skills and knowledge through education. Thus, having access to targeted and high-quality educational tools is of great priority. Nursing students creating this content with the appropriate guidance and monitoring will provide a unique point of view in the process. Current students have a grounded and realistic understanding and perception of how effective different methods of teaching via such materials really is. Combining this with the professional and experienced guidance of trusted lecturers, the end-product would prove an effective way for future nurses to learn and internalize common practices and interventions, essentially improving competence when eventually entering the employment market.

The need for high-quality ECG learning material specifically is relatively high, given that in multiple studies, as well as our own experience, the overall professional nursing staff's know-how on ensuring the electrocardiogram quality is lacking. The

2004 and 2016 studies found shortcomings in the high-quality ECG recording of nursing staff. (Riski, 2004; Nickasch, Marnocha, Grebe, Scheelk & Kuehl 2016.) Therefore, it is important to ensure that studying nurses are entrusted with effective learning material on the issue as well.

4.2 Importance for own development

Developing educational material from scratch will further familiarize the authors with unique aspects of nursing, especially patient education and guidance. Assuming the role of the teacher will provide the student with a new point of view when it comes to understanding nursing interventions and emphasizing them properly. Producing a video will also accustom the student with generally beneficial skills related to audio, visuals, and information presentation.

5 PROJECT PLAN

After choosing our topic "How to take high-quality ECG", we started looking for theoretical information on our topic. With the benefit of having fluent Finnish skills, we are able to use both Finnish and English studies and use databases including these two languages. To find reliable resources we used SAMK Finna, PubMed, Cinahl, Terveystietti and Google scholar.

We ended up making educational video based on the articles we read as well as our own experiences as a student. Audio visual learning material helps students visualize what they have learned, and, according to research, also helps motivate them (Fuady, R., & Mutalib, A. A., 2019).

Initially the idea for a video was inspired by older instructional videos from a couple decades ago. However, most of this planned aesthetic was scrapped in favour of

clarity, as an excessive focus on aesthetics may be largely distracting from the core message of the video.

6 PROJECT IMPLEMENTATION

After establishing a basis of background information, we began planning the manuscript. We gathered everything related onto a first draft and refined it to the point where we would have only the essentials left to fill a video of moderate length. Once our script was finished and approved, we reserved a simulation room at the SAMK campus to film the acted scenes in. A friend of ours agreed to play the role of the patient. The filmed material was edited alongside slides, graphs, subtitles and background music as directed within the initial manuscript. Once a final draft of the video was approved, we conducted some viewings and gathered feedback to review our success and whether there was anything to improve upon. Based on the feedback, however, there was nothing that needed changing in the version provided for the test viewings.

From the initial plans we kept the retro-inspired background music to provide a soft and amusing aspect into the education. This aspect was implemented to enhance learner interest while keeping it subdued enough not to be harmfully distracting. The video is paced in a calm manner with effectiveness in mind, to provide an easy-to-understand guide with as little filler as possible. Audio and visual stimuli are produced to complement one another. Visual aides are carefully selected to be clear, direct, and without distracting clutter. (Cohen, Sasha, 2017. The University of Sydney.)

7 PROJECT RESULT

The output of our project is a video for educational use, from which we asked for feedback from two teachers and students. The feedback we receive is discussed in this thesis. When the video was ready, teachers who are teaching to take an ECG asked us to use our video in a teaching situation. The video was made available to teachers.

8 EVALUATION

8.1 Product evaluation

A free online questionnaire involving Nursing students and teachers was used to evaluate the educational video (Appendix 5). Both the video and a link to the survey's web address were emailed to respondents. The e-mail contained a cover letter (Appendix 4) for the survey. The questionnaire was sent to a total of 38 people, two of whom were teachers and 36 students. Of these, 14 replied to the questionnaire. The feedback survey covered the topic, content, the need, purpose, and development of the video. The topics included in the survey were selected based on the content of the video. Since the video is entirely the work of the signatories, feedback had to be obtained from as many different perspectives as possible.

The video and a link to the survey were sent to the target people by e-mail. Responding to the survey was voluntary and the survey was fulfilled anonymously. The survey used multiple-choice questions, a scaling scoreboard, and free feedback. After collecting the results, the mean was calculated to find the average of the results. The results were edited into clear graphs using the mean, to clarify the visualization of the feedback.

Table 1 shows the feedback on the need and purpose of the video in a pie chart. In the survey, there were charted whether respondents felt that the topic of the video was useful for their studies and whether they felt that the video was necessary in relation to the content of the teaching. Respondents were 100% unanimous that the video is useful and necessary for teaching and learning.

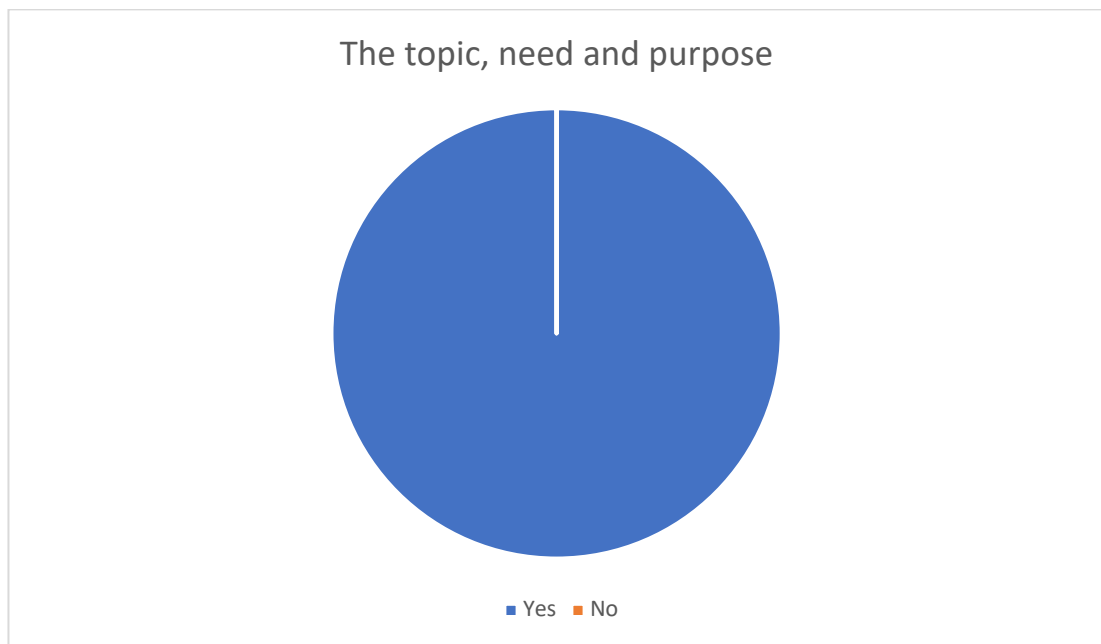


Table 1. The topic, need and purpose. (Rajala N. 2021).

The content of the video was rated on a scale of 1-5 (1=very poor, 5=very good, 0=no comments). In this way, the content could be evaluated using numerical evaluation as in quantitative research (Price, P., Jhangiani, R., & Chiang, I., 2015). In summary, the content of the video was felt to be clear, and the implementation has been successful. The bar chart shows (Table 2) an average of the feedback given for each aspect of the content, which was the storyline, the narrator's replicas, the music, the filming, and the subtitles.

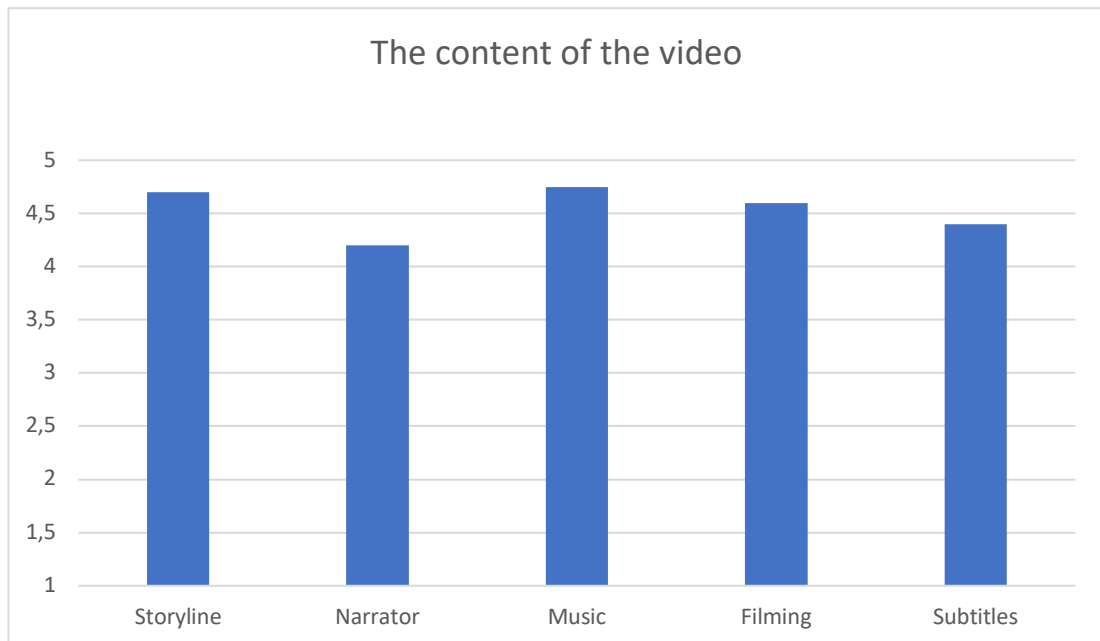


Table 2. The content of the video. (Rajala N. 2021).

An open-ended question is an important part of the survey to make the feedback more accurate. It also allows the respondent to comment on an issue that does not appear in the survey. (Züll, C., 2016.) In the open-ended question section of the survey, feedback was received from a total of 5 answers and each answer was read. Respondents commented that the narrator's tempo could have been a little calmer and slower. The narrator's replicas were clear and the vocabulary professional. Respondents also commented that the subtitles were at times a bit challenging to read, but accessibility was achieved. In order to keep the video comprehensive enough and at the same time moderate in duration, the narration could not be slowed down (Brame, 2015).

In one section, respondents were allowed to choose different teaching situations in which to use the video. The options for the multiple-choice question were in connection with theoretical studies, as pre-study material for theory studies and simulation, in a simulation lesson and as self-study material. In the end, there were also options to answer that the responder would not use the video in any situation, as well as the Other option. These answers were followed by open-ended answers to which the respondent had the opportunity to explain why he or she would not use the material, or in what other situation the material would be used. The chart (Table 3) shows that all respondents would have used the material in at least one of the given

situations. The graph shows the answers as a percentage, with a maximum reading of 1 corresponding to 100% of the answers.

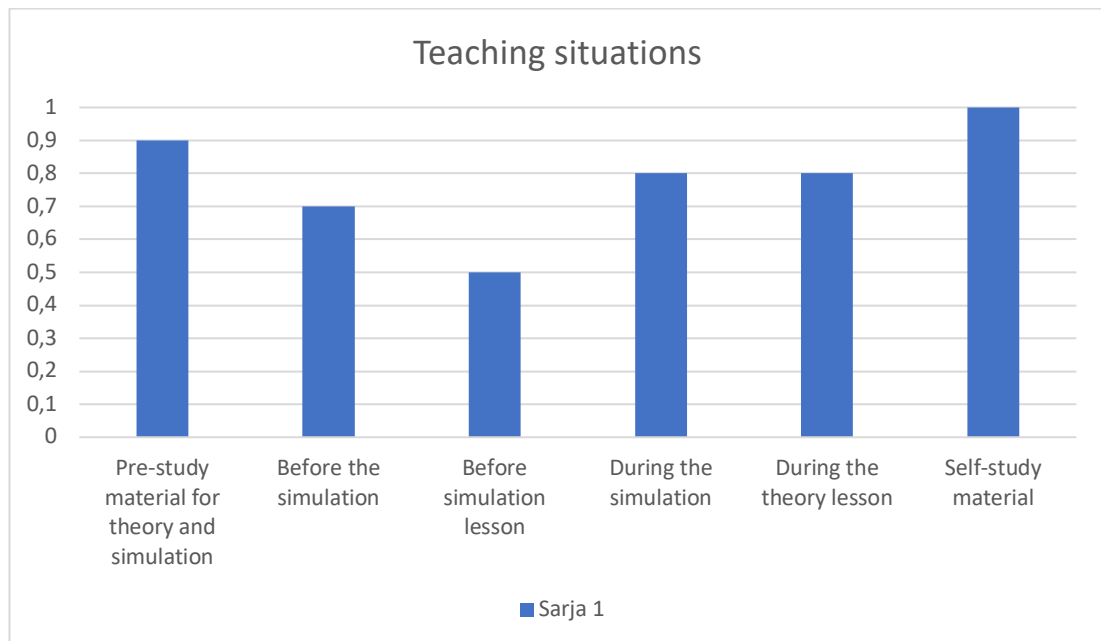


Table 3. Teaching situations. (Rajala N. 2021)

8.2 Project evaluation

Our project got off to a good start, during the planning phase we created a schedule that had to be stopped due to overlapping schoolwork, work, and personal life. The authors could have been more collaborative with the supervisor so that the schedule would not be so long. The authors received good guidance and perspectives from the supervisor and the thesis was developed according to these comments.

9 CONCLUSION

Based on the results we received, the video was successfully implemented. The need for video has been great, and video is a good complement to teaching Nursing students as technology advances and becomes an increasing part of student learning.

Adding instructional videos to teaching will increase students' interest in the topic they are learning. The instructional videos also give a concrete idea in addition to the theoretical studies. (Brame, 2015; Duncan et al. 2013.)

9.1 Ethics and reliability

The research shall be conducted, and the results recorded, presented and evaluated in accordance with the policies of the scientific community, which shall include integrity, general accuracy, reliability and precision. Data acquisition, research and evaluation methods must be adapted to scientific criteria and be ethically sustainable. The researcher needs to take others work and achievements into account so, that they respect others work and refer to these properly. The research will be planned, implemented, and reported according to the requirements of scientific data. The research permit has been applied if needed. An agreement on the researcher's rights, responsibilities, obligations and permits must be made before starting the research. If there is any funding needed during the research, participants must know from what organization or private financier the financial support has been received. (TENK, 2013)

The signatories have themselves written, directed, filmed, and edited the video. the signatories also act as a nurse in the video as well as a narrator. The manuscript can be found in Appendix 2. For the descriptions, we asked for an assistant for the role of the patient. We made a written agreement with the assistant that the video may be used in teaching situations at Satakunta University of Applied Sciences, and the assistant will not receive any financial compensation for his or her performance. With the consent of the assistant, his or her name is mentioned in the final texts of the video in the role of the patient. The basis of this agreement can also be found in Appendix. The video has been shot as agreed in the simulation facilities of Satakunta University of Applied Sciences.

The electrocardiogram seen in the video has been checked by a medical professional. The sources of the borrowed images used in the thesis are visible. Utilizing both English and Finnish proficiency, we found very comprehensive sources that follow

Finnish regulations and practices. The latest publications and articles have been used in the thesis to maintain reliability. Although devices have evolved over the years, the theoretical basis for ECG sampling has remained the same, so older material has also been used as a basis for its reliability. (Riski, 2004.)

The feedback questionnaire was sent by e-mail and was accompanied by a cover letter in English and Finnish. The recipients were people from different nationalities, so this ensured that the international students understood the content. As we are proficient in Finnish, we also prepared the cover letter in Finnish, because the recipients included also Finnish speakers. In the cover letter, we said that giving feedback is completely voluntary, and feedback is given anonymously. The first part of the feedback survey shows that the results will be deleted after analysis.

9.2 Follow up projects and development

Since this thesis only dealt with the basics of taking a 12-lead ECG, in the future it would be good to make material about taking a 15-lead ECG, which is commonly used in the study of a patient with chest pain. This thesis examined the most common arrhythmias that may occur in the ECG. In the future project could also orient with arrhythmias and how to treat them.

REFERENCES

Brame, C. J. 2015. Effective educational videos. Vanderbilt University. Referred 25.1.2021

<https://cft.vanderbilt.edu/guides-sub-pages/effective-educational-videos/>

Cohen, S. 2017. Designing Effective Educational Videos. The University of Sydney. Medicine and Health, Teaching research. Referred 14.11.2021

<https://educational-innovation.sydney.edu.au/teaching@sydney/designing-effective-educational-videos/>

Duncan, I., Yarwood-Ross, L. & Haigh, C. 2013. YouTube as a source of clinical skills education. Nurse Education Today. Volume 33. Issue 12. 1576-1580. Referred 20.9.2021

<https://doi.org/10.1016/j.nedt.2012.12.013>

Eteisvärinä. Käypä hoito -suositus. Suomalaisen Lääkäriseuran Duodecimin ja Suomen Kardiologisen Seuran asettama työryhmä. Helsinki: Suomalainen Lääkäriseura Duodecim, 2017. Referred 25.1.2021

www.käypähoito.fi

Fuady, R., & Mutalib, A. A. 2019. Audio-Visual Media in Learning. Journal of K6 Education and Management, 1(2), 1-6. Referred 19.11.2021

<https://doi.org/10.11594/jk6em.01.02.01>

Hekkala, A-M. 2020. Kammiovärinä. Sydänliitto. Referred 25.1.2021

<https://sydan.fi/fakta/kammiovarina/>

Hekkala, A-M. 2020. Sydämen sähköinen toiminta. Sydänliitto. Referred 2.12.2020

<https://sydan.fi/fakta/sydamen-sahkoinen-toiminta/>

Hekkala, A-M. 2019. Eteisvärinän oireet ja tutkiminen. Sydänliitto. Referred 25.1.2021

<https://sydan.fi/fakta/eteisvarinan-oireet-ja-tutkiminen/>

Honkanen, J. 2002. EKG:n mittaaminen. HUS/LT. Referred 15.12.2020

<http://www.kolumbus.fi/jukka.u.honkanen/tdata/ekgmittaus.pdf>

Ikola, K., Peltomaa, M., Karjalainen, M. 2017. Teho- ja valvontahoitotyön opas. Duodecim Oy. Referred 25.1.2021

<https://www-terveysportti-fi.lillukka.samk.fi/dtk/aho/koti>

Kettunen, R. 2020. Tiheälyöntiset rytmihäiriöt (takykardiat). Lääkärikirja Duodecim. Referred 25.1.2021

https://www.terveyskirjasto.fi/terveyskirjasto/tk.koti?p_artikkeli=dlk00087

- Lähteenmäki, E., Setälä, J. 2014. Video opetuksen tukena. Tampereen ammattikorkeakoulu, Ammatillinen opettajakorkeakoulu. Referred 22.11.2021
- Mind Tools Content Team. 2021. Cognitive Load Theory. MindTools. Referred 25.1.2021
<https://www.mindtools.com/pages/article/cognitive-load-theory.htm>
- Moran, G. 2020. Cardiology Teaching Package. The University of Nottingham. Referred 2.12.2020.
<https://www.nottingham.ac.uk/nursing/practice/resources/cardiology/index.php>
- Mäkijärvi, M. 2019. EKG. Duodecim. Referred 6.12.2020.
<https://www.oppiportti.fi/op/opk04500>
- Nickasch, B., Marnocha, S., Grebe, L., Scheelk, H., & Kuehl, C. 2016. 'What do I do next?' Nurses' confusion and uncertainty with ECG monitoring. Medsurg Nursing. Referred 25.1.2021 <https://nursingfy.com/wp-content/uploads/2018/08/ECGMonitoringArticle.pdf>
- Potilasohje, Kliininen fysiologia ja isotooppilääketiede, 2020. Lepo-EKG (sydänfilmi). Hoito-ohje. Satakunnan Sairaanhoidopiiri. Referred 25.1.2021
<https://hoito-ohjeet.fi/fi>
- Price, P., Jhangiani, R., & Chiang, I. 2015. *Research Methods of Psychology – 2nd Canadian Edition*. Victoria, B.C.: BCcampus. Referred 19.11.2021
<https://opentextbc.ca/researchmethods/>
- Riski, Hanna-Maarit 2004. EKG-rekisteröinti – EKG-käyrän teknisen laadun arviointi. Akateeminen väitöskirja. Turku: Turun yliopisto. Referred 25.1.2021
- Tarek, A. 2019. Electrocardiography. Medscape. Referred 23.8.2019
<https://emedicine.medscape.com/article/1894014-overview>
- TENK, Finnish Advisory board on research Integrity. 2013. Responsible conduct of research and procedures for handling allegations of misconduct in Finland. Helsinki. Referred 22.11.2021 https://www.tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf
- Website of Satakunta University of Applied sciences 2020. Referred 22.11.2021.
<https://www.samk.fi/>
- Züll, C. (2016). Open-ended questions. GESIS Survey Guidelines, 3. Referred 20.11.2021

APPENDIX 1

Literature retrieval

Datab ase	Keyword	Findi ngs	Chec ked	Selected articles
Pubme d	ECG AND registration AND nursing, Electrocardi ogram AND nursing Electrocardi ogram AND nursing AND registration, Electrocardi ogram AND 12-lead AND nursing	16 172 9 16	3 1 3	Zègre-Hemsey, J. K., Garvey, J. L., & Carey, M. G. (2016). Cardiac Monitoring in the Emergency Department. <i>Critical care nursing clinics of North America</i> , 28(3), 331–345. https://doi.org/10.1016/j.cnc.2016.04.009
Duode cim Oppip ortti	Ekg	1036	5	Nikus, K. & Mäkijärvi, M. 2016. <i>Kardiologia</i> . Duodecim Oy. https://www.oppiporrtti.fi/op/kar01104/d Salmenperä, M. & Yli-Hankala, A. 2014. <i>Anestesiologia ja Tehohoito, Elektrokardiografia (EKG)</i> . Duodecim Oy. https://www.oppiporrtti.fi/op/ajt00665/d o?p_haku=ekg#q=ekg
SAM K Finna	Ekg	43	4	Thaler, M. (2018). <i>The only ekg book you'll ever need</i> . ProQuest Ebook Central https://ebookcentral.proquest.com Mäkijärvi, M. 2019. <i>EKG</i> . Duodecim Oy. https://www.oppiporrtti.fi/op/opk04500

APPENDIX 2

Educational Material for Taking High-Quality ECG (2021)

Scene	Video	Audio
1	<p>Title: Educational Material for Taking High-Quality ECG.</p> <p>Wall transition to other slide.</p> <p>Introduction: Electrocardiography is a test used in assessment of cardiovascular condition. It is an essential test for interpreting cardiac rhythm, system abnormalities, preexcitation, and atrial abnormalities by measuring the electric impulses within the heart and the circulatory system.</p>	BGM
2	<p>Transition to picture of ECG device.</p> <p>Bullet points, what should be checked:</p> <ul style="list-style-type: none"> • The device is working • wires are ok • You have all equipment needed • You know how to use the device 	<p>"The condition of the ECG device should be checked before starting the measurement. There is a variety of different ECG devices in common use, and while details of their operation may differ, the essentials remain the same".</p>
3	Preparation:	<p>"The patient should be identified and properly</p>

	<ul style="list-style-type: none"> • Avoid stimulants (e.g., nicotine, alcohol) • Withhold heavy meals • Loose clothing • Remove excess jewelry. <p>(example images of jewelry pop in and out of the picture)</p> <p>The patient is sitting on the operation table, exposes wrists, ankles and chest.</p> <p>The patient moves supine position, the picture freezes.</p> <p>Text: The patient must avoid being in contact to metal parts to avoid misreading.</p>	<p>prepared before the examination."</p> <ul style="list-style-type: none"> • "They should not have consumed stimulants, such as nicotine, for four hours prior, nor heavy meals for two hours prior." • "The patient's clothing should be loose to allow proper circulation." • "Large pieces of jewelry, such as watches, pendants, and anklets, may interfere with the readings, and should be removed for the examination. It's typically okay to leave on smaller jewelry like rings, earrings and piercings." <p>"The patient should feel calm and relaxed during the operation. The measurement does not cause any pain or discomfort to the patient. The patient must have their upper body, as well as their wrists and ankles exposed."</p>
--	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

	<p>Text: In order to attain a high-quality ECG, the skin must remain undamaged.</p>	<p>"The patient must not be in any contact with the metal parts of the bed or operating table to avoid misreading."</p> <p>"Body hair should be shaved from the areas where electrodes are placed. The skin should be cleaned from dandruff or grease with 80% denatured ethanol. If the skin is rough, the skin should be gently grated with sanitary sandpaper. If the skin is damaged or irritated, the electrodes should be relocated."</p>
4	<p>(Short video of pumping hand disinfection bottle)</p> <p>The patient is in supine position, the picture is zoomed to patient's chest. In the corner there is picture of chest connections.</p> <p>The nurse counts the ribs and place the V1 and V2 electrodes. The nurse will show the mid-clavicular line and places V4 electrode (counts the 5th rib). Nurse places the V3 electrode. Nurse shows horizontal segment for V5-6 electrodes and anterior axillary line and mid-axillary line. Nurse places the electrodes.</p>	<p>"Remember good asepsis"</p> <p>"Chest connections V1 and V2 electrodes come between the 4th rib on both sides of the sternum. On the left side of the chest, V4 electrode is placed between the 5th rib on mid-clavicular line. The V3 electrode is placed between the V2 and V4 electrodes. The electrodes V5-6 are placed sideways in a horizontal segment from V4 electrode. V5 on anterior axillary line and V6 on mid-axillary line. The connections of the wires to the electrodes go logically in order V1 to V6. The wires are numbered".</p>

	<p>Wall transition to whole picture of the patient. In the corner, is a picture of limb connections with wire colors. Nurse places the limb electrodes to wrists and ankles.</p> <p>The picture of limb connections from the corner zooms bigger. When talking about wire connection colors, circle around that place/color appears.</p> <p>In the picture, words</p> <ul style="list-style-type: none"> • -'Ride' appears in red font next to right hand • -'Your' in yellow font next to left arm • -'Green' in yellow font next to left leg • -'Bike' in black font next to right leg. <p>Wall transition to picture of connected wires.</p>	<p>"In limb connections electrodes are placed on the patient's wrist and ankles on the inner side of the limb. Electrodes should be placed at the same height on the same limbs. For example, if the patient has had their leg amputated by the knee, both leg electrodes are placed on their respective thigh."</p> <p>"When connecting the wires on left side limbs yellow wire is connected to left arm, green wire to left foot. On the right-side limbs red wire is connected to right arm, and black wire that works as a ground wire is connected to right foot."</p> <p>"A mnemonic to help you remember the correct order of the wires can be 'Ride Your Green Bicycle': R in Ride is for Red on the Right hand, and carrying clockwise on the patient Y in Your is for Yellow on the left hand, G in Green is for green on the left foot, and B in Bicycle is for black in the right foot."</p>
--	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<p>5</p>	<p>Speed video of patient in a blanket, and nurse inserting the patient information into the device.</p> <p>Video of ECG registration (name, hetu) (and printing the gram). *talks about sinus rhythm* The video of registration shadows to picture of sinus rhythm in the centre. P-wave, QRS complex and T-wave appears in the picture among the audio.</p> <p>Gram of AF appears to left up corner of the picture.</p> <p>Gram of VT appears to right up corner of the picture.</p>	<p>"The device may require information of the patient in order to perform the ECG, this should be done after placing the electrodes, while ensuring the patient's comfort. This gives the patient time to adjust for the measurement and leaves time for the electrodes to stabilize."</p> <p>"The normal rhythm of the heart is called the sinus rhythm. Proper movement of the atria and ventricles are displayed as three distinct waves on electrocardiograph. These waves are labelled as the P wave, the QRS complex, and the T wave".</p> <p>"In atrial fibrillation (AF) the heart rate is irregular, and no P wave is detected in the ECG. The heart rate is usually over 100 per minute. Atrial fibrillation is not life threatening, thus it increases the risk of heart failure and stroke".</p> <p>"Ventricular tachycardia (VT) is cardiac arrhythmia in which the lower chambers (ventricles) of the heart do not function</p>
----------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

	<p>Gram of VF appears to left down corner of the picture.</p> <p>Gram of PEA appears to right down corner of the picture.</p> <p>Gram of asystole appears in the center of the picture, on top of sinus rhythm.</p> <p>Wall transition to a blank slide, onto which appear an image of a patient holding onto the railing of the bed, an image of the patient tensed up (e.g., sitting up), an image of a misplaced electrode, and an image demonstrating patient education.</p>	<p>simultaneously with the upper chambers. Long lasting VT may cause cardiac arrest; thus, it is quickly restored to a steady sinus rhythm by electronic rhythm transmission".</p> <p>"Ventricular fibrillation (VF) is life threatening arrhythmia where the ventricles of the heart are in vibrating state and the heart does not pump blood into the body. CRP must be started immediately".</p> <p>"Pulseless electrical activity (PEA) the heart has electronic function, but it is weak and there is no palpable pulse, the patient is unconscious. CPR must be started".</p> <p>"Asystole is when there is no electrical function on ECG and ECG shows only straight or wavy line. There is no palpable pulse, and the patient is unconsciousness. The CPR must be started, and the procedure is the same as PEA".</p> <p>"Artifacts caused by the patient can include muscle tension, patient movement and contact with metal. Improper placement of the electrodes as well as poor attachment also cause distortion in the electrocardiogram. If error readings appear on</p>
--	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

		the ECG it is advisable to go through the patient guidance and electrode placement".
6	Video of nurse removing the electrodes	"Remove the electrodes from the patient's body after the measurement and cleanse the adhesive from the skin with sanitary wipes."
7	End splash screen including the creators, sources used, the name of the actors, the client and target audience, and thank you.	BGM

Consent to Use of Produced Material

I consent to Noora Lempinen and Jasperi Mahlamäki using the material filmed about me as part of their thesis in the educational video How To Take High Quality ECG. With this consent, I also agree that I will not be rewarded in any way for my share. With my consent, my name may appear in the final texts of the thesis after my role as Patient.

Pori 15.4.2021

Signature

Clarification of the name

Hey! As a thesis, we make teaching material on taking a high-quality ECG in the form of a video. The video will be used by SAMK in teaching situations. We ask that you watch the video and respond to our survey. Answering is done anonymously and answering is voluntary. Your answers will be used in the evaluation of the thesis. Links to the video and the survey can be found below.

Best Regards,
Noora Rajala and Jasperi Mahlamäki
Nursing student, SAMK

Same in Finnish

Hei! Teemme opinnäytetyönä opetusmateriaalia laadukkaan EKG:N ottamisesta videon muodossa. Video tulee SAMK:n käyttöön opetustilanteissa. Pyydämme Teitä katsomaan videon sekä vastaamaan tämän perusteella laatimaamme kyselyyn. Vastaaminen tapahtuu anonyymisti, sekä vastaaminen on vapaaehtoista. Vastauksianne käytetään opinnäytetyön arvioinnissa. Videon sekä kyselyn linkit löytyvät alta.

Ystävällisin terveisin,
Noora Rajala ja Jasperi Mahlamäki
Sairaanhoitajaopiskelija, SAMK

APPENDIX 5

As SAMK's students, we made a teaching video for SAMK on the use of teaching a high-quality ECG in English in the form of a teaching video. With this survey, we gather feedback on the work we do. Answers will not be saved. The answers will be deleted after analysis.

Do you think our topic is useful for teaching Nursing students?

1. Yes
2. No

Evaluate on scale 1-5 (1 very bad - 5 very good - 0 I can't say) the content of the video

Story line	1	2	3	4	5	0
Narrator replicas	1	2	3	4	5	0
Audio	1	2	3	4	5	0
Filming	1	2	3	4	5	0
Subtitles	1	2	3	4	5	0

In which teaching situation would you use video to support student learning?

1. As preliminary material for simulation / theory lesson
2. Before the simulation
3. In connection with theoretical studies
4. During the simulation class
5. To support independent study

6. I would not use the material at all

7. Other (open-ended question)

If you answered the previous question “I wouldn’t use the material at all,” why? (Open-ended question)

On a scale of 1-3 (1 unnecessary - 2 can't say - 3 necessary) how would you rate the need for the video.

1. Unnecessary

2. I can’t say

3. Necessary

How would you improve the video? Other feedback? (Open-ended question)