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Physiotherapy in the intensive care unit

The supplementary independent study material for physiotherapy students

DEGREE PROGRAMME IN PHYSIOTHERAPY
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Abstract

This thesis is was made to enhance the knowledge of the physiotherapy students' in the topic of the physiotherapy in Intensive Care Unit by drafting information into an independent study material package to be used in addition to the excisting curricula in Satakunta University of Applied Sciences in Bachelor's Physiotherapy Degree Programme. The aim of this thesis is to update the information on what physiotherapy in the intensive care unit is.

This is done by providing supplementary interactive Moodle material, which student can study independently. The material in the thesis and students' package was gathered through compilation of the information from various medical and academic sources, such as scientific articles, websites of official authorities and books. It explains the main principles of the work of the physiotherapist in the ICU ward, shows new evidence-based practices, and explain how to implement them in a practical setting. In this study, the newest methods of rehabilitation are discussed from a physiotherapeutic viewpoint.

Key words: Intensive care unit, critically ill, physiotherapy, rehabilitation

CONTENTS

1 INTRODUCTION

Acute and critical care has evolved from simple mechanical ventilation of respiratory patients to the pharmacological support and close 24/7 monitoring of critically ill people, who have dysfunction of one or a few organs and are at the risk of death. This significant change over the past decades created the need for the highly skilled multiprofessional staff team that now includes physiotherapists. (Singer & Webb 2009, 31)

The workplace like intensive care unit requires a lot of knowledge of the specific equipment, procedures as well as the newest evidence-based treatment approaches and communicational and practical skills. Absence of one of the requirements can adversely affect the work of the unit and patients' care and increase the potential risks for everyone, who is involved in intensive care, such as environmental risks for medical personnel, ethical troubles, productivity, quality of care and the outcomes of patients. (Esin & Sezgin 2017, 2)

Even though the role of the physiotherapists in the intensive care unit varies from country to country, basic principles and latest shreds of evidence in this field should be known by the physiotherapy students to be prepared to begin the work in this unit, whenever it's needed.

The current outbreak of coronavirus disease 2019 (COVID-19) highlighted the significance of the physiotherapists in intensive care units. In a 12-hours shift, one professional has to do and assist in plenty procedures in the hospital from alternating patient's position to weaning from mechanical ventilation and extubations, as well as assisting in airway clearance and coughing. (Guimarães 2020) Moreover, providing care for the patients in other wards, who were discharged too soon for ICU to set free more beds, was added into the list of responsibilities of the physiotherapist. Increased working load created the shortage of highly skilled medical professionals, including physiotherapists. (Website of International Labour Organization 2020)

Physiotherapy has a quintessential role throughout the patient's hospitalization process. (Righetti, et al. 2020) This thesis acknowledges this fact and stands in as study material for the students to provide the basic principle of the work in the ICU and introduce the latest evidence-based methods of care.

2 AIM AND OBJECTIVES

This thesis aims to update the information on what physiotherapy in the intensive care unit is. It explains the main principles of the work of the physiotherapist in the ICU ward, shows new evidence-based practices, and explain how to implement them in a practical setting. In this study, the newest methods of rehabilitation are discussed from a physiotherapeutic viewpoint. The objective of this thesis is to compile the study material in a comprehensible, common language way for the benefit of the student reader.

3 INTENSIVE CARE UNIT

The intensive care unit (ICU) is a special ward in a hospital with an organized system of care for the seriously ill patients, who stay there after traumas or operations for close monitoring by the specialized medical personnel and multiple organ support, for the period when the patient's life is under the threat. Activities of the ICU ward very often extend further with the inclusion of an emergency department, other hospital wards, which sometimes require ICU professionals (for example, cardiorespiratory ward) and a follow-up clinic. In 2017 The world Federation of Societies of Intensive Care Medicine categorized ICU into 3 different levels. In the ICU of level 1, there is a basic provision of oxygen and noninvasive monitoring with a bigger amount of nursing staff than in any other ward of the hospital. In the ICU of level 2, there is a capability of the provision of invasive monitoring with a short-term basic life support system. In the ICU of level 3, there is a full range of life support technologies and monitoring options, as well as a possibility of developing the ward through conduction of studies and research. Level 3 ICU usually also serve as a resource of acute care on a regional (geographical) level. (Marshall, et.al. 2017) The length of stay in the ICU can vary from 3 days to several weeks (Website of NHS UK, 2020).

Sedation medications are commonly used in the ICU for many reasons. First of all, the used ICU equipment, which supports the patient's life may be uncomfortable, to decrease the discomfort and anxiety caused by it patient may be sedated. (Website of NHS UK, 2020) Secondly, because of the consequences of the trauma of the brain or nervous system, some people become restless, aggressive or touchy. In this case, there is a risk that a person can pull out the tubes and supportive devices. To prevent such situation patient also may be sedated with medications. (Website of health system of the University of Wisconsin-Madison 2020) Moreover, untreated pain and perturbation implicitly result in negative consequences in the short- and long-term period. Sedatives in combination with other medications ease the pain and help the patient overcome the health issues. (Hughes, McGrane & Pandharipande 2012)

On the other hand, when sedation used for a prolonged time or big dosage, it does not play a beneficial role. However, incorporating physiotherapy techniques, like early mobilization, with breathing trials and daily interruption of sedatives potentially lead to improvement of the rehabilitation outcomes and health state. (Hughes, McGrane &

Pandharipande 2012, 53–63). For non-medical professionals visiting ICU might be a scary and frustrating experience, for example for the loved ones of the patient. It is the medical staff's responsibility to explain the ongoing process of treatment and answer all appearing questions. (Website of NHS UK, 2020)

3.1 Essential ICU equipment

After hospitalization of the patient to the ICU ward, which is displayed in Picture 1. the person might be provided with one or a few of the following ICU pieces of equipment, depending on the patient's state. It is important to note that not all of the patients require it.

Picture 1. ICU room (University of Wisconsin Hospitals and Clinics, 2019)

3.1.1 Naso-Gastric (NG) and Oral-Gastric Tube

A small, flexible tube goes into the stomach through patient's mouth or nose to provide food and/or medications straight into the stomach, if there is a disturbance of the gastrointestinal tract or if the patient cannot swallow independently. Such a tube can also serve as a mean to remove the bodily fluids out of the stomach to prevent vomiting. It is usually secured on the face with a medical tape and the other end of the tube is connected to the feeding pump, suction device or drainage bag. It might also simply be closed with a spigot, which is quite a rare case. (Website of ICNSW 2020, Website of health system of the University of Wisconsin-Madison 2020)

3.1.2 Endotracheal Tube

The endotracheal tube (ET tube), which looks like a long plastic tube, is needed for invasive ventilation. It is inserted into the lungs through the mouth and throat. Because of such insertion patient cannot talk and other means of communication are needed, such as communication books and tablets. Another end of the tube is attached to the ventilator. The process of inserting the tube is called intubation. Its' purpose is to assist in the breathing process. (Website of ICNSW. 2020, Website of health system of the University of Wisconsin-Madison 2020)

3.1.3 Central venous pressure line, Central line or Triple lumen

Central venous catheters (CVC) is an intravenous line (also called a central line or triple lumen) which is inserted into one of the largest veins in the body to give the patient nutritional fluids and\or medications. CVC is inserted when smaller veins (for example, in the arm) cannot be found. The most commonplace for CVC is in the jugular (neck) vein followed by the subclavicular (shoulder) vein and the femoral (groin) vein. (Website of ICNSW. 2020)

3.1.4 IV pumps or Syringe pumps

A syringe pump (also called syringe driver) drives small amounts of medication straight into an IV tube. The benefit of using such a pump is that it can be programmed for specific time and amount of medication, and it immediately notifies medical staff when the medication was delivered and in case of inability to deliver the medication. It should never be touched by people who are not involved in the patient's treatment process. (Website of ICNSW. 2020)

3.1.5 Saturation monitor

The monitor is attached to the patient's finger to measure the oxygen saturation level in the blood. When it is impossible to attach it to a finger (for example, in case of hand amputation), it can be placed on an ear, mouth or nose. (Website of ICNSW. 2020)

3.1.6 Ventilator

The breathing machine, which facilitates the patient's breathing or fully supports the process, when the patient is not able to do it independently. (Website of ICNSW. 2020)

3.1.7 Foley catheter

An indwelling urinary catheter is positioned into the bladder to drain out urine. On the other end, the catheter has a urinary drainage bag, which has measurement marks to display the amount of content. It can be used not only to control bladder function but also when the patient cannot go to the toilet independently. (Website of ICNSW. 2020)

3.1.8 Monitor

The ICU bedside monitor displays constantly updated measurements of vital functions such as heart rate and rhythm (electrocardiogram or ECG), blood pressure, temperature, oxygen saturation and breathing rate (respiration) as shown in Picture 2. (Website of health system of the University of Wisconsin-Madison 2020)

Picture 2. ICU monitor (The Ottawa Hospital, 2016)

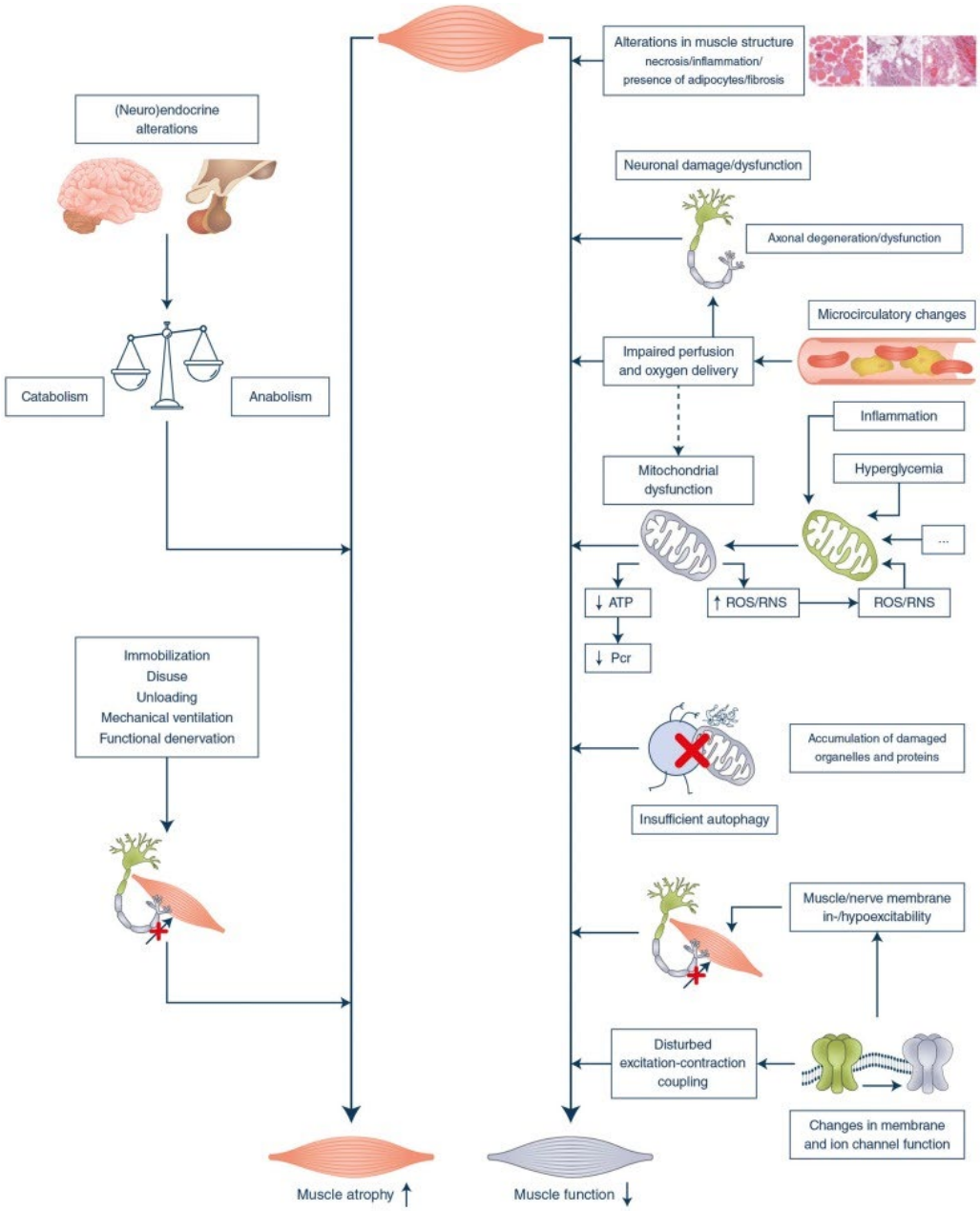
3.2 Possible complications of the ICU-treatment

A study published by Steenberger et. al (2015) on BMC Anesthesiology, investigated "*the one-year mortality rate and its predictors regarding long-term intensive care-treated patients together with their health-related quality of life (HRQL), place of living, healthcare use and long-term complication characteristics after intensive ICU discharge*" showed that half of the investigated patients (which is about 370 people out of 740) did not return to their pre-hospital place of living and had numerous long-term complications, especially chronic fatigue, problems related to the processing of relatives and impaired toleration.
Moreover, such patients and sometimes their family members present with cognitive and neuropsychiatry complaints related to decreased quality of life.

Most common complications of ICU treatment are pressure ulcers and diaphragmatic and chest muscles weakness in association with breathing difficulty. (Website of The

Ottawa Hospital 2020). Infections, pneumonia, thromboembolism and delirium are the complications which should be considered by the professionals. To summarize all possible complications after intensive care treatment, medical professionals introduced the term post-intensive care syndrome (PICS). PICS is defined as a new or worsening impairment in different health areas of the person, such as physical, cognitive, or mental, emerging from critical illness onset and persisting beyond discharge from the intensive care unit. PICS-F refers to the acute and the chronic psychological effects of critical illness on the family of the patient and includes the symptoms that are experienced by family members during the critical illness as well as those that occur following death or discharge of a loved one from the ICU. It has been observed that up to 30% of family or the caregivers experience stress, anxiety, depression, and complicated grief. (Rawal, Yadav & Kumar 2017, 90–92).

Not uncommon is ICU-acquired weakness (ICUAW) due to prolonged immobilization with the future progression of critical illness myopathy and polyneuropathy, overlapping syndromes when the motor and sensory axons are involved resulting into flaccid and symmetric paralysis presenting in 25-45% of ICU patients. (Zhou, et.al. 2014, 101–110) However, some primary neuromuscular disorders, with muscles weakness as a symptom, can trigger the need for intensive care but those conditions only account for <0,5% of all ICU admissions. (Vanhorebeek, Latronico, & Van den Berghe 2020, 637–653). ICUAW is typically symmetrically widespread and affects more proximal part of the limb than distal and respiratory muscles, whilst facial muscles are preserved. Muscle tone is almost always reduced and deep tendon reflexes can be also reduced or stay normal. (Stevens, et.al. 2009, 299-308) (Latronico & Bolton 2011, 931-41) (Kress & Hall 2014, 370) Moreover, during the first week in ICU muscle mass loss can outreach 10%. (Puthucheary, et.al. 2013). Pathophysiology of the ICUAW is not fully investigated, as it brings potential risks for the patients, but in Picture 3, there are represented assumed mechanisms involved in the development of it. (Vanhorebeek, Latronico, & Van den Berghe 2020, 637–653)



Picture 3. Pathways of loss of muscle mass and function. (Intensive Care Medicine, 2020)

4 REHABILITATION PROCESS IN THE ICU

Rehabilitation in an ICU, especially if started early enough after stabilization of the vital functions often while patients stay unconscious and connected to life-support machines, is essential in decreasing sequelae related to ICU treatments and PICS. Such a process requires consideration of probable impediments, client-centred goals, attainability, accessibility of resources and safety measures. (Parker, Sricharoenchai & Needham 2014, Website of the Mobilization Network 2020) Moreover, mental health also

should be included into consideration and appropriate interventions can be applied in co-operation with psychologists or psychotherapists as it directly affects patient's motivation and process or rehabilitation. (Shang, et.al. 2020, 73)

No less important is the provision of information to the patient, which is based on set rehabilitation goals and the state at the moment of discharge from the hospital. The conversation about what to expect after discharge and how to continue the rehabilitation should consist of important and relevant for the person and situation information. This is essential as it is might be daunting and baffling to move from hospital to home. Moreover, the above-noted transfer is difficult as for patient as for family members and/or caregivers, so all of them should know how to seek help and support when it is needed. (Website of National Institute for Health and Care Excellence 2020)

Management of severely ill patients and their families requires a holistic approach not only during ICU stay but also after discharge. Recovering after "the storm" is a long-lasting process. The follow-up can become easier by the elimination of the risk factors, such as unskillful communication by hospital professionals as well as the inability to get information about or access to sick loved ones with decision-making responsibility. Better outcomes can be achieved with pain control methods, avoidance of the excess use of strong sedatives, timely recognition of delirium or any other cognitive dysfunctions, early mobilization and quality of sleep regaining. (Mani 2020, 293–294)

4.1 Challenges of the rehabilitation in ICU

Sometimes such barrier as limited availability of the rehabilitation staff occurs and there is not much that can be done about it except for hiring more professionals.
Furthermore, from the clinical point of view, mobilizing seriously ill persons may be stressful for physiotherapists and therefore the type of the interventions chosen may be limited to less-demanding modalities. Besides, it can be hard to find available time for rehabilitation in the patient's schedule because of diagnostic procedures and testing, that track patient's state. (Parker, Sricharoenchai & Needham 2014)

Another challenge is when there is a shortage of ICU equipment and medical personnel. This was especially noted by many professionals around the world – for example, in India, USA, China and Spain - at the beginning of the 2020 year during the coronavirus outbreak. (Ranney, Griffeth & Jha 2020, 382) Lack of these important things creates risks not only to the patients but also to the ICU staff, who directly contact patients and work in the ward. (Joshi & Raman 2020) Under the pressure of rapidly changing circumstances, physiotherapists have to adapt as anyone else. Adjusting to the modified ways of work under the strict infection control may include being a bridge between ICU and general wards by reducing consequences of ICU care. This happens because a lot of patients are being discharged from the ICU a bit earlier, than the full recovery appears, to increase the amount of the beds for more acute patients. Moreover, recommendations published in the Journal of Physiotherapy in March 2020 by P. Tomas et al suggest a reduction of the interactions between physiotherapists and COVID-19 patients to reduce the risk of future infections. (Thomas et.al. 2020, 73-82) At other point, physiotherapists play a significant role by providing support and advice to colleagues on the exercises and weaning from mechanical ventilation. (Haines & Berney 2020, 67-69) Therefore, telehealth could be considered as a possible solution and prevention of unnecessary exposure to health care providers. (Joshi & Raman 2020)

Despite the progress of the research in the medical field, mortality rates during and after critical illness are still high. Multiple burthens - the challenges of survivorship is what every time the patient meets after the discharge from the ICU. Suffering after painful treatments, constant tiredness and psychological struggles concerning their deformed bodies and minds take a lot of time and power for the patients. As a result, they might refuse to keep fighting the disease. (Iwashyna 2010, 204-205) Therefore, medical professionals working in rehabilitation have to shift attention towards the quality of the survivorship and sustention of the patient's life after the discharge. (Haines, Berney, Warrillow & Denehy 2018)

4.2 The multi-professional approach in the ICU

A multidisciplinary team-based approach is primary in the successful implementation of early rehabilitation practice in the ICU. (Parker, Sricharoenchai & Needham 2014) Team members are responsible for constantly updating and improving their knowledge and co-operational skills inside the team. This can be proved by the quality improvement project conducted in Johns Hopkins Hospital in 2006, which among else included multidisciplinary education for all members of the ICU. This resulted in improved physical functioning of the patients who were ventilated mechanically. (Needham et.al. 2010, 536-542) Moreover, successful multi-professional co-operation can eliminate rehabilitation challenges like unavailability of the patient due to diagnostics and testing procedures. Additionally, a medical director may advocate for the appropriate allocation of staff, resources and equipment to ensure that all eligible patients can safely engage in rehabilitating activities. Other than that, every person, whom patients meet in the ICU ward, plays a big role in supporting and encouraging them during rehabilitation. (Shang et.al. 2020)

5 PHYSIOTHERAPY IN ICU

Physiotherapeutic interventions as part of a multi-professional team approach are integral in reducing consequences of ICU stay, promoting lung function and aiming to reach a pre-hospitalization state of health and improved quality of life after discharge. It is crucial to make a clear plan of the interventions in co-operation with other team members, which are oriented to above-mentioned aims and patient's needs.

Studies by Wu, et al. (2019, 598-606) assessed the feasibility of in-reach rehabilitation for critical care survivors and determined whether the additional in-reach rehabilitation reduces hospital length of stay and improves future rehabilitation outcomes, showed that there were no significant differences between the usual ward therapy group and intervention group with more occupational and physiotherapy sessions per week. They note, that more important is the quality of the provided rehabilitation and not the quantity of it.

To be able to successfully provide physiotherapy to the patients in the ICU the physiotherapist should have some particular knowledge about specific interventions and assessments of the patients' in ICU, as they might differ from what is usually used because of the patient's ability to communicate, as well as how to read monitors and lab results. Moreover, a physiotherapist working in ER and/or ICU wards will come in contact with arterial blood gas (ABG) tests regularly. That is why a knowledge of arterial blood gases, specific tests and what may influence results is important when working in these sectors. (Bendandi 2019, 21)

5.1 Assessment

Before the physiotherapeutic intervention, assessment of the musculoskeletal and cardiorespiratory systems, functioning and activities are needed to evaluate the patient's capacity and draw an individualized treatment plan. Dutch experts' scope of recommendations of assessment includes assessment tools with moderate to good metric properties for use in clinical settings. Observation for the signs of oedema, muscle atrophy, contractures, bedsores, wounds and decubitus – are the tools to assess the musculoskeletal system. (Sommers et.al. 2015, 1051-1063)

Moreover, the following tests have adequate reliability and are recommended for use to evaluate the functional abilities and possible impairments in relation to the International Classification of Functioning, Disability and Health (ICF). Richmond Agitation Sedation Scale (RASS) checks patient's mental functions, responsiveness and consciousness. Standardized Five Questions (S5Q) evaluates the ability to cooperate by requiring the patient to answer 5 simple questions. Goniometry measures ROM. Medical Research Council sum score (MRC) and Handheld dynamometry (HHD) measure muscle strength. Modified Ashworth Scale (MAS) analyzes muscle tone. Modified Nottingham Sensory Assessment (NSA) assesses sensory function. De Morton Mobility Index (DEMMI) evaluates functional ability and The Borg Scale monitors balance. (Sommers et.al. 2015, 1051-1063)

5.2 Treatment methods

Physiotherapy is the field of health care which involve numerous different approaches for treatment and prevention of disease without referring to medications. However, when both are combined (physiotherapy and medication) the results of the patient's treatment can lead to quicker and more successful rehabilitation. (Website of NHS UK 2020)

5.2.1 Passive and active-assisted range of motion exercises and positioning

Passive range of motion exercises (PROM) is the movements applied to the joint entirely by another person (or other persons) or a special machine, which is now used very rarely due to its' uncomfortableness and unreliability. During this, the joint should be entirely relaxed and the body part is moved throughout the available range of motion. (Website of the Physiopedia 2020). The implementation of passive range of motion exercises shows significant results in decreasing oedema, increase in range of motion and function of upper extremities and improvement of the daily living activities of stroke patients, who were provided with acute rehabilitation. (Kim, Lee & Sohng 2014, 149-156) Other studies also report sensory improvement in all the limbs after administering early PROM rehabilitation. (Hosseini, Peyrovi & Gohari 2019, 39-44) Moreover, patients who received physiotherapy in the ICU showed a significant effect on the reduction in ventilatory dependency and shorter length of stay. (Roth et.al. 2013, 33-38)

Other than that, according to ICU experts from Wuhan, China *"Prone positioning has a beneficial effect on oxygenation, lung recruitment, and stress distribution. The physiological effects of prone positioning include redistribution of lung densities".* (Shang et.al. 2020) Although prone positioning improves perfusion mismatch and ventilation, especially in patients with unilateral disease, who were placed with affected lung uppermost. (Ambrosino et.al. 2012, 487-492) To achieve the effects described above, the patient should be in such a position over 12h. (Shang et.al. 2020)

5.2.2 Early mobilization

The term “mobilization” means any physical activity, which has enough intensity to create physiological benefits, like ventilation, improved blood circulation, attentive behaviour and enhanced muscle metabolism. (Paton, Lane & Hodgson 2018, 557-571) It includes any functional activity, cycle ergometry, electrical stimulation and inspiratory muscle training. Early mobilization is well-founded and a relatively safe technique in treatment during the stay in the ICU. Together with other interventions, early mobilization improves functional outcomes of the patient and decrease the risk of deep vein thrombosis and venous stasis. (Ambrosino et.al. 2012, 487-492) There is a special agreement about the use of this technique for unconscious or sedated patients. (Hanekom et.al. 2011, 771-787) When positioning the patient during the intervention: the head of the bed should be at least 45 degrees. Moreover, regular changes of the patient posture in bed are highly recommended beyond the standard 2h regimen, as well as the daily intervention of passive movements of all the joints and electrical stimulation (if approved by the doctor). (Ambrosino et.al. 2012, 487-492)

Among the other benefits of the early mobilization is reduced healthcare costs. This arising from the shorter days in ICU ward and lesser time of mechanical ventilation. Decreased length of stay in hospital also contributes to it. According to these results, the new financial models predict reasonable net savings from the investment in early mobilization rehabilitation programs. (Parker, Sricharoenchai & Needham 2014)

5.2.3 Neuromuscular stimulation

Recent studies conducted in the First Affiliated Hospital of the Hunan University of Medicine in 2017-2019 evaluated the consequence of the use of neuromuscular stimulation on the mechanically ventilated patients with COPD in ICU. The results showed the effectiveness of the transcutaneous neuromuscular stimulation performed twice a day for 30 minutes each session on the improvement of the muscle strength and reduction of ICU acquired weakness. (Chen et.al. 2019, 709-713) Moreover, this method showed significant benefits for critically ill patients with severe chronic heart failure by preventing the development of critical illness polyneuromyopathy (CIPNM). The

weaning from mechanical ventilation period is much shorter in those patients as well as the ICU stay after it. (Routsi et.al. 2010)

5.2.4 Respiratory (Chest) Physiotherapy

Chest therapy is used to regain the balance between respiratory muscle strength and the load of the respiratory system, as both are affected during prolonged mechanical ventilation and consequent diaphragmatic dysfunction. That is also why the proper weaning from mechanical ventilation is crucial. Recent scientific articles and trials (Ambrosino, et al. 2012) show that therapist-driven protocol (TDP) eases the process of weaning. TDP is a daily care plan which is chosen in consensus with all the professionals involved in patient's care. It includes everyday changes that are done (e.g. changes in the settings of the ventilator, duration the therapy, medication doses etc.) All of the above requires high professional expertise in this area. (Ambrosino et.al. 2012, 487-492)

Inspiratory muscle training (IMT) has a proved positive effect on inspiratory muscle strength and quality of life in patients, who were dependant on mechanical ventilation for over 7 days and were recently weaned from it. With the high-intensity approach, which consists of 5 sets of 6 breath at a minimum of 50% of maximum inspiratory pressure (MIP) performed once every day, the IMT requires close supervision of the physiotherapist and co-operation with doctors and nurses. The MIP is the basis for the evaluation of the individual intensity of the IMT for each patient and can be measured via the ventilator or respiratory pressure meter. (Bissett et.al. 2019, 249-255)

5.2.5 Virtual Reality System

Virtual reality (VR) is a combination of technical equipment and systems used by people to get into the simulated world. VR systems are based on human's physical and emotional perception and interaction with the artificial world. The person can have all or one of the sensations, like visual, sensory and auditory) in response to it. (Beaucote et.al. 2019)

This type of therapeutic intervention was reclaimed better than any other method of rehabilitation in ICU because it moves people to a more pleasant environment, like nature, as it has a restorative effect. Patients get into a relaxed mood which is demonstrated by the significant decrease in respiratory rate. Such effect plays a beneficial role in coping with the stressful environment of the ICU and painful everyday procedures. Furthermore, the VR systems with visual and audible input promote the perception of cognitive stimulations in severely ill patients. Moreover, it is relatively easy to use because it can be adjusted for the patient's needs and does not require vigorous physical activity. (Gerber et.al. 2019, 287)

However, there are incidents of the use of more active VR systems, such as Nintendo Wii. In the 2019 year, Brazilian researchers from the University of São Paulo evaluated the level of activity that can be achieved by the patients in a safe environment during physiotherapy sessions with the use of Nintendo Wii. Results showed that light to moderate levels of activity can be achieved and VR rehabilitation is more likely chosen by the patients than any other method of care. (Fu, Gomes & Schujmann 2019, 456-465)

5.3 Implementation of the methods and Cancellation criteria

Rehabilitation is conducted to stop the functional decline, which is caused by the disorder or the treatment of the disorder and to restore functional abilities as soon as possible. Usually, acute rehabilitation starts at the same time as the course of the treatment. Therefore, risk management is particularly important to achieve success. The criteria for the cancellation of rehabilitation was created to ensure the elimination of the risks for the health of the patient. (Sakai et.al. 2019) The following tables summarize the information about most common Cardiovascular considerations (Table 1.), Respiratory considerations (Table 2.), Physical symptoms (Table 3.), Neurological consideration (Table 4.) and other relevant for ICU considerations (Table 5.). The tables were modified on the back of the Criteria for the cancellation of rehabilitation according to the Clinical Guidelines Committee of the Japanese Association of Rehabilitation Med-

icine (Sakai et.al. 2019) and the Expert consensus of physiotherapists and ICU professionals from Australia, United States, New Zealand and Finland (Hodgson et.al. 2014, 658).

The traffic-light system was created to assist in the evaluation of safety criteria. Low risk of an adverse event is indicated by green clour, potential risk of an adverse event is outweighed by the benefit of early mobilization is indicated in yellow colour and significant potential risk of an adverse event requiring consultation with senior ICU staff is indicated in red colour.

Cardiovascular considerations	In-bed exercises	Out-of-bed exercises
Heart rate: - >150bpm - 120-150 or <40bpm - 40-120 bpm		
Mean Arterial Pressure (MAP): - Below target range & causing symptoms - Below target range despite support - Greater than lower limit of target range with low level or no support - Greater than lower limit with moderate support - Greater than lower limit with high level of support		
Known or suspected pulmonary hypertension		
Requiring pharmacological treatment of bradycardia or awaiting emergency pacemaker insertion		
Bradycardia but no requirements for medications or pacemaker		
Dependent rhythm of transvenous or epicardial pacemaker		
Stable underlying rhythm of transvenous or epicardial pacemaker		
Shock of any cause with lactate >4mmol/L		
Known or suspected acute deep vein thrombosis (DVT) or pulmonary embolus (PE)		
Known or suspected sever aortic stenosis		
Cardiac ischemia and/or dynamic EKG changes		

Table 1 Cardiovascular considerations. Modified from Sakai et.al. (2019) and Hodgson et.al. (2014, 658)

Respiratory considerations	In-bed exercises	Out-of-bed exercises
Fraction of inspired oxygen: - < or = 0.6 - > 0.6		
Percutaneous oxygen saturation: - > or = 90% - <90%		
Respiratory rate: - < or = 30 bpm - >30 bpm		
High-frequency oscillatory ventilation (HFOV)		
Positive end-expiratory pressure (PEEP): - < or = 10 cmH_2O - >10cmH_2O		
Ventilator desynchrony		

Table 2 Respiratory considerations. Modified from Sakai et.al. (2019) and Hodgson et.al. (2014, 658)

Physical symptoms	In-bed exercises	Out-of-bed exercises
Chest pain at rest and during rehabilitation, chest palpitations, shortness of breath, dizziness, cold sweat, nausea, temperature >38^{0}C, unstable major fracture of pelvic, spine or lower limb, open wounds of chest or abdomen, uncontrol active bleeding		

Table 3 Physical symptoms. Modified from Sakai et.al. (2019) and Hodgson et.al. (2014, 658)

Neurological considerations	In-bed exercises	Out-of-bed exercises
Level of consciousness: - Patient is drowsy, calm or restless (e.g. RASS -1 to +1) - Patient lightly sedated or agitated (e.g. RASS -2 to +2) - Patient unrousable or deeply sedated (e.g. RASS < -2) - Patient very agitative or combative (e.g. RASS > +2)		
Delirium: - CAM-ICU negative - CAM-ICU positive, patient able to follow simple commands - CAM-ICU positive, patient not able to follow simple commands		
Intracranial pressure: - Active management of intracranial pressure - Intracranial pressure monitored without active management		
Craniectomy		
Spinal precautions (pre-clearance or fixation)		
Acute spinal cord injury		
Subarachnoid haemorrhage, unclipped aneurism		
Vasospasm post-aneurismal clipping		
Uncontrolled seizures		

Table 4 Neurological symptoms. Modified from Sakai et.al. (2019) and Hodgson et.al. (2014, 658)

Other therapies, devices and drains	In-bed exercises	Out-of-bed exercises
Subgaleal drain		
Open lumbar drain		
Femoral sheaths		
Continuous renal replacement therapy		
Venous and arterial femoral catheters		
Prone positioning		
Nitric oxide therapy		
Femoral intra-aortic balloon pump		
Extracorporeal membrane oxygenation: - Femoral or subclavian (not single bicaval dual lumen cannulae) - Single bicaval dual lumen cannulae inserted into a central vein		
Pulmonary artery catheter or other continuous cardiac output monitoring device		
Nasogastric tube, central venous catheter, pleural drain, wound drain, intercostal catheter, urinary catheter, ventricular assist device		

Table 5 Other considerations. Modified from Sakai et.al. (2019) and Hodgson et.al. (2014, 658)

The implementation of these recommendations has the potential to maximize early mobilization while minimizing the risk of adverse safety events, which in turn might improve functional outcomes and translate into reduced ICU and hospital length of stay. (Hodgson et.al. 2014, 658)

6 PROCESS OF THE THESIS AND METHODS

This thesis was created with the purpose of making a supplementary study material about physiotherapy in the intensive care unit and the main principle of the work there. Multiple sources such as medical books, scientific articles, government and scholastic websites, as well as other reliable literature sources were used as a reference for the creation of this work for the period from 2010 to 2020 years. The aim of this was for future SAMK students to gain knowledge on the topic and to be able to apply the knowledge in real-life settings. From this practice-based thesis, an interactive Moodle study material was composed with the use of H5P program. The whole schedule can be found in Appendix 1.This program was used because it allows to include different kind of content, like audio files, quizzes, question's polls, text, pictures and many other. The use of various types of information allows students to perceive the study material in all possible ways.

7 DISCUSSION

In composing supplementary independent study material for the physiotherapy students of SAMK and gathering of the information available on the physiotherapeutical methods and ICU had to limit the topics covered not to overlap the material, which is already provided to the students by the teacher during contact lessons.

Topics such as physiotherapists' experiences in ICU had to be forgone due to length limitations in this study material and the lack of the information on this topic. However could be a further study in itself. How the limits of this study material was decided, was to give the reader an overall view of the physiotherapy in the ICU in under 30 pages. With the information compiled the reader should gain an understanding from a physiotherapist point of view on the topic and precautions to take when treating a critically ill patient.

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APPENDIX 1

PLANNED SCHEDULE – Viktoriia Konovalova

	Months		
Process stage	Planning	Data acquisition	Writing
Topic - selection - definition	Spring - Summer 2019	Autumn 2019	Autumn 2019
Planning of content - thematic plan - research plan - roadmap	Autumn 2019	Winter 2019	Winter 2019
Literature - availability - reading	Winter 2019 – Spring 2020	Winter 2019 – Spring 2020	Spring 2019 – Autumn 2020
Specification of the research or development task	Autumn 2019	Spring 2020	Spring 2020
Compilation of the theoretical background/framework/background material	Spring 2020	Spring 2020	Spring 2020
Methods - Gathering of the information - Planning study material - Creating study material	Summer – Autumn 2020	Summer – Autumn 2020	Summer – Autumn 2020
Results or development proposals etc. - classification - conclusions	Autumn 2020	Autumn 2020	Autumn 2020
Writing	Autumn 2019 – Autumn 2020	Autumn 2019 – Autumn 2020	Autumn 2019 – Autumn 2020
Evaluation - proofreading - pre-examination - submittal of the thesis	November 2020	November 2020	November 2020

Source: Hakala, J. T. 2004. Opinnäyteopas ammattikorkeakouluille. Helsinki: Gaudeamus.