Appendix

1. Appendix Notes:

Note 1: Safety: "Red flags"

Strength of recommendation: moderate
The criteria for the recommendation (fig 2) have values 1 and 2.
The suggested criteria are of significance for the judgment of the hemodynamic stability, cardiorespiratory reserve and the level of awareness, to be able to safely mobilise out of bed and/or activate an intensive care patient.

Literature:

- Adler 2012: level: A1, Schweickert 2009: level A2, Burtin 2009: level B, Bourdin 2010: level C, Morris 2008: level C, Bailey 2007: level C, Brimioulle 1997: level C, Kasotakis 2012: level C, Hanekom 2011: level D, Nordon-Craft 2012: level D, Stiller 2003: level D, Kress 2009: level D, Leditschke 2012: level B, Needham 2010: level B, Balas 2014: level B, Damluji 2013: level C, Mah 2013: level B, Olkowski 2013: level C, Perme 2013: level B, Roth 2013: level B, Sricharoenchai 2014: level B, Wilcox 2013, level D, Rod 2013: level D.

Note 2: Clinimetrics for physical assessment

- Responsiveness:
  Strength of recommendation: Moderate
  The recommendation to measure responsiveness values between 1 and 4.
  Responsiveness shows the awareness and the ability of the patient to react to a task. It is important to differentiate between cooperative and non-cooperative reactions.
  To measure the responsiveness of the IC-patient, the following clinimetric tools are advised:
    - Richmond Agitation Sedation Scale (RASS): Measures the awareness of the IC-patient: Scientific conclusion of value 1.
    - Standardized Five Questions (S5Q): Measures the cooperation of the IC patient: Scientific conclusion of value 4.

  Literature:
    - Sessler 2002: level: reliability study, Ely 2003: level B, Adler 2012: level A1, Gosselink 2008, 2011: level D, Robinson 2013: level A1

- Joint mobility:
  Strength of recommendation: Low
  The recommendation to measure joint mobility has a value 4.
  Evidence states that the risk of contractures increases, if range of motion (ROM) is not assessed in the first week of intensive care unit admission.

  Active and passive ROM (AROM, PROM) should be measured with a goniometer according to the neutral-zero method and should measure large joints such as: Shoulder, elbow, wrist, hip, knee and ankle.

  Literature:
    - Ryf 1999: level D, Clavet 2008, 2011: level C, Gosselink 2008, 2011: level D.

- Muscle strength:
  Strength of recommendation: Moderate
  The recommendation regarding the choice of measurement tools has value 2.
  Measuring muscle strength in the intensive care is reliable (level 2).

  The following clinimetric tools are advised to measure muscle strength in an intensive care patient

  Musculoskeletal system:
    - Manual Muscle Testing (MMT): MRC (sum)score
    - Hand held dynamometer (HHD) or hand grip strength (Jamar) if an MRC-score of 3 has been reached

Literature:

- Nordon-Craft 2012: level D, Fan 2010: level: Hermans 2012: level: reliability study, Vanpee 2011: level: reliability study, Vanpee 2014: level A1, Baldwin 2013: level: reliability study.

- Muscle tone:

  Strength of recommendation: Low

  The recommendation to measure muscle tone has value 4.

  Literature has not reached consensus on what clinimetric tool to use to measure muscle tone in intensive care patients. The Dutch stroke guideline (KNGF richtlijn beroerte, 2014) recommends the Modified Ashworth Scale (MAS) to measure the resistance against passive movement.

  The MAS can be used to assess the muscle tone of an intensive care patient in the intensive care setting.

  - Modified Ashworth Scale (MAS)

  Literature:

  - Royal Dutch Physiotherapy Association (KNGF) guideline stroke 2014: level: guideline, Bohannon 1987: level: reliability study.

- Sensibility:

  Strength of recommendation: Low

  The recommendation to measure sensibility has value 4.

  Literature has not reached consensus regarding the measurement of sensibility, coordination and proprioception in intensive care patients. Burtin (2009) states that cycling 20 minutes daily on the ward might affect muscle coordination and thereby leading to improved physical functioning.

  The Dutch stroke guideline (KNGF richtlijn beroerte, 2014) advises to use the (Modified) Nottingham Sensory Assessment (NSA) to test sensibility and proprioception.

  The (Modified) Nottingham Sensory Assessment (NSA) can be used to assess the sensibility, coordination and proprioception in an intensive care patient in the intensive care setting.

  - (Modified) Nottingham Sensory Assessment (NSA)

  Literature:

  - Royal Dutch Physiotherapy Association (KNGF) guideline stroke 2014: level: guideline, Bohannon 1987: level: reliability study.

- Balance:

  Balance will be evaluated within the DE Morton Mobility Index (DEMMI). See: Note 2, functional status

- Functional Status:
  Strength of recommendation: Low
  The recommendation has value 4.

  No consensus has been met about the use of clinimetrics on the activity level in intensive care patients. Moreover, many measurement tools are not reliable and have not yet been
  validated for the intensive care population.

  Many measurement tools have a floor or ceiling effect. This means that they are not applicable for the intensive care. In literature, many of these instruments are first being used after the patient has been discharged from the intensive care unit.

  In elderly patients, the DE Morton Mobility Index (DEMMI) has been used during hospital intake. This tool is able to detect small clinical differences, can be used from a low level, does not have a ceiling effect and does not need a lot of material or time for its performances.
  The DEMMI includes items of the Berg Balance Scale (BBS), Barthel Index (BI) and the Functional Independence Measure (FIM).
  To measure the level of activity in the intensive care, experts advice to use the DEMMI instead of the Functional Status Score for the Intensive Care Unit (FSS-ICU).
  The DEMMI has been tested on reliability and validity in the clinical setting (although only in elderly patients and not in the intensive care population).

  The following clinimetric tools can be used to assess the level of activity of an intensive care patient in the intensive care setting:
    - DEMMI

  Literature:
  - NICE: level guideline, Adler 2012: level A1, Nordon-Craft 2012: level D, Thomas 2009 and 2011: level A2, Burtin 2009: level B, Kasotakis 2012: level C, Winkelman 2012: level B, Zanni 2010: level C, Gosselink 2008: level D, Gosselink 2011: level D, De Morton 2008: level reliability study, Denehy 2013: level reliability study, Tipping 2012: level D, Hodgson 2014: level D, Trush 2012: level B.

Note 3: Interventions

Strength of recommendation: Low
The recommendations given for physiotherapeutic treatments are based on literature with values 1, 2, 3 and expert opinions.

The effects of physiotherapeutic interventions on deconditioning of intensive care patients are based on values of 1, 2 and 3 (see table 2).
Effects on the level of anatomical features, such as preventing a decrease in protein levels and an increase in inflammatory inhibitors, can be reached through minimally training the muscles actively or passively or by using a Continuous Passive Motion (CPM) for 20 minutes.

Literature:

- Hanekom 2011: D, Schweickert 2009: level A2, Gruther 2010: level A2, Gerovasili 2009: level B,
  Karatzanos 2012: level B, Poulsen 2011: level B, Routsi 2010: level B, Martin 2011: level A2, Cader 2010: level B, Caruso 2005: level B, Burtin 2009: level B, Morris 2008: level C, Chang 2005: level C, Moodie 2011: level A1, Griffiths 1995: level B, Meesen 2010: level B, Winkelman 2012: level B, Reid 2004: level B, Clavet 2008 and 2011: level C, Gosselink 2008, 2011: level D, Moree 2011: level D, Heather 2008: level D, Genc 2012: level B, Chang 2011: level B, Zafiropoulos 2004: level C, Stiller 2004: level C, Kraemer 2002: level D, Kho 2012: level D, Romer 2003: level B, Amidei 2013: level B, Angelopoulos 2013: level B, Calvo-Ayala 2013; Level A2, Camargo Pires-Neto 2013: level D, Chen 2012: level B, Hermans 2014: level A1, Parry 2013: level A1, Kayambu 2013: level A1, Li 2013: level A1, Hirose 2013: level B, Stockley 2012: level D, Stiller 2013: level D, Rodrigues 2012: level B, Williams 2014: level A1.

Note 4: Recommendation of qualitative and quantitative training aspects

No evidence available in detail in intensive care patients.
Due to the fact that there are insufficient foundations on parameters of training and exercise physiology in the intensive care, no recommendations can be provided on training variables and progression in in training to increase the musculoskeletal and cardiopulmonary systems in intensive care patient.
In order to guarantee the safety during training, it is advised to monitor the criteria on when to terminate training (See note 6).
It is advised to monitor and evaluate the effort with the use of the duration, number of repetitions and the BORG scale (see note 7) (scientific conclusion of level 3 and 4)

Literature:

- Morree 2011: level D, Burtin 2009: level B, Winkelman 2012: level B, Morris 2008: level C, Hanekom 2011: level D, Babb 2012: level D, Kraemer 2002: level D, Gosselink 2008: level D, Amidei 2012, level D.

Note 5: Parameters

Strength of recommendation: Moderate
The parameters have values 1 and 2

The following recommendation parameters are necessary to monitor the safety of an intensive care patient during mobilization and activity.

- Clinical view:
  - Decreased level of awareness/consciousness
  - Sweating
  - Abnormal face colour
  - Pain
  - Fatigue
- Heart rate
- Blood pressure
- Oxygen saturation
- Respiratory frequency

Literature:

- Hanekom 2011: level D**,** Adler 2012: level A1, Schweickert 2009: level A2, Stiller 2003 and 2007: level D, Brimioulle 1997: level B, Kasotakis 2012: level C, Winkelman 2012: level B, Bourdin 2010: level C, Bailey 2007: level C, Thomsen 2008: level C, Kress 2009: level D, Burtin 2009: level B, Zanni 2010: level C.

Note 6: Termination criteria

Strength of recommendation: Moderate
The recommendation has values 1 and 2

The criteria to terminate exercise with an intensive care patient are of importance to assess the load of the cardiorespiratory system of an intensive care patient.

It is advised to terminate treatment if the following criteria are met:

- Heart rate: <40; >130
- Blood pressure (MAP): <65 mmHg; >110 mmHg
- Respiratory frequency: > 40 p/min
- Oxygen Saturation: <90%
- Arrhythmia
- Clinical symptoms:
    - Decreased level of awareness/consciousness
    - Sweating
    - Abnormal face colour
    - Pain
    - Fatigue

<u>Literature:</u>

- Adler 2012: level A1, Schweickert 2009: level A2, Winkelman 2012: level B, Burtin 2009: level B, Bourdin 2010: level C, Morris 2008: level C, Stiller 2003 level: D, Hanekom 2011: level D, Mah 2013: level B.

Note 7: Evaluation of interventions

Strength of recommendation: Moderate
The recommendation related to the monitoring of safety have value 1 and 2. In relation to physiotherapeutic interventions, with value 3 and 4.

The recommended parameters are of importance for safe treatment, monitoring and evaluating the physiotherapeutic interventions of an intensive care patient.

The following parameters may be used to monitor, assess and/or evaluate the intensity of the effort on the intensive care patient:

- Clinical view:
  - Decreased level of awareness/consciousness
  - Sweating
  - Abnormal face colour
  - Pain
  - Fatigue
- Heart rate
- Blood pressure
- Oxygen saturation
- Respiratory frequency
- Tidal Volume
- Treatment frequency
- Number of repetitions
- Number of sets
- Duration of the activity
- BORG scale

<u>Literature:</u>

- Hanekom 2011: level D, Adler 2012: level A1, Schweickert 2009: level A2, Stiller 2003 and 2007: level D, Brimioulle 1997: level B, Kasotakis 2012: level C, Winkelman 2012: level B, Bourdin 2010: level C, Bailey 2007: level C, Thomsen 2008: level C, Kress 2009: level D, Burtin 2009: level B, Zanni 2010: level C, Morree 2011: level D, Gosselink 2008: level D, Amidei 2012, level

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3. Appendix: work cards diagnostic and therapeutics process

Diagnostic Process

Screening

(Additional) patient history

It is recommended to screen every patient on the presence of red flags (contraindications) and relative contra-indications to consider (possible) risks and benefits before and during every physiotherapy treatment session.
The criteria mentioned below are (relative) contra indications for mobilizations out of bed and physical activities of intensive care patients and have to be taken into consideration during the clinical reasoning process.
An intensivist needs to be consulted in case of a patient showing one of the following conditions before mobilization/physical activities.

Red Flags (level 1)

Heart rate
- Recent myocardial ischemia
- Heart rate <40 and >130

Blood pressure
- MAP < 60 mmHg and > 110 mmHg

Oxygen Saturation
- ≤ 90%

Parameters of Ventilation
- FiO2 ≥ 0.6
- PEEP: ≥ 10cm H2O

Respiratory Frequency
- Respiratory Frequency > 40 p/M

Level of consciousness of patient
- RASS score: -4, -5, 3, 4

Doses inotropic
- High inotrope doses
  - Dopamine ≥ 10 mcg/kg/min
  - Nor/adrenaline ≥ 0,1mcg/kg/min

Temperature
- ≥ 38.5°C
- ≤ 36°C

Relative contra-indications (level 3 and 4)
- Clinical View
  - Decreased level of awareness/consciousness
  - Sweating
  - Abnormal face color
  - Pain
  - Fatigue
- Unstable fractures
- Presence of lines that make mobilization unsafe.
- Neurological instability: ICP ≥ 20 cmH2O

Physiotherapeutic assessment of functional movement

It is recommended to use these clinimetrics when needed for evaluate impairments and activities restrictions within the ICF classification.

Assessment of the musculoskeletal system
- Edema, muscle atrophy, contractures, deformities, bed sores, decubitus, wounds

Assessment

Function
- Cooperation
  - S5Q (level 4)
- Active and Passive limitations in ROM
  - ROM (level 4)
- Muscle strength
  - MRC (sum) score (level 2)
  - Hand held dynamometer or hand grip strength (Jamar) if MRC score of 3 has been reached (level 2)
- Muscle tone
  - MAS (level 4)
- Sensibility
  - NSA (level 4)

Activities
- Transfers
  - DEMMI (level 4)
- Walking
  - DEMMI (level 4)

Therapeutic process

Non-responsive and non-cooperative patient
- Rass Score < -2 (level 2)
- S5Q < 3 (level 4)

Responsive and adequate patient
- Rass Score ≥ -2 (level 2)
- S5Q ≥ 3 (level 4)

Treatment plan

Passive (Note 3)

- Passive Exercise (level 2)
  - Repetitions: 5 times/joint
  - Sets: 1
  - Frequency: Once daily
- Stretching (level 2)
  - Duration: 20 minutes
- Passive cycling (level 2)
  - Duration: 20 minutes
- EMS (level 1 and 2)
  - Duration: 60 minutes
  - Intensity: 45 Hz
  - Frequency: Daily
- CPM (level 2)
  - 3 x3 hours daily
- Splinting (level 4)
  - Duration: 2 hours on and 2 hours off

Active (Note 3)

- Exercise Therapy (level 4)
  - Intensity: (level 4)
    - BORG 11 – 13
  - Duration: (level 4)
    - Repetitions: 8-10
  - Sets: 3 (level 4)
    - BORG 11 – 13
  - Frequency: 1-2 times daily (level 4)
    - BORG 11 – 13
  - Build up: (level 4)
    - Step 1: Increase duration
      - Increase repetitions to 10
    - Step 2: Increase number of sets
      - From 1 set to 3 sets
    - Step 3: Increase intensity
      - From Borg score 11 to 13
    - Step 4: Increase frequency
      - From once daily to twice daily
- ADL training: Balance, standing, walking (level 3)
- Out of bed mobilization (level 2)
- Cycling (level 2)
  - Duration: 20 minutes
  - Build up: Build up interval training towards 20 minutes

Treatment process

During the interventions, parameters of safety and effort should be monitored and evaluated (Note 4, 5, 6, 7)

- Heart rate (level 1)
- Blood pressure (level 1)
- Respiratory frequency (level 1)
- Oxygen saturation (level 1)
- Change in clinical symptoms such as: (level 3 and4) — Screening continues
  - Level of awareness/consciousness
  - Sweating
  - Abnormal face color
  - Pain
  - Fatigue
- Duration of the intervention (level 4)
- Number of repetitions (level 4)
- Number of sets (level 4) — After the treatment
- Frequency of the intervention(s) (level 4)
- BORG-score (level 4)

It is advised to stop therapy if the following criteria are met: (level 1)
- Heart rate: < 40; > 130
- Blood pressure MAP: 65 mmHg; > 110mmHg
- Respiratory frequency: > 40/min
- Oxygen Saturation: < 90%
- Arrhythmia