

Perceived staff workload in the ICU: Conventional versus robotically assisted mobilisation

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Background: Mobilisation in Intensive Care Units (ICUs) is important to improve patients' outcomes and to avoid immobility related complication [1, 2]. Although there is evidence that mobilisation on ICU is safe, several barriers impede its regular implementation in the ICU routine [3, 4]. These include patient-related, structural, cultural and process-related barriers [5]. Additionally, providing optimal mobilisation in critically ill patients requires high levels of personnel effort, especially if the patients are ventilated, sedated, delirious, weakened or obese. Therefore, realization of mobilisation on ICU is challenging and currently often insufficient in time and intensity [6, 7]. Devices and robotically assisted systems provide an opportunity to overcome some of these barriers by supporting and simplifying mobilisation. For example, the physical effort and the distress of physiotherapists and nursing staff conducting mobilisation could be decreased. Devices like tilt tables or bed-cycle ergometers can be applied on ICUs and their feasibility and safety were shown [8–10]. Innovative robotically assisted devices combining verticalization and gait-like leg movements enable a particular type of mobilisation, which might be especially effective for the recovery of critically ill patients [11]. The robotic system VEMOTION (Reactive Robotics, Germany) was introduced to support mobilisation therapy of severely affected patients. VEMOTION enables to mobilise patients directly in their bed by combining in bed-verticalization and gait-like leg movements. However, although the robotic approach potentially facilitates mobilisation, it is unclear how it is perceived by health care professionals. Therefore, the aim of this study was to evaluate the perceived subjective workload of nurses on ICU when performing the robotically assisted mobilisation compared to the workload perceived when performing standard mobilisation without robotic assistance.

Methods: The evaluation took place in a neurological ICU (Schoen Clinic Bad Aibling, Germany) within a randomized controlled study between October 2022 and April 2023 [12]. Mobilisations were carried out by trained ICU nurses. For patients assigned to the intervention group,

nurses could choose to mobilise with the robotic device or to mobilise conventionally without the device. Patients assigned to the control group were mobilised manually by the nurses without using the robotic device. In the course of the study, nurses were asked about their perceived subjective workload when mobilising ICU patients using the NASA-Task Load Index (NASA-TLX). The NASA-TLX is one of the most widely used instruments to assess overall subjective workload [13]. The scale is multidimensional as it consists of 6 subscales: Mental demand, physical demand and temporal demand, frustration, effort, and performance. Each subscale ranges from 0 to 20, whereby 0 indicates no strain/frustration. Each nurse answered the questionnaire once during the study period. To rate the robotically assisted therapy workload, nurses were required to have performed the therapy independently at least once. Multiple linear regressions were applied to investigate the association of perceived workload (Items 1,2,3,5 due to the highest reliability as suggested by [14]) with the nurses' age and sex.

Results: A total of 25 nurses (13 women, mean age 36.3 ± 9.8 years) completed the NASA-TLX after a median amount of 4 (IQR 2–5) independent robotically assisted mobilisations. Overall, the individual dimensions of the index were predominantly scored in the mid-range, with no extreme values observed (**Table 1**). Concerning the subcategories mental, physical or temporal demand, frustration and performance, the robotically assisted and conventional mobilisation were perceived as equally demanding. Only in the subscale "effort", which considers the mental and physical work in order to accomplish a given level of performance, the robotically assisted mobilisation was perceived as significantly less demanding compared to the conventional mobilisation. The multiple linear regression with age, sex, and type of mobilisation as independent variables did not result in a significant model ($(F_{3,20})=1.062$, $p=.387$, adjusted $R^2=0.008$). Furthermore, none of the independent variables were significantly associated with the workload (all $p > .180$).

Table 1: Perceived workload: Results of NASA-TLX

	Robotically assisted Mobilisation n=12	Manual Mobilisation n=13	p-value
1. Mental Demand How much mental and perceptual activity was required? Was the task easy or demanding, simple or complex?	8.3 ± 4.0	7.5 ± 5.5	.717
2. Physical Demand How much physical activity was required? Was the task easy or demanding, slack or strenuous?	7.8 ± 6.0	10.8 ± 5.4	.199
3. Temporal Demand How much time pressure did you feel due to the pace at which the tasks or task elements occurred? Was the pace slow or rapid?	11.6 ± 5.7	10.0 ± 3.0	.390
4. Performance How successful were you in performing the task? How satisfied were you with your performance?	13.5 ± 5.6	14.4 ± 4.3	.660
5. Effort How hard did you have to work (mentally and physically) to accomplish your level of performance?	7.8 ± 5.0	12.4 ± 3.8	.015
6. Frustration How irritated, stressed, and annoyed versus content, relaxed, and complacent did you feel during the task?	8.1 ± 6.5	8.7 ± 5.8	.805
Overall Workload (addition of Items 1,2,3,5)	35.3 ± 16.6	40.7 ± 10.6	.352

Conclusion: Although conventional mobilisation and robotically assisted mobilisation were mostly perceived to require equally moderate workloads, nurses using the robotic device reported significantly lower perceived effort required to achieve a given level of performance, indicating its potential for enhancing efficiency and reducing physical strain. Age and sex did not influence the perceived workload in either group. As robotic devices are promising tools for improving mobilisation of critically ill patients, further investigations on therapy effects are warranted. More routine in using the robotic device could lead to a lower perceived workload, which needs to be clarified in future studies involving a larger sample size.

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