A holistic concept for measuring stress factors: Future sensor technologies for outpatient nursing staff and exoskeleton development

L. M. Wirth, M. Peters, N. Will, M. Tabie, T. Rossol, N. Pfeiffer, T. Wittenberg, J. Behrens, S. Lienenbrink, C. Thron

Purpose Mobilization of elderly or disabled patients is one of the most stressful and physically demanding tasks within nursing (DNQP 2020, BGW 2024). In particular outpatient nursing care faces special challenges, as there are usually no colleagues on site to provide physical support and (electro-mechanical) aids are not provided in all cases. Even though modern technologies such as exoskeletons are nowadays available to reduce the weight of the patients during the mobilization procedures (Strube-Lahmann et al. 2023), the mobilization process remains stressful. In this contribution we will present (1) the conceptual and methodological foundations of a holistic concept for the measurement of stress and strain factors (with the help of sensor technology) for outpatient nursing staff, and (2) the derivation of explorative research approaches for the (further) development of exoskeleton solutions to relieve employees in the outpatient field of activity. In recent years, a number of different exoskeleton systems have been developed that are also intended for use in occupational care (Rayssiguie et al. 2022, Vallée 2024). However, widespread use has not yet been observed. It is currently unclear whether it is only the framework working conditions that are hindering the use of these weight-reducing systems or whether the systems already available on the market do not yet comprehensively address the needs of professional caregivers at different qualification levels.

Method In the beginning of 2024, an interdisciplinary working group was formed to advance the concept idea and identify challenges and possible approaches for a new, disruptive technological development of new exoskeleton models that are specifically geared to the needs of (outpatient) care. The aim here is to present the reorientation towards specific burdens in outpatient care along with different qualification levels and the development of supporting robotic systems based on these needs. In terms of scientific discourse, the Contribution raises the question of whether the concept developed is suitable for adapting and further developing existing exoskeletons with regard to the needs and requirements of users without being able to present concrete results. **Results and Discussion** The envisioned holistic concept can be divided into three different tasks:

a) A systematic review of biopsychosocial stress factors in outpatient care scenarios. This review will identify factors for comparing stress and strain in relation to physical and psychosocial demands in the day-to-day work of outpatient nursing and support staff.

b) Sensor-supported measurement and self-reported outcome measures (PROMs) of biopsychosocial stress in outpatient care. In preparation for the measurement, the factors from task (a) are analysed within the route data of the outpatient services to combine partial surveys with extrapolations if necessary. Recourse to the data from the tour planning and documentation systems is also being considered in order to assign corresponding stresses to individual tasks in the homes of people in need of care, in order to enable extrapolation for more tours than those actually measured.

c) Design of an alternative (robotic or mechatronic) systems to relieve the burden on employees in outpatient care. Based on the findings of tasks (a) and (b), workshops on the (further) development of future systems to reduce biopsychosocial stress (e.g. during mobilization) will be held together with employees from outpatient care. In the workshops, the field of application and technological possibilities will be closely interlinked. Based on the results of the research, the event will provide impetus for the (further) development of exoskeletons or similar solutions for the physical and, in some cases, psychosocial relief of employees in outpatient care.

During the presentation, the concept steps will be explained and put up for discussion.

References

Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrtspflege (BGW) (2024): Rückengerecht arbeiten in der Pflege. Hamburg. URL: https://www.bgw-online.de/resource/blob/18122/f2a96d9de20d29c2209f09efbd480128/bgw07-00-000-starker-ruecken-data.pdf (l.v. 19.05.2024).

Deutsches Netzwerk für Qualitätsentwicklung in der Pflege (DNQP) (2020): Expertenstandard nach § 113a SGB XI „Erhaltung und Förderung der Mobilität in der Pflege". Osnabrück.

Rayssiguie, Esther, and Mustafa Suphi Erden (2022): A Review of Exoskeletons Considering Nurses. *Sensors* 22(18), 7035. URL: https://doi.org/10.3390/s22187035.

Strube-Lahmann, Sandra, Müller, Franziska, Naumann, Björn, Müller-Werdan, Ursula, Lahmann, Nils (2023): Pilotierung eines aktiven Exoskelettes in der stationären Akut- und Langzeitpflege.Zeitschrift für Neurologie & Rehabilitation. 29(1). S. 56-61.

Vallée, Alexandre (2024): Exoskeleton technology in nursing practice: assessing effectiveness, usability, and impact on nurses' quality of work life, a narrative review. *BMC Nurs 23*(156). URL: https://doi.org/10.1186/s12912-024-01821-3