Implementing new digital technologies and robotics in a German neurological rehabilitation clinic: A survey with health care professionals

S. Bloemeke[1], A. Buetikofer[1], C. Mirbeth[2], C. Ohneberg[2], I. Eberl[2], K. Jahn[1], F. Müller[1]

1 Schoen Clinic Bad Aibling, Department of Neurology, Research Group, Bad Aibling, Germany

2 Catholic University of Eichstätt-Ingolstadt, Germany

Background: Digital and robotic technologies are offering high potentials to support care professionals and improve patients' quality of life without compromising the quality of care [1, 2]. Nevertheless, the users' perspective is rarely considered in the development of robotic systems [3, 4]. Within the collaborative project ReduSys, funded by the German Ministry of Education and Research (BMBF), the following multimodal systems are being developed:

- Medical Smart Bed: A special mattress, which enables a contactless and continuous measurement of vital parameters.
- PROST: A system that records the amount of liquid intake automatically.
- FLOW: A digital care assistant for smartphones and/or tablets that facilitates the communication between nurse and patient enabling the visualization and transmission of patient needs.
- Robody®: An innovative humanoid robot controlled via virtual reality interfaces by the care taker. The robot is able to provide small health services.

As the technologies are intended to be tested and may be integrated into clinical practice, an initial objective within the project was to survey and interview nursing staff, patients and other health professionals about their perception of the digital solutions that are being developed. The main aim was to ensure that the perspective of potential users can be included in the further development of the technologies. The analysis was conducted at a stage when the technological systems were still in development and not finalized, allowing for potential modifications. Consequently, the results may contribute to the ongoing development of robotic systems. We primarily focused on finding out whether the technical systems of the ReduSys project could be easily integrated into existing structures in the opinion of the employees. Furthermore, we asked the employees if they would be willing to try out and evaluate the technologies in the clinical setting within the research project.

Methods: We conducted a mixed methods study [5] and aimed to answer the following research question: "How are the technical systems of the ReduSys project evaluated by potential users in terms of feasibility and ethical-social aspects?" The quantitative part included a survey with nurses and other health care staff (research, hygiene and therapists), the qualitative part included semi-structured interviews with health care professionals and patients. Study participants were all employees of a neurologic rehabilitation clinic in Germany. We firstly presented the technologies of the ReduSys project, along with some potential use cases within a project presentation. After the project presentation the employees were invited to anonymously complete the survey. The questionnaire was divided in four parts and included closed and open questions. In the first section, socio-demographic data of the participant was recorded to describe the sample. This included age, gender, professional role and professional experience. The second part consisted of closed questions on general interest in technical systems and professional contact with digital data collection systems (e. g. digital patient files). The third part comprised closed questions on the individual ReduSys technologies and had additionally free text fields, where the employees could add what they like or dislike about the system. The last part contained open questions and a standardized assessment, the System Usability Scale [6], to evaluate the overall system. The closed questions had a four-stage scaling (Likert Scale) of the answer options from "totally agree" to "totally disagree".

Here, we present parts of the quantitative section of the study, specifically the analysis of following two closed questions on the individual digital solutions and robotics by means of descriptive statistics [7]:

1. Can the system be easily integrated into the existing clinical setting?
2. Would you be willing to test the system in the clinical setting within the research project?

Results: In total, 30 employees (20 nurses, 4 research associates, 3 therapists and 3 hygiene professionals), with an average age of 41.3 years (SD 12.6) and an average work experience of 17.3 years (SD 13.3), participated in the study and completed the survey. The results of the survey are represented in **Table 1**. Regarding the first question, participants envisioned seamless integration of the PROST system and the Medical Smart Bed into the existing clinic structures. Concerning the digital care assistant FLOW and the humanoid robot Robody®, the majority of the participants believed that the implementation of these systems in the existing clinical structure

could be challenging. A notable advantage of the technologies, as highlighted by several respondents, was the potential alleviation of manual data entry. On the other side, some participants raised concerns about the possibility of encountering time-consuming technical issues. Regarding the second question, the majority expressed interest in the prospect of testing and evaluating the introduced technologies in the clinical setting.

Table 1. Results of the survey

The system can be easily integrated into existing structure.

	FLOW (n=29*)	PROST (n=29*)	Medical Smart Bed (n=29*)	Robody® (n=29*)
Totally disagree	5 (17.2)	0 (0.0)	1 (3.4)	8 (27.6)
Disagree	11 (37.9)	3 (10.3)	2 (6.9)	13 (44.8)
Agree	8 (27.6)	15 (51.7)	11 (37.9)	6 (20.7)
Totally agree	5 (17.2)	11 (37.9)	15 (51.7)	2 (6.9)

I would test the system within the research project.

	FLOW (n=30)	PROST (n=29*)	Medical Smart Bed (n=29*)	Robody® (n=30)
Totally disagree	3 (10.0)	0 (0)	0 (0)	5 (16.7)
Disagree	3 (10.0)	1 (3.4)	2 (6.9)	5 (16.7)
Agree	12 (40.0)	7 (24.1)	10 (34.5)	12 (40.0)
Totally Agree	12 (40.0)	21 (72.4)	17 (58.6)	8 (26.7)

Data is displayed by n (%); *missing data n=1

Discussion: The survey results indicate that healthcare staff is generally open to test new technologies and to a potential implementation in clinical practice. However, there are also important concerns that must be taken into account. Clinical testing of the systems should be planned carefully and not burden the daily routine of hospital staff. Although the technologies were presented to users in an experimental stage, this is common practice in order to adapt them to requirements. The survey has shown the importance of including the potential users of future technologies in the development process in order to identify what needs have to be considered when making the technologies useful for clinical setting.

Funding:
This Project is funded by the Federal Ministry of Education and Research (BMBF) under grant agreement n° 16SV8829.

References:

1. Christoforou EG, Avgousti S, Ramdani N, Novales C, Panayides AS. The Upcoming Role for Nursing and Assistive Robotics: Opportunities and Challenges Ahead. Frontiers in digital health 2020; 2: 585656
2. Petrovic M, Gaggioli A. Digital Mental Health Tools for Caregivers of Older Adults-A Scoping Review. Frontiers in public health 2020; 8: 128
3. Buhtz C, Paulicke D, Hirt J, Schwarz K, Stoevesandt D, Meyer G, Jahn P. (2018). Robotische Systeme zur pflegerischen Versorgung im häuslichen Umfeld: ein Scoping Review. Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen 2018; 137–138: 1–8
4. Mutlu B, Forlizzi J. Robots in organizations: The role of workflow, social, and environmental factors in human-robot interaction. In: Proceedings of the 3rd ACM/IEEE international conference on Human robot interaction (HRI '08). Association for Computing Machinery, New York, NY, USA 2008: 287–294
5. Creswell JW, Plano Clark VL. Designing and conducting mixed methods research (2nd edition). Sage 2011
6. Brooke J. SUS – a quick and dirty usability scale. In: Jordan PW, Thomas B, McClelland IL, Weerdmeester B, editors. Usability Evaluation In Industry. London: Taylor & Francis 1996
7. Bourier G. Beschreibende Statistik: Praxisorientierte Einführung - Mit Aufgaben und Lösungen. Wiesbaden: Springer Fachmedien 2022.