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First Integration of a Service Robot and a Communication Application into a Nursing Isolation Setting – An Observational Study Evaluating Walking Distances, Stress and Radiation Doses

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Abstract

Nurses spend a significant proportion of a workday on non-nursing or auxiliary tasks, mainly due to the unilateral patient call system. This leads to work interruptions, a decrease in quality of care and stress for nurses. One approach for relieving nurses is the integration of new technologies. We performed an interventional study for seven months in a nuclear medicine station in a maximum care hospital, where we integrated a smartphone app for patient-staff communication in combination with a service robot for delivery of non-nursing and service items and evaluated the effects on walking distances and stress. We also examined the radiation dose to the nursing staff. To this purpose, we observed nurses at nine different time points for six shifts to measure walking distances and interruptions. Additionally, nurses and service personnel completed a questionnaire adapted from the NASA RAW TLX at the end of each shift to assess stress. Short walking distances accounted for the largest share of the caregivers' walking distances. There was no direct effect of the technique on stress levels and walking distances, only a shift towards shorter walking distances with longer implementation. The total number of walking distances seemed to be proportional to the feeling of interruption and the individually experienced stress. This first use of the combined technology implementation in the acute clinic worked well. While this work provides an initial indication of where the implementation of this combined technology could potentially relieve the burden on nurses and service staff, further research is needed to establish causal relationships.

Trial registration details

The trial was registered with the German Clinical Trials Register (DRKS) on 16.02.2022:DRKS00028127.

Keywords Assistive robotics · Inpatient care · Nursing science · Digitalization

1 Background

In hospitals, nurses play a crucial role as they are always present at the patient's bedside and act as a vital link between patients, other healthcare professionals, and family members [1, 2]. However, studies indicated that a significant portion of a nurse's work time is spent on non-nursing or auxiliary tasks, such as distributing food and water [3–6]. Harrison and Nixon reported approximately up to 15% per shift [7], Biron et al. up to 21% of time spent on non-nursing related walking tasks [8]. In addition, the prevalence of these non-nursing tasks has increased due to cost-cutting measures and the need to review expenditures [9, 10].

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The non-nursing tasks were primarily due to the patient call system and unilateral patient requests [11]. The patient call system merely indicates that a patient needs assistance without providing specific details about the urgency, nature, or extent of the need. As a result, these requests interrupt nursing tasks and processes, leading to increased complexity in the nursing workflow [12–16]. Other interruptions include brief face-to-face interactions between nurses [14] while a smaller percentage is attributed to work system failures such as missing medications [8]. Consequently, these non-nursing tasks and workflow interruptions can negatively impact the quality of inpatient care [17] and contribute to the occurrence of medical errors [18]. In addition, they leave nurses with less time to devote to their core nursing responsibilities, which can lead to increased stress levels, job dissatisfaction, higher turnover rates, or even intentions to leave the profession [1, 12, 14, 18–20]. This issue is not limited to specific specialties or functional areas within hospitals, but rather represents a pervasive challenge [3, 21, 22].

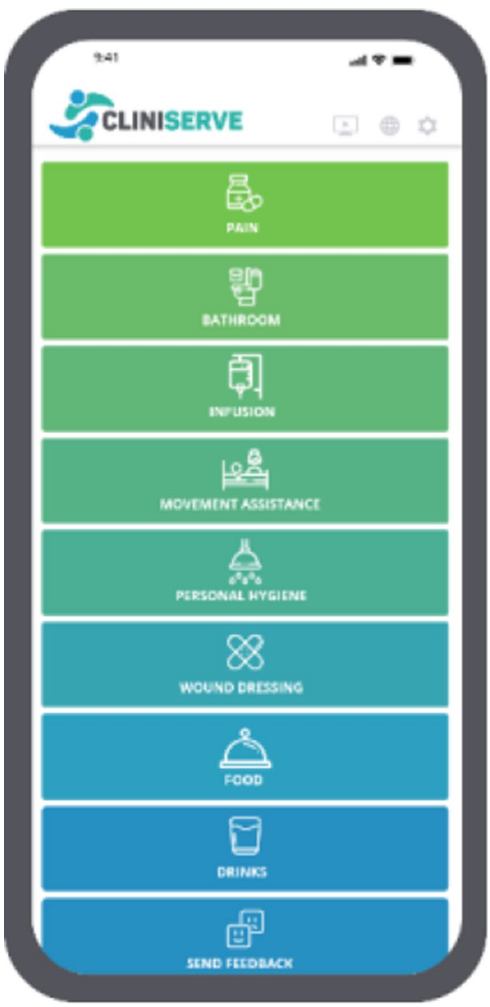

Fig. 1 Patient view of the Cliniserve App

Technological advances, such as robots or smartphone applications, offer new potential solutions for restructuring work processes [3, 23, 24] and reducing the burden on nurses. By now, the usage in healthcare remained limited [3, 25–29]. One promising approach to support nurses might be to combine several technologies to generate the greatest possible benefit. So far, however, the implementation of robotic systems has hardly gone beyond the test phase [29]. In light of the shortage of nursing staff, it is crucial to examine more closely whether service robots can relieve the burden on nursing staff by taking over transportation tasks, for example [6].

To date, only a limited number of studies have examined the use of communication apps and service robots in hospital settings [28–31]. These studies have examined nurses' perceptions of robots in a nursing context [32] and have identified a need and desire for robotic assistance [33, 34]. However, they do not provide comprehensive insights into the extent to which service robots, particularly when paired with a smartphone application, can effectively support and reduce the daily workload of nurses. Sommer et al. suggest to investigate the usage of different types of service robots in different departments to optimize utilization [6].

Although there are studies that deal with the use of robots on a nuclear medicine ward, e.g. to record vital data and radiation doses of patients [35] or to use a passive robot for fluoroscopy-guided arterial puncture [36], to our knowledge there are no studies to date that investigate the use of service robots and their influence on the radiation exposure of staff on a nuclear medicine ward. The fact that more and more radiopharmaceuticals are being produced makes it important and essential to control the dose for nuclear medicine staff [37]. Using service robots on a nuclear medicine ward could have the potential to reduce radiation exposure for nursing staff, as patient contact for certain tasks could be reduced by having the corresponding tasks performed by a robot.

Within the REsPonSe project (Robot system for relieving nurses from service activities), which was carried out on a nuclear medicine ward, we linked two technologies to improve communication between patients and station staff [38] and reduce radiation exposure.

The first technology, the Cliniserve smartphone app [39] allowed patients to submit service requests (e.g. such as drinks or fresh towels), information about therapy (e.g. empty infusion bag or stopped infusion), and their health status (e.g. pain or discomfort) using predefined buttons (see Fig. 1). Apart from predefined tasks for the service robot, the app sent the requests to the correct and responsible professional group in the nursing or service area. The recipients received the request on their professional smartphone and could confirm, forward, or ask queries in a timely manner.

As a result, the patient received feedback on their request as quickly as possible.

The second technology used was the JEEVES service robot (see Fig. 2) [40]. Originally designed as a moving minibar for the hotel industry, JEEVES was adapted to the requirements of an acute care hospital as part of the REsPonSe research project. The robot is equipped with four refrigerated drawers and can autonomously navigate the corridor through a predefined map. The service robot had existing safety mechanisms, such as avoiding objects and people.

For this study we implemented a combined technology, we linked both these technologies so that patient requests for water, towels, cool packs and toothbrushes went directly to the service robot via the Cliniserve app. The robot then processed the requests and autonomously delivered the requested items. Here we used the Cliniserve app to control the process, such as the arrival or opening of the drawers. The Cliniserve app forwarded all other requests to the responsible professional group. Then we observed what effects the implementation of the combined technology had on nurses and service staff.

Fig. 2 Service robot JEEVES ©Robotise AG 2020

1.1 Aim

According to previous rsearch [6, 28–32] we aimed to investigate the effects of integrating a combined technology consisting of a robot for delivering service items and a smartphone application for patients and station staff. Specifically, we aimed to measure the effects on (a) walking distances, (b) stress levels, and (c) radiation exposure on nurses and service staff in the context of a nuclear medicine station.

2 Methods

2.1 Design and Study Setting

The study was part of the interventional mixed-methods study [41, 42] of the REsPonSe project [38]. In here, we conducted an observational study design [43] to evaluate walking distances with a self-designed standardized observation scheme [44, 45] and examined the stress load at the end of the observed shifts using a standardized questionnaire based on the Raw NASA TLX [46–48].

We conducted the study in a nuclear medicine station within a university hospital located in the southern region of Germany. The station consisted of two corridors, each containing nine patient rooms. The investigation took place in one corridor because the corridors in between were secured by fire doors and thus no passage for the service robot could be guaranteed. On a morning or afternoon shift, two to three nurses worked on the station, supported by two service staff who assisted with service activities on weekdays from 8 am to 3 pm. The measurements were only carried out during the early and late shifts and not during the night shift. This was due to the division into care areas on the ward. While the ward was divided into 3 areas during the early and late shifts, there were only 2 care areas during the night shift. In order to avoid distortion of the data due to generally longer walking distances, data was therefore only collected in the early and late shifts.

The patients admitted to this station receive elective therapies for a duration of three to five days, following a regular rotation of 6–12 weeks. These patients were in a stable health condition and stayed isolated in their rooms for 48 h after therapy administration [49], during which basic care and meal administration were not required. The nature of the therapy led to minimal visitor traffic on the station and very few emergency transports.

2.2 Evaluation Plan

We conducted the study over a period of seven months. On average, one-week survey periods were set every three to four weeks. During each period, we monitored six shifts of one nursing staff member each to identify changes, provide support and monitor (see Fig. 3). One Tuesday, one Thursday and one day on the weekend were accompanied in the early and late shifts. Because the therapies, and therefore the processes on the unit, were structured and planned, the data was comparable.

In the first month, we conducted a baseline survey (t0) without new technologies. In the second month (t1), we introduced the Cliniserve app. For this, all nursing and service staff received one hour of training in the use of the app. Nine smartphones were provided on the unit for staff and two smartphones for patients in case they wanted to participate in the study but did not have a suitable device with them. The manufacturer trained the staff to explain the technology to patients and to install the app on their smartphones if they wanted to participate in the study. In addition, we placed information material in the patient rooms and as well in the station floors.

In the third month (t2), the service robot JEEVES was installed on the station floor. Employees of the manufacturer carried out a mapping and trained the station staff in its handling (regarding cleaning, refilling, possible error messages and handling in case of emergency). To ensure safety, robot operators were at the station from 9 am Tuesday through Sunday, adjusted during the process to 8 am, until 6 pm. The service robot was only on site during the supervision by the manufacturing company. Observations took place every 3–4 weeks to adequately document use and potential relief.

In the last month (t9), we realized autonomous operation. Here, the robot operators were only on site to intervene in case of emergency.

2.3 Description of Materials

2.3.1 Standardized Observation Scheme for Walking Distances

To ensure comprehensive documentation of the tasks performed by individual nurses during a single shift, we assigned each task a unique number. For every task, we recorded the requester, walking distance (categorized in collaboration with nurses as short <10 m, medium $10 \leq x > 30$ m, long≥ 30 m), duration in minutes, and a task description. For the sake of simplicity, short distance is calculated with approx. 5 m, medium with approx. 20 m and long with approx. 30 m to provide an approximate walking distance in meters. The categorization of walking distances was recommended by an experienced caregiver. As a pedometer would have led to distortions due to the different step lengths of the caregivers, we decided on a categorization system. Based on the assessment of the nursing staff on the shift, we defined which distances were classified as long, short and medium. An initial measurement of the distances was carried out on the ward using the Bosch Professional GLM 50 C laser distance meter. During the observation of a shift, a member of the study team then noted the different distances per task and categorized them accordingly. We documented only work-related tasks and did not rate their performance.

2.3.2 Questionnaire about the Perceived Workload

In addition, the employees of the respective observed shift assessed their subjective perceived workload using a standardized questionnaire. The questionnaire consisted of six questions focusing on the perceived workload during the shift. The questions relied on the NASA Task Load Index (TLX) and utilized a 20-point Likert scale [46, 47]. The six questions specifically addressed interruptions, complexity, situational stress, performance, effort, and frustration. Prior to participating, we obtained written informed consent from the participants. Both survey methods were tested in a preliminary study [50].

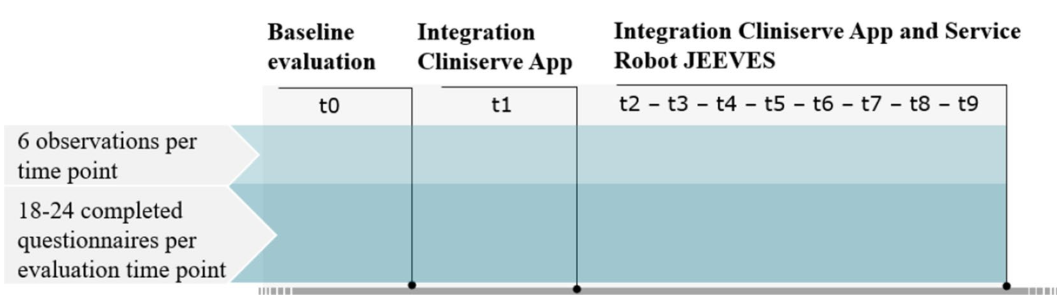

Fig. 3 Evaluation Plan

2.3.3 Radiation Exposure

Data was recorded over several months (during robot use and the comparison period). Each nurse wore an electronic (=directly readable) dosimeter for each shift and recorded the values at the end of the shift. We compared these collected values for the two periods.

2.4 Participants

We included the nursing staff of the hospital's nuclear ward who were involved in testing the combined digital-robotic system. They had a skill level 6 or higher qualification according to the European Qualifications Framework for Higher Education [51] and different years of experience. In addition to the 16 participants from the nursing staff, 2 service assistants were also included who had no nursing training and carried out service activities such as bringing drinks, food, towels or a newspaper instead of nursing tasks. Examples of nursing activities would include changing bandages or emptying bladder catheters. After informed and written consent, they were included in the study. There was therefore a pool of nursing and service staff, 2 male and 16 female, who took part in the nine measurement points. Other people not involved in this observational study who were present during the observed shift or during tasks around the observed person were only recorded if the observed person was directly approached/talked to or involved. For the questionnaire, all nurses and service persons who worked during the observed shift and gave informed consent were included. Due to the shift system and some part-time staff, it was not always possible to accompany the same nursing staff during their shift. Repeated measurements of the same nursing staff at different times are therefore possible. Direct measurement by the research team and control of the completion of the questionnaire prevented missing data.

2.5 Analysis

First, we analyzed the data descriptive [52] using SPSS Statistics Version 29 software [53]. In here, we described the characteristics for every time point for the observations and the questionnaires. We conducted Kolmogorov-Smirnov tests to check whether the data follows a normal distribution. We analyzed the data descriptively and calculated chi-squared test and posthoc tests for walking distances. Chi-square tests were carried out at the decisive points in time t0: baseline, t1: implementation of the app, t2: implementation robot, t8: final phase of supported use of the technologies with a significance level of <0.001 after bonferroni correction. These points in time were chosen to indicate changes in the best possible way.

When evaluating the questionnaire, we focused on stress. The other components were analyzed graphically with Excel. The radiation exposure to the nursing staff measured with an electronic dosimeter (DMC 3000; Mirion Technologies, Atlanta, Georgia, United States) during the roboter test phase was compared to a measurement period without roboter assistance (Wilcoxon sum test).

The data from the comparative periods on radiation exposure were tested for the hypothesis of whether the use of the digital-robotic system has an influence on the radiation exposure of employees. For this purpose, significance tests are carried out if changes in radiation exposure are detected.

3 Results

The Kolmogorov-Smirnov tests for walking distances (number of interruptions, replaceability by DRS and duration) and the questionnaire items (interruption, stress, complexity, performance and effort) were significant with $p<.001$ indicating non-normal distribution.

3.1 Walking Distances

Across all time points in the survey, nurses walked 3444 distances in their shifts. These are divided into 2.299 (67%) short distances, 629 (18%) medium distances, and 516 (15%) long distances. The nurses walked in total approximately 39.555 m (range between 2455 and 5629 m). A detailed overview of the walking distance distribution across all time points can be found in the supplementary material (Online Resource 1).

Short walking distances made up most of the walking distances in a range from 62.42 to 71.21%. Figure 4 shows that in the baseline survey without technologies, the highest percentage of participants walked short distances (62.42%), followed by 22.93% medium and 14.65% long walking distances. At t1 (implementation of the communication application), there was an increase in short and long distances and a decrease in medium distances in comparison to baseline. At t2 (additional implementation of service robot) and subsequent t-points, the percentage of shorter distances increases. For t8 (final phase of supported use of the technologies) there is a strong decrease in long walking distances observable in comparison to the time points in advance. At t9 (stand-alone use without support) long walking distances slightly increase again, but still remain lower than in t0-t7.

A chi-square test of independence showed a significant association between walking distances and observation time points X^2 (6, $N=1231$)=20,281, $p=.002$. Posthoc tests were performed pairwise between t0, t1, t2 and t8 (see Online Resource 2). After adjusting the alpha according to the

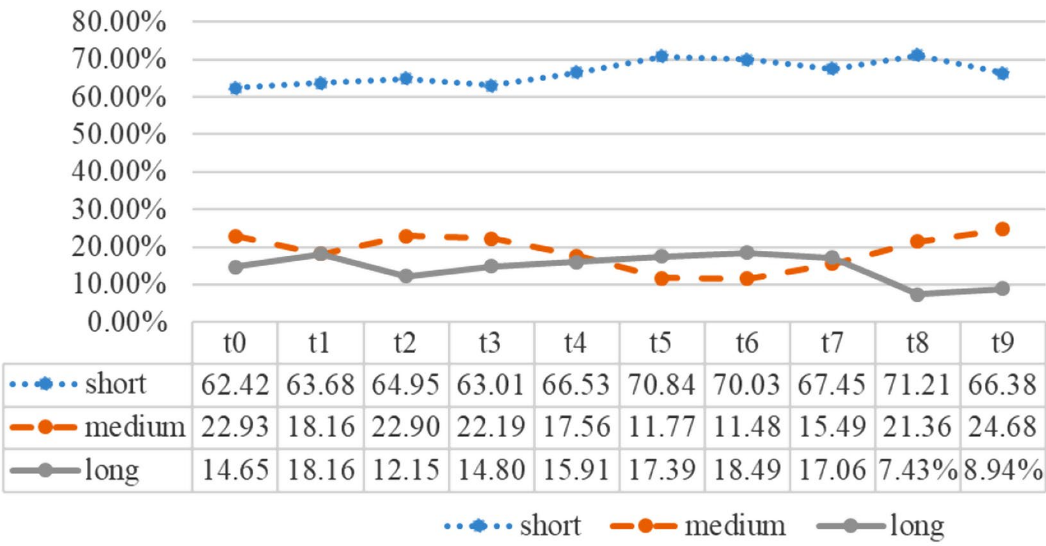

Fig. 4 Overview of walking distances (in %) by time points

Table 1 Population characteristics questionnaires

time point	total questionnaires	percentage	amount nurses	amount service	presence of service personal
t0	19	11%	16	3	53%
t1	18	11%	13	5	78%
t2	19	11%	15	4	58%
t3	20	12%	17	3	50%
t4	15	9%	11	4	67%
t5	14	8%	12	2	50%
t6	19	11%	15	4	53%
t7	14	8%	11	3	57%
t8	16	9%	14	2	56%
t9	18	11%	15	3	56%
total	172	100%	139	33	58%

bonferroni method the alpha value was set to <0.001 A significant difference X^2 (2, $N=703$) $=17.573$, $p=<0.001$ was only detected between t1 (implementation of the Cliniserve app) and t8 (robot being fully implemented) .

3.2 Situational Stress

A total of 172 questionnaires (range 14–19 per time point) were completed during the survey period, 81% of which were completed by nurses (Table 1). The number of questionnaires was evenly distributed across all survey times (range 8.1 −11.0%). In 57% of cases, service staff were present during the surveyed shift to respond to patient service requests. All items were fully completed.

The rating of each shift, summarized by time point, varied over the six months (see Fig. 5). Respondents consistently rated their performance as above average, with a median score of 17. A comparison of the t0 baseline survey with t8 shows a minimal loss of one point. The assessment of interruptions during the work performed was rated with a median of 4, fluctuating between minimal interruption of 2 and slightly moderate interruption of 6. Complexity and effort show similar value trends, so that a connection between the items can be assumed. The complexity of the work processes was rated with 5 at t0, the median shows a decrease to 4 points. At t8, the effort required to complete tasks increased by up to 8 points compared to the baseline survey, with a median of 6. Situational stress increased from 3 to a median of 4 points compared to the baseline survey.

The relationship between respondents' stress levels and the presence of service personnel was examined in more detail (see Table 2). Eight out of ten time points showed that median stress levels were higher on shifts where service staff were present. These shifts occurred on weekdays when admissions/discharges and new treatment prescriptions took place. Patients without service staff were cared for only on weekends, when only follow-up care was provided. A detailed overview table about the presence of service personnel and the relationship with interruptions, complexity, performance and effort can be found in the supplementary material (Online Resource 3).

The stress appears to be for the most part related to the number of long walking distances and the total number of walking distances at the respective time points (see Fig. 6). The feeling of being interrupted behaved similarly to situational stress. The total number of walking distances was proportional to the feeling of interruption and the individually experienced stress.

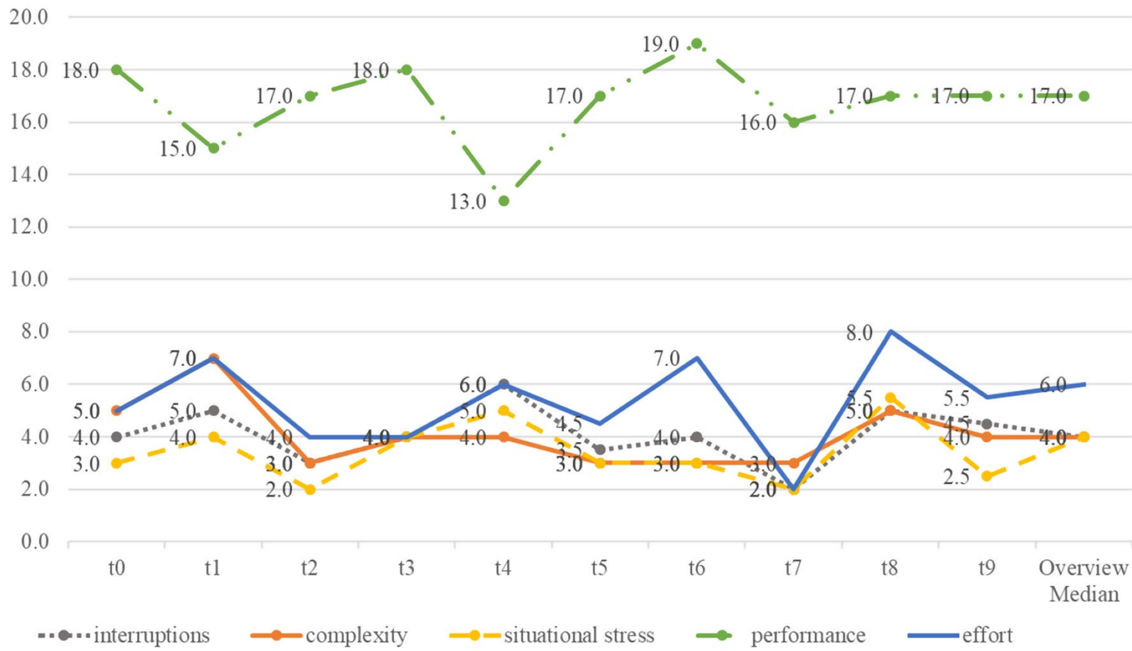

Fig. 5 Questionnaire results summarized across time points (range: 0 = not at all, 20 = strongly agreeing)

Table 2 Median and interquartile range of situational stress across time points

	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	overview median (IQR)
service yes	5 (11)	6 (7)	2 (3)	3,5 (4)	7 (6)	6 (5)	4,5 (2)	8,5 (7)	7 (9)	2,5 (5)	5 (6)
service no	2 (14)	2,5 (3)	1 (1)	4 (7)	2 (5)	0 (2)	3 (4)	1 (0)	2 (5)	2,5 (8)	2 (3)
total	3 (12)	4 (8)	2 (2)	4 (5)	5 (7)	3 (8)	3 (4)	2 (8)	5,5 (6)	2,5 (5)	4 (6)

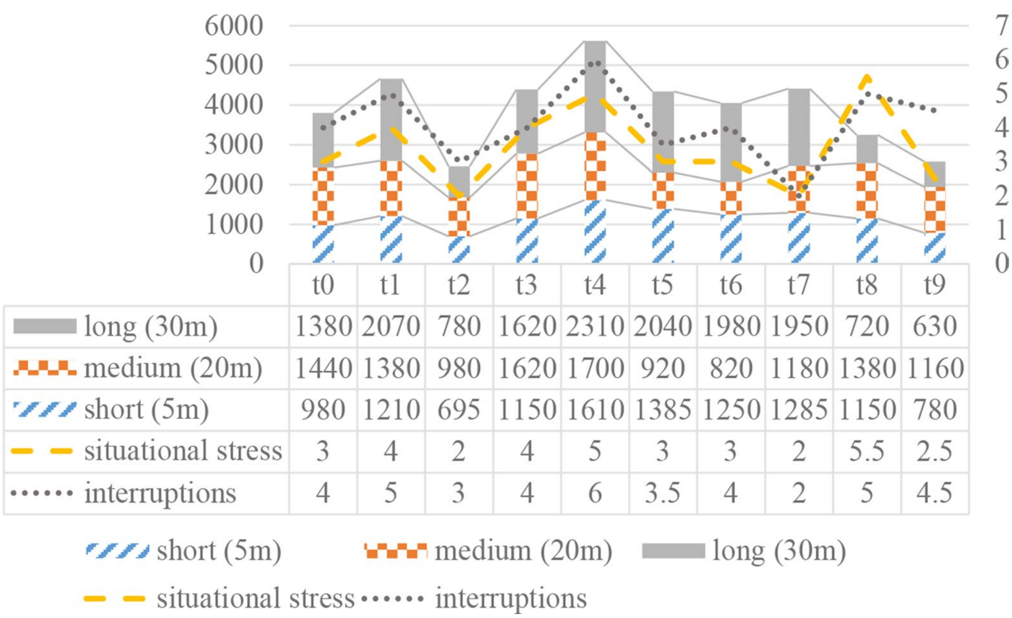

Fig. 6 Walking distances in relation to perceived stress and interruptions

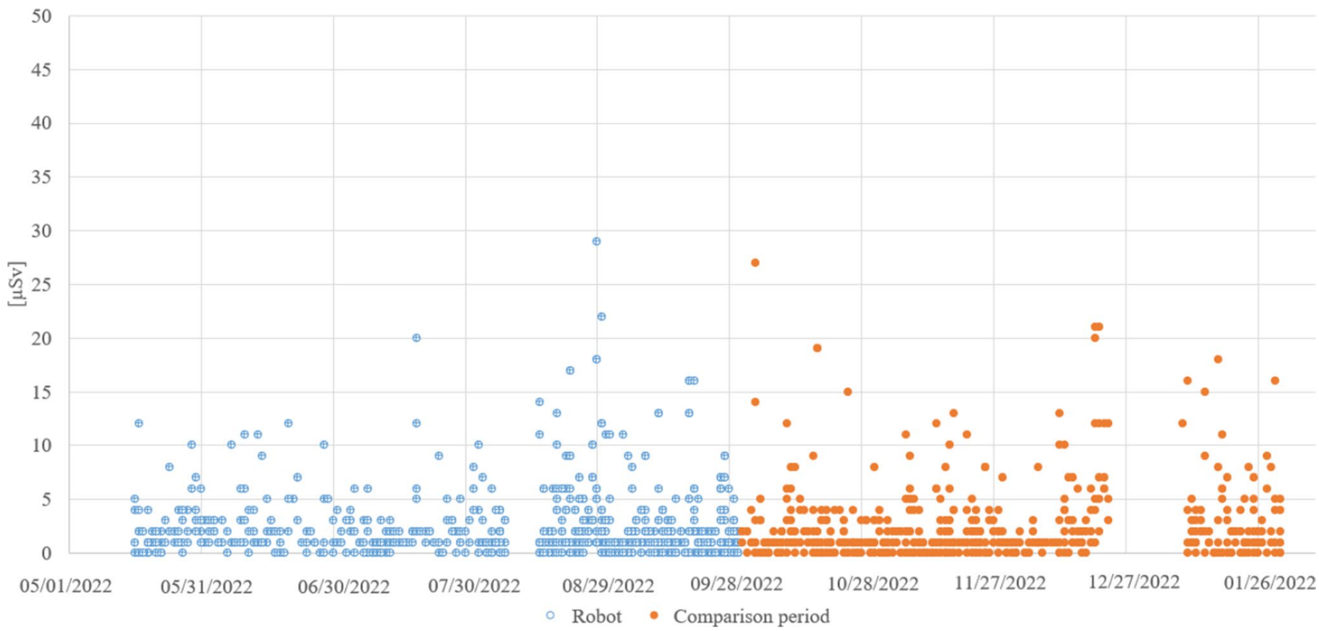

Fig. 7 Radiation exposure

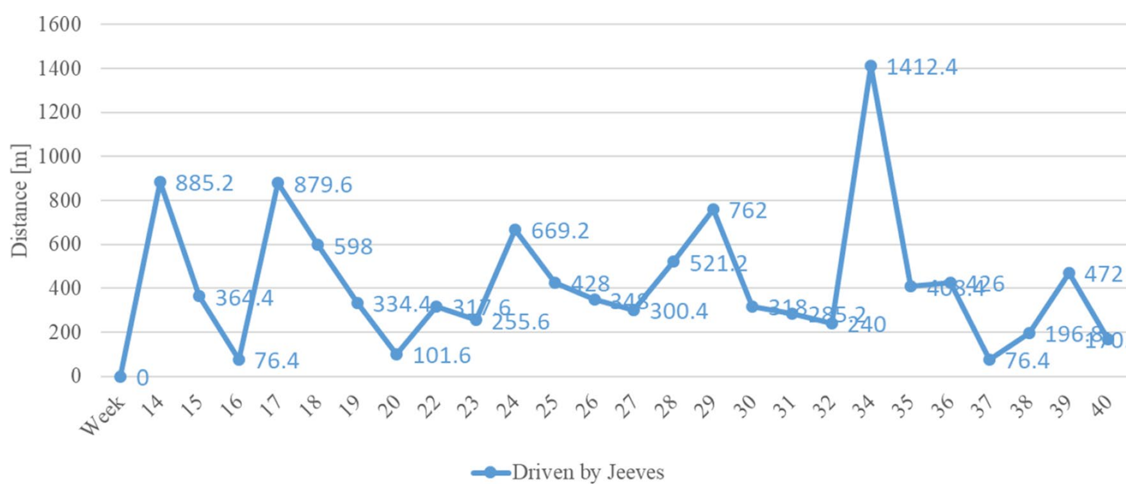

Fig. 8 Distance driven by Jeeves per week

3.3 Radiation Exposure

The radiation exposure during the robot test phase was 3+/-7 μSv and 3+/-6 μSv in the comparative time period. No significant differences were found (p=.23) between the radiation exposure with and without the usage of the robot in combination with the app (see Fig. 7).

3.4 Utilization of the Robot and the App

During a two-week observation period in which only the app was used, a total of 25 patient inquiries were made via the app. Of these, 41% were service requests and 59% were care requests. Over the six-month period in which the app was used in combination with the robot, a total of 657 patient requests were made via the app. 75% of these were service requests and 25% were care requests. Figure 8 shows an overview of the distance driven by the robot per week.

4 Discussion

There was no direct effect of the implementation of either combined or separate technology on walking distance, stress levels and radiation exposure only a shift towards shorter walking distances with longer implementation. Beyond this, the total number of walking distances appeared to be proportional to the feeling of interruption and the individual situational stress experienced. However, there were too many confounding factors to assess causality, and no linear relationships.

To our knowledge, there is no other study that examined the use of a service robot in a comparable setting. However, due to the COVID-19 pandemic, considerations have been made about the use of robots to minimize physical contact and prevent infection. It is possible to deliver medicines, food trays and medical supplies or dispose of contaminated waste in a hospital [54, 55]. In addition to reducing the risk of contamination, this could also shorten walking distances for nursing staff.

We observed an association between the amount of walking distances, especially long walking distances, covered by a nurse during her shift and the perceived stress. Previous literature has found that walking is a major contributor to physical workload and takes up a large proportion of nurses' time [12, 56]. In contrast to digital applications like the ones we used in the study, there are also approaches such as decentralizing the station base to reduce walking distances. In a study by Copeland and Chambers, the number of steps and energy consumption could be significantly reduced by decentralizing the base [56].

No significant differences were found between the walking distances at baseline status compared to when using the app, as well as the baseline status compared to the usage of the app and robot in combination. The significant difference between the walking distances when only the app is used compared to the app in combination with the robot emphasizes that the combined use has the potential to reduce long walking distances for nursing staff. However, even if this is the case, the clinical relevance of these results is debatable, as.

Even though the reduction in service activities in terms of walking distances is positive, it needs to be considered that there is additional work involved in explaining the technologies and setting up the communication app for all patients [57]. While a known stress factor is eliminated, a new one is added to which the nursing staff are not yet accustomed and which can cause additional stress [58].

In our study, an association was observed between situational stress and perceived interruptions. A high number of interruptions also seems to be associated with a high level of stress. This is in line with previous studies which found that higher stress levels can be caused by numerous interruptions [59–61]. Moreover, a lack of time and resources to complete the task has been identified as a stress factor [19] as well as the overall workload [19, 62]. A study of Shan et al. [63] showed that disrupting nurses can lead to increased mental workload and negative outcomes. They suggest that nurses' mental workload can however be reduced and better managed if nurses are properly trained to deal with the interruptions [63].

Stress is experienced differently dependent on the individual [64] and also influenced by how high the personal workload is [19]. A description of the surveyed person's working day is relevant in order to adequately evaluate their feelings. The NASA TLX has already been validated as an instrument to measure subjective workload in the health care sector [65] and is frequently being used [63, 65, 66]. The preliminary study across different wards in the hospital showed that the mean situational stress ranged from 4 to 14 depending on the ward [50]. Previous studies have indicated that nurses working in intensive care units and emergency wards are exposed to higher levels of stress than nurses working on other wards [62, 67, 68]. However there was also a study indicating that nurses in the neurosurgery department exhibited a higher degree of objective stress when compared to their counterparts in the intensive care unit [69]. The level of stress can therefore vary in the different departments of a hospital and between hospitals and must be taken into account when evaluating the perception of stress [68, 69].

There was no advantage to using the robot in terms of radiation exposure for nursing staff. This is probably due to an already existing high-level standard for radiation protection. The nursing staff are already well trained in radiation protection and minimize patient contact as far as possible. Approximately 70% of evaluated work shifts revealed a radiation exposure of less than 2 µSv. Otherwise, significant radiation exposure occurs in particular during very complex nursing activities, which of course cannot be performed by the robot.

In the future, inpatient care will face more challenges with the limited availability of trained nurses [27]. Technology might be one of many answers to this shortage of health-care professionals, with the potential to replace or support everyday ward tasks that do not require a nurse and do not affect the quality of care provided to patients. Assistive Robots performing pick-up and delivery services can streamline food distribution, improve medication distribution, contribute to infection prevention by minimizing human contact, and provide user-specific delivery services [70]. By integrating robotic assistants into these areas, healthcare facilities can increase efficiency, reduce staff workload and improve the overall quality of patient care. These different possible applications of robots in nursing care will however require detailed studies in the future to evaluate whether the large-scale integration of such technologies is feasible. In addition, the impact of technology on communication and the relationship between patients and nursing staff must be monitored.

4.1 Limitations

Some limitations should be in mind when interpreting our results. Observational studies are vulnerable to selection bias. Since we observed only one ward and one nurse per shift due to limited staffing resources, it was not possible to determine the distribution of tasks within each shift or whether this nurse performed more or less than an average number of tasks. The researchers only measured the walking distances categorically at specific points during the survey, which may have resulted in deviations from actual walking distances. As filling out the questionnaire was voluntary, it is possible that only motivated personnel undertook this activity. Given that the focus of the study was on nursing and service staff, the effects on patients when using the app and the robot were not examined in detail, which can be considered a limitation.

5 Conclusion

This first use of the combined technology implementation in the acute clinic worked well. There was no direct effect of the combined technology on stress levels and walking distances, only a shift towards shorter walking distances was recognizable. The data from this study are not yet sufficient to reflect the effects of long-term use but provide a starting point for further investigations. Since shortages of skilled workers and demographic change are making patient care increasingly difficult and more complex, approaches to relieving the burden on nurses must be sought and investigated. There is a need for further research into testing in other departments that are less strictly regulated. While this work provides an initial indication of where the implementation of this combined technology could potentially relieve the burden on nurses and service staff - a reduction of walking distances might facilitate the work and thus counteract the stress level of nurses, further research is needed to establish causal relationships.

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Author Contributions Conceptualization and Methodology: Angelika Warmbein, Ivanka Rathgeber, Uli Fischer; Investigation: Ivanka Rathgeber, Janesca Seif, Angelika Warmbein, Astrid Delker, Christian Zach; Formal analysis and Writing original draft: Angelika Warmbein, Laura Sehn, Astrid Delker, Christian Zach; Writing - review and editing: Christoph Ohneberg, Nicole Stöbich, Inge Eberl, Uli Fischer; Funding acquisition: Inge Eberl, Uli Fischer; Resources: German Federal Ministry of Education and Research (funding code 16SV8416); Supervision: Uli Fischer; All authors read and approved the final manuscript.

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Data Availability The data that support the findings of the study are not openly available due to reasons of sensibility but are available from the corresponding author on reasonable request.

Declarations

Ethics Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Ethics Committee of the Medical University of Ludwig-Maximilian University Munich, Germany (No. 21-1202).

Employment Not applicable.

Informed Consent Informed consen was obtained from all individual participants included in the study.

Competing Interests All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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