Bridging between clinical nursing practice and robotics: Which nursing tasks can be transferred to robots?

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Introduction

The nursing workforce shortage is a chronic and critical issue worldwide[1]. A potential solution to bridge the gap between the increasing nursing needs and nursing workforce supply in a super-aged society is to delegate nursing tasks to robots. However, the introduction of robots into the medical/nursing field in Japan is still limited. An investigation was conducted into the current state of nursing tasks, identifying tasks that can be delegated and separating them from other tasks.

The role of nursing profession in Japan is defined in the Public Health Nurses, Midwives, and Nurses Act as "a person who has acquired a nursing license from the Minister of Health, Labour and Welfare to provide medical treatment or assist in medical care for injured and ill persons or puerperal (postpartum) women, as a profession"[2]. Practically, include tasks such as support for medical treatment (e.g., clinical observation and assessments of patients' condition, administration of medicines, and wound management) in out- and in-patient settings, cleaning and setting up around patients' unit, assistance for meals, physical cleanliness/hygiene, and safe activities and good rest, coordination with family and local medical institutions upon discharge, patient/family education, and so on. Nursing assistants are defined as "persons who, as a member of the nursing team, provide nursing assistance that does not require professional nursing skills under the direction of a nurse in a place where nursing care is provided"[3]. In Japan, nurses must have obtained a nursing license by completing a prescribed nursing education program and passing the national nursing examination. In contrast, nursing assistants are not required to have a specific license or qualification.

Most countries worldwide are facing a shortage of nurses[1], as a consequence of several factors, such as insufficient training capacity to meet the demand, low salaries not commensurate with qualifications, tasks and responsibilities, and outflow of nurses to other countries. In high-income countries, including Japan, the imbalance between the needs of society and the nursing workforce supply due to aging populations has contributed to the growing shortage of nurses in recent years. Japan is the largest super-aged society in the world, with the aging rate reaching a record high of 29.1% in 2023[4]. The number of older people is expected to increase significantly over the next two decades, with a peak expected in 2040[4]. Simultaneously, the birth rate is steeply declining. For example, in 2023, 750,000 births (40,000 less than those in 2022) occurred, and the total fertility rate fell to 1.68[5]. Japan has the highest life expectancy in the world, 84.3 years, but a healthy life expectancy of 74.1 years[6]. Consequently, many older adults live for approximately ten years under medical and nursing care, thus increasing the demand for medical and nursing needs.

With the rapid increase in nursing services, a shortage of nurses is prone to occur. The problem lies not only in population decline but also in nurse turnover, which has generally remained around 11% for the past decade[7]. However, a National and Public Hospital Workers' Union Japan survey, including approximately 50% of nurses, reported they could not provide "adequate nursing care" owing to shortages and other workloads. Moreover, approximately 75% of nurses "want to quit their job" [8]. Nursing assistants also continue to be in short supply, and their retention rate is low; approximately 30% of both nursing assistants and nurses resign within a year of employment[7]. A report stated that "nurses should perform tasks appropriate to their nursing license that reflect their abilities to the maximum extent possible in practice"[9]. In addition to nursing tasks that require knowledge and skills, there are tasks that do not require skills, and nurses are frequently demanded to spend a large amount of time on such tasks[10 11]. The inability to provide adequate nursing care due to being overwhelmed by tasks causes job dissatisfaction, which, in addition to fatigue, increases nurse turnover[11]. Task shifting among healthcare professionals is being considered; however, this measure is challenging to implement as the population is declining, and the number of people in all professions is decreasing. The challenges in

introducing foreign nursing staff to Japan have already become apparent[12], and the increasing needs of the rapidly aging populations in Asian countries also make this measure unlikely[13].

One potential solution to the nursing workforce shortage is delegating the nursing tasks to robots. In recent years, various Information and Communication Technology (ICT) applications have been introduced in healthcare. However, little progress has been made in introducing ICT to nursing field. For example, the 'nursing record', which records information related to the patients' condition, has been computerized, but the tasks of the human nurse have remained the same, only the tools have changed. Tools to reduce workloads need people to use them; however, in future, the number of people will decrease overwhelmingly, requiring a function to perform some nursing tasks independently, rather than as a tool. This study aims to clarify the detailed tasks of nurses and nursing assistants and examine which tasks could be delegated to robots.

Methods

We conducted a survey in 2023 that covered all five wards (surgical, internal medicine, community-based care, women-only, and palliative care) of a private general hospital with 200 beds in central Tokyo. With the cooperation of the nursing department of the hospital, we selected nurses and nursing assistants who had worked in the ward for at least one year and could independently perform standard tasks. The selected candidates who gave their informed consent. They were recruited for the survey as study participants.

A time allocation study was conducted by direct observation (shadowing) to identify not only the regular tasks described in the nursing operations manual, but also the detailed and miscellaneous tasks in between the lines[14]. The researcher who has a nursing license and clinical experiences accompanied the participant from the beginning to the end of the day shift work at approximately one meter, observing and recording all the actions of the participant. The actions were counted as one from one action to the next, and required time for the action was measured in minutes using a standard wristwatch. Where several actions were observed simultaneously, the time expended was divided by the number of actions. These direct observed data were categorized by the actions according to their content; clarify the nature of the task, the time needed for each action, and the frequency of their occurrence. During or after the direct observation, semi-structured interviews were conducted with the participants regarding the burdensome tasks and the tasks that they wanted to or not to shift to robots. The interviews were recorded with the consent of the participants and were qualitatively and descriptively analyzed after being converted into text. The participants were verbally informed of the research details in advance, and their written consent was obtained. The study was conducted with the approval of the Ethics Review Committee of the Faculty of Medicine, Tokyo Medical and Dental University (C2022-032). This work was supported by JSPS KAKENHI Grant Numbers JP19K11215 and JP22K11138.

Results

In the target hospital, 25–30 nurses were assigned to each ward of approximately 30 inpatients. Working hours were in two shifts: day shift 8:30–16:30 and night shift 16:30–8:30. All nurses, except those working short shifts, worked both day and night shifts, with eight days off in four weeks and no more than four-night shifts per month. In the wards, five to six nurses, a head nurse, and one or two nursing assistants worked the day shift, while three nurses worked the night shift. No family accompaniment existed except in exceptional cases such as highly critical or terminal periods, and the nurses and nursing assistants were responsible for patients' daily lives. Each ward had five to six private and four-bedded rooms, two communal toilet, one bathroom, one storeroom, one linen room, and one waste room, as well as an elevator and one lift each for large and small luggage.

1) *Nursing tasks*

Direct observation of nurses was conducted on ten participants, two in each ward (Table 1). All participants were female, had a median experience of 16.5 years, and were in their 30s and 40s. The observation period was approximately seven hours, but eight of the ten participants arrived at work 15–30 minutes earlier than the stipulated time and started work. The lunch break was 45 minutes, but the median actual break was 40 minutes. The median number of observed actions was 316, which was less for nurses with more years of experience.

The observed actions were categorized into 40 domains according to their contents, and the time spent on each action and the number of occurrences were calculated (Figure 1). The "nursing record entries" consumed the most time, followed by "reporting and exchanging information between nurses". "Moving within the ward" was the third most time-consuming and most frequent activity. On average, 83 trips per one dayshift were made to and from wards and staff stations to exchange information, retrieve items from wards to the equipment and linen rooms, and separate waste after patient care and dispose of each item in its designated place, requiring 46 minutes. While tasks, such as "explanation to patients", "medical treatment", and "clinical observation" require specialist knowledge and skills, tasks such as "disposing rubbish", "tidying", "cleaning", and "other small tasks requested by patients" (e.g. changing batteries in TV remotes, picking up items that have fallen under the bed, and taking drinks from the fridge) do not require specialist knowledge and skills. These non-skilled tasks accounted for approximately 75% of all tasks.

Six of the ten participants were interviewed regarding the tasks they would/would not like to delegate to the robot. All study participants wanted to transfer the nursing record entry. They also asked for more efficient information-gathering tasks such as patient conditions, the day's schedules, and their reminders. Some also suggested that robots would be better for tasks that repeat the same content, such as showing patients around the ward on admission or explaining preparations before the general examination. Tasks requiring muscular strength, such as moving a patient from a bed to a wheelchair, were also mentioned. Looking after patients with dementia, especially at night, was also mentioned by several participants. However, no requests for transferring the third most time-consuming task—moving around the wards—was mentioned, nor was there any sense of burden. The tasks that they did not want to be delegated to robots included direct patient care and listening to patients, with the participants stating that "we would like to have time to just talk to patients and listen to them calmly", "We would like to bathe all the patients who need assistance with bathing every day, just as they do at home."

2) Tasks of nursing assistants

The survey of nursing assistants was conducted on seven participants, two in each of the four wards where assistants were assigned at the time of the survey and one in one ward (Table 2). All participants were female, with a median experience of ten years. The nursing assistants worked 8:30-16:30 without overtime and had the prescribed 45-minute lunch break. The median number of observed actions was 407, and, contrary to the nurses, the participants with more years of experience had more actions.

The observed actions were categorized into 24 domains, and the time spent on each and the number of occurrences was calculated. Figure 2 shows the average time and number of occurrences spent by the seven nursing assistants on their daily tasks. Nursing assistants spent most time moving around the ward, followed by exchanging information between assistants. In addition to assisting with bathing, changing bed sheets, cleaning and setting up the patient's units, and so on, non-skilled but essential life support tasks for the patients were performed, such as helping patients with small purchases and using their smartphones (the small requests which patients hesitate to ask to the nurses). Ordering and restocking medical and hygiene materials used in the wards was also their task, and they would order and pick up any items needed the next day. When the patients were moved from one room to another before or

after surgery, the nursing assistants were also responsible for moving beds, shelves, and the belongings of the patients. All nursing assistant tasks are non-skilled, but the skilled tasks for nurses would be impossible without them. The nursing assistants were constantly aware of this and performed miscellaneous and detailed tasks with anticipation and care based on their experience to ensure that medical and nursing care was performed smoothly.

Regarding the nursing assistants, when interviewed about the tasks they would like transferred to robots, they mentioned tasks such as ordering and restocking supplies, carrying heavy items such as beds and selves, and accompanying patients with minor illnesses when go out from the ward activities such as shopping and medical examination.

Discussion

The study results show a crucial juncture in the evolution of clinical nursing practice, highlighting the essential role of human nurses and the growing potential of robotics to support this profession. Our findings reveal a substantial part of the nursing workload comprised of non-skilled tasks, such as moving around the ward, disposing of rubbish, and managing various administrative tasks. These are areas where robotic assistance could not only alleviate the physical burden on nurses, but also reclaim valuable time for patient care and other high-value, skilled tasks that require human judgment, empathy, and interaction.

Interestingly, while our participants did not perceive tasks like moving around the ward as burdensome, the quantifiable data suggest that the time dedicated to such activities could be strategically reallocated to enhance patient care if robots were to assume these responsibilities. This aligns with the notion that nursing professionals, deeply committed to patient welfare, might underreport their own strain or the inefficiency of their work patterns. By introducing robots to handle tasks such as waste disposal, carrying supplies, and even managing straightforward, but time-consuming administrative duties, we can envision a shift towards a more sustainable model of nursing that prioritizes human interaction and the application of clinical ability.

However, the seamless integration of robots into the nursing ecosystem requires careful consideration. It is essential to acknowledge the nuanced dynamics of patient care that robots cannot replicate, such as the empathetic communication and understanding that form the cornerstone of nursing. The goal of integrating robotics is not to replace nurses, but rather to complement their work, allowing them to dedicate more time to patient care and tasks that use their irreplaceable human skills.

Furthermore, our study participants expressed a clear preference for retaining direct patient care activities within the human domain, emphasizing the value of personal interaction in nursing. This insight is pivotal, guiding us towards implementing robotic solutions in a manner that respects and preserves the human essence of nursing. As we navigate the challenges of a global nursing shortage, the goal should not merely be to offload tasks to robots, but to enhance the quality and reach of nursing care through thoughtful collaboration between humans and technology.

Conclusion

In conclusion, bridging the gap between clinical nursing practice and robotics presents an opportunity to address workforce shortages, while maintaining, if not enhancing, the quality of care. By targeting specific non-skilled tasks for robotic assistance, we can relieve the workload on nurses, allowing them to focus on the core of their profession: providing compassionate, skilled care that supports the health and wellbeing of their patients. This vision for the future necessitates a collaborative effort between healthcare professionals, technologists, and policymakers to ensure that robotic integration respects the values of nursing and meets the evolving needs of our societies.

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Table 1 Characteristics of the study participants (Nurses)

Contents	Participants									
	A	B	C	D	E	F	G	H	I	J
Clinical experiences (years)	25	13	20	20	13	30	9	13	20	9
Observed time (hours/minutes)	8 h 46 m	7 h 16 m	5 h 31 m	6 h 22 m	7 h 49 m	7 h 04 m	7 h 35 m	8 h 15 m	7 h 02 m	6 h 57 m
Observed actions	349	317	171	292	412	320	289	320	310	314
Lunch break (minutes)	40	45	44	40	35	40	40	43	45	38
Preparation foe the day’s work (minutes)	30	15	0	0	30	13	25	40	26	30

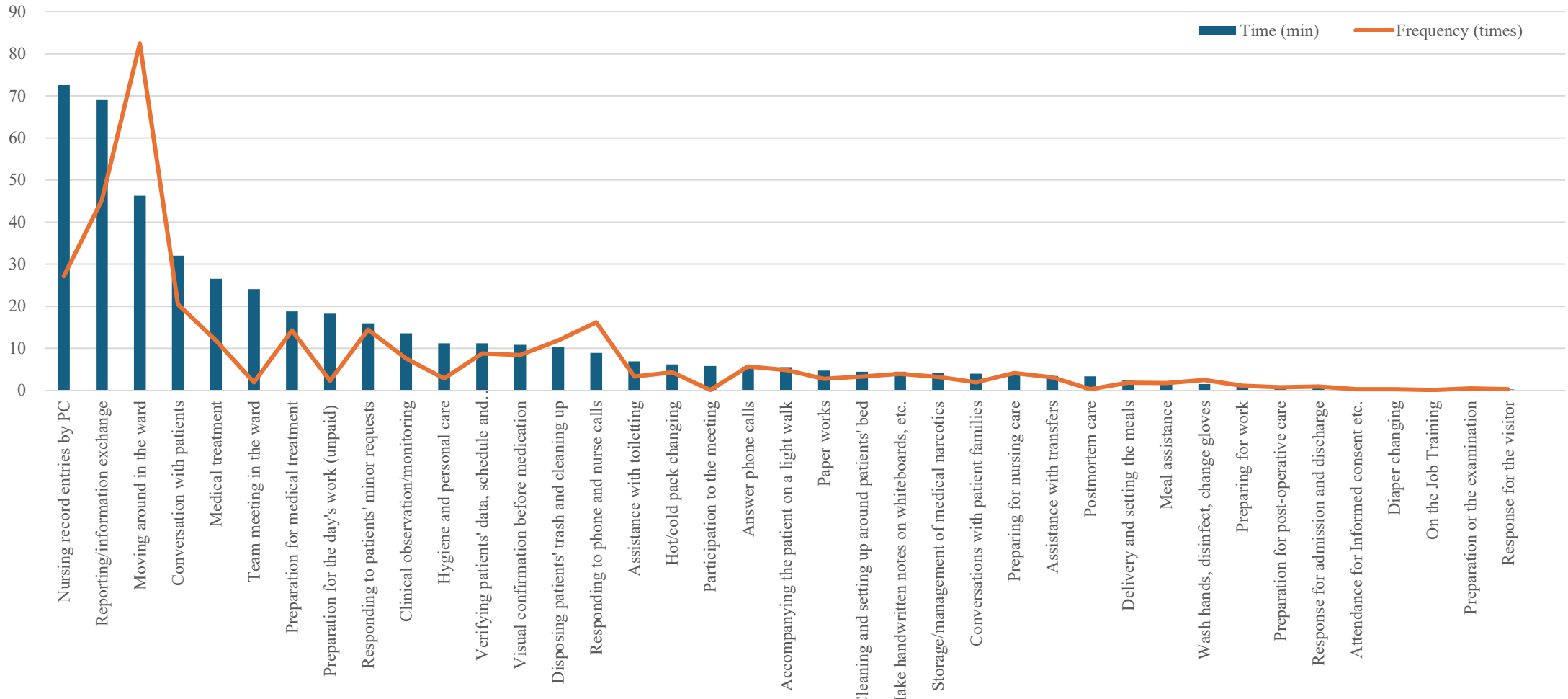

Figure 1 Observed nursing tasks: length of time and frequency (average of 10 nurses)

Table 2 Characteristics of the Study participants (Nursing assistants)

Contents	Participants						
	A	B	C	D	E	F	G
Age	48	45	47	47	47	60	27
Work experiences	15	10	10	10	10	5	1
Qualification	None	Certificate	Certificate	Certificate	Certificate	None	None
Observed time (hours)	7 h 0 m	5 h 30 m	4 h 42 m	4 h 57 m	5 h 39 m	5 h 21 m	6 h 09 m
Observed actions	245	391	403	419	408	407	305

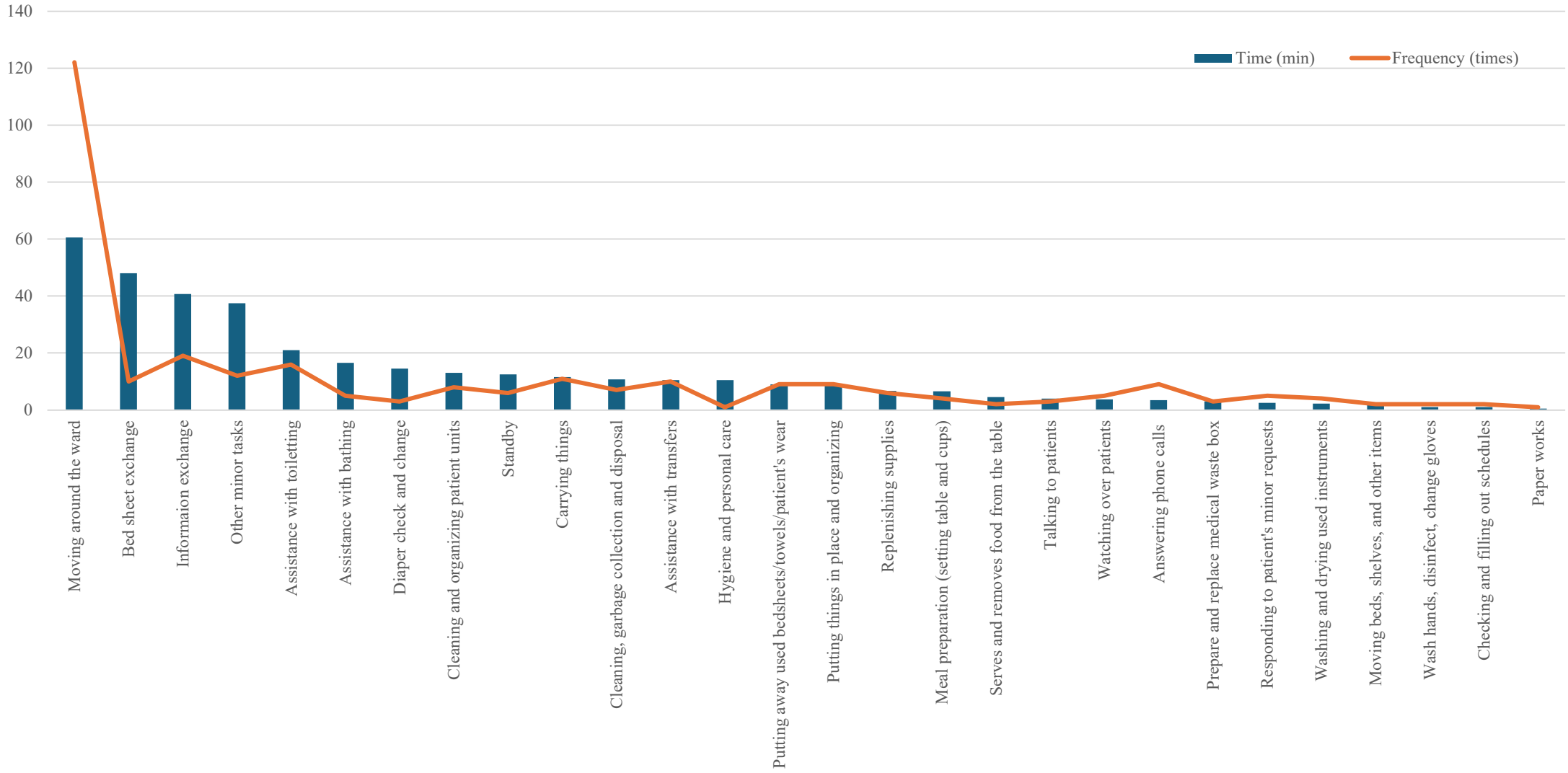

Figure 2 Observed nursing assistants' tasks: length of time and frequency (average of 7 nursing assistants)