

# Rapid Service Design Method for Services with Robots in Healthcare Facilities under COVID-19

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## Abstract

Under the influence of COVID-19, rapid research and design are required for the service design process, and even before COVID-19, there were expectations for the adoption of service robots as an answer to labour shortages in the medical field. Against this background, we developed a method for rapid service design method to organise services with robots under COVID-19. This method aims to achieve rapid service design based on behavioural change by introducing rapid ethnography and behavioural design into the research, analysis, design and evaluation steps. To test this method, we implemented two services in two months. The results of the interviews and questionnaire survey of the demonstration experiments confirmed the validity of these services and thus the validity of the method.

Keywords: rapid service design, behavioural design, digital twin, healthcare

## Introduction

Under the influence of COVID-19, more rapid research and planning are required in the service design process. Traditionally, rapid service design has been required in healthcare settings, and in this context, the impact of COVID-19 has resulted in an increase in the number of patients and working hours (Klimkiewicz et al., 2021). As a result of longer working hours, increased psychological stress has been reported in several papers (Wang et al., 2020). Based the recommendations of the CDC, Centers for Disease Control and Prevention, (2022), access to hospitals for outsiders has been severely restricted, which has made it difficult for service designers to conduct adequate observations and interviews in the field.

To achieve rapid research, the rapid ethnography method has been proposed in the field of human–computer interaction (HCI) and is defined as “a collection of field methods designed to provide a reasonable understanding of users and their activities under significant time pressure and limited time in the field” (Millen, 2000, p.1). Rapid ethnography was originally proposed for use in methods such as rapid assessment and rapid evaluation, primarily in the field of public policy, to speed up field assessments (Vindrola-Padros & Vindrola-Padros, 2018); it then propagated to HCI and has been discussed in relation to design. Traditionally, it has been of particular use in the healthcare sector (Ackerman et al., 2017; Cupit et al., 2018; Rapport et al., 2021) but it has also been developed in the fields of entrepreneurship (Ranabahu, 2017) and finance (Khambete et al., 2017).

Even before COVID-19, there were expectations for the adoption of service robots as a response to labour shortages in the healthcare sector (Vänni & Salin, 2017). The use of service robots has the advantage of preventing the spread of infection and reducing human error, as well as reducing direct contact with frontline staff, which allows them to focus their attention on higher-priority tasks and avoid direct exposure to infection (Holland et al., 2021). However, for service robots to be deployed and for workers to perform different tasks in coordination with robots, the human side also needs to change its behaviour in line with the robots. Behavioural design (Wendel, 2013) thus needs to be introduced into the service design process.

Based on these considerations, we formulated the research questions for this study as follows. When developing a rapid service design method for planning services with robots, how should rapid ethnography be introduced into each step of the design process, including research, analysis, design and evaluation? How should behavioural design be introduced? The next section clarifies some of the useful theories, tools and methods in this process.

The remainder of this paper is divided into six sections. In section 2, we summarise a literature review on rapid ethnography, rapid service design, behavioural design and their implications with the aim of developing a rapid service design method. In section 3, we propose the method and describe the service design process. In section 4, we present the results of the user study from a survey conducted at Shonan Kamakura General Hospital. In section 5, we discuss the validity of the proposed method based on the results of the user study. In section 6, we provide a summary and future.



## Literature Review

### Rapid Ethnography

Prior to its introduction into the field of HCI by Millen et al. (2000), rapid ethnography aimed to assess the current status of a programme or service in public policy (e.g. healthcare) and was not linked to design. McNall et al. (2004), using the HIV/AIDS Integrated Health Intervention Study as a case study, argued that when programme managers need a rapid and intensive evaluation of a specific programme process, “rapid evaluation is preferable to comprehensive evaluation models”. McNall and Foster-Fishman (2007) also summarised descriptions of 13 projects, published between 1988 and 2005 (i.e. response to humanitarian crises, HIV/AIDS primary care programme, HIV/STI transmission patterns, healthcare systems, local natural and human resource management, etc.), that used rapid evaluation, assessment and appraisal in the field, and found that the key challenge was “balancing speed with trustworthiness”.

Millen et al. (2004) summarised three characteristics of rapid ethnography:

- 1) Focus the fieldwork appropriately before going into the field. Focus on key activities. Use key informants such as community guides and liminal group members.
- 2) Use multiple interactive observation techniques to increase the likelihood of finding exceptional and useful user behaviour.
- 3) Use collaborative and computer-based iterative data analysis.

Given that the definition by Millen et al. (2004) is about 20 years old, it is preferable in this paper to adopt a definition that also takes into account papers published after 2000. Vindrola-Padros and Vindrola-Padros (2018) conducted a systematic review on rapid ethnography covering 26 articles, and they explored the benefits and challenges of using rapid ethnography. In particular, they identified the need for a more detailed description of research design and the delays caused by the ethical governance process. Based on the review, the authors proposed a definition consisting of six requirements.

### Rapid Service Design

Similar to this paper, Segelström et al. (2009) attempted to introduce ethnography into service design. They focused on three definitions of Malinowski’s ethnography and tried to reflect them in the service design process in two points: use of ethnography as a method to empathise with the future users of the service, and use



of ethnography to stimulate idea generation. However, it is difficult to use the case of Segelström et al. (2009), as it is not an example of rapid ethnography.

The design sprint (Banfield et al., 2015) is a method that combines rapid research and service design. It is a time-constrained, five-phase process that uses design thinking to reduce the risk of bringing a new product, service or a feature to market, and was originally developed at Google Venture. The design sprint aims to create a prototype in five days, but it does not include field or customer research, and only interviews with potential customers are conducted during the validation of the prototype.

A case study linking rapid research and service design is the Transition to Online Care project conducted at the Princess Margaret Cancer Centre under COVID-19 (Rodin et al., 2020). A triple-diamond process, which is an extension of the double-diamond process (Design Council, 2007), was created that involved frontline staff throughout the entire process: discovery, design and testing, implementation and improvement. As a result of the design of the transition process, the target of a 50% transition from face-to-face to virtual care was achieved in four days. One of the findings of the case study was that the Virtual Care Management System team mapped and analysed each step of the traditional outpatient workflow and identified critical bottlenecks that hindered the delivery of virtual care.

### **Behavioural Design**

Wendel (2013) proposed a framework called the CREATE Action Funnel based on research in psychology and behavioural economics; this framework sets five cognitive preconditions for people to make behavioural decisions: the cue or trigger that makes one think about taking a particular action; reaction, which is the instinctive first response to the idea of taking the action; evaluation, which is a more rational cost/benefit analysis of taking the action; ability, or seeing whether one can even take the action right now; and timing, which involves determining whether it is urgent to take the action right now.

Integrating the approach of Wendel (2013) and the service ecosystem design of Vink (2019), Takeyama et al. (2020) proposed a three-step method to promote behavioural and institutional change simultaneously. In the first step, the CREATE action funnel framework is used to identify the factors from the five cognitive preconditions for people to decide on a behaviour. In the second step, the institutions are analysed from a psychological perspective. In the third step, behavioural and institutional change strategies are designed.



Vink (2019) highlighted the role of institutions within the service ecosystem – including rules, norms and beliefs – in limiting or enabling the behavioural possibilities of actors in the system. Palthe (2014) identified the following as barriers to organisational change: “regulative elements” related to law, such as policies, work rules and so forth; “normative elements” related to morals and ethics, such as work norms or habits; and “cultural-cognitive elements” related to individual cognition, such as beliefs and values. Based on these factors, Vink (2019) identified that there are invisible social structures (i.e. the regulative, normative and culturally cognitive elements) in care homes behind the visible experimental elements (i.e. elements that people can see, hear and feel in the field) and that service design should be based on these elements.

In designing development programmes and policies, Datta and Mullainathan (2014) distilled key insights from behavioural economics into a concise framework of constraints on people’s decisions. Specifically, they proposed seven design principles based on four basic resource constraints: scarcity of self-control, scarcity of attention, scarcity of cognitive capacity and scarcity of understanding.

Lockton et al. (2010) proposed the design with intent method for designing products and systems that influence user behaviour. The method uses six different lenses and a set of “key” design patterns applicable to a wide range of target behaviours for inspiration; 11 different prescriptions are then used to realise the intended outcome (a specific user behaviour) that they wish to achieve. However, the limitation of the method is that it largely applies to problems that have already been “solved”.

For the purpose of organisational change in a manufacturing company wanting to implement a product service system, Buschmeyer et al. (2016) developed a framework with three phases related to behaviour change – instruments to influence behaviour, behavioural change and change success – and 11 elements that make up each phase. They found that, among these 11 elements, human resource development and goal setting had the greatest impact on change efficiency and solution orientation.

## Design Implications

Based on the three previous research studies on rapid ethnography, rapid service design and behavioural design, the rapid service design method proposed in this paper has the following characteristics. The research step includes three features:

- 1) Appropriately narrow the focus of the fieldwork and zoom in on key activities (three institutions: regulative, normative and cultural-cognitive elements).
- 2) Use key informants.



### 3) Use several interactive observation methods.

These three characteristics are based on the three characteristics of rapid ethnography proposed by Millen et al. (2004). This allows for quick and accurate analysis. Furthermore, the focus on the three institutions identified by Palthe (2014) as key activities seeks to identify key phenomena of behaviour change, taking into account the second characteristic of rapid ethnography organised by Vindrola-Padros et al.

The analysis step uses collaborative data analysis, taking into account the characteristics of RE as organised by Vindrola-Padros et al. More than one field researcher is used to save time and cross-check data. This allows for quick and accurate analysis.

The design step plans services based on three systems following the behavioural design approach proposed by Takeyama et al. (2020). When introducing a new service, behaviour change on the part of the service adopters is essential, and the design must take into account the phenomena that hinder behaviour change.

The evaluation step involves two features:

- 1) Evaluate services based on the CREATE funnel.
- 2) Map each step of the workflow and use it for evaluation.

First, it should also have the behavioural design features proposed by Wendel et al., because evaluation using the CREATE funnel allows assessment of whether the design is based on the five cognitive prerequisites for people to make behavioural decisions. Second, it should have the rapid service design features proposed by Rodin et al. (2020), because explicitly presenting each step to people in the field facilitates understanding of the barriers present.

## Method

### Rapid Service Design Method for Services with Robots

Based on the findings from the literature review, we designed a rapid service design method for planning services with robots (Figure 1). The skills and knowledge required for service designers using this method include qualitative research methods and qualitative text analysis methods for the research, analysis and evaluation steps, as well as detailed conceptual design methods using basic design tools such as personas and journey maps for the design step.





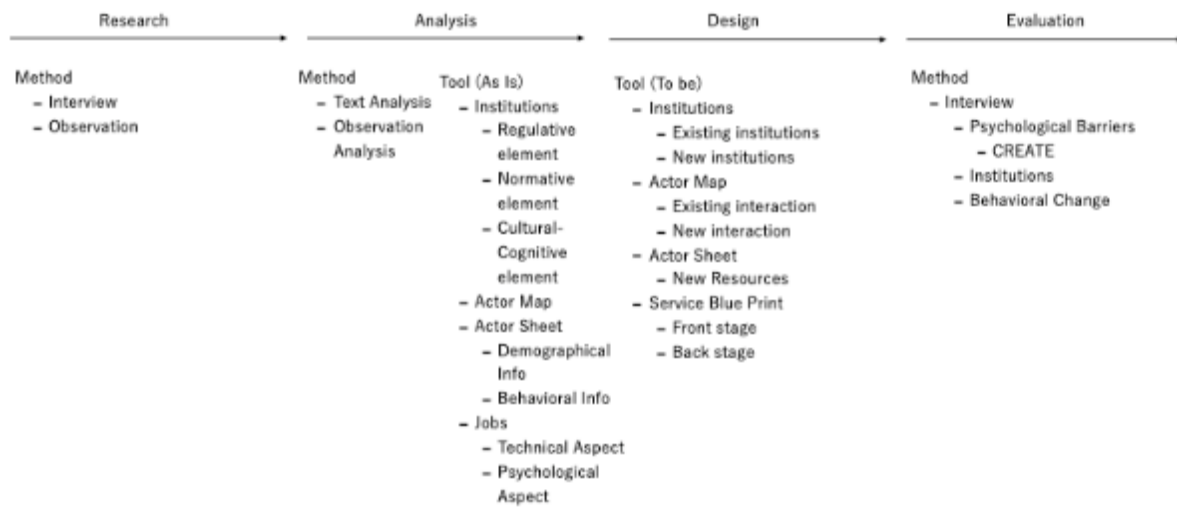


Figure 1. Process for rapid service design method for planning services with robots

The first step is research. During the fieldwork planning phase, service designers should narrow down the focus of the fieldwork. They should also carry out the actual fieldwork in multiples, zooming in on key activities through interviews and observations. Specifically, service designers should collect data on the jobs of the key informants and explore which jobs should be replaced by robots. Data from three institutions should be collected, which the service designers can use to select jobs that can be delegated to humans.

The second step is analysis. The service designers should analyse the data collected by several people during the fieldwork. Here, qualitative text analysis (Kuckartz, 2014) is used to extract institutions and jobs. Attributes and behavioural information are collected for each actor to create personas and journey maps. The relationships between actors are also summarised to analyse the service ecosystem.

The third step is design. Based on the results of the analysis, the service designers should plan the service ideas. Including the presentation of service ideas to stakeholders bridges the gap between service providers and beneficiaries. The detailed design for service ideas involves not only organising the relevant existing institutions, but also designing new ones if necessary. In creating the service ecosystem necessary for service operation, service designers need to organise the new interactions and new resources that will be required by the actors in the new service.

The fourth step is evaluation. Through interviews and questionnaires, service designers should identify psychological barriers to service adoption. In addition, the



validity of the service concept should be tested by gathering stakeholder opinions about the of details behaviour change.

## Case Study

### Project description

Based on the proposed methodology, we conducted a service design project in a medical facility. The main body of the service design project was Toppan Printing Co. Ltd., which is one of the largest printing companies in the world, based in Tokyo. The client of the project was Shonan Kamakura General Hospital, which is a 658-bed private general hospital in Kamakura, Kanagawa Prefecture. The project required a service design for Shonan Kamakura General Hospital using Toppan Printing’s digital twin system TransBots (Toppan, 2021) (Figure 2). Using virtual reality (VR) and computer vision (CV) technologies, TransBots is a digital twin solution that centrally manages and controls multiple types of service robots.

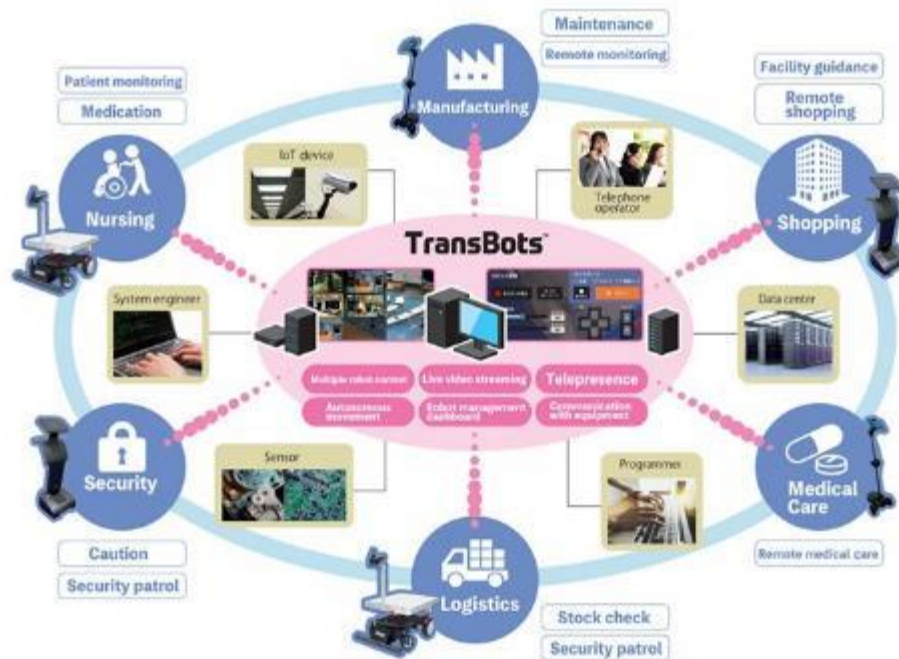


Figure 2. TransBots

### Research

First, to appropriately narrow the focus of the field research, we limited our target to nursing jobs, because there is a chronic shortage of nurses in the Japanese nursing labour market. For example, the Ministry of Health, Labour and Welfare’s (2005) Sixth Supply and Demand Outlook Study for Nursing Staff predicted a shortage of





about 42,000 nurses in 2006 and 16,000 in 2010. The subsequent Seventh Supply and Demand Outlook Survey for Nursing Staff (Ministry of Health Labour and Welfare., 2010) predicted a supply shortage of about 56,000 in 2011 and 15,000 in 2015, with no improvement. In this situation, in addition to improving the efficiency of nurses' work, there is a need to reduce the burden by sharing the workload. We conducted an interview with Ms S, a senior nurse, at Shonan Kamakura General Hospital on 21 December 2021. A list of interview questions is given in Table 1. The interview lasted 90 minutes.

Purpose	Questions
Job identification	Q1: What types of jobs are involved in a typical day's workflow? Q2. How would you rank each job in order of importance? Q3. When do problems or difficulties arise in a series of jobs?
Institution identification	Q4. What work rules do you follow? Q5. What are your team rules? Q6. What are your personal work beliefs and philosophies, if any?

Table 1. List of interview questions

### *Analysis*

Using the data obtained from the interviews, the service designers carried out qualitative textual analysis. First, all of the interview findings were transcribed and converted into text data. Next, the pre-defined coding targets – institutions and jobs – were coded. For institutions, coding was carried out by distinguishing between regulative, normative and cultural-cognitive elements. Once the jobs had been extracted, the functional and psychological aspects of the jobs were also extracted. The analysis resulted in the extraction of 15 jobs and four regulative elements, seven normative elements, and six cultural-cognitive elements (Tables 2 and 3).

The most useful insight was that robots cannot currently be entrusted with important jobs that directly involve inpatients. For example, in the case of nurses, it was considered difficult to replace jobs directly related to their inpatients, such as changing positions, managing cleanliness, toileting, taking blood pressure and assisting with meals. Based on this insight, we decided to servitise jobs that are less directly related to inpatients, but which nurses frequently perform in their daily work.



Regulative elements	Normative elements	Cultural - Cognitive elements
R-1 There is a defined area in the hospital where calls can be made	N-1 There is no rule that the nurse in charge necessarily takes the patient to the room	C-1 Some patients complain about nurses using their phones
R-2 Double-checking between nurses for medication	N-2 Use notes to let people know what you want to share	C-1 Nurse call pitches are accepted if explained
R-3 Confirm patient's name, date of birth and explain why they need to take the medication	N-3 Ensure compliance with manuals	C-3 Mobile phone texting operation is questioned
R-4 Double-checking is an ironclad rule in medical practice	N-4 Electronic medical records are used that can be used. (Due to lack of hardware rather than team policy)	C-4 Operating a terminal during a conversation with a patient does not give a good impression (although this is not the case for many patients)case for many

Table 2. List of institutions (excerpts)

Current job	Technical aspects	Psychological aspects	Frequency	Observation results
(1) Receptionist	Receiving patients at the nurses' station.			White nursing uniform (70% of all 4F) Working on PC.
(2) Checking admission documents.	If there are any deficiencies, have them filled in on the spot or after showing the patient to his/her room.			
(3) Guiding patients to their rooms.	Guidance on the way to the toilet, etc., and explanation of room facilities (basically handled by the nurse at the reception desk on the spot, but on a flexible basis).			White nursing uniform: at the patient's bedside Pink nursing uniform (1 nurse): making the bed

Table 3. List of jobs (excerpts)

## Design

Based on the institutions and jobs resulting from the qualitative text analysis, five service ideas were constructed and proposed to the hospital staff, of which the following two ideas were adopted. These two were chosen for three reasons: they are jobs that take up a lot of the nurses' time; they can be carried out by non-nursing staff; there is a perception that they are perceived as low-priority jobs for nurses at the individual and organisational level; and they are technically feasible.

The first service is to guide inpatients to their hospital room. When a patient is admitted to hospital, after completing the reception, the telepresence robot can guide the inpatient from the reception desk to the hospital room where he or she will be admitted. Once in the room, a nurse uses the telepresence robot (Figure 3) to explain the hospital stay to the inpatient. At Shonan Kokusai Kamakura Hospital, there are



just over 500 inpatients per day (Nurse Specialist, 2022), and if it takes an average of 30 minutes to guide each inpatient, a total of 15,000 minutes – or 250 hours – are required per day. The adoption of this service would reduce the nursing workforce by 250 hours.

The second service is to guide inpatients to examination rooms. On days when an inpatient has an examination of some kind, a service robot goes from the nurse station to the inpatient’s room and guides the inpatient to the examination room (Figure 4).

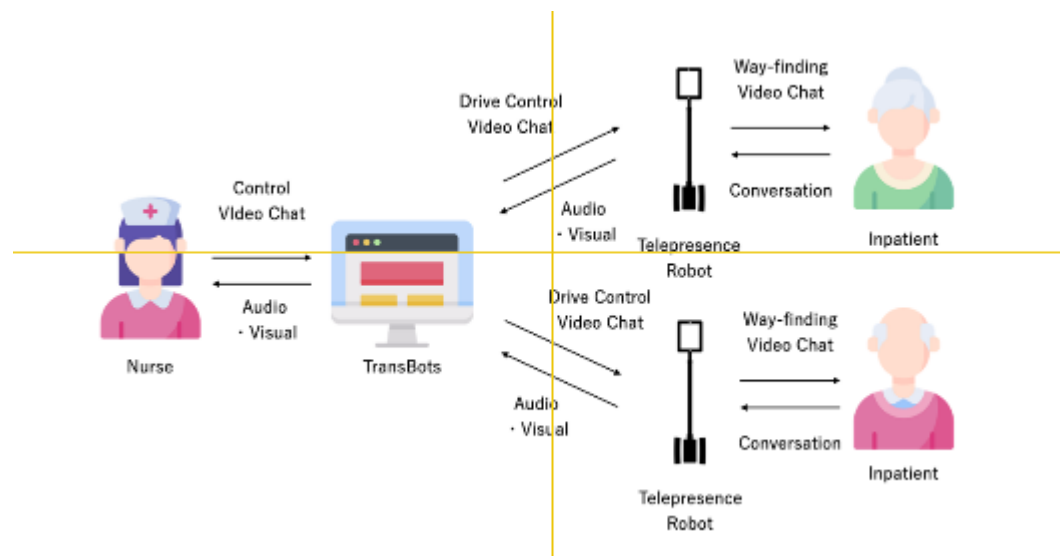


Figure 3. Guiding inpatients to their hospital room



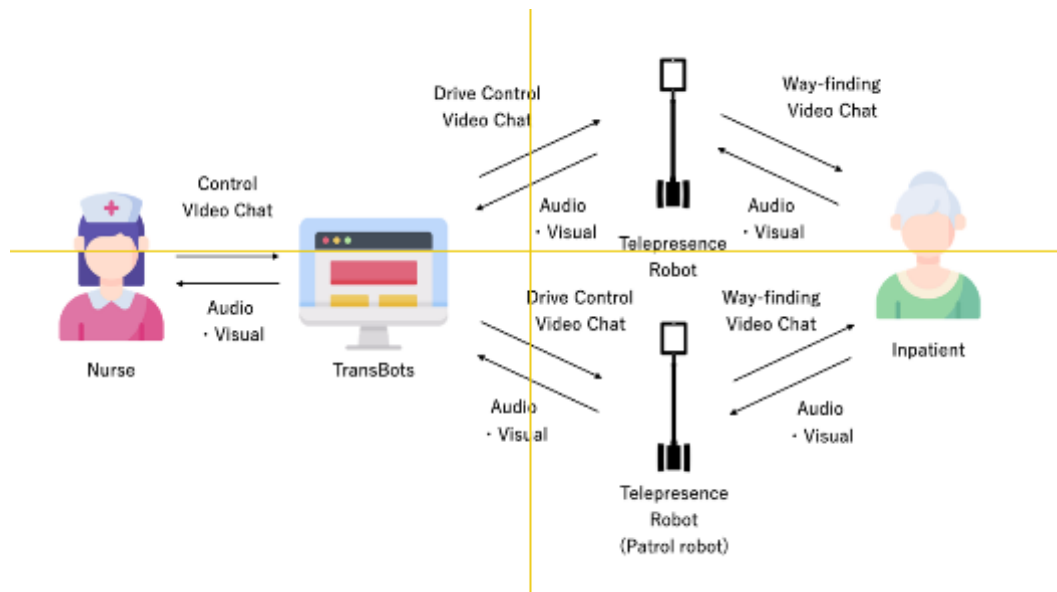


Figure 4. Guiding inpatients to an examination room

Both services were designed on the basis of the extracted normative elements. Specifically, these were: “N-1, There is no rule that the nurse in charge necessarily takes the patient to the room”; “N-5, When guiding the patient, the guide is next to the patient”; and the cognitive-cultural element “C-5, Try to give careful explanations to the patient”.

After designing these service concepts, we organised the resources needed for each service. Specifically, for a nurse as an operator and for inpatients, we organised the existing resources that would be required even without the introduction of the service robot and the new resources that would be generated by the adoption of this service. We also designed the service blueprint and organised the front- and back-stage actions for the inpatient activities.

## Results

### Overview of the Demonstration Experiment

On 25 January 2022, we conducted a demonstration experiment of the two service concepts. The purpose of this experiment was for nurses to evaluate the usefulness and safety of service robots and to identify issues for actual implementation. The usefulness was evaluated qualitatively in terms of whether the service would be useful to prevent infection and assist in the division of labour, as well as whether the



system was easy to use; safety was evaluated qualitatively in terms of whether there were any concerns about the running functions or operation of the robot.

The experiment was conducted in the hospital ward area on the fourth floor of the main building. Two service robots were used – Ohmni (OhmniLabs, 2022) and temi (2022) – to compare the usability of these robots. Two nurses participated in the evaluation: one as a TransBots operator and one as a patient communicator. A patient was asked in advance to participate in each scenario and participated only if consent was given.

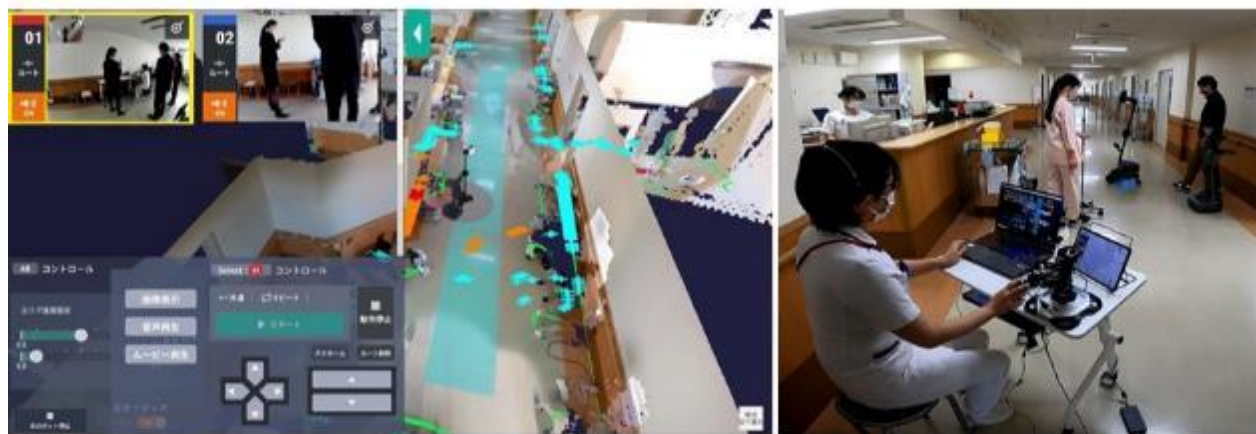


Figure 5. TransBots operational user interface (UI)

The demonstration day consisted of three parts: operational experience, demonstration experiment 1 and demonstration experiment 2. First, for approximately 50 minutes, a nurse acting as an operator was able to practise the basic functions of TransBots (manual driving, automatic driving, multi-vehicle automatic driving, telepresence and video chat). Then, in demonstration experiment 1, a patient was guided by the robot from the reception area of the hospital ward to his/her room, and the nurse in charge explained the inpatient's admission to his/her room via the telepresence function. Next, two patients were simultaneously guided by two robots from the reception area of the hospital ward to their rooms, and the other nurse explained their admission via the telepresence function. In demonstration experiment 2, one robot guided an inpatient from the room to the examination room; this experiment also included a scenario in which another robot tried to find a lost patient and continued guiding him or her, assuming a realistic situation in which a patient has strayed from the robot guide.

We conducted two evaluations: an interview immediately after the demonstration experiments and a questionnaire survey at a later date. The immediate post-





experiment interview sought to gather first-hand opinions about the operating experience and demonstration experiments 1 and 2. In the later questionnaire survey, we collected opinions primarily related to the behavioural changes that would occur as a result of the adoption of the new services, using figures. Although we initially attempted to conduct interviews at a later date with the two nurses we had requested, the nature of their duties made it difficult to arrange a date and time in advance and to set aside an hour during working hours for interviews, so we changed the method to a questionnaire survey with an emphasis on open-ended statements.

In the post-experimental interview, we verbally asked and received responses to several questions related to the following two validation items:

- 1) Ease of use of TransBots, including multi-unit control, and
- 2) The potential for three-way communication between robots.

Meanwhile, in the later evaluation, we distributed a questionnaire form and asked for ratings on the following two validation items; each item was rated on a five-point scale (1 being negative and 5 being positive), with requests for open comments:

- 1) Each behavioural change that occurred in service concepts 1 and 2, and
- 2) Institutions related to the introduction of robots.

## Experiment Results

### *Post-experimental interviews*

Table 4 shows the questions and answers given to the nurse acting as the operator during demonstration experiment 1. Although the guidance was carried out without any problems, it would be desirable to be able to adjust the speed more precisely according to the patient's condition.

Questions	Answers
Q1: Did you guide the patient smoothly?	Ohmni is very slow and stops crackling, so the patient seems to stumble.  temi seems to guide more smoothly.  temi is ... slow speed: too slow; medium speed: still slow; high speed: a bit fast.



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Q2: Were there any inconveniences?	Ohmni should run more smoothly. The slow speed may cause the patients to stumble.
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Table 4. Questions and answers: Demonstration experiment 1

Table 5 shows the questions and answers for the nurse acting as the operator in demonstration experiment 2. Several issues were noted with the user interface (UI), including the size of the screens and switching between them.

Question	Answer
Q3: Did you find the stray robot?	The robot on the screen was so small that I couldn't really see what was going on.  I had to get very close to the other robot to see it.  Maybe I could get used to looking at two screens, but I would forget to switch monitors.  I can't trust the robot in terms of safety and security. I was worried about bumping into a patient in a wheelchair or something.

Table 5. Questions and answers: Demonstration experiment 2

Table 6 shows the questions and answers for the nurse acting as the operator to check the overall impression of the service. Negative comments about the operation of the UI stand out. These are at a level that could be resolved by an experienced user. As the nurse noted, we believe that the problems could be solved by a dedicated operator rather than a nurse.

### *Questionnaire survey*

The questions and answers from the questionnaire survey are shown in Table 7, after a graphical representation of the current job and the changes in the job after the adoption of the robot (Figure 6), to determine the level of tolerance for specific behavioural changes. The responses to all of the questions were positive. This is probably due to the nurses' own perception, at the cognitive level, that guiding is a job that can and should be replaced by robots, as indicated by the response that guiding is a job that can be done without being a nurse.



Questions	Answers
Q4: What are your general impressions of the operation?	<p>The map is hard to understand.</p> <p>It is difficult to see the location immediately on the overhead image</p> <p>It is difficult to understand the operation</p> <p>Operations that can be done with a single button, such as just clicking or tapping, would be desirable.</p> <p>If the robot is a guide to a room, typing the room number is not a problem, as I am used to keystrokes.</p> <p>It would be better if the robot could be controlled by dragging, in the same way as the chat.</p> <p>It is more convenient to type the room number when specifying a route.</p> <p>It needs to be something that everyone can use a device such as an iPhone.</p>
Q5: How did you feel about the conversation function through the robot?	<p>It is good that it can be controlled by dragging.</p> <p>The volume is low.</p>
Q6: How did you feel about the robot handling the situation?	<p>It is pointless if the nurse is in the control room all the time, and it does not eliminate manpower if the robot has to be constantly monitored.</p>

Table 6. Verification of overall service impressions



Questions	Answers
Q1: How do you feel about robots guiding hospitalised patients instead of people in the future?	<p>RESULTS: 5 – I think it would be good.</p> <p>In a large hospital ward, there are calls and responses from other patients while the robot is going to and from the hospital. Guiding people to their rooms is a job that can be done by non-nurses.</p>
Q2: [After arriving at the ward] What do you think about communicating with patients through the robot instead of face-to-face?	<p>RESULTS: 4 – Acceptable.</p> <p>I think it depends on the patient's activities of daily living and level of understanding.</p> <p>Sometimes it is not possible to understand without direct contact.</p>
Q3: [Connecting to the nurse in charge] What are your impressions of the function where the operator (nurse) calls the nurse in charge on the tablet and connects with the patient?	<p>RESULTS: 4 – It could be improved, but it is usable.</p> <p>I think the operator could explain it as it is, but in the end, I think it would be better if the person in charge of the room visited the room without connecting here, because they check the location of things and the activities of daily living and set up bed fences and nurse calls. Some people also need to have blood samples taken.</p>
Q4: [Start of guidance] What do you think about using robots (instead of people) to take inpatients for examinations in the future?	<p>RESULTS: 5 – I think it's good.</p> <p>It's a job that doesn't need a nurse</p>

Table 7. Evaluation of behaviour change



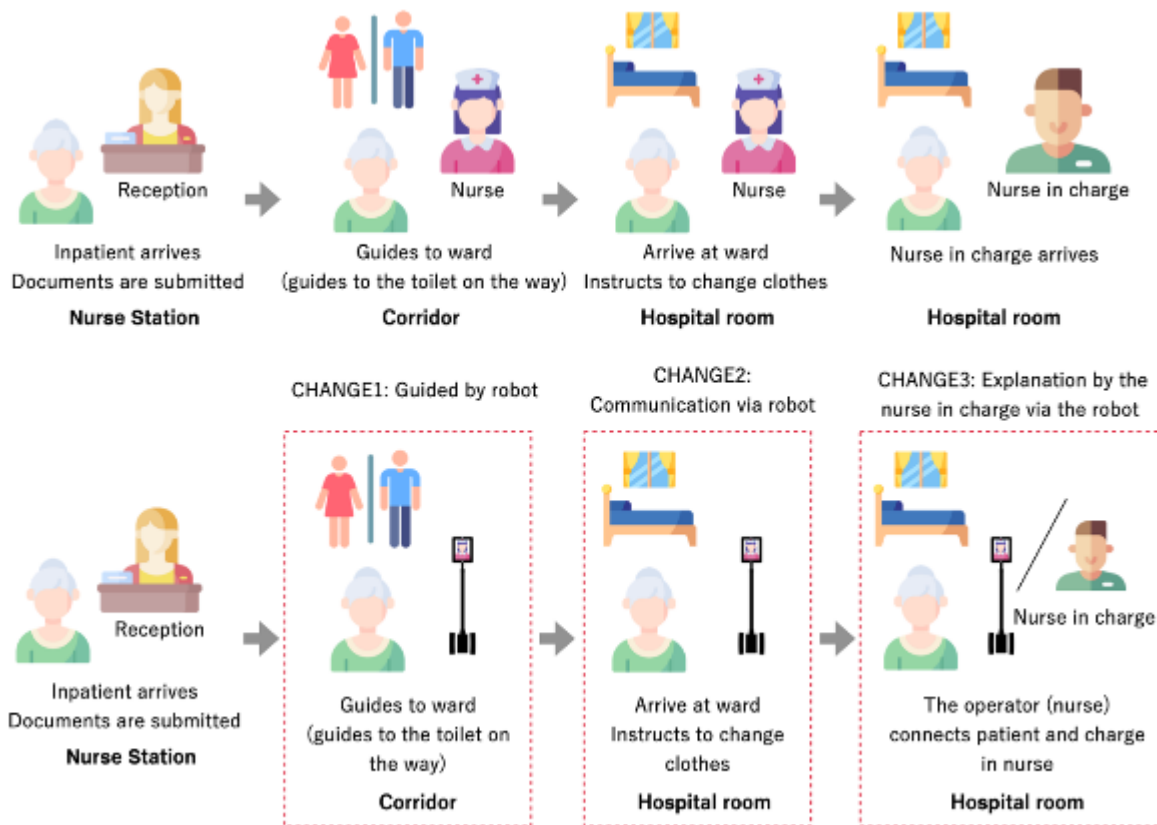


Figure 6. Changes in current jobs and jobs after robot installation  
 Demonstration 1: Guiding inpatients to their hospital rooms

Finally, Table 8 shows the questions and responses to identify existing and new institutions for adopting the services. Although it was not possible to obtain any actual comments on the institutions, it would be desirable for the services to be managed by operators, as the nurses themselves showed some reluctance in operating them.





Questions	Answers
Q5: Are there any existing institutions (e.g. seminars, study groups in teams) that promote the adoption of robots, IT technology, etc.?	We're forming a team at the deputy chiefs' meeting.  Announcement on Workplace about the adoption of robots and recruitment of collaborators.
Q6: What new institutions (e.g. workplace rules, arrangements within a team, mindset) do you think are necessary for the adoption of robots?	Safe and without harm to patients  Make sure that there is always a human eye on the end result.
Q7: What additional services do you think are needed to get the robots up, running and fully utilised?	The fact that people are needed to operate the robots was not what I expected.  If they work automatically after being programmed, we could do other work during that time.

Table 8. Evaluation of institutions

## Discussion

### How Should Rapid Ethnography be Introduced?

In developing a method for rapid service design for services with robots, we set the first research question – how should rapid ethnography be introduced in each step of the design process, including research, analysis, design and evaluation? Based on the literature review, we introduced rapid ethnography primarily in the research, analysis and design stages, and as a result, we were able to develop two services in about two months from research to demonstration.

More specifically, during the research stage, we appropriately narrowed the focus of our fieldwork and focused on nurses. Multiple designers also carried out real fieldwork, and through interviews and observations, we obtained data on key activities, nursing jobs and institutions. In the analysis stage, we analysed the data obtained from the fieldwork in plurality; we extracted the functional and psychological aspects of the three institutions and jobs using qualitative text analysis. In the design stage, we proposed two service concepts based on the three institutions using an



approach that would allow service robots to replace existing jobs. In the evaluation stage, the results of the post-experimental interview and the questionnaire survey showed that the responses to the service concepts themselves were generally positive, although a number of points for improvement were raised regarding the UI and the user experience (UX). We can thus conclude that the rapid ethnography method worked effectively in terms of the time required from research to design and the validity of the service concept.

### **How Should Behavioural Design be Introduced?**

In developing the method for rapid service design for services with robots, we posed the second research question – how should behavioural design be introduced into each step of the design process (i.e. research, analysis, design and evaluation)? For the second question, we proposed a concept based on the existing institutions in the design step, while in the evaluation step, we presented specific behaviour change details for each service and collected the opinions of stakeholders. We received positive responses for the two service concepts.

Specifically, in questions 3–6 of the post-questionnaire survey, we compared workflows between existing jobs and the proposed service concepts and explicitly showed nurses what kinds of change would occur. We then asked them for their opinions about the content of the changes, and received effective opinions for all of the questions. These results could be attributed to the design of the service concepts through the selection of alternative jobs from the perspective of the three institutions.

We also analysed two service concepts using the CREATE funnel to investigate psychological barriers. The first element, the cue (i.e. the trigger for coming up with an action) was not examined in this demonstration. However, in actual operation, it would be desirable to link the cue to the reception and examination systems and to have a specification whereby the cue is received by the nurse.

Second, the reaction or intuitive response, received negative comments in both the post-interview and post-questionnaire survey regarding the TransBot UI, so it would be desirable to conduct a usability test based on the expected users and make improvements.

Next, in the evaluation (or cost-effectiveness), the service was considered to be achievable if non-nurses with IT skills were assigned to operate the system in a 1:n ratio. Both the post-interview and the post-questionnaire survey revealed many negative insights regarding operation by the nurses themselves. The operation of TransBots requires new operating resources for the nurses. When the service idea was proposed, both the nurses and the organisation responded positively, but it can



be assumed that the nurses found the operation of Transbots more complex than they had expected during the pre-experimental training, which led to their negative opinion, as they found it difficult to master the system. It would thus be preferable to delegate operation to someone else in the hospital with IT skills (i.e. not nurses) or to an external operator.

Regarding the ability component, which indicates whether the service is feasible, both the post-interview and the post-questionnaire survey revealed a number of negative opinions from the nurses operating the system themselves. To acquire these operating resources as an organisation, it would be desirable to design institutions that include training sessions on the operation of this system and the use of the IT system as an evaluation item, in addition to recruiting appropriate personnel within the company, as mentioned in the answer to Q7. If, through these opportunities, the nurses could have been asked to participate in the experiment when they were sufficiently familiar with the operating procedures, it is possible that different responses would have been elicited.

Finally, with regard to timing, which indicates whether or not implementation can be done now, if nurses are currently given responsibility for the system in actual operation, the system would be linked to the reception and examination systems and would receive cues; if the nurses are engaged in another job, they would be unlikely to be able to give guidance immediately. If, on the other hand, external operators are put in charge, this would increase the likelihood of implementation.

It should also be noted that if the use of an IT system is a prerequisite, as in this project, we should have checked the level of knowledge of the IT tools in advance in the first step of survey, in addition to the jobs and institutions, because, depending on the answers, even if one of the actors needs to acquire the skills and knowledge to operate TransBots, an approach such as asking another actor who is not a nurse, IT department staff or external staff could be considered.

### **Useful Theories, Tools and Methods**

This service design method is unique in that it focuses on institutions and jobs from the research to the design stage. First, we listed the jobs that were performed by humans and extracted candidates for jobs to be replaced by a service robot. We then designed the final service concepts based on the three institutions. This step allowed the service concepts themselves to act as a clear filter for the acceptability of the services to be designed, based on rules, norms and cultural and cognitive factors.

In this service design project, we focused on the jobs of nurses to improve the operations of the hospital as a customer. However, it would also be possible to



consider a pattern that focused on the patients as users, with a focus on the value proposition for them. It would be possible to design a more accurate service design by clarifying, at an early stage, whether the customer, the hospital, is more interested in improving hospital operations or the patient experience, using a questionnaire survey or other methods.

## Conclusion

The project was able to implement the services in a short period of time using an existing service platform called TransBots. However, we were able to complete the research, analysis, design and evaluation steps in a total of about two months with the existing platform, and we received positive feedback for the two service concepts. This demonstrates the effectiveness of this service design method, which focuses on rapid ethnography and behavioural design. In the evaluation, we found a number of negative evaluations regarding the UI/UX of TransBots itself. As the aim of this paper was not to improve the existing TransBots platform but to evaluate the service design method and the implemented service itself, we only mention the evaluation of TransBots itself in passing. However, TransBots currently appears to be difficult for nurses to use if they do not have sufficient operating resources. From a service design perspective, if the use of this system is to be considered, the overall design of the service ecosystem needs to be reconsidered by improving the UI/UX, assuming users have low IT skills or using staff either from the organisation's internal IT department or external operators.

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