Clinical and Non-Clinical Handovers: Designing for Critical Moments

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ABSTRACT
Recent studies call for attention to the relevant work that non-clinical personnel do, not only to support clinical work, but also to the overall healthcare information infrastructure. Based on a case study of orderlies work in a major university hospital, we further investigate and characterize orderlies work with particular focus on handover situations as these support the collaboration and continuous coverage of hospital work practices. The case study involves interviews with orderlies and clinicians and a pilot study of a task management application. Based on our findings, we describe three different types of handovers (clinical to non-clinical, non-clinical to clinical, and intra non-clinical), and highlight the challenges that arise during the main tasks with handovers situations; patient transport and patient mobilization. We discuss the importance of establishing and sustaining a common ground, supporting the alignment of tasks and negotiations, as well as enhancing the patient contact within and among clinical and non-clinical personnel. We also present a couple of design recommendations to account for these challenges and handover types in the design of handover tools to support orderlies work practices.

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H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

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Non-clinical work; handovers; hospital orderlies; design

INTRODUCTION
A handover is an important type of collaboration that supports the continuity of work practices in many different workplaces such as manufacturing, air traffic control, healthcare, IT helpdesks, software programming, and etc. [32, 40, 41]. The most common and visible type of handover is the "shift change" that happens when for example a person or a group is replaced by another, with the same functional knowledge [48], taking the control and responsibility of the work [40, 41]. For shift changes to happen smoothly, establishing a common ground, efficient communication and having prior knowledge about the work to be done are needed [22, 32, 20]. However, there are other types of handover that have received little attention but are also important to consider when designing information technology to support work practices. An example of these is the referral handover [15] that takes place when a specific task and its responsibility are given to another practitioner or a subgroup with a different expertise [40]. Sharma [40] provides two examples of referral handovers describing the collaborative process of computer helpdesk personnel groups, not necessarily collocated at the same workplace.

While handovers are key mechanisms that help to sustain the continuity of work practices in most workplaces [40, 41], they are also prone to errors and breakdowns that can result in detrimental situations particularly in the healthcare domain, where continuous coverage of patient care is at stake [44, 16, 25, 20]. Indeed, the clinical handover or shift changes among health care professionals (nurses and doctors) have been previously investigated and reported not only by medical science [16, 25, 20], but also by the HCI and CSCW communities [34, 14, 19]. However, the hospital is a complex work environment in which many heterogeneous actors (clinical and non-clinical practitioners, patients, etc.) use and share many different resources and knowledge [48, 18, 10, 8] in order to manage the patient’s care trajectories [13, 44]. As such, establishing and sustaining continuous coverage in the hospital will also entail all the operational and maintenance work done by non-clinical workers, not only to support clinical work, but also to enhance the overall healthcare infrastructure [2, 10, 46, 8].

In this paper, we seek to understand the different types of handovers that take place when two divergent groups of practitioners (clinical and non-clinical personnel) collaborate to provide continuous coverage of patient care, that might benefit or affect the overall hospital information infrastructure. Based on a case study investigating orderlies’ work practices in a large university hospital over a period of 14 months, we describe the patient- and non-patient related handover tasks and identify three different types of clinical and non-clinical handovers: the patient or referral handovers among clinical and non-clinical personnel (clinical to non-clinical, and non-clinical to clinical), and the intra non-clinical handovers between orderlies. We also discuss the importance of sustaining...
the dynamics of handover tasks, the impact of patient contact during handover events, and how the orderlies’ task overview can serve as an infrastructural entity. Based on our findings, we discuss a couple of design recommendations to improve the design of handover tools to support orderlies’ work and the healthcare infrastructure, and provide future directions for our work.

RELATED WORK
The clinical handover is one of the most reported shift handovers in which healthcare professionals (nurses or doctors) collaborate in different shifts to provide continuous coverage of patient care [34, 45]. For instance, Tang et al. [45] investigated the nurse’s information flow during shift handovers and found two parallel processes (information assembly and information disassembly) in which nurses engage during the shift change. The information assembly process is a type of sensemaking handoff [40] that takes place at the beginning of the shift change when an incoming nurse tries to make sense of different kind of information from many different sources [45]. In contrast, an information disassembly process happens when nurses have to disaggregate all the information to make it available for the incoming nurse at the end of shift [45]. This information is often handed over to the incoming nurse through a verbal handover, and more formally through the electronic medical record [14]. In addition, Chen [14] highlights that handovers can also occur during the same shift (in-shift handovers) when for example nurses take lunch and ad hoc breaks.

Similar to nursing shifts, physicians also engage in different shifts through the day to provide continuous coverage of patient care. For instance, during the morning shift any particular event that takes place during the night shift would be briefly discussed between the physician and the medical interns [21]. At the beginning of the shift, medical interns also start assembling information regarding their assigned patients such as finding out each patient location and gathering laboratory results, etc. [21]. To facilitate diagnosis and treatment, many healthcare professionals with different competencies, skills and experiences [7] collaborate between and across hospital departments [6, 21]. For instance, two nurses with the same competences at the same department would be required to perform a chemotherapy procedure [7].

When the collaboration between different departments is needed, task responsibilities and information are exchanged across departments [7, 6]. For instance, when a doctor prescribes an examination that requires an X-ray procedure or a lab test [5], then a referral handover takes place as the task responsibility is handed over to the specialized departments where radiologists or laboratorists respectively, would continue with the caring process. However, there are other actors or non-clinicians involved between these transitions of care across hospital departments that are often overlooked such as hospital orderlies [2, 8], medical secretaries [27, 10] and registration assistants [29]. In the case of an X-ray examination, the medical secretary might have the responsibility to make the request [5], and the hospital orderly is the one transporting the patient across departments (patient transport) [2, 8, 43]. To support the formal and more informal ways of communication at the hospital, healthcare professionals often rely on different cognitive and coordinating artifacts such as patient charts [45], doctor’s progress notes [4], nursing notes [47], booking calendars [5], handover sheets [35], the whiteboard and doctor’s list [34]. While nursing notes often facilitate getting medication overviews [47], whiteboards can support the communication and coordination of clinical personnel providing a local overview and awareness of activities (e.g., patients’ locations, procedures), thus facilitating the information handover [34]. While the electronic medical record has been primarily designed to support healthcare professionals, non-clinical personnel such as medical secretaries, registration assistants and social workers also find it critical for their work [10, 29]. In addition, hospital orderlies also rely on paper-based tools (e.g., staff schedule, task list) and more technological-based tools such as a bed tracking system [1], or a task management system [8, 43] to support their work.

As explained above, handover situations are key to sustain the collaboration in the hospital, however, the differences of competences and skills among clinical and non-clinical personnel make the coordination of hospital work more complex, challenging the overall healthcare information infrastructure. For instance, clinical (nursing and physicians) handovers are prone to communication errors or omissions of patient information during shift changes [20]. Communication errors and breakdown of routines also occur in referral handovers between clinical and non-clinical personnel like in the case of missing information during patient transports [2, 43]. As such, there is not only a need to improve the communication strategies during clinical handovers [25, 20], but also during handover situations among clinical and non-clinical personnel as any breakdown or delay in these transitions might bring unwanted consequences during patient care [1, 2, 43].

In contrast to the work of doctors and nurses [48, 36, 45] as well as registration assistants and medical secretaries [10, 29] where the rhythms of work usually take place at the same department, the work of hospital orderlies is highly distributed in and across departments with different work rhythms [8, 43]. As the temporal and spatial dimensions of orderlies’ work are neither static nor stable [8], the possibility of having resources and communication issues during shift changes increase [1, 2, 43]. As such, this paper seeks to further investigate and characterize the different types of handover situations that take place among hospital orderlies (including in-shift handovers) and between the orderlies and other members of the healthcare information infrastructure, to inform the design of future handover tools to support orderlies’ work practices, and the overall healthcare infrastructure.

RESEARCH SETTING AND METHODS
The study took place at a major regional hospital that together with other specialized hospitals are being merged into one university hospital. Currently, the regional hospital is under reconstruction to enable this major expansion. Originally, the hospital consisted of 160,000m², but after the expansion it will consist of more than 470,000m² indoor space. The user studies
The university hospital consists of more than 40 clinical departments employing more than 10,000 people. The hospital has an overall capacity of more than 1100 beds, and performs more than 81,000 operations a year while receiving almost 800,000 outpatient visits and 41,000 visits at the emergency ward, and takes care of 100,000 hospitalized patients. In addition, the hospital’s service department employs more than 50 full-time orderlies and 15 part-time orderlies. From these, 26 are working during regular day hours on average, 8 orderlies during the evening, and 8 orderlies during the night shift.

**Data collection**

The data collection was performed as part of a larger research project that primarily focused on designing and implementing a task management application (TMA) to support the coordination of orderlies’ work, and the logistical work of the hospital. Apart from the mobile application, an additional interface was implemented to complement the departments’ EMR system involving healthcare professionals (doctors and nurses) across the departments in the process. The application has been deployed in two different university hospitals, and the first deployment has been previously reported [8, 43].

The work reported in this paper comes from the second deployment of the application in a different hospital in which the organizational setting and the orderlies’ work arrangements differ from the first deployment. In the first hospital, the coordination of orderlies’ work has been reported in a more centralized form relying on a task coordinator before the deployment of the application [8, 43]. In contrast, the coordination of orderlies’ work at the second hospital was decentralized in which the orderlies themselves are in charge of the task coordination, before the deployment of the TMA.

In order to examine the orderlies’ work practices at this second hospital, we combine both qualitative and quantitative study methods in three distinct stages: an exploratory stage that includes a workshop and informal interviews, followed by a pre-intervention and an intervention stages including observations, semi-structured interviews and questionnaires. We are only including the results from the qualitative studies to report the findings related to the main topic of this paper.

**Initial Exploration**

During the initial phase, a one-day workshop took place to explore the design of the new TMA with different stakeholders from the hospital: 4 orderlies from four different departments (Renal, Urology, Pediatrics and Gynecology & Obstetrics), 2 orderly managers and 4 task requesters (nurses and secretaries) from the Urology, X-Ray and Renal departments. The workshop was organized by the software company responsible for the development of the TMA and was conducted by: 5 software developers, two user experience engineers and one researcher (the first author). The workshop focused on the potential issues of the task management application, when creating, booking and ending tasks. At the workshop, the software company also shared with the participants the preliminary findings of their own empirical studies of orderlies’ work practices. These insights included different concerns such as the registration of tasks by the orderlies on behalf of the task requester using TMA, and about the automatic registration of the orderlies’ waiting time through TMA. Additional informal interviews were held to get further feedback on the application, issues and ideas from the participants.

**Pre-Intervention**

During the pre-intervention stage, we examined the work of hospital orderlies in this second university hospital with a particular focus on the cross-boundary challenges that take place between clinical and non-clinical personnel. First, semi-structured interviews of 18 orderlies were employed concerning: a) the handover of tasks of hospital orderlies, especially when collaborating with the clinical personnel, b) the task overviews and how these were used to support orderlies’ work practices, and c) the orderlies’ prioritization mechanisms utilized at the hospital. The same 18 orderlies were also given questionnaires concerning various aspects of the orderlies work during the handover of tasks to colleagues (e.g., ‘I get quick assistance from my colleagues’).

To complement the interviews and questionnaires, 70 hours of observations were performed of the orderlies’ existing work practices (e.g., tasks, resources, personnel involved, etc.) with particular focus on the intra- and inter departmental cross-boundary challenges (spatial, temporal, organizational). Observations were conducted within the day-shift period at the university hospital (roughly from 07:00 AM to 3:00 PM).

**Intervention**

A pilot study was conducted after introducing the task management system at the hospital. However, due to infrastructural and technical challenges (such as limited WiFi coverage) the pilot study was postponed several times. When the task management system was deployed it was first running at few selected departments. TMA has two different interfaces, one for mobile devices and the other one for a big display mounted at the coffee room. Shortly after the introduction of the TMA, we observed the work of orderlies in different departments were the TMA was deployed, and in some departments that were not part of the pilot study. The observations were conducted in four workdays, around 30 hours, covering 8 orderlies from 6 different departments. These observations focuses on aspects such as the orderlies’ use of the TMA, and the orderlies’ communication challenges with the clinical personnel.

**Data Analysis**

Handover events were identified as the main concept for further exploration in this paper. During the analysis, we extracted different handover events from our diverse studies and further categorized them as clinical to non-clinical, non-clinical to clinical, and intra non-clinical handovers. The different types of handover events come from the observations and/or as the most frequently discussed and emphasized topics by the participants. To describe the clinical to non-clinical and the non-clinical to clinical handovers, we identified three additional aspects (information, the patient, and the patient contact) that are important to characterize these handovers. Regarding the intra non-clinical handovers, they are often related to resource activities that might or might not need continuous coverage.
In the following we describe in detail the organizational setting including the main patient-related and non-patient related handover tasks, as well as the different types of handover.

**FINDINGS**

This section describes the organizational setting and the actors involved during handovers events as well as the different types of patient related and non-patient related handovers that emerged from our analysis.

**Organizational setting**

Aligned with previous studies, the work that orderlies do involves a number of heterogeneous actors (clinical and non-clinical personnel) and resources through a collection of diverse action and interactional processes [8, 43]. However, the organizational setting in this study of orderlies’ work differs from previous studies where 2 or 3 big groups of orderlies provide continuous coverage across departments [8, 43].

**Groups of Orderlies**

In this university hospital we identified two different groups of orderlies. The main group includes orderlies who are dedicated to one or two specific department(s) according to the size of the department, except for the X-ray department which has no designated orderlies. In this case, the X-ray department will call to the specific department’s orderly in which the patient belongs to. Apart from the dedicated orderlies at each department, this hospital has an additional group of 5-6 orderlies, called the ‘flying group’, which are distributed across the whole hospital in order to assist the different departments when these are busy or otherwise would perform scheduled tasks. The flying group is only active during the regular day-shift (7 am. to 3 pm.).

These groups of orderlies engage in different tasks during the day-shift that are prone to handover situations among the clinical and non-clinical personnel as follows.

**Patient-related Handover Tasks**

The main patient-related handover tasks we observed are: the patient transport and the patient mobilization. The patient transport relates to the transportation of patients from one department to another when requested as part of the treatment plan. There are two types of patient transports, which are the bus transport and the bed transport. While the bus transport involves the use of a mini bus (see Figure 1a) and can have up to three patients sitting on it, the bed transport involves a bed pusher (see Figure 1b) that the orderly can mount and drive having only one patient laying on the bed.

In contrast to the patient transport, the patient mobilization often involves physical lifting or movement of patients using lifts or special linen that can turn the patient over. The patient mobilization takes place at the same department and does not require a cross-department collaboration as in the case of patient transport. The patient mobilization is primarily performed by the orderly but in some departments it could be done together with the clinical personnel. For instance, the nurses or physical therapists often take part of the patient mobilization at the ICU (Intensive Care Unit).

**Cross Coverage of Patient Care**

Patient transport does not necessarily require an explicit handover, as in some critical cases a cross coverage of patient care takes place between clinical and non-clinical personnel. For these critical transports both a nurse, a doctor and an orderly will be part of the transport, when the patient is in a medical unstable state. For example we observed a transport of a patient in coma where both a nurse, a doctor and an orderly were part of the transport. This cross coverage of patient care also enables the doctor to handover specific medical details regarding the patient when arriving to the receiving department. Furthermore, we also observed situations where it was only the nurse and the orderly who transported the patient. The decision of whether the nurse and/or doctor will be part on the transport depends on the clinical personnel’s assessment of each patient medical condition.

In some cases, the patient mobilization task would also involve a cross coverage according to the current state of the patient. Most patients often interact with one or two orderlies during the day, except if there is a task in which the orderly has requested an assistance from another orderly like in the case of a difficult patient mobilization. We also observed some cases...
Non-patient Related Handover Tasks
In this hospital, we also observed several non-patient related handover tasks in which the orderlies engage in as part of their work practices. These non-patient handovers tasks can be, but are not always, less critical and less demanding compared to the patient-related handovers described above as they do not require a continuous coverage of patient care. However, these non-patient handover tasks can still be of high priority, for example when the orderlies are the ones responsible for transporting more critical resources such as blood (e.g., used for operation and is crucial especially for acute cases), or blood samples of hospitalized patients that need to be tested at one of the laboratories at the hospital. Furthermore, orderlies also transport other less critical resources such as beds, mail, and other physical equipment across the hospital departments. For example we have observed the orderlies transporting a broken scanner from the clinical department to the technical department for repair. Even the orderlies’ own equipment used for transport such as the bed pushers have been handed over to the technical department for repair or maintenance.

Ordering, Registration & Coordination of tasks before the TMA
When a specific task that involves clinical and non-clinical handovers is requested, the task requester (e.g., a nurse or secretary) calls a specific 5-digit code, which redirects the call to the orderly at the specific department. The orderly receives the call through their own designated wireless DECT-phone. When the communication is established, the nurse for example would request the task to the orderly by stating, e.g., I have a bed transport (meaning the patient can not stand) from the Y department to the X-ray department at 9 am.

The DECT-phone is not only used for communication, but also for task registration. Every time an orderly has performed a task, the orderly would type in a 6 to an 8-digit number to register the task completion consisting of: first 2 digits for the dispatching department, the next 2 digits for the task type (of which there are 28 different types), and the last 2 digits for the receiving department. In addition, the orderlies can enter 2 digits more to indicate the amount of time above average that they spend on a particular task. The orderlies’ management and upper management at the hospital used this information to decide the amount of assigned orderlies for the hospital in total, and for each individual department.

The orderlies’ task coordination is primarily decentralized in a way that each orderly does an individual prioritization of the tasks requested by the clinical personnel. The prioritization of tasks is primarily done based on each orderly’s experience together with their understanding of the clinical needs and rhythms of each hospital department. If the orderly needs assistance (e.g., if the work load at his particular department is high) he can call co-workers at other nearby departments, or call the flying group. When the work load is low or the flying group are idle, orderlies would wait in the orderlies’ coffee room to receive task requests through a stationary phone from other orderlies, or special requests from departments with no designated orderly.

Changes in Ordering and Articulation of tasks after TMA
While the types of handovers did not change after the introduction of the task management application, the way in which the orderlies deal with handovers changed. For instance, the action of requesting a task changed to a more asynchronous form by using the application rather than receiving the requests through a phone call. However, the DECT-phones would still be used to sustain a direct communication between the clinical personnel and the orderlies when needed. In addition, TMA replaced the need for using the DECT-phones for registration of completion of tasks, as the registration became more implicit through the application.

When clinicians articulate tasks that would be then refereed to the orderlies for its execution, there would be three different handover situations (clinical to non-clinical, non-clinical to clinical, and intra non-clinical) that take place as part of the hospital work arrangements. The same types of handovers emerged across our studies regardless of the small changes in the organizational setting introduced by the TMA. These specific types of handovers will be further described.

Clinical → Non-clinical Handovers
In relation to the patient-related handovers tasks (patient transport and patient mobilization), we identified three different aspects (information, the patient and patient contact) that are important to characterize the clinical → non-clinical handovers. These aspects will also highlight a number of cross-boundary challenges during the handover situations.

Information and Needed Resources
There is a handover of information from the clinical personnel to the non-clinical personnel (orderlies) when a patient-related task is requested. This information is primarily related to the patient’s medical condition, in the form of physical medical records such as paper based journals etc. This information could also be verbally disclosed by the nurse if for example she mentions issues that are important for the orderly to know when performing the requested task.

When the task request is not clearly received, the dedicated orderly often asks for more details for clarification. For instance, we observed how the orderlies ask whether or not a patient can stand or has to be laying off during the patient transport. The orderlies need this information as they have to decide whether to transport the patient by using the mini bus or the bed pusher. The nurses are often aware of this difference and when requesting this task they would explicitly tell the orderly whether it is a bed transport or a bus transport, however, in some cases they might not be fully aware of the needed information for the transport. Orderlies sometimes request the patient’s name to avoid looking at the department’s schedule or medical records.

Apart from the patient’s condition and the patient’s name, we also observed orderlies asking for additional information relevant to the specific task regarding the needed resources. For example, asking whether or not an oxygen tank would be needed for the transport. There are also more important reasons to ask for additional information as in the case of X-ray scans as stated by an orderly during the interviews:
Another piece of important information is the patient location. There is a difference in quality between a x-ray of the patient and the patient location (which is preferred) or laying down, which is not always possible due to the patient’s condition. In other circumstances, a x-ray can be particularly requested with the patient standing by the clinicians. If orderlies do not receive this information, they would have an extra work as they would transport the patient back and forth again between the patient’s department and the X-ray department.

Another piece of important information is the patient location as orderlies might not often know the specific room of the patient that needs to be transported or mobilized. Orderlies might have to drive around the dispatching department to find the secretary at the hub or a particular nurse at the department, to ask for the location of the patient, or a particular room during a patient transport. Orderlies would inform back to the nurse or the secretary when the patient is located and the task is completed. While introducing the TMA, all relevant rooms and locations in which patients can be located were registered into system such that the clinicians could easily select the relevant room. As such the naming of rooms were standardized across the clinicians at the different departments. But even with the locations in the system, locating a patient can still be very time consuming task. For instance after the introduction of the TMA, we observed the following situation in which the orderly had troubles finding a patient:

An orderly is just outside the room where the patient is hospitalized according to the TMA. The orderly checks the room and the patient is not inside the room. Thus, the orderly has to locate a nurse to ask where the patient is. The orderly keeps an eye out for the patient and heads towards the department hub to ask a nurse. The first nurse we meet on the way does not know where the patient is, so the orderly continues to the hub. The orderly asks a nurse at the hub, who says that the correct room is shown in the TMA. The orderly and the nurse heads back to the room, and now the patient is in the room. While trying to locate the patient, the orderly did not know that the patient was in another room talking to another patient.

Moreover, the ways on how the clinical departments deal with the handover of information differs from one department to another, as well as on how much the orderly has to do to get the required information, as one orderly explains in this interview:

'It can be different from department to department. There are some departments where the journal is ready and it says where the patient belongs to and then they have a medical record where it says where the patient is going to and where they are hospitalized, etc. (...) then you just go to the counter and grabs the journal and continues with the task. However, there are other departments where it [the journal] is not ready and then you quickly need to figure that out... you have to go there by yourself and find where the patient is, etc.’ (pre-intervention)

For patient mobilization, it is also important and critical to get information about the condition of the patient and the needed resources, as the mobilization involves more physical contact with the patient. For example, when a patient has hip issues, the orderly needs to be aware of this before moving the patient so that they can change their moving procedures e.g., request additional help or choosing between lifts or special linen for mobilization.

The Patient

It is not only the information and resources that are important to get ready before the patient is handed over to the orderlies. The patient also needs to be ready for the specific task e.g., patient transport. The orderlies highlight this as a potential time saver, for example, if patients get notified by the clinical personnel before the orderlies arrived:

'When I’m driving to the x-ray department with a bed tour I always ask the nurse Can the patient stand? and the nurse replies But it [the transport] has to be in the bed?... Yes, but that wasn’t what I asked for. I asked whether the patient can stand on their own or needs to stay in bed. Otherwise, I risk that when I’m over there and ask the patient can you stand, the patient says: No, I can’t. Well then they make a scan where the patient is laying down and when we come back they say he can easily stand on his own. But the patient said that he couldn’t (...). Sometimes you miss that information, and it can sometimes be hard to get it. Then you have to figure it out over there (at the receiving department).’

(An important aspect of the patient-related handovers is the patient mobilization. It is important to get ready before the patient is handed over to the orderlies. The patient also needs to be ready for the specific task e.g., patient transport. The orderlies highlight this as a potential time saver, for example, if patients get notified by the clinical personnel before the orderlies arrived:

'When I’m driving to the x-ray department with a bed tour I always ask the nurse Can the patient stand? and the nurse replies But it [the transport] has to be in the bed?... Yes, but that wasn’t what I asked for. I asked whether the patient can stand on their own or needs to stay in bed. Otherwise, I risk that when I’m over there and ask the patient can you stand, the patient says: No, I can’t. Well then they make a scan where the patient is laying down and when we come back they say he can easily stand on his own. But the patient said that he couldn’t (...). Sometimes you miss that information, and it can sometimes be hard to get it. Then you have to figure it out over there (at the receiving department).’

(pre-intervention)

An important aspect of the patient-related handovers is the patient’s contact with both the clinical and the non-clinical personnel, especially for tasks that need to be done inside of the patient’s intimate space, as an orderly explains in an interview:

'you get a lot of physical contact with the patient. You can say that you cross the intimate space for many patients if you help with personal things (...) so if it is only one
orderly that takes care of this department at the day shift and another orderly at the night shift, then it is only 2 different orderlies. When the patient sees a familiar face every time, then you have a better patient relationship. There are many patients that appreciate that one is a familiar face they see.’ (pre-intervention)

The schedules facilitate patient contact as orderlies are often working at the same department for a week, and this assignment helps fostering a long-term patient-orderly relationship:

‘Sometimes you are at the same department for a week. If there is somebody who needs a lot of help for the personal things, then it is almost only me that the patient sees in the day shifts, and you are only unfamiliar the first or the second time. Then there is no reason to be shy over that you are naked while I help you and the nurse is washing you. Because you overcome that embarrassment the first time, but if it is a new face again, then the situation is different. It means a lot to the patients.’ (pre-intervention)

Indeed, one of the orderlies explained how the emotional part of the patient care would get worse, if patients see a new face every time:

‘I would claim that. It does that and also the pure professional part. Because, you can say that patients are different or they can have different things. One might have a bad leg, and you just know that they are a bit sore here and there and things like that (…). But when I am at the same department for a week, as we sometimes do, then I know that she is sore there (…). It is also what you experience sometimes, that I think is really nice, when you can also collaborate during the mobilization of a patient, when a nurse says: ‘Yeah, I don’t know how we should move the patient, I haven’t mobilized her before’, but I have, so now I look at her and say this is how we do it. So that gives some huge improvements’ (pre-intervention)

In contrast to a patient mobilization that involves more physical patient contact, during a patient transport the dedicated orderly often talks to the patient as they are used to transport the same patient. In this way the orderlies starts to get contact and experience with the patient care trajectory.

We also had another observation that highlight the importance of contact between the patient and their relatives. The following observation is an example of this having the relatives as another source of information (also related to the previous sections), based on their previous experiences of the patient’s care trajectories:

There was a patient that needed a transport to a specific treatment. The orderly arrived outside of the patient room to be transported and saw some people were sitting outside. The orderly asked if they knew where the patient was. They explained that they were the relatives (daughter and son of the patient), and asked whether the orderly was about to transport the patient. The relatives were concerned that the patient should be transported now, as the patient has low blood count and normally the patient would get blood transfusion before the treatment. The orderly did not know, so the relatives found and asked the nearest nurse, who also was not sure, so the relatives located the doctor, which decides that the blood transfusion should be done before the specific treatment. All of these took place while the orderly was waiting in order to know whether the patient should be transported now or later. (intervention)

Non-clinical → Clinical handovers
After having described the important aspects of the clinical to non-clinical handovers, we will focus on the reverse namely the non-clinical to clinical handover events. These handovers have similar issues as the previous presented, but we have also observed other new cross-boundary issues that we will present in this section. In particular in the following observation, we saw the orderly as the orderly first actor noticing a breakdown in the cross-boundary work between two clinical departments:

The orderly is about to handover a patient (as part of a patient transport) to the receiving department. The orderly asks the receiving department’s head nurse at the hub, where the patient should be placed? The nurse replies: ‘We don’t have that patient in our records, are you sure this is where the patient is supposed to be?’ The orderly then calls the dispatching department and the nurse who receives the call is not the nurse who dispatched the patient, and does not know the patient. The orderly then drives back, with the patient, to the dispatching department to find the nurse. When the orderly finds the nurse and explains the situation, the nurse calls the receiving department to clear up the matter. Apparently, when the dispatching department had called to book the examination of the patient, the receiving department did not register it in their EMR system. After the call, the orderly drives again bringing the patient back to the receiving department, who now is ready to receive the patient. (pre-intervention)

From this observation, the orderly takes an active role handling the clinical departments’ breakdown in communication, otherwise the orderly would not have been able to deliver the patient. This kind of breakdown is not unusual and can happen due to different issues. For example if the dispatching department registers the wrong time, or articulates the wrong time to the orderly, or the receiving department registers the wrong time for the patient examination, x-ray scan, etc.

Furthermore, we have also observed at certain departments that the orderlies use the emergency pull-string to notify the dispatching department when a patient is returned, rather than verbally inform them about this. This will turn on lights outside of the room, where the clinical personnel, such as nurses, will then become aware that a patient from a specific room has returned. This practice is primarily used at clinical departments, with relatively few patient emergencies.

Intra Non-clinical handovers
The last category of patient-related handovers are the ones that take place within the non-clinical personnel or orderlies. These types of handovers are crucial for the orderlies to stay
efficient across the departments, especially when sudden burst of tasks are requested at a specific department. When these bursts happen the orderlies can ask for assistance from their co-workers, or if the co-workers are idle they will call around and ask whether somebody needs assistance. One of the orderlies explains how this take place in the following quote:

(...) the departments. It is a bit different depending on which codes you have, where it is busy time at the different departments. We are quite good at collaborating, so we just call each other if there is anything. If you know who often is busy, then you call that guy to hear if you can relieve the guy for some trips. It is a bit easier when somebody is calling you and then you can handover some trips, otherwise they would have to call around and try to handover tasks. Instead of driving back (to the coffee room), when I’m over there (the department) then we might as well just help each other. (pre-intervention)

During the interviews the orderlies sometimes described the handover of tasks as ‘selling a task’ to their colleagues. In particular, during one of the observation rounds one of the orderlies explained that at the ICU the orderlies preferred to ‘sell’ the short patient transport trips, as they require less time and take up less of their colleagues’ time. This means that these trips are easier for the orderly to ‘sell’, or handover them to their colleagues.

**DISCUSSION**

Our study describes different clinical and non-clinical handovers that take place within and across the university hospital departments. In contrast to previous studies in which orderlies are distributed in 2-3 big groups working across the whole hospital [8, 43], the coordination of the orderlies’ work in this hospital was totally decentralized and the orderlies were in charge of the prioritization and execution of tasks. However, our study revealed that the coordination of work was challenging due to several cross-boundary breakdowns of routines. In this section, we discuss the importance of sustaining dynamic handover tasks in relation to the overall healthcare information infrastructure. We also discuss the impact of patient contact during handover events as well as a couple of organizational challenges. Last, we present a couple of design recommendations based on the lessons learned from our study.

**Sustaining Dynamic Handovers Tasks**

At the hospital, there are many material and in-material mechanisms that support the coordination of hospital work practices, in particular among healthcare professionals. For example, organizational structures and divisions of labor [7], departmental work calendars [5], handover sheets [35], whiteboards [34], as well as doctor’s list [35] and nursing notes [47]. The digitalization of the patient record has improved the coordination of work practices not only among clinicians [47, 31] but also for non-clinical workers [10, 29]. In addition, Hertzum and Simonsen [23] have shown the positive effects of electronic records over paper-based records regarding clinicians’ mental workload, achievement of overview and clarity in the responsibilities of work tasks, and need for exchanging information. While the physicians experienced a reduction in mental workload, the nurses experienced less missing information and details to pass on during handover events [23]. Digital calendars [3] and interactive displays [11] have also supported the coordination and communication across practitioners with multiple work trajectories e.g., doctors, nurses, and surgery technicians. In particular, the AwareMedia display [11] has integrated video, chat, the surgery plans and a tracking system to show progression of surgeries. Keeping updated information about the dynamic changes across operating theatres has helped for example to “lessened articulation work and improved awareness” in the hospital [11].

All the aforementioned elements are needed not only to support the articulation of hospital work, but also to help establishing common ground at the hospital. Indeed, establishing a common ground is one of the most important strategies to support handover activities [40]. As evident in our study, establishing a common ground between clinical and non-clinical personnel is as important and challenging as among clinicians [20]. Similar to clinician’s handovers, our study shows the importance of traceability of orderlies’ tasks (e.g., decisions, time, resources) in order to make the work of orderlies more efficient. The orderlies’ handover of tasks, in particular the patient transport, are very dynamic and prone to errors. In the more problematic cases, our study reveals that having prior knowledge [32] of the task and of the patient would enable the orderlies, not only to ask questions facilitating a shared understanding and avoiding assumptions, but also to show the importance of their work to the clinicians. While Hertzum and Simonsen [23] demonstrate how the electronic record lessened the need for communication among clinicians to enable more room for discussions, our study revealed that the TMA and the standardized naming of rooms and locations freed the negotiations that previously the orderlies and clinicians had during handover tasks. As such, TMA partially supported the establishment of common ground among clinical and non-clinical personnel. While the orderlies were able to get more explicit information regarding the handover task through TMA (e.g., showing the name and the room of the patient for the transport), the nurses also became more aware of the orderlies’ workflow through the implemented add-on to the hospital EMR system. Besides TMA, the DECT-phones were still used to support the synchronous communication and coordination of orderlies’ work when needed, as a complementary support for the establishment of common ground. A high common ground is required in particular when the work has to be done in distributed locations [30]. In the case of the orderlies’ distributed work, if a common ground is not established, many breakdowns in routines and missing information during the referral handover will impact not only orderlies’ work but also the overall healthcare infrastructure. In our study, TMA partially supported the orderlies to get a sense of the local and global coordination by providing them with a list of colleagues with their current tasks and locations.

In CSCW, there is an on-going discussion about establishing a common ground that has been manifested in a recent special issue of the CSCW journal (e.g., [37, 33]. From this discussion, we align with Koschmann [24] that suggested that establishing a common ground should be done through the lenses of the
motive coordination theory [39] through the understanding of how motives are coordinated in practice. Understanding the motives and values of clinicians, orderlies, patients and relatives is highly important for investigating clinical and non-clinical handover tasks as multiple trajectories intersect with very different values and motivations. This might help to provide a broader view of the situation at hand, rather than having an objectified or decontextualized view of the common ground among different stakeholders.

The Impact of Patient Contact during Handovers
Aligned with a previous study in a different hospital [42], patient transports and patient mobilizations are the most recurring tasks at this hospital. As shown by our studies, these tasks involve patient contact as most of the work orderlies do has a direct or indirect connection to the patient’s body, what Strauss has termed as body work [44]. A particular aspect that was highlighted during our study was the level of trust the dedicated orderly builds with patients, which is a type of sentimental work [44]. The patient contact differs according to the task at hand. While some patients would prefer a known face when the work that has to be done is on their bodies e.g., cleaning the patient during a patient mobilization, a known face would not make a big difference during a patient transport as the patient is usually transported using a vehicle.

In addition, having prior experience with the patient and the patient condition could help not only to promote a better relationship with the patient, but also promote the collaboration between the clinical and non-clinical personnel. In our study, orderlies often stated that if the patient would have to meet a new orderly every time, the quality of the care experienced by the patient would dramatically decrease as well as the collaboration with the clinical staff. While patient contact will facilitate the execution of a task, the close physical connection with the patient could also involve some kind of dirty work [44], in particular during patient mobilizations (e.g., cleaning a patient), this might also affect the emotional state of the orderly. In these cases of a difficult patient mobilization, a strategy might be to request the assistance of a colleague or a nurse that has previously been in contact with the patient to help lessen the effect of dirty work.

Orderlies’ Task Overview as an Infrastructural Entity
Prior to the introduction of the application, our study revealed a number of breakdowns of routines mostly related to missing information about the requested task (e.g., needed resources), the patient (e.g., condition, name, and location) or the patient not being ready for the specific task (e.g., patient transport, and patient mobilization). The breakdown in the orderlies’ routines affected the efficiency of the hospital as orderlies needed to spend more time finding the necessary information for the task to avoid for example wasting time locating the patient or repeating the transport. As shown in our study, TMA addressed some of these challenges by facilitating the registration of tasks, including the missing details, and presenting an enhanced task overview.

Research has shown that the electronic patient record [9] and the nursing plan [28] support physicians’ and nurses’ achievement of overview, supporting the hospital information infrastructure. Similarly, the orderlies’ task overview could eventually become an important and integrated part of the hospital information infrastructure. Similarly to the previous studies [8, 43], the orderlies’ overview provided by TAM helps to order and make more visible the work that orderlies do. As such, the orderlies’ overview can serve as a mechanism to account for and visualize the work trajectory of orderlies, similar to the electronic patient record and the nursing plan regarding the work trajectories of doctors and nurses. In contrast to more static coordination mechanisms [38, 12] such as departmental work calendars, we have seen how the orderlies’ overview is constantly changing and being (re)negotiated according to the situation at hand, partly facilitating the local and global coordination [43] by providing the list of colleagues and their current tasks and locations as explained above.

Design Implications and Future Directions
The organizational setup of orderlies work in this university hospital is very different from previous studies [8, 43]. In this hospital, each department has one or two dedicated orderlies that can be supported by the flying group of orderlies, in particular during the day-shifts, increasing the complexity of handover tasks due to the different types of actors involved. While we have seen that the technology (TMA) has facilitated the registration process and the coordination of work practices by reducing the level of missing information to some degree, we could see that there could be some opportunities for the technology to account for the more immaterial mechanism of interaction [7] presented in our study. Hence, we propose a couple of design recommendations for future design of handover tools to support orderlies’ work practices.

First, it would be important to integrate the orderlies’ previous experience with patients in the interface of the application to promote and sustain both the patient and orderly comfort with the upcoming task. In particular, our study shows the importance of patient contact in everyday interaction. We have seen how the orderlies engage in different types of comfort work [44] trying to minimize or prevent discomfort during the handover tasks, in particular during patient mobilizations. In this case, the technology could first enable the task requester (e.g., nurse) to register the complexity of the upcoming task, as well as inform and make the orderly aware of this complexity and the patient condition through the interface in advance. If the orderly considers that he needs assistance with the upcoming task, the application should enable the orderly to request assistance from either a colleague (from the flying group or another department) or a nurse that has previously been in contact with the patient. While requesting a task, the technology should also enable the task requester or nurse to register a direct assistance (e.g., by the nurse) for the upcoming task whenever possible (if anticipated), and make this visible to the orderlies. When the assistance is coming from someone who has not yet been in contact with the patient, it is important that the dedicated orderly introduced the new face to the patients. Following some of the actions and interactions involved in the “getting to know a stranger and walking with another” process [26], might help lessening the impact of a new face during the handover task in case of dirty work. Having displayed the prior
experience of the orderlies in the interface of the application might also help the orderlies with the prioritization of tasks when they know in advance that any of the upcoming tasks is related to a known patient. Overall, our findings suggest that CSCW tools that aim to support handovers within and among clinical and non-clinical personnel should be designed to enhance the patient contact and minimizing discomfort between orderlies, patients, an other members of the care network.

Similar to nursing practices [14], the coverage of orderlies’ work moves from a continuous to a cross coverage form especially during peak hours increasing the number of intra non-clinical handovers. As evident in our study, flying and dedicated orderlies engage in different negotiations (“selling tasks”) making alignments between different tasks and artifacts to get the work done. At the moment, TMA only keeps track of all unassigned tasks and the orderly’s currently booked task. Considering the good intentions among orderlies to help each other, the orderlies’ overview could be enhanced not only by displaying the history of tasks (to find out who needs help), but also actively promoting the action of “selling tasks” among their colleagues. A strategy to explore could be making the action of “selling tasks” more fun and engaging through the use of gamified elements [17] in the interface. Implementing simple game design elements in the orderlies’ overview such as a leaderboard (showing the number of handover tasks that have been referred to each orderly) or a weekly badge (showing the more helpful orderly) can encourage the orderlies to keep helping each other during the peak times.

Future work on our side is to investigate how gamified elements [17] can support the work practices of orderlies in a complex non-game context such as the hospital. We will also investigate how the orderlies achieve overview of the situation at hand by exploring different ways to account for mobile and temporal aspects of orderlies’ work in the interface. We are also interested in investigating how this application is appropriated and integrated into the overall hospital infrastructure and the workarounds performed by clinical and non-clinical personnel to get their work done.

CONCLUSION

In this paper we describe and characterize the work that orderlies do with particular attention to handover situations. Understanding these handover situations is key in designing CSCW systems that can facilitate the active role and logistical work of orderlies in relation to the overall health information infrastructure. Based on our empirical material collected before and during a pilot study of a task management application, we characterize the different types of handovers that take place as part of the orderlies’ work practices, namely: clinical to non-clinical handovers, non-clinical to clinical handovers and lastly the intra non-clinical handovers. Furthermore, this paper discusses the importance of sustaining the dynamics of handover tasks among clinical and non-clinical personnel, to avoid potential breakdowns and delays in the orderlies’ work. Our study shows the importance of patient contact and how prior experience with a patient could also promote the collaboration between clinical and non-clinical personnel. We also discuss how the orderlies’ task overview can serve as an important infrastructural entity of the hospital information infrastructure.

To our knowledge this is the first study that explicitly focuses on clinical and non-clinical handovers. Our findings suggest that system design should account for these types of handovers when designing and implementing handover tools to support orderlies’ work practices. We provide a couple of design recommendations that account for the immaterial mechanisms of interaction such as orderlies’ prior knowledge of the task, the patient, the patient contact and the good intentions of the orderlies to help each other. The handovers, issues and recommendations reported in this paper are far from complete and we encourage designers and researchers to further explore and support handover situations towards the design of CSCW systems and tools that support these events during patient care.

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