

Nurse Usage of HIS to Coordinate Work across Shifts

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Abstract

To provide continuous patient care, nurses rely on various forms of Health Information Systems (HIS) to coordinate work across shifts. While these technologies are critical for the quality of patient care, we know little about the practical challenges nurses face in making use of them when distributed across shifts. Against this backdrop, we used a social-technical design perspective grounded in organization theory to investigate how nurses used a HIS to support coordination across work shifts. We collected data by interviewing and observing nurses in their everyday work. Our analysis reveals interesting differences in how technology supported coordination, partly because of the specific coordination challenges nurses faced and because of nurses' perception of the HIS as an enabler of coordination. We contribute to the literature on nursing in the context of work shifts with empirical insights into and a conceptual framework for studying nurses' use of HIS across work shifts.

1. Introduction

Shift work has increasingly gained attention within both academia and institutional life. Work shifts represent a particular work arrangement and are increasingly important to organizations. A growing number of industries experience a trend toward this type of work arrangement, often referred to as the 24/7 society [13]. Retail and service organizations increasingly adapt to expanding opening hours and 15% of full-time employees engage in this type of work arrangement with more than half of these as the standard in their industry [34].

For the healthcare industry, shift work is the traditional way to provide care to patients. Patient care often requires a continuation of the care process not only between healthcare institutions, but also between work shifts. Shift work creates the need for nurses to coordinate the care process across shifts as patients often remain in the hospital beyond a single shift. To

provide continued care, nurses deploy various forms of Health Information Systems (HIS) to support the coordination of their work both within and across shifts. By using HIS, nurses can transfer critical patient information in a standardized manner to deliver care and increase care quality. However, using HIS to coordinate and share critical patient information remains a challenge, particularly across work shifts. The temporal separation of nurses providing care to the same patient increases the challenge of coordinating the different sub-tasks in the care processes and it makes the use of HIS compulsory in order to guarantee patients receive the best care possible. Another challenge relates to the input and update of critical patient data. The temporal dimension requires a common understanding of how to input and update the HIS. Misuse and refraining from updating can have great implications on the quality of patient care and satisfaction as the temporal separation renders it difficult to consult nurse colleagues from previous work shifts. To advance knowledge about these important challenges, we draw on literature concerned with shift work and how coordination of nurses' work unfolds through technology. As we show in the following section, shift work affects every aspect of a person's life engaged in this type of work arrangement. Against this backdrop, we investigate the question of how nurses support coordination across work shifts through HIS.

In conducting our study, we relied on a social-technical design perspective grounded in organization theory. We adapted models and concepts from Galbraith (1995), Mintzberg (1983), Leavitt (1965), and Malone and Crowston (1994) and focused on four interrelated elements, namely *task*, *people*, *coordination*, and *technology*. We followed an exploratory case study of one emergency department unit in a mid-sized hospital in Denmark. Our data collection included interviews and observations and helped us reveal interesting insights into how a HIS supported nurses in coordinating patient care across work shifts. As sub-task interdependencies were high, nurses perceived the HIS as an enabler of coordination

within day shifts. Here, nurses divided sub-tasks among them with care provision as a team effort. *Across* work shifts, sub-task interdependencies remained high, however, the perception of the HIS as an enabler of coordination diminished. Here, nurses consolidated sub-tasks and worked more independently in the care process. As a result, the HIS was perceived as just another tool offering some functionality to support coordination.

We structure our paper as follows. First, we account for the literature concerned with shift work and coordination of healthcare professionals' work through technology. Second, we present the theoretical framing we relied on in this study. Third, we describe our research design and the methods we applied to collect and analyze data. Fourth, we present our findings related to nurse work coordination through the observed HIS across work shifts. Fifth, we discuss our results in relation to extant literature, highlighting our contribution to theory and practice.

2. Literature background

The literature on shift work offers different streams with foci ranging from the organization of shift work [14] and the particular terminology used to the description of concepts such as work hours [4] and work shift [2] through particular scheduling practices [14, 21]. A prominent stream in the shift work literature relates to the impacts such work arrangements have on people and performance. Numerous studies investigated the impacts of shift work on social factors including job satisfaction [33], psychological factors such as burnout [20] or fatigue [19], and physiological factors such as cardio-vascular diseases [5, 22]. The sheer number of these studies indicates the importance of understanding the many and severe impacts of this type of work arrangement. As a result, we base this research on the assumption that providing continuous patient care beyond a single work shift challenges the way nurses coordinate work across shifts through technology.

A prominent example of coordination technology for nurses in work shift arrangements is electronic white boards. The literature suggests that electronic white boards can enhance the coordination of care provisioning. For example, Wong et al. (2009) state that electronic white boards enhance nurses' coordination by offering access to patient critical information in a timely manner and supporting a quick identification of healthcare professionals assigned to individual patients [36]. Aronksy et al. (2008) suggest that electronic white boards support overall emergency department coordination. Their study found that

electronic white boards support effective communication both within and outside the emergency department [1] as an indication of enhanced coordination through technology.

Focusing on coordination across work shifts, a related stream of literature deals with transitional care and coordination challenges associated with it. Transitional care deals with the coordination of the continuation of the care process between different healthcare institutions or different levels of care within the same institution [12]. Coleman (2003) suggests requirements of technology to facilitate the transition process, including the incorporation of patients' and healthcare professionals' needs and preferences, patient critical information such as medications, physical and cognitive function, and administrative patient-centric information such as contact information [10]. Cipriano et al. (2013) agree that technology can facilitate the transition of care and the coordination of such. For coordination to be effective, some underlying requirements must be addressed. Technology needs to reflect the coordination process as a team effort and needs and preferences of healthcare professionals have to be considered [7].

Some studies state that patient transitions happen unexpectedly and are urgent in nature [11], rendering transitional care and technology requirements more challenging. Other related concepts such as handoffs, however, are treated as more planned and not unexpected events during the care provision process. These events deal with the transition of patient information from one healthcare professional to another, including a transfer of either control over or the responsibility for the patient [9]. Handoffs can be seen as a coordination mechanism between work shifts [8] and literature on the handoff process suggests that technology can support the coordination process between shifts. Staggers et al. (2010) investigate nurses' use of technology in the process of handing over patients at the end of work shifts. Their results suggest that for technology to be used as an effective tool to transition from one work shift to the next, it needs to incorporate context-specific information, the integration of information across technologies, and it has to provide support throughout work shifts [31]. Similarly, Tang and Carpendale (2007) investigate the information flow during the handoff process. The authors show that nurses use a variety of technologies in this process to transfer information back and forth between personal and common information spaces and support task execution [32]. Bernstein et al. (2010) suggest that a technology can minimize risks associated with transferring patient information and responsibility from one shift to another. Engesmo and Tjora (2006), however, suggest that technology-

supported handoff processes may have negative practical implications as compared to personal interactions and that nurses' perception of the audience for whom critical patient data was recorded changed [15].

To the best of our knowledge, however, we lack explicit and detailed insights into nurse work coordination through HIS across shifts. Studies investigating technology-supported coordination in a healthcare context omit individual work shifts and implicitly assume one overarching care provision process. Coordination through technology across work shifts has not yet received attention to advance our knowledge in this area. The most obvious reason for this is that the unit of analysis of studies on the use of HIS do not include variations across shifts. Wong et al. (2009) was the only study we could identify that touched upon technology-supported coordination during different work hours, implicitly including across work shifts considerations. The authors discuss that healthcare professionals may achieve coordination through the use of an electronic white board and add the example of huddles in night shifts [36].

3. Analytical Framing

To conduct our study, we adopted a social-technical design perspective grounded in organizational theory. Focusing on four classical elements, namely *task*, *people*, *coordination*, and *technology*, we argue that nurses perform distinct but interdependent tasks, which then have to be coordinated to result in appropriate overall patient care. In order to support the coordination between the individual tasks, nurses use technology.

We found inspiration in Galbraith (1995) and Mintzberg (1983) and adapt their concept of task and coordination in investigating how nurses support coordination across work shifts through technology. Both authors address how work can be divided into tasks and how coordination unfolds to coordinate these tasks to reach a stated goal [16, 29]. We define task as a piece of work that has to be done and which contributes to an overall goal or activity in the organization [25]. In our context, the tasks in the care process relate to patient admission, patient treatment, and patient discharge. We define coordination as the organization and interaction of independent pieces of work [25, 27]. These independent pieces of work must be effectively coordinated to reach a stated goal.

We further adapted the concept of people and technology by Leavitt (1965). We focused on people, as it supports us in studying human actors within an organization. In our case, we focused on nurses' use of

a HIS in an emergency department unit. To include a more contemporary approach to technology, we found inspiration in Burton et al. (2015). The authors introduce systems, which may be computer-based and provide meaningful information [6]. Figure 1 illustrates the model we used to analyze our data.

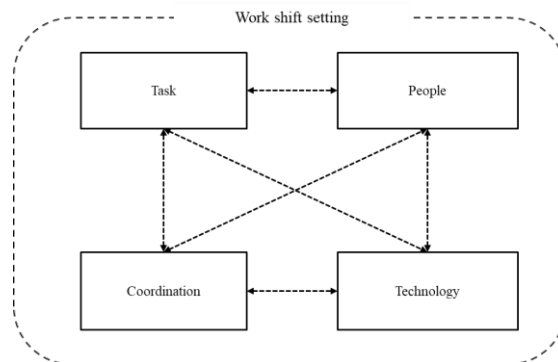


Figure 1: Data analysis model.

Konsynski and Stohr (1992) adapted the model by Leavitt (1965) to fit an Information Technology (IT) context and outlined the organization's *environment* as a crucial element in studying IT [23]. To account for the context in which we conducted our study, we included *environment* and adapted it to shift work.

4. Research Design

Our research followed an exploratory single case study design [1, 2] to investigate how nurses support coordination through a HIS when distributed across work shifts. As we outlined above, we lack explicit and detailed insights into this topic. We therefore opted for a qualitative method as it is particularly helpful when exploring an emerging issue [1, 3, 4] as well as enhancing in-depth understanding of the events taking place [28].

Our study took place in one of two emergency department units of a mid-sized regional hospital in Denmark. The hospital is equipped with about 340 beds, employs around 2,300 full-time employees, and discharged more than 51,000 patients in 2016 [17]. The services offered span over 20 in- and outpatient departments and associated sections and clinics [18]. The unit is the entry point for the majority of patients to the hospital. Nurses in the unit occupy different roles assigned to them at the beginning of each work shift and work in teams of two. One nurse occupies the role of coordinator responsible for the patient flow through the unit by managing nurse teams and their workload. Data collection took place from October

2015 through July 2016 and included interviews and observations.

Interviews. We included permanent nurse staff, as nurses were the principal users of the HIS. The selection process to find interviewees took place in cooperation with the head nurse of the unit. We selected interviewees based on two criteria. First, individually nurses had to work a minimum of two work shifts. As we were interested in coordination through the HIS across shifts, we needed to cover all work shifts. Second, together nurses needed to occupy all nurse roles. In total, we conducted 16 semi-structured [24], in-person interviews, which lasted approximately one hour. Questions asked revolved around three main topics. The first topic concerned a particular work shift. An example of questions asked included “*With whom do you work together during your [day, evening, night] shift and how does that collaboration look like?*”. The second topic aimed at investigating how coordination unfolds. Here, questions revolved around information gathering and sharing. Examples included “*How do you communicate and coordinate with others?*”. The third topic dealt with the use of the HIS and interaction with other technologies. Examples of questions asked included “*How do you generally use the [HIS] as [nurse role] during [day, evening, and night] shift?*” and “*How do you collaborate with your colleagues using [the HIS]?*”. We tape-recorded all interviews and transcribed them for later analysis resulting in about 290 pages of transcribed interview data.

Observations. As for the interviews, we included permanent nurse staff and followed the same selection process and criteria for identifying nurses to observe. We conducted about 65 hours of observations, where observation periods mirrored an eight-hour work shift as either day, evening, or night shift. We followed a participant-observer approach with moderate participation [30] and took on-the-spot notes during each observation period. On-the-spot notes yielded about 23 pages of transcribed observation data.

Other data sources. To gain a contextual understanding, we supplemented interviews and observations with internal documents available to all regional hospitals outlining guidelines and instructions of daily operations, processes, and structures. Nurse role descriptions are an example hereof.

Technology. We focused on a specific HIS deployed in the unit. The HIS provides essential patient and staff information, treatment processes and plans, and facilities. It offers a real-time overview of patients and their progress in the treatment process, a communication tool, and a hospital-wide platform to coordinate patient relocations across the hospital. Screens displaying the HIS hang in one dedicated room

in the unit to which only healthcare professionals had access authorization. Figure 2 shows an exemplary patient overview from the HIS.

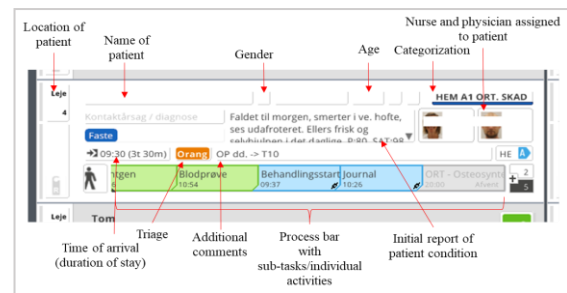


Figure 2: Patient overview.

As depicted, besides basic patient information such as name, gender, and age, the overview offers an initial report of the patient’s condition. It further shows the nurse and physician assigned to the patient, the location of the patient in terms of room and bed, the severity of illness as triage, and the patient’s arrival time. The categorization field shows the type of patient such as surgical or medical and a field offers space to add additional comments. The bottom of the overview displays a process bar showing the progress of the patient in the treatment process. Nurses can use pre-defined activity sets as well as manually add one in the process bar. Colors indicate whether an activity is planned, in progress, finished, or delayed.

Data analysis. To code out data, we transcribed all interviews, digitalized all field notes from our observations, and used NVivo 11 Pro. We based the data analysis on Miles and Huberman (1994) and used the four elements from our model above as initial codes, adding both the nurse role and the observation period (see Figure 1). Our coding approach was inclusive, and the coding process was iterative in nature. Additional codes emerged through the coding process and we applied check coding [28] to increase reliability. Besides the contextual knowledge of observation periods and role descriptions, we specified the element of *task* by distinguishing between *patient admission, treatment, allocation, discharge, and other work processes*. We further specified *coordination* by distinguishing between *within unit, across unit, and shift change* to capture events taking place in the overall coordination process. For *technology*, we further distinguished between the *HIS and other technology*. We added *offline usage and desktop* as codes to the HIS. To interpret the relationship between the four elements and outline how nurses support coordination through the HIS when distributed across work shifts, we sorted all quotes and events according

to the individual elements, work shifts, and role descriptions.

5. Results

In this section, we present our findings of how the HIS supported nurse work coordination across shifts. We follow the same structure as in our data collection and divide the section according to work shifts. The first part of the section presents findings related to day shifts. We include evening shifts as the second part for the sake of completeness. As we present below, evening shifts mirror day shifts with the only significant difference in number of nurses at work. The third part presents the findings related to night shifts. As we outline below, our findings show an interesting aspect right before transitioning from night to day shifts. We present these in the fourth part.

Day shifts. Within day shifts, two aspects were prevalent in how the HIS supported nurse work coordination. The first one relates to nurses' perception of the HIS. Nurses perceived the HIS as an enabler of coordination, supporting them in providing care to patients. Updates in the HIS happened frequently and in a timely manner. Prioritization to update resulted from high sub-task interdependencies in the care process and teamwork in which two nurses formed a team. Within a team, each nurse took on specific sub-tasks. The HIS supported them in coordinating the different sub-task both within and across teams. Within-team coordination was supported by offering an overview of the patients assigned to the team and visualizing the progress of the care process. Nurses were able to better arrange their work and anticipate the team's workload. Across teams, coordination support related to the visualization of patients' severity of illness by displaying the respective triage color. Nurses gained a more detailed overview of the workload across teams and the unit. As a result, they were able to better anticipate the overall workload of the unit and thus provide the delivery of care. The frequent and timely updates in the HIS also supported the coordinator in managing the patient flow through the unit. The coordinator was able to make more-informed decisions about which nurse to assign to patients and allocate a location to newly arriving patients by considering the circumstances of the patients' illness.

The high sub-task interdependencies and the perception of the HIS as an enabler of coordination had the effect that the HIS became a compulsory tool to support coordination within and across teams. Nurse colleagues expected colleague nurses used the HIS as a support tool, which constantly reinforced its use.

The second aspect relates to the specific coordination challenges nurses faced within day shifts. Besides the high sub-task interdependencies in the care process, coordination unfolded in a vertical-command fashion in which the HIS provided a structure and control tool for coordination. The work arrangement of nurses in teams of two and a single nurse coordinator required a highly structured approach in coordination within and across teams. Within teams, one nurse assumed responsibility to exercise vertical control to assure a structured approach to the execution of sub-tasks and coordination of these. Here, the visualization in the HIS of both the progress of the care process and the assignment of patients to nurse teams acted as a control to assure progress in the care process and the quality of care. Across teams, the coordinator exercised vertical control by deciding which nurses would receive newly arriving patients. The HIS supported the coordinator by providing a tool to structure the care process and control for the execution of it by visualizing the progress of the care process.

Evening shifts. As mentioned above, evening shifts mirrored day shifts, both in how nurses perceived the HIS as an enabler of coordination and in providing a structure as well as control tool for coordination. The main difference between day and evening shifts related to the number of nurses at work. Fewer nurses staffed evening shifts; however, the work setup with structural division and teamwork remained the same. A minor difference related to team boundaries. Between-team boundaries loosened, and nurses would occasionally work across teams and consolidate sub-tasks. They would not share the workload of some patients, but independently provide care. These instances would only occur when the number of nurses be insufficient to provide care to all admitted and newly arriving patients. However, nurses' overall perception of the HIS as an enabler of coordination and as a structure and control tool remained.

Night shifts. Within night shifts, the support of the HIS to coordinate nurse work diminished. This did not stem from a change in functionality in the HIS, as it remained the same without any changes. To coordinate the different sub-tasks in the care process, nurses still had the visual representation of the patient and the process bar available (Figure 2). The diminishing in the support stemmed from nurses' coordination needs. Coordination needs reduced significantly within night shifts, partly because of a change in nurses' perception of teamwork and partly because of the consolidation of sub-tasks to a single nurse.

Within night shifts, nurses formally still worked in teams of two. However, the significant reduction in the number of nurses at work resulted in them practically working in one large team consisting of all nurses at

work. As a result, the unit's overall coordination needs reduced, while sub-task interdependencies remained high. The coordinator joined the team incorporating additional responsibilities of a regular ward nurse and participated actively in the care provision process. As a result, vertical control changed to horizontal control. As compared to the day and evening shifts, the HIS only provided a restricted structure and control tool for coordination. Formally, one nurse occupied the role of the coordinator; however practically, the other nurses would take over the responsibility of the coordinator occasionally and act accordingly. This was particularly evident when a new patient arrived. Patient reception followed a more ad-hoc approach than a coordinated one. During patient reception, the HIS provided only limited support. Nurses still had the initial reports of the patients' conditions available (Figure 2), but updates of the process bar only occurred randomly. Random updates mostly related to which nurse received the patients and setting up pre-defined activities set in the process bar.

The second reason for reduced coordination needs was the consolidation of sub-tasks. Sub-task interdependencies remained high within night shifts, but structural division was no longer given. Instead of sharing the workload, night shift nurses consolidated sub-tasks and performed them independently. As a result, coordination needs resided in the individual nurse rather than across nurses. Additionally, the unit's work setup included the omission of certain sub-tasks such as extended patient treatment, relocation, or discharge depending on patients' conditions.

These two aspects led nurses to perceive the HIS as a tool offering only some functionality to support coordination. Nurses reverted to a simpler form of coordination support such as notes, or they did not use any support tool, since they were able to coordinate without any specifically spelled out information.

End of night shifts. Nurses' perception of the HIS as an enabler of coordination returned right before the end of night shifts. The work setup of the night shift remained, but nurses started to update the HIS. Two aspects motivated this change in perception. The first one related to the coming shift transition process. Nurses knew that the formally assigned coordinator was dependent on updates in the HIS to hand over patients to the incoming day shift nurses. The coordinator would use the HIS as a visual support to inform the incoming coordinator of the day shift about the patients' treatment progress during night shifts. The day shift coordinator could then assign incoming nurses to the patients and anticipate workload of the individual teams so that care provision could continue. The second aspect related to the need for information of incoming day shift nurses to continue care

provision. As a result, it was the information needs of incoming day shift nurses and not the coordination needs of nurses in the night shift that drove the perception of the HIS as an enabler of coordination. As within day shifts, the HIS became a compulsory tool to use right before shift transition.

6. Discussion

Our results show that across work shifts, nurses changed perception and usage of the HIS. Their perception transitioned from being a support both within nurse teams and across in the course of coordinating sub-tasks in care provision to just another tool nurses had available. Teamwork and the structural division as well as vertical control changed during a 24-hour period resulting in this transition process. This is attributed to changes in nurses' coordination needs in the care provision process across work shifts. Coordination needs travelled through three distinct phases. The first phase related to day shift coordination needs in which the structural division of work and the high sub-task interdependencies require a high level of coordination, both within nurse team as well as across. Nurses perceived the HIS as an enabler of coordination. Updates happened frequently and in a timely manner allowing nurses to get a visual representation of the care provision progress, the nurse teams at work, and the workload of the teams. This is in line with previous studies on technology support of coordination. By offering access to patient information and a quick overview of assigned healthcare professionals, technology can enhance coordination [36]. The perception of the HIS as an enabler of coordination is also in line with previous studies on coordination. By offering a pre-established mechanism for coordination, the HIS provides coordination support in a context of high sub-task uncertainty and task interdependency. Taking the size of the nurse staff during day shifts into account, our findings are in line with previous studies [35] and show the use and perception of the HIS as an impersonal coordination mechanism, where hierarchy was established through teams in which sub-tasks were strictly divided among team members.

An interesting aspect is the HIS becoming a compulsory tool. The perception of being an enabler of coordination motivated nurses to use the HIS. As the unit deployed teamwork as a means of arranging nurse work, the use of the HIS by one nurse in a team created pressure to use for the other. In that, to use the HIS as a coordination tool was difficult. Potentially, conflicts within a team could arise, if a team member refrained from using the HIS. In a healthcare setting, where

technologies are critical for the quality of the care provision process, consequences of disuse could be detrimental for the care quality and thus patients. The same holds true for across nurse teams and shifts. Non-use of the HIS by a team could lead to potential conflicts with other teams and result in a decrease in the quality of care. A potentially even greater conflict would arise, if nurses refrained from updating the HIS right before shift change during night shifts. The incoming day shift nurses would be inadequately equipped to continue care provision and the risk of having to recommence the entire care provision process would be high.

The second phase related to evening shifts where coordination needs began to fluctuate. As evening shifts mirrored day shifts in its work setup, coordination needs were mostly high. However, between-team boundaries loosened and challenged nurses' perception of the HIS as an enabler of coordination. Nurses' dominant perception entitled the HIS as an enabler; however, the fluctuation in coordination needs challenged the perception of it. Evening shifts represented more transition periods between how the HIS supported coordination.

The third phase related to night shifts. The perception of the HIS changed to being just another tool offering some functionality to support coordination. Coordination needs were at a minimum as nurses consolidated sub-tasks and executed them independently. Sub-task interdependencies remained high, but due to the consolidation of sub-tasks, nurses' needs to support coordination diminished. In addition, teamwork was perceived differently, where all nurses practically work in one large team containing all nurses at work. Previous literature shows that high task interdependency leads to the use of a combination of coordination mechanisms [35]. Nurses during night shifts, however, refrained from using the HIS to support sub-tasks coordination as the consolidation of these diminished coordination needs. Further, in line with previous studies the reduction in the number of nurses and change in team structures during night shifts led to more personal coordination mechanisms and horizontal control [35].

Across work shift, the teamwork aspect is crucial to continue care provision. To optimally support coordination, IT needs to incorporate care provision as a team effort [7]. Our study shows that the perception of teamwork changed across work shifts and resulted in a change in how the HIS supported nurse work. Nurses went through being a part of a team within day shifts to transitioning through being in a team, but also occasionally work independently within evening shifts through performing sub-task independently within night shifts. The HIS incorporated the teamwork effort

in its functionality to support effective coordination of the care process; however, the change in nurses' perception of teamwork across shifts rendered the HIS to being just another tool offering some functionality. Another interesting aspect in this transition is the period right before the shift change period from night to day shifts during which night shift nurses reverted to perceiving the HIS as an enabler of coordination. It can be seen as another phase nurses' coordination needs travelled through. Nurses during night shifts updated all patient information in the HIS right before shift change. This action represents a preparation for the actual shift change, so that the HIS could support the handoff process of patients from the night shift nurses to the day shifts nurses. Using the HIS to support shift change is in line with previous studies [31]. As this behavior was not visible during other pre-shift change periods, the update of the HIS right before shift change could also be seen as a particular coordination need. The night shift nurses acted as a mediator between the different coordination needs of night shift and day shift nurses. The change of perception of the HIS as an enabler of coordination right before shift changes did not stem from night nurses' needs and the benefits they would receive by using the HIS, but by the anticipated coordination needs of day shift nurse. In all phases, the support of the HIS to coordinate nurse work differed, partly because of the specific coordination challenges nurses faced and because of nurses' perception of technology as an enabler of coordination.

Limitations. Our investigation is subject to two prominent limitations. The first one relates to the choice of research design. We followed an exploratory single case study approach in our investigation deeming the approach adequate due to the emerging character of our research topic. We outlined that this pertains to our investigation as we outlined the importance of looking into how nurse support coordination through technology across shifts both from a practice orientation as well as grounded in literature. However, using an exploratory single case study approach brings into question the generalizability of our findings and to what extend these hold across cases.

The second limitation relates to the choice of participants of the study. As we only included principal users of the HIS, the questions arises how other users affect coordination support.

Implications. From a research perspective, further investigations need yet to be conducted. Generalizability calls for further investigations to strengthen our results and enhance understanding of the underlying mechanisms supporting coordination through technology across shifts. Theoretically, our study challenges our understanding of how technology-

supported coordination unfolds. The motivation to use does not only stem from the user's own perception of or need to use the technology, but is also driven by the behavior of other users.

From a practical perspective, our results call for hospitals to be aware of their work setup across shifts in which the demand for coordination may vary and thus result in technology being just another tool to offer coordination support.

7. Conclusion

We investigated how nurses supported coordination through a HIS when distributed across work shifts in an emergency department unit of a mid-sized regional hospital in Denmark. We collected data by interviewing and observing nurses in their everyday work and supplemented with internal documents to gain a deeper contextual understanding. Our results reveal interesting difference in how a HIS supports coordination across work shifts. These differences stem from two factors. The first factor relates to nurses' perception of the HIS as an enabler of coordination. As nurses worked in teams of two during day shifts and assign certain sub-task to each other, the HIS supported them in coordinating these sub-tasks so the overall aggregated task of care provision was performed as a team effort. During night shifts; however, the work setup required nurses to consolidate individual sub-tasks. A nurse was responsible for the care provision process of a patient and performed sub-tasks independently, challenging the perception of the HIS as an enabler of coordination. Across work shifts, nurses faced the particular challenge of having to share critical patient information to continue the care provision process for patients admitted beyond a single work shift. In the course of a 24-hour period, the perception of the HIS ranged from being an enabler of coordination to being just another tool offering some functionality to support coordination.

The second factor relates to specific coordination challenges nurse faced. The work setup of nurses into teams and structural sub-task division within day shifts resulted in the perception of the HIS as a structure and control tool. It supported nurses in coordinating the different sub-tasks as well as exercise control over colleague nurses to ensure care provision. Within day shifts, the perception of the HIS as a structure and control tool dominated. It changed, however, within night shifts. The work setup required less coordination among the individual nurses as coordination needs resided within each nurse.

In summary, the HIS experienced a transition from being an enabler of coordination and a structure and

control tool to being just a tool offering some functionality to support coordination.

With our study, contributed to the literature on nursing in the context of work shifts by applying organization theory to this particular context revealing insights into how nurse work coordination is supported by technology. We further offered a framework for studying nurse work coordination across shifts.

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