

# What Teams Need to Be Clear about – an Activity Theoretical Perspective on Shared Understanding in Health IS Implementation

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**Abstract.** Shared understanding facilitates the implementation of IS and can help to prevent unintended consequences. However, research is hitherto not precise on the kind of knowledge such understanding needs to capture. Taking an activity theory perspective, this paper theorizes that shared understanding needs to cover knowledge, experiences and perspectives on the contested activity systems the HIS is implemented in. Analyzing the data of an in-depth case study, it is found that issues emerging during the rollout can be traced back to a lack of shared understanding about the affected activity systems, particularly to insufficient shared understanding about the instrument-mediated relationships between contradictory motives, rules and the evolved division of labor. These findings are synthesized in a framework on critical aspects of shared understanding. This framework offers a coherent explanation for the rise of unintended consequences and enhances our learning of shared understanding in IS implementation.

**Keywords:** Health IS, Implementation, Shared Understanding, Activity Theory

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## 1 Introduction

Society expects a great deal from health information technology (IT), particularly concerning quality, safety, and efficiency of healthcare [1]. Imagine a hospital implementing a health information system (HIS) to fulfill these expectations. Its management follows the advice of text books and clarifies the problems the IS should tackle, builds consensus, considers various options, chooses an IS that meets its needs, plans implementation carefully, continually involves stakeholders and maintains strong commitment [2, 3]. Nonetheless, after the rollout, unintended consequences such as workflow challenges and resistance arise leading the intended outcomes untapped.

The literature reveals that this scenario is not unique, but that HIS implementation regularly disappoints users and stakeholders [2]. Implementing information systems (IS) that meet the difficulties of the healthcare domain and its various stakeholders is thus a major challenge [4], particularly since HIS must account for numerous social and technical factors that originate in a complex and evolving environment [2, 5]. In this regard, shared understanding enables interdisciplinary teams to implement IS effectively [6, 7]. Such shared understanding involves the recognition of diverse perspectives, resolution of differences in meaning and an agreement on the socio-technical requirements and the role of the IS within the activities it is employed [8].

However, research has to date not precisely worked out the kind of knowledge and experiences that need to be covered by shared understanding, which enables teams to efficiently implement IS and to avoid unintended consequences [8]. To guide design and implementation of HIS that are better able to meet expectations and thus improve HIS implementation outcomes, it is valuable to gain deeper understanding of the aspects of healthcare activities that shared understanding needs to cover. Consequently, this paper aims to contribute to our knowledge by exposing and classifying socio-cultural characteristics of healthcare activities and the various perspectives of stakeholders that need to be recognized and aligned during HIS implementation. Thus, we put forth following research question: *What are crucial aspects of healthcare activities that need to be covered by shared understanding during HIS implementation to avoid unintended consequences?*

To approach this question, we conducted an interpretative case study of an HIS implementation in a large German hospital. Grounded in Activity Theory (AT), we developed initial assumptions about aspects of healthcare activities that need to be recognized, shared, and considered during IS implementation. AT informed our understanding of the elements and complexities of collective activities, the significance of diverse perspectives and the role of HIS as a mediating instrument. The assumptions derived from AT did not only guide data collection and analysis, they were also constantly refined during this process. By means of iteratively interpreting data and refining the theoretical concepts, we could develop a coherent explanation of the rise of unintended consequences that emerged during and after the rollout of the HIS. These explanations then informed the development of a framework, which points to crucial aspects that need to be covered by shared understanding to avoid such problems. Before we lay out our theoretical stance, we briefly point up the complexities of HIS implementation and introduce the concept of shared understanding.

## 2 Theoretical Foundation

Stability and reliability are pivotal in healthcare settings [9]. IS implementation should thus carefully manage change to healthcare activities, which are increasingly complex, contested, highly hierarchical, and multidisciplinary in nature [9-11]. Concerning this matter, prior research identified that embedding generic HIS as “one size fits it all” is reasonably difficult [12, 13]. Rather, the design and functionalities of HIS and evolved practices need to be wisely adapted [10, 14], such that the HIS fits with the socio-organizational context. These adjustments need to span the complete implementation process [15]. Consequently, several literature reviews have identified management and user involvement as critical measures for the design and implementation of HIS [2, 16].

Users, managers and IT professionals need to be aware of individual knowledge that is crucial for the design and implementation of HIS such as knowledge on the capabilities and limitations of the HIS as well as perspectives regarding necessary adjustments to work practices [16]. Aligning HIS and established work practices successfully is thus contingent on shared understanding.

### 2.1 Shared Understanding

Shared understanding is commonly defined as “the overlap of understanding and concepts among group members” [17] and refers to the extent to which a basic understanding of a common subject matter exists [6]. The common subject matter in IS implementation is the creation and adaptation of an IS that is well aligned with existing and emerging practices [6, 18-20]. As our research focuses on HIS implementation, we define shared understanding here as overlapping mental representations of knowledge and experience that allows people involved in HIS implementation to form joint explanations and expectations of the HIS and how it affects healthcare activities.

It is assumed that an understanding of reality is primarily constructed in the mind of the individual by organizing and combining new experiences with existing experiences and knowledge [21]. Thus, there are multiple constructions of reality and “there is no objectively, right understanding on a certain object of interest that matches reality, but rather different conceptualizations that may ‘fit’ reality better or worse” [8]. However, research on shared understanding clearly shows that combining and aligning individual understandings of IT professionals and their stakeholders is important for successful IS implementation projects [see e.g. 6, 18, 19, 20, 22-24].

Shared understanding does not imply that people involved in IS implementation simply accumulate individual conceptualizations of reality. Rather, they need to share their perspectives, negotiate meanings, and agree on a mental representation they want to follow [8]. Moreover, it is assumed that teams hold several mental representations, which are usually framed as task- and team-related models and either cover knowledge on the task, the way the task is approached or the team [8, 25]. Besides these rather broad categories, IS research has hitherto barely worked out the detailed kind of task-related knowledge and experiences that are crucial for effective IS implementation [8].

Though prior research reveals that insufficient fit between the HIS and the socio-organizational context contributes to HIS implementation failures [14], the kind of

knowledge about healthcare activities that needs to be enacted remains unclear. AT provides concepts to analyze collective IS-mediated activities and to approach this gap. AT exposes the interrelations of the constituents of work activities and thus illuminates the socio-organizational context. Hence, AT should help us to understand what needs to be recognized, shared, and considered during IS implementation, particularly concerning the role of the HIS within these activities. Below we offer a brief introduction to AT.

## 2.2 Activity Theory

Although AT is still rather unfamiliar in IS research, it has emerged as an important theory for understanding change of IS-mediated work activity [26]. AT relates the different conceptions of human activities and the material, mental, and social resources through which they are enacted [27, 28]. To frame these relations, AT introduces the activity system as analytical unit that covers how diverse actors work together [28].

The triangular activity system comprises the mutual aim of the activity (the *object*), all the people who are directed towards the object (the *subjects*), cognitive and materialized *instruments* used in activity to realize the outcome more efficiently, explicit and implicit *rules* that govern the work, the way tasks are distributed (the *division of labor*) and the wider *community* of practitioners that revolve and evolve around the object [29-32]. Instruments, rules, and the division of labor empower actors with experience and skills collected in the past, relate the subjects to the community and determine the possibilities and boundaries of their actions [21, 29, 30, 33].

The object as a key concept of AT refers to a physical or cognitive entity that is under construction, moving from a 'problem space' to a result or an outcome [28, 31]. As the "true carrier of motives of the collective activity systems", the object takes shape and acquires its value by being transformed by multiple members of an activity system. Thus, the object is an enduring purpose of the activity and determines individual goals and actions through which, in turn, it may be achieved [31].

Though object-relatedness is a key characteristic of human activity [34], it is not free of contradictions. People frequently perceive difficulties in constructing a connection between the goals of their individual actions and the motive of the collective activity [34]. These problems stem from the multi-voiced and contradictory nature of human activities [31]. AT views activity systems as an accumulation of multiple perspectives, traditions and interests, where the division of labor creates different positions of the participants and the instruments, rules, and conventions carry multiple layers and strands of history [35]. Such contradictions are exemplified by diverse perspectives on the patient who may be considered as a person to be helped or as a source of revenue. Likewise, HIS as one of multiple instruments employed in healthcare activities can be viewed as a resource to provide better healthcare or to generate higher revenues.

Such contradictions within activity systems cannot be observed directly, they can only be identified through their manifestations [36] such as tensions, disturbances, and breakdowns that destabilize activities and reveal inefficiencies [31, 37]. Moreover, contradictions are also viewed as driving change. Building on these ideas, we conceptualize IS implementation as a process of reconfiguring activity systems to

resolve contradictions or mitigate tensions. IS implementation projects are thus only successful, when tensions, disturbances, and breakdowns could have been reduced.

Modifying elements in activity systems also bears the risk of new or amplified contradictions that may surface as unintended consequences. To avoid the rise of unintended consequences, these contradictions need to be identified, considered and proactively approached by means of adequate strategies and measures such as purposeful adaptations to the IS and other cultural historical elements of the activity.

### **2.3 Summary and Initial Assumptions**

Literature shows that effective design and implementation of IS is contingent on shared understanding [see e.g. 6, 19, 20, 23, 24]. However, prior research is not precise on the kind of task-related knowledge, experiences, and perspectives shared understanding needs to cover [8]. Building on the concepts of AT, we assume that the design and implementation of IS not only requires knowledge of individual actions and interactions with the IS, but also of the joint activity the IS mediates. IT professionals, users and stakeholders thus need to share their individual knowledge and perspectives on the system of instruments employed in collective activities and rather invisible aspects such as rules and the division of labor as well as the strands of history they carry.

An understanding that combines divergent conceptions of the historically evolved and contested activity systems, their elements, and interrelations is expected to enable IT professionals and users to identify contradictions and to agree on the role of the HIS within these systems. Such shared understanding will enable them to anticipate and avoid unintended consequences during and after rollout. Vice versa, we expect that significant obstructions of work activities indicate that the people involved in IS design and implementation based their actions on insufficient shared understanding of the contested activity systems. Thus, they were not able to anticipate novel or amplified contradictions and resulting tensions as reflected by unintended consequences.

## **3 Methods**

To identify the aspects of healthcare activities that need to be captured by shared understanding, we decided to take an interpretative perspective and to conduct a single, in-depth case study [38-40]. An interpretive lens acknowledges that people create their own subjective and inter-subjective meanings as they interact with the world [38]. Case studies are capable to provide an ample description and analysis of these perspectives [40]. Thus, the case study approach fits well with exploring crucial aspects of healthcare activities that need to be recognized, considered, and shared in this specific context.

In line with Eisenhardt's [41] recommendation for case study research, we framed our research question in the light of prior research. Moreover, we engaged in an iterative process of considering theoretical concepts from extant literature, developing assumptions about the characteristics of shared understandings, comparing the patterns identified with our theoretical deliberations and enhancing our theoretical perspective [39]. Below, we introduce the case, and describe data collection and analysis in detail.

### 3.1 Research Case

In 2011, a large teaching hospital in Germany with approx. 9,000 employees in 17 clinics and 40 specialist departments started an initiative to gradually implement an IS for care documentation (henceforth CareDoc) at almost all intensive-care stations such as the internal medicine, the gynecological clinic, and the psychiatric clinic. Replacing the former paper-based nursing documentation instrument, CareDoc was intended to enable the wards to comply with external requirements, such as increasing the efficiency of day-to-day clinical activities and optimizing reimbursement. From an AT perspective, the paper-based instrument should be replaced to resolve tensions between the abilities of the hitherto employed instruments and evolving aspects of the object of healthcare activities, particularly efficient provision of healthcare services.

The paper-based care documentation is ward-specific and essentially a large piece of paper. This instrument is used to document basic patient data such as demographics and vital parameters, medications, treatment, and nursing reports. CareDoc replicates and extends these functions as it, for instance, also enables users to enter orders and to manage schedules. Moreover, CareDoc provides interfaces to the hospital's central information system used to manage master patient data and accounting processes.

Responsible for most medical documentation (i.e., data entry), the nurses at the ward are the key-users of CareDoc and thus particularly relevant during requirements-elicitation. This fact is also reflected by the project team responsible for the adaptation and implementation of CareDoc at the wards. The team was led by an IT project manager and supported by two IT professionals and three nurses. The nurses were relieved of their day-to-day activities at different wards to a varying degree (25-75 %).

Depending on the specialization of the clinic, the vendor of CareDoc provided several basic templates that reflect best practices from other hospitals. In the early phase of the project, the project team involved various users, whose task was to learn how the templates need to be aligned with standard processes at the clinics and their wards. The resulting customized templates reflect approx. 80% of the functionalities needed in all clinics. The remaining 20% were identified as ward-specific and were added as customization prior to the rollout at the wards. The customizations were predominantly informed by the nurses. To gather the requirements, a standard implementing procedure was adopted for every ward. First, the project team and the staff at the ward, particularly the nurses, jointly created a specification document that reflects ward-specific requirements. The project team then customized CareDoc accordingly. Two weeks before the rollout of CareDoc on the ward, the users were trained to use the adapted version of CareDoc. During the rollout phase, which lasted about 14 days, members of the project team helped ward staff to implement CareDoc within their day-to-day work and to fix emerging issues. The rollout strategy, particularly the selection of CareDoc and the basic template development, included key success factors noted in the literature: selection of adequate technology, senior leadership, and continuous consultation of key-users during all project phases [2, 3]. Thus, this case gives us the opportunity to identify aspects of healthcare activities that are not easily recognized by best-practice measures, but are critical for avoiding unintended consequences.

### 3.2 Data Collection and Analysis

Data was collected between 11/15 and 03/16 at the addictive disorders ward of the psychiatric clinic. The addictive disorders ward was chosen for two reasons. First, from 2012 to 2015, CareDoc was already rolled out at nine other intensive-care wards. Thus, the project team has gained significant experience and benchmarks concerning the adaptation and implementation of CareDoc. Moreover, they have already refined the templates so that they sufficiently cover most standard requirements. Second, the nurses at this ward were particularly engaged during the requirements elicitation and unanimously agreed on the general requirements so that little problems were expected.

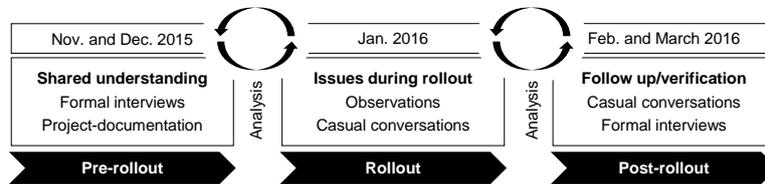
We took the role of an ‘outsider researcher’ during ward-specific requirements-collection, customization, and rollout. We triangulated data sources (i.e., interviewed key-users and project team members, talked to and observed nurses and physicians, and reviewed documents) to safeguard reliability and credibility of the data [39, 42, 43].

**Table 1.** Formal Interviews (approx. 9.5 hours)

<i>Interviewee</i>	<i>Interviews (total length)</i>	<i>Documentation</i>
PT01 (Project Manager., IT professional)	2 (45 min.)	Notes/memorized report
PT02 (Project Team, IT professional)	3 (90 min.)	Notes/memorized report
PT03 (Project Team, nursing background)	1 (40 min.)	Verbatim report
PT04 (Project Team, nursing background)	2 (50 min.)	Notes/memorized report
PT05 (Project Team, nursing background)	2 (50 min.)	Notes/memorized report
NU01 (Nurse at the ward)	3 (110 min.)	Verbatim report
NU02 (Nurse at the ward)	3 (70 min.)	Verbatim report
M01 (Ward Mngr., line manager of nurses)	3 (100 min.)	Verbatim report

The formal interviews were set up as semi-structured conversations [40]. The interview guideline contained open questions about the interviewees’ knowledge and experiences on the affected activities and the role of CareDoc within. The interviews covered all available project members as well as involved key-users as assigned by management (Table 1) and aimed at exposing the knowledge, experiences, and perspectives the key-users and project team members shared. During the interviews, we gathered data on their conceptions of the healthcare activities, knowledge, and experiences regarding conventions and tools that are related to care documentation and that govern actions and interactions between the people involved. The formal interviews were recorded and transcribed whenever possible. Some of the interviewees felt uncomfortable with the recordings. However, during these interviews a comprehensive number of notes was taken and a report based on these notes was prepared immediately after the interviews.

To identify emerging issues and to collect data on the tensions within the activity systems that may cause these issues, one researcher was on-site during rollout (5 days, 9 hours per day) and observed nurses’ use of CareDoc, related outcomes and problems that significantly obstructed work activities. In addition, we conducted a vast number of informal conversations with nurses, physicians, and the members of the project team to gain understanding on the issues we have observed and on underlying tensions. These casual conversations and observations were instantly recorded in the case diary.



**Figure 1.** Iterative process of data collection and analysis

In accordance with the principles of interpretative research, data collection and data analysis occurred in a mode of continuous interplay, such that we were always open and willing to modify our initial assumptions (see Figure 1). One researcher constantly coded the data. The other researcher cross-checked the coding to ensure inter-rater reliability. Once agreement on the coding was reached, we compared, analyzed, interpreted and discussed emerging patterns as a team effort [42]. Whenever our interpretations differed, we went back to the data, theory, and/or the field and discussed the findings until we came up with an interpretation that was plausible for both authors [39]. Data collection lasted until all inconsistencies and gaps were resolved.

Aimed to understand which conceptions of the activities the IT project team and the nurses as key-users share, the first analysis cycle was conducted between the pre-rollout and the rollout phase. After coding the data on the individual conceptions of the work activity (i.e., open coding) [42], the resulting codes were analyzed and categories formed. The categories could have been assigned to an activity system component (e.g., subject or rule) or to a relationship between multiple components (e.g., relation between actors and implicit rules). Next, we compared the findings in each category to identify similarities, connections, and patterns between the individual conceptions.

During the second major cycle of data analysis, we focused on issues that emerged during the rollout and potential tensions between CareDoc and the healthcare activities. To do so, we coded data from the rollout-phase in search for aspects of the activity system that have previously not been shared as well as pointers to underlying tensions. Again, we created categorical codes, compared the resulting codes with the activity system components and assigned them to one of the activity system codes.

Finally, we analyzed the coded data and created a conceptual matrix [42]. For each problem that emerged, the matrix encompassed the aspects of the activity system that were covered by the shared understanding before the rollout as well as our AT-analysis of tensions within the activity system developed in the second cycle. This matrix allowed us to generate an overview of relevant data and to analyze how the emerging problems relate to aspects of the activities of nurses that were not covered by the shared understanding that guided adaptation and implementation of CareDoc.

## 4 Findings

The rollout strategy, including key success factors as noted in the literature [2, 3] helped to adapt CareDoc such that it enables nurses to document relevant data and to comply with standards. Moreover, CareDoc provides management and clinicians data better in

quality (i.e., reimbursement and diagnosis). However, we also observed unintended consequences that emerged during and after rollout. These issues mitigated efficiency gains considerably and provoked resistance. Below, we analyze how these issues can be traced back to insufficient shared understanding of the activities affected by the HIS. We briefly present three of the most apparent unanticipated issues, illustrate the tensions and underlying contradictions, and analyze the aspects that were not covered by the shared understanding, which was developed during requirements elicitation and customization of CareDoc. Table 2 provides a summary of these findings.

**Table 2.** Summary of findings: contents of shared understanding (SU)

<i>Aspects that were covered by SU</i>	<i>Aspects that were <u>not</u> covered by SU</i>
Expected individual performance gains (e.g., documentation, reimbursement)	Contradictory perspectives (e.g., caring for patients vs. documentation quality and costs)
People/occupational groups involved in the activities that are affected by CareDoc	The historically evolved contradictory role of the community (e.g., volunteers and trainees)
The form and function of the formal paper-based documentation instruments and resulting technical requirements regarding types of data-fields, forms, reports, etc.	Additional, ward-specific enhancements of the formal instruments, their role as governance mechanism (e.g., reminder, overview), and the limitations of CareDoc (providing overview)
Legal requirements on healthcare activities (e.g., transparency, authentication, and medication handling)	Interpretation and evolved (contradictory) implementation of rules as reflected by norms, the instruments, and the division of labor

The first vignette refers to the coevolution of the instruments and other aspects of healthcare activities such as handover of tasks and performing medication in cases of emergency. The formal official paper-based documentation templates did not enable nurses to get a quick overview of all vital parameters, medication, and observations of the patients at the ward. To work around these shortcomings, over the years, nurses created and gradually refined ‘monitoring sheets’ for every patient at the ward. These letter-sized sheets hung at the board, enabled nurses to keep track of patients (e.g., in case of emergency and during shift handovers) and offered great flexibility. Data such as vital parameters, adapted dosages or important events were recorded on these sheets before typically trainees or voluntaries updated the formal documentation.

During requirements elicitation, it was decided to replace the monitoring sheets with CareDoc reports. Recording and analyzing data directly in CareDoc should reduce errors and enable early access to care documentation. However, the reports offered were not able to occupy the role of the monitoring sheets sufficiently: the report must be manually activated, is only accessible via the small monitors at the wards and does thus not offer a quick overview. For instance, NU02 stated that “*the monitoring sheets enabled us to overview patients much more easily [...] which is quite important at a closed psychiatric ward.*” Moreover, the reports did not occupy the function of a to-do list and reminder in the way as the monitoring sheets did. In consequence, shift hand-over was considerably obstructed and nurses’ willingness to utilize CareDoc decreased.

Though the tensions between the adapted set of instruments and the nurses began to surface early, the project team, ward mgmt., and physicians were not able to understand

why nurses requested to keep the monitoring sheets until the rollout. Particularly physicians, who presume timely and accurate data, advocated to use the CareDoc reports. This indicates that the project team did not thoroughly consider the role of the monitoring sheets as an important mediator between the actions and interactions of the nurses. Thus, these neglected the historically collected skills that enable nurses to deal with specifics at the wards (e.g., adapting medication, keeping track of patients).

The second vignette concerns medication management at the ward. Legally, nurses are only allowed to administer drugs as prescribed by a physician. Since physicians are frequently not available at the addictive disorders ward of the psychiatric clinic on short notice, however, nurses are in the need to adapt the dosage on their own and get authorization retrospectively (e.g., in case of an acute delirium or when symptoms like restlessness or shivering appear). This well-practiced shift in the division of labor has become an accepted norm at the wards. Since they feel less comfortable setting the dosages without consulting a nurse, physicians even asked if it *“is possible to calculate the optimal dosage within CareDoc”* (observation note).

Though, physicians, nurses, and IT professionals discussed the need for dynamic dosing intervals, customized related forms accordingly and agreed that the dosage could not be ‘calculated’, their shared understanding did not enable them to anticipate that CareDoc considerably restricts the flexibility as given by the paper-based instrument. These historically evolved aspects of the medication activity, particularly the tension between the way tasks are distributed in case of emergency and the legal requirements, were not uncovered during requirements engineering. Neither the nurses shared their knowledge and experiences regarding these aspects, nor did the IT project team point out that CareDoc will increase transparency due to time stamps of physicians’ authorization of medication and nurses’ administration of medication and thus, most likely, limits flexibility regarding medication handling at the ward.

Only during the rollout, the nurses recognized that CareDoc does not allow them to adapt the administration of medications on short notice or to enter up physicians’ authorization after administering adapted medication without causing legal problems and –at worst– risking adverse personal consequences. Awareness of these problems negatively impacted nurses’ attitude towards CareDoc. This even caused some of them to resist using the system until it was clarified how to deal with medication management in cases of emergency.

The third vignette reflects how gradual changes to the object of healthcare affected the division of labor. During the last years, cost pressures, and workload significantly increased at the wards, which stressed the need to gain efficiency. Therefore, the way tasks are distributed was continuously adapted. Amongst others, volunteers and trainees are increasingly asked to measure and document vital parameters. Legally, this must be supervised and authorized by a certified nurse, who also signs the documentation. In practice, however, nurses have not the time to accompany the volunteers and trainees and thus only sign the documentation afterwards.

Due to an IT policy, volunteers do not possess a user account that is required to perform documentation in CareDoc. Thus, after the rollout of the IS, documentation of vital parameters was limited to nurses and trainees. This obstructed the evolved mode of task distribution and increased nurses’ documentation effort considerably. Since they

either need to record vital parameter on their own or must sign recordings of trainees, they had less time to care for patients, which is usually the true motive of their activity (“we spend too much time at the computer and have less time for the patients”, NU01). Moreover, some of the nurses did not want to key in data they have not collected (“I will not key in data that I have not measured”, NU03).

Data collected prior to the rollout reveals that nurses and IT professionals did not share knowledge concerning the nature, history, and significance of the mode of task distribution at the wards and how CareDoc enforces conflicting legal requirements. During requirements elicitation, IT professionals and nurses did not consider how CareDoc could amplify tensions between legal requirements and the division of labor. Thus, neither IT professionals could anticipate that the characteristics of the IT tool would destabilize established ways of doing, nor ward management could clarify roles and responsibilities and thus take measures to mitigate or resolve these tensions.

## **5 Discussion**

The paper-based instrument was found to limit the efficiency of healthcare activities (e.g., documentation quality, reimbursement). These tensions should be resolved by an HIS. Selection of an adequate system, senior leadership and user involvement enabled the project team to adapt the HIS so much that it covers most requirements, particularly those that concern the interactions of individuals with the system. However, as with similar HIS implementation initiatives reported in prior literature [2], the replacement of the legacy tools provoked unintended consequences. These were not anticipated, although the people involved could build upon benchmark data from nine rollouts prior to the addictive disorders ward and templates that are based on best practices from other hospitals. Case study data reveals that IT professionals and stakeholders failed to create shared understanding on critical aspects of the socio-technical environment the HIS is embedded in. The framework presented below summarizes and classifies these.

### **5.1 Crucial Aspects of Healthcare Activities**

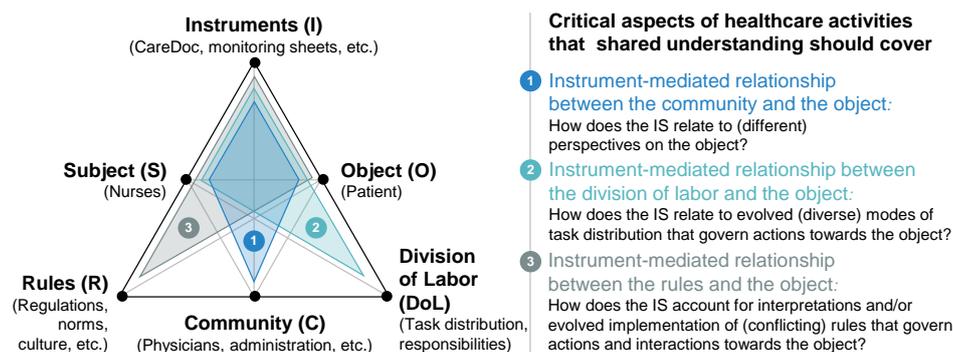
The unintended consequences we have observed indicate that users, managers, and IT professionals had difficulties to share –often– tacit knowledge and experiences related to three characteristics of their collective healthcare activities, particularly those that go beyond individual requirements. Accordingly, they struggled to anticipate how these aspects relate to the novel HIS, particularly how contradictions within the activity systems are mitigated or amplified by HIS implementation. In Figure 2 these aspects are classified (1-3) and located in a triangular activity system diagram (1-3).

The first aspect reflects that healthcare activities are characterized by contrasting objectives (aspect 1). Data reveals that the way the legacy tool and the IS account for different perspectives on the object of the collective activity was hardly considered (e.g., maintaining monitoring sheets vs. entering data directly in the HIS and using the reports). We found that exposing the contested nature of the activities and bearing in mind how the instruments account for divergent motives and thus how they impact the

relationship between professional groups is critical. Creating shared understanding on this aspect would have most-likely enabled actors to anticipate and avoid the issues.

Second, patient care is characterized by a tension between the need for stability and sensitivity for variation [9]. This tension is also reflected in the historically evolved division of labor, which provides stability but needs to be sensitive to variation (e.g., in case of an emergency). Employed instruments need to account for these evolved and diverse modes of task distribution (aspect 2). Thus, actors must ensure that the HIS can govern routines and variations like their predecessors did or adapt the division of labor accordingly (e.g., task distribution between nurses, trainees, and volunteers).

Third, healthcare is highly influenced by regulation and traditional hierarchies [9]. However, evolved practices may contradict these conventions. Since HIS are often designed to comply with formal rules, they have the potential to amplify these contradictions. Hence, people engaged in IS implementation need to recognize, share, and consider explicit and implicit rules that govern actions and interactions between the subject and the community and clarify the role of the HIS within (aspect 3).



**Figure 2.** Aspects of healthcare activities that should be covered by shared understanding

The framework can help practitioners to more carefully consider the complex mediating relationships between instruments, rules, and the division of labor, facilitate the creation of shared understanding on the role of the HIS within and enables them to resolve contradictions without amplifying existing or creating novel ones.

Though awareness of the critical aspects will help, practitioners need to bear in mind that learning about an activity is at large inherent to the participation in an activity [44]. Thus, creating shared understanding might require IT professionals to participate in activities that are or may be affected by the HIS. This will most-likely enable them to better illuminate the aspects identified here, to anticipate emerging issues and to develop corrective actions. Practitioners might employ strategies such as cooperative prototyping, where users and IT professionals are involved [45]. Mutual prototyping may raise issues and shifts questions from subject-object interactions towards the rather invisible IS-mediated aspects of collective activities. Moreover, best-practices and approaches like the “MindMerger” [8] could benefit from methods that put an emphasis on the collective nature of human activity such as “expansive visibilization” does [31].

## 5.2 Limitations

Although this research offers a coherent explanation for the rise of unintended consequences after IS implementation in a complex setting, some limitations need to be acknowledged. First, the empirical data analyzed in this research stem from a single in-depth case study. Thus, it has to be shown if the activity theoretical perspective on shared understanding also explains outcomes in other settings. Second, data about early phases of the project could only be collected retrospectively, particularly regarding the design of the standard templates. Third, the timeframe for data collection was restricted. Thus, the rise of additional unintended consequences after data collection cannot be ruled out. Fourth, the number of interviews conducted is limited, some of the interviewees did not feel comfortable with recordings and only one researcher could monitor the rollout. Fifth, only the three most significant issues that emerged during and after rollout are reported in this paper. Though the analysis of the other outcomes support the conclusions drawn, the theoretical concepts still need to demonstrate their empirical validity [46]. Further research employing multiple and longitudinal case studies in other settings or quantitative studies that operationalize and test the theoretical statements may increase the confidence in the mechanisms identified here.

## 6 Conclusion

We know that effective design and implementation of HIS is contingent on shared understanding [see e.g. 6, 19, 20, 23, 24]. However, our learning on the kind of task-related knowledge and perspectives that need to be shared is limited. Our research contributes to this gap by providing a theoretically grounded framework that captures crucial aspects of healthcare activities that should be recognized, shared, and considered during HIS implementation projects. Moreover, we contribute to prior research by increasing our understanding on the socio-organizational aspects HIS must fit with [14]. We reveal that the people involved in HIS implementation need to create shared understanding about socio-organizational aspects that are not necessarily exposed using best-practice approaches. Following AT, the people involved need to recognize that HIS occupies positions within complex, collective, and historically evolving activity systems [35]. To resolve contradictions within these systems without provoking novel ones, the multiple perspectives and traditions that are carried by its actors, its artefacts, rules, and conventions need to be recognized, shared and aligned.

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