



# Conditioning the work of colleagues: health professionals' explorative work in technology design

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## Abstract

Professional learning at work is related to the opportunities to participate in explorative and constructive practices. Co-designing tools and technologies to support work offers such opportunities, which need to be better understood in the field of professional and vocational learning. As digitalisation initiatives become more ambitious and aim at wider service reorganisation, more professionals from nontechnical domains become involved in the work of designing technologies and developing routines for their practice. This study explores how health professionals participate in the design of a technology for the registration and sharing of patient information across healthcare units in a Norwegian city. Over a year, we observed the design meetings with a team of health professionals and IT developers. The health professionals were mandated this task as part of their regular work to ensure that the way of categorising and displaying patient information would serve the services' needs. The interactions in the design meetings were analysed to examine how categories of patient information were explored and negotiated as objects of design. Our findings show how the team needed to test candidate categories for various contexts of use. This implied both negotiation of future service routines and efforts to reconfigure tasks and responsibilities in multiple service contexts. This work brings extended responsibilities and opportunities for learning to health professionals. We discuss how their decisions are consequential beyond their own workplace as the information system and its categories condition the work of colleagues in the wider service chain.

**Keywords** Health care · Design work · Categorisation · Information systems · Professional learning

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## Introduction

Over the past two decades, researchers in the field of professional learning and development have been increasingly interested in how professional learning at work is intrinsic to changes in work practices and material-semiotic tools (e.g., Lehtinen et al., 2014; Ludvigsen & Nerland, 2018; Mäkitalo, 2012; Markauskaite & Goodyear, 2017). When new tools, such as digital technologies, are introduced, the ways of working are modified, bringing implications for professional knowing and learning. Shifts in technology may change how knowledge is represented, supported and shared among professionals, but also how tasks and responsibilities are organisationally distributed. As digitalisation initiatives become more ambitious and aim at wider service reorganisation, the implications for professionals are not limited to their technology use. Increasingly, professionals from nontechnical domains are involved in designing technologies and developing work routines for their field of practice (Donetto et al., 2015; Hyysalo, 2010). As such, they must actively examine and shape future work practices. These activities and their related learning opportunities should be better understood in the field of professional and vocational learning.

We contribute to this wider agenda by focusing on a specific work context from the health sector, where healthcare professionals (HCP) in a large Norwegian city are involved in designing a system for registering and sharing patient information. These technologies typically come with two aims: coordinating patient services across healthcare units and generating data to monitor and improve the services provided (Bossen & Piras, 2020; Lupton, 2018). As such, they are more than tools that serve to digitise and share information. They are also standardising devices that create order in information flows and coordinate activities across time and local settings. Through their design, such technologies serve to reconfigure the relations between actors, tasks and responsibilities in the wider ecosystem of health care (Monteiro et al., 2013). Since task distribution and routinisation of work processes are implicated by their design, they may imply new conditions for work (Petraiki & Kornelakis, 2016). As noted by Marcu et al., designing health record systems for other service contexts implies accounting for ‘how data are captured and used from various perspectives across the care team, and rearranging workflows with data to provide more opportunities for interpretation and negotiations’ (2021, p. 421). Our analysis aims to enhance our understanding of how professionals become involved in reconfiguring work practices and relations through participating in design processes and how learning opportunities are offered during these processes.

Analytically, we examine the work of constructing categories of patient information and how tensions in this work are negotiated and resolved in design discussions. In this context, categories (for test results, diagnosis, medical treatment, rehabilitation, etc.) are necessary to organise information across work settings, with implications for the coordination of service and treatment. Thus, categories not only store and order information, but they also need to be functional regarding distributing work across environments and flexible enough to take on different meanings in different work contexts (Bowker & Star, 2000); the categories should enact different

forms of knowing and priorities when professionals pursue their various tasks and responsibilities. As objects of design, categories highlight tensions regarding what terminologies and functionalities to use, but also what professional action and future work practices they imply. Here, learning is seen as intrinsic to such challenges and an emerging property of design work as the professionals must explore and negotiate the category properties to move on (Mäkitalo, 2012). Therefore, we direct analytical attention to categories as objects of design and the challenges they create in discussions. We pose the following research questions:

*How are categories of patient information negotiated as objects of design?  
What challenges and opportunities for learning emerge from such negotiations?*

In the analysis, we focus on discussions around the categories used for information on falls and risks of falling among home care patients because fall-related challenges were extensively worked upon by the design team, thus illuminating the complexity when designing for patient information. Although a fall may seem like a straightforward incident to register when an elderly person loses balance, it can actually have multiple known and unknown causes (e.g., tripping on the carpet edge or a result of medical diagnosis), resulting in various severe consequences. For HCPs, a fall may signal underlying problems requiring investigation. At the organisational level, patient falls are expensive and often require hospitalisation and increased health care needs. Better opportunities to monitor patients' fall and fall risks over time were therefore an expressed ambition in the design project.

Our study contributes to research on professional work and learning by investigating how health professionals conducted the design of information technologies as a creative-constructive practice. We show how this work implies a series of category-related negotiations that consider and condition colleagues' work. We begin by reviewing research on related forms of collaborative design work and the potential learning opportunities found in this work.

## **Exploring and negotiating professional concerns in design work: a brief review**

When new routines and changes are introduced in work organisations, employee participation is important as the expressed concerns and suggestions can offer valuable learning opportunities for individuals and communities alike (Valleala et al., 2015). This is also true for designing information systems as they are entangled with work practices and often envisioned to foster change. Acknowledging employee participation and interdependencies with existing infrastructure and work practices, the ways of understanding and conceptualising design processes have therefore expanded in time and space (Monteiro et al., 2013). Simonsen et al. (2020) argued that the here and now of design processes must be temporally transcended by exploring and tracing existing practices to envision and articulate new and alternative relations of future practices. Such design work includes 'understandings of current practices, awareness of the multiplicity of related issues and concerns, and the various

infrastructural scopes involved' (p. 140). This expanded scope implies participation by a wider set of participants.

Project meetings and activities organised in the design process have become a critical arena in which different practices and contexts of use can be accounted for. Scholars have focused on how design projects involve various participants and how prospective users and their work practices are considered in the process. For instance, Bossen (2011) presented how participants' depiction of clinical practice was 'abstracted from actual practice' (p. 489) in the co-construction of a standard. The standard became inadequate when implemented in practice, illustrating some of the pitfalls of representing work in general ways in design processes. Further, Ulriksen et al. (2017) described time-consuming and complex negotiations of professional understandings between clinicians and computer scientists actively contributing to developing standardised elements and clinical concepts of health records. While professional understandings show one type of contextual differences relevant for design, Bardram and Houben (2018) illustrated in their study the differences in usage and information needs of health records across a variety of care units. These studies illustrated the complexity of design work in health care through a variety of contextual understandings. Furthermore, the studies showed how design processes also expand in terms of the scope of participants and settings as the amount of work and contributions needed from participants are recognised.

It follows from the more variegated set of participants and user contexts that design processes are sites for the negotiation of concerns (Andersen et al., 2019) that must be handled in the social interaction of the design team. This often implies learning by exploring, aligning and making mutual adjustments when tensions arise. Several studies have described the challenges implied by such tensions and negotiations. Lundin and Mäkitalo (2017) analysed how health professionals and patients brought in and negotiated various concerns when designing an application for patient-generated data. Their negotiations showed how the participants balanced concerns by taking the position of others in envisioning and preparing for the future use of the application in different contexts of use. Obstacles were also shown to be productive in studying how concerns are handled and aligned. Here, Ros and Grossen (2020) showed which conflicts created progress and stimulated professional learning in an interprofessional team coordinating psychiatric work for persons with intellectual disabilities; the study showed that negotiating tensions revealed underlying contradictions and new versions of obstacles in an iterative manner, which needed to be elaborated on and (re)formulated for the participants to resolve conflicts and make progress. Furthermore, Cerna et al. (2020) showed how the increased use of patient-generated health data generated tensions in categorisation when the professional context of chronic care needs to be aligned with the lived experience of patients. Multiple meanings of categories have design implications as the authors proposed mechanisms in the system for making data reliable through talk. The tensions in collaborative categorisation work and design processes illustrated invoke different concerns and forms of knowledge that need to be negotiated iteratively to progress and account for different future system uses. If design work aims at reconfiguring the distribution of tasks and responsibilities in the service, how a design team

relates to existing routines are critical. This was illustrated in the design process of a health record for capturing students' behavioural data, where reorganising wider workflows was hindered due to a priority of adapting the system to established practices (Marcu et al., 2021). For the design team, this implied more limited opportunities for expansive participation. Thus, the scope and ambitions for change can be important for the learning opportunities offered.

In sum, attending to different user contexts in design work and negotiating the tensions arising form a complex interactional process. Although the participation of professionals was highlighted, they have narrowly focused on how external work contexts and workers are accounted for in team discussions. Our study contributes to research on professional learning and development by exploring what these processes entail and how the negotiation of design solutions also involves conditioning colleagues' work.

## Analytical perspective

Working on categories as objects of design is an explorative practice that implies professional learning. The tensions arising from diverging needs, discourses and contexts of use can cause gaps in understandings that must be acted upon and learned from to progress with the work (Mäkitalo, 2012). Crucial is an understanding of the categories' embeddedness in institutional and professional discourse. Categories are designed to order information and enable the work; they need to be functional in identifying tasks and needs and related to professional discourses and priorities (Bowker & Star, 2000). Hence, institutional categories are the backbone of professional practices; they are socio-materially embedded, activity-tied, accountable means of performing work (Mäkitalo & Säljö, 2002b). This implies that categories are both future-oriented and consequential as they come with certain entitlements and obligations directing the professionals towards certain actions and accountabilities. As coordination devices, categories serve as a locus of work activities from varying contexts, making them multifunctional (Bowker & Star, 2000). Bowker and Star (2000) alluded to the requirement of multirepresentational forms because of the futility of creating unitary knowledge categories. Hence, tensions arise between the need to standardise categories that are stable over time and local settings and still allow for sensible and adaptive use as it becomes a performative element of work in different local contexts (Timmermans & Epstein, 2010). Due to the multifunctionality of categories, their meaning and use are inherently dynamic and contestable; however, the very purpose of standardising information in systems and infrastructure is to stabilise practices and coordinate work that would otherwise be daily contested and negotiated.

In designing technology for registering and sharing patient information, categories are the main object of the design in terms of exploring how to represent and order relevant information for multiple contexts of use. The notion of 'context of use' sensitises our analysis to how categories make sense to participants in relation to different work contexts. With categories as objects of design,

questions of how to represent and order information will not only involve negotiating categories, but will also be potential sites of dispute and negotiation of institutional ways of knowing and reasoning. Billig's (1996) account of how social dilemmas are managed through argumentation is useful in this context since processes of categorisation and particularisation are at the very heart of the matter. Design participants may argue about the relevance of a category by questioning its boundaries (what it includes or excludes). By attending to particular instances of using a category, its relevance and boundary can be justified, but instances of use can also be invoked to contest its relevance, providing a means to argue for alternative categories (Billig, 1996). In discussions on how categories are to be materialised, their boundaries can be tested towards particular contexts of use, to explore how they may function for local purposes. New instances of use can be incorporated, and the category boundaries can be adjusted to fit this purpose or an alternative category can be suggested. Based on such testing of their local use and standard features, categories are worked on as socio-material objects of design, where various concerns are negotiated, balancing inherent tensions in their potential meanings and uses. When candidate categories are negotiated, a design team tests their 'robustness' and checks whether their meaning potentials can be stabilised in ways to function in diverse work settings.

In the analysis, we draw on this dynamic notion of categories to explore how gaps and tensions are negotiated as the design process and team's understanding progress. As categories constitute institutional practices by shaping participants' possibilities for action and ways of working (Mäkitalo & Säljö, 2002a), shifts in their properties can condition the work of colleagues through alteration of work processes. Thus, we analyse how categories are negotiated as consequential for professional practice, which involves envisioning future work tasks, routines and responsibilities in various service contexts.

## Empirical context and methodology

Our empirical case is a design project located in the municipal health service of a large Norwegian city; the project was devoted to developing a system for registering and sharing patient information. It began in 2018 as an initiative from four city districts aiming to increase coordination and the quality of patient handovers between care units. In 2020, the project was adopted by the city's central health agency and embedded in its broader digitalisation agenda. The composition of the core design team (see Table 1) reflects the recognition that such design projects are not restricted to technological design but need to be grounded in—and become consequential for—the services provided. As the project leader stated in one of our conversations, 'As I have said all along, digital development is not the most important issue. Organising the services in a new way is'.

**Table 1** Team members, their professional backgrounds and affiliations

	<i>Role (abb.)</i>	<i>Professional background</i>	<i>Affiliation</i>
<i>Core team</i>	<b>Implementation coordinators (IC1-6)</b>	Nurse or physical therapist	From city districts and rehabilitation centers committed to the project.
	<b>Project leader (PL)</b>	Consultant with engineering background and management experience	Externally hired from a consultancy firm by the Central health agency.
	<b>Developer (D)</b>	Developer with informatics background	Externally hired from a technology firm by the Central health agency.
	<b>Pharmacist (PHA)</b>	Pharmacist/consultant	Nursing home agency. Participated on an irregular basis.

The focus on reorganising services implies new tasks and responsibilities for the design team's health professionals. The design process applied a bottom-up strategy through a continuous design approach, in which parts of the system can be implemented without requiring the solution to be fully developed. Hence, design, development and implementation activities ran in parallel and required the participants to engage iteratively in testing out and developing functionalities aligning with the health services, which also implies learning.

The analysis is based on observations of design meetings spanning one year, from June 2020 to July 2021. During this period, the design work was organised as regular meetings carried out one to two times per week. Because of the pandemic, all meetings were carried out digitally through the Microsoft Teams platform. At the time of writing, the information system was partially implemented in selected healthcare units, while further functionality was being developed and additional units were planning to use the system.

We applied an ethnographically informed approach to study design work as it unfolded in its natural settings (Bjørn & Østerlund, 2014; Luff & Heath, 2019). The data corpus comprised video and audio recorded meeting observations, interviews and talks with key participants and project documents accessed through the project's digital portal. Meeting observations were either video or voice recorded and supplemented with handwritten fieldnotes. Each week, during the data collection period, informal talks were held separately with two key participants on the core team (the project leader and most active implementation coordinator) to deepen our understanding of the meeting discussions in the design project and include their reflections.

The analysis was conducted in several steps. First, we reviewed the entire data corpus and conducted an initial coding of the themes in the meeting discussions. Second, we identified the central categories the team worked on, which showed that issues relating to falls and fall risk were frequent and recurrent topics. We

identified 12 meetings in which these issues were extensively discussed. We revisited the recordings and field notes and identified rich and significant episodes that were transcribed in detail (Derry et al., 2010). Third, these episodes were further analysed to reveal how the candidate categories were suggested and explored and how these were tested by negotiating and accounting for imagined contexts of use. This included object-focused discussions of managing and coordinating courses of action and divisions of labour of organisational tasks (Hindmarsh & Heath, 2000). We focused on the articulation and displaying of professional concerns and knowledge about service routines to each other as negotiations-in-action unfolded in the team's interaction (Hall & Stevens, 2015; Jordan & Henderson, 1995). In addition, we attended to how the categories became materially manifested in the interface. In several rounds of analysis, the data excerpts and interpretations were iteratively discussed between the authors and colleagues on the broader research team.

### **Analysis: Negotiating patient falls and fall risks as functional categories**

The initial analysis of the 12 selected meetings identified a set of questions and concerns raised in the team discussions, including how falls and fall risks should be registered, what terminology to use, what type of information could be standardised and what needed to be kept open for local adaptation, how ways of registering falls and/or the risk for falling should generate tasks and responsibilities within the services provided and how this service work would be best organised. This testifies to the indexicality of categories in such design work; the discussion oriented towards multiple objects and contexts of use. Moreover, the discussions moved between temporal frames as the phenomena of falls and fall risk in health care include concerns for the registration of fall incidents, care for persons who have experienced falls and the prevention of future falls. Figure 1 illustrates the envisioned service work flow that the design team oriented to during these meetings (between a registered fall and how services are supposed to follow up and prevent new falls).

In what follows, we present an in-depth analysis of three excerpts selected to illustrate the recurrent categorisation challenges in the design meetings in relation to patient falls. All three excerpts are extracted from two-hour meetings where different



**Fig. 1** Workflow of handling falls within services



type of design issues and functionalities are worked on by the team. In the excerpts, we use the following abbreviations: PL=project leader, IC1-5=implementation coordinators from various healthcare units, D=developer, and PHA=pharmacist. Throughout the analysis, quotation marks (") are used to highlight the categories found, or suggested, at the interface of the system they are developing. See transcription legend in Attachment 1. We start by presenting a discussion where the team members negotiate terminological issues in order to make a category actionable. The second excerpt revolves around distinguishing categories and their contexts of use, while the third excerpt shows how the project team negotiated and assigned responsibilities in future services.

### Making categories actionable

A first issue is to make a category functional on mobile devices, which requires the team to explore potential candidate categories and test their actionable features. The team only have one topic on their agenda for this meeting: *demonstration and functional clarifications by the Developer*. The following excerpt is extracted from a discussion occurring one hour into the meeting. The discussion concern what a particular category in the system is supposed to enable and how this can be comprehensibly formulated as a label. The current candidate category 'diagnosis' (with specific diagnosis in brackets) is too extensive in its application for options to be properly readable in a drop-down menu on mobile devices (Fig. 2), which is pointed out by the developer (D). The following discussion is premised on this contingency. It revolves around the use of the platform on mobile devices and is conducted entirely in the context of the software interface (i.e. the system-user configuration).

In Excerpt 1, PL initiates a discussion by reformulating the problem with the current category – that lists of diagnoses change over time and that only diagnoses associated with the risk of falling are relevant (1). While the category 'diagnosis' will not be able to function in its current formulation, it may still be relevant as a reasonable cause for a patient's fall, and the project team explores the meaning of the category they aim for, and how it could be formulated in a comprehensive manner.

**Fig. 2** The discussion revolves around the categories shown on the screen in the meeting

#### FALL RISK FACTORS

Fall risk  Yes

Fall risk factors

Movement	X
Medical drugs (ex.:.....)	X
Diagnosis (ex.:...)	X
House (ex.: carpet)	X less
Select or search options ▼	

**Excerpt 1** From video observation, meeting 5

- 
- 1 PL                    Diagnosis lists are changing; even though it is not that frequent, they change over time. What do you think or how do you explain the risk of falling as a diagnosis? That is what we are having trouble with. How best to possibly explain... what do we mean when...what this factor of fall risk means.
- 2 IC1                    One could have called it something like 'mental/somatic illness'. Find another word than diagnosis maybe.
- 3 PL                    Mmm. What we are trying to express is that the patient has a diagnosis that invol...*can* involve an increased fall risk. That is what we are trying to express.
- 4 IC1                    Yes, right, but it is not ... there will be so many individual differences in each diagnosis. And diagnoses, all these neuro diagnoses will have...to a larger extent, higher risk for each individual.
- (A few lines omitted)
- 5 IC1                    Could we have ... could we have written 'exposed diagnoses', or 'disposed diagnoses'?Or?
- (A few lines omitted)
- 6 D                     How would you formulate it?
- 7 IC1                    That's the question. You could write 'diagnosis as fall risk', but that is maybe implicit.
- 8 PL                    M-mm
- 9 IC1                    It is in relation to mobility but also in relation to cognitive functioning.
- 10 PL                    Mmm. The patient's diagnosis increases fall risk. But that is so long ((laughs)).
- 11 IC1                    Can one say 'underlying disease' then?
- 12 PL                    Yes [enthusiastically]. What do you others think of that?
- 13 IC2                    Maybe the closest you get.
- 14 PL                    M-mm, m-mm.
- 15 IC2                    That points in the direction of something that it is something that matters.
- 16 PL                    Yes.
- 17 IC3                    Agree.
- 18 PL                    Let's try that.
- 

By narrowing down the long list implied by 'diagnosis' to 'mental/somatic illness', IC1 contributes with a candidate category characterised by a more limited boundary (2). However, PL hesitates to make this direct link and, instead, emphasises the importance of themselves formulating more tentative terms (3), thereby alluding to the potential uncertainty of early registrations. IC1, however, does not seem to pick up on the relevance of this concern and, instead, argues that one can never find a category with precision since some diagnoses can carry a higher risk than others for particular individuals (4). Following further discussion, which oscillate between suggestions on how to reformulate the 'diagnosis' category and delineating particular instances of fall risk, such as mobility or cognitive functioning, D again requests a formulation to label the category (6). This question trigger IC1 into suggesting an abbreviation ('diagnosis as fall risk') that represents an approximation of what they are after. Although this suggestion is immediately followed by a critical comment (that such a formulation is overly implicit), its intermediary quality becomes a baseline for the following discussion. They do not continue to try to find a relevant selection of particular diagnoses to fit a category at this stage in their work. Instead, they seem to aim more at highlighting the relation: a formulation that *suggests a potential link* between a diagnosis and the

risk of falling (5, 7, 10), signalling that a more thorough investigation may be relevant. Suddenly, IC1 comes up with a solution that seems to meet their current concerns. By formulating the category as 'underlying disease' (11), two things are achieved. First, the patient's diagnosis is still displayed as relevant not only by including 'disease' in the category but also, by adding 'underlying', the tentative nature of this relevance is simultaneously displayed in its formulation. That this solution is appreciated is visible through the enthusiastic confirmation by the PL (12) and the other team members (13, 15, 17). PL ends this part of the discussion by saying that they will keep this alternative (18). The team then go on to discuss other platform functionalities.

Although the solution is still a temporary one that will be returned to and further negotiated in upcoming meetings, the team has moved a step forward in their understanding of this categorisation challenge by exploring and testing candidate categories. Their testing, which involved oscillation between instances and boundaries of candidate categories, has led to a more specific understanding of the functionality that the category needs to have. This will make it more robust and easier for colleagues to use in their daily work practices.

### Distinguishing categories and contexts of use

A second issue the team worked on in the meetings concerned the ambiguity of a category and the consequence implied by its formulation in terms of further actions. To address and resolve this ambiguity the team explores and envisions potential category-related actions. The excerpt below is from a discussion 45 min into the meeting where, according to the agenda, they are discussing *solutions under development and new opportunities and fall risk follow-up*. It is known that the fall registration and measures to prevent new falls have been rather poor in municipality services, the team explores new opportunities for the system to support and facilitate the follow-up process of falls in the services. In the following discussion, the team oscillates between the here and now of registering a fall and how to analyse and take measures on potentially more severe causes of falls. Figure 3 below is taken from the PowerPoint slide that PL shares on the screen, which shows the categories involved in registering a fall.

**Fig. 3** Discussion points from PowerPoint used in the meeting

#### Fall registration

- Date of fall
- Time of fall
  1. Time
  2. Night, morning, daytime, evening, unknown
- Where/ Fall location
  1. Free text
  2. Indoor/ outdoor
  3. List of rooms in addition to the "outdoor" option
- Fall description
  - Situation (legs failed, dizzy, stumbled, loss of balance ...)
- Fall injuries
  - Y/N
  - Consequence (type of injury, body location ...)
- Measure proposal?
- (Automatic: Registered by, date, time, fall case)

The categories listed above are used as a starting point for the discussion in the meeting. The attendees discuss their way through the categories ‘time of fall’ and ‘where/fall location’. For example, they discuss whether the ‘where’ category should be structured or unstructured and that structured fields provide the possibility of working systematically with falls. Following a discussion of these categories, the exchanges move over to ‘fall injuries’ and revolves around the discrepancy surrounding what the ‘consequence’ category enables and how it is used in the established system (i.e. Geric). As it becomes clear that ‘consequence’ has been used only for acute bodily injury, PL initiates a discussion to explore the possibilities of moving beyond the mere registration of injuries here and now.

**Excerpt 2a** From video observation, meeting 8

- 
- 1 PL Yes, because ‘consequence’ is a bit ambiguous. It can be...Is it about the consequence.... right, a consequence can be that you [the patient] cannot attend a doctor’s appointment, right? Or the consequence can very concretely be related to...is there an injury. How do you use that field today?
- 2 IC4 It is related to injury.
- 3 PL Yes
- 4 IC4 It is more like if it became a fracture or if...yes...a description of if there was a consequence of the fall there and then.
- 5 PL Mm-mm, yes, so the question there is...so what you are saying then is that it is both type of injury, where on the body, etc.?
- 6 Someone Mm-mm
- 7 PL So, what about if there is no injury? What does it say? Nothing?
- 8 IC4 Yes, we write that then. Experience no injury after the fall.
- 9 PL Again, this is about being able to analyse it. So, the question is, would it be appropriate for you to have one saying yes/no to fall injury in addition to the consequence, which is free text?
- (Silence)
- 10 IC4 Yes, for what is an injury?
- 11 IC5 Sometimes, the injury can be observed...12 hours later. It is not always possible to observe the injury right away.
- 12 PL No?
- 13 IC5 But there is still an injury, that there is...
- 14 PL Yes, but then one can do the registration later. And write ai, there was an injury. And then one writes what it is in ‘consequence’.
- 15 IC5 Mm-mm
- 16 IC1 That is a difficult one. Because you may have the consequence of increased fear of falling.
- 17 PL Yes.
- 18 IC1 And you may have the consequence hospitalised.
- 19 PL Yes.
- 20 IC1 Or the consequence of not possible to live at home. ‘Consequence’ is quite broad ((laughs)).
- 

In Excerpt 2a, PL initiates a problem for discussion by arguing that the ‘consequence’ category seems ambiguous and asks how it is used today (1). IC4 quite resolutely responds that it is used for injury (2), followed by some elaboration and confirmations from others in the team (4, 6, 8). Having established how it is used, PL follows up by clarifying the purpose of her question: to explore the possibility

of using the system for analytical purposes. She then suggests that 'fall injury' is distinct from 'consequence' (9) and is given a dichotomous response option (Y/N).

In the continuation of the discussion, the PL invites the team to explore the 'consequence' category in terms of what would fit into its boundaries as an instance relevant to report (i.e. 'what are you looking for'). First, IC5 provided examples of the current practices of registering injuries (11, 13), followed by IC1 listing three examples of possible broader consequences of falls that health personnel must act on (16, 18, 20). The discussion continues as PL elaborates on the fuzziness of the category boundary and whether further distinctions can be made to make it less ambiguous (21):

**Excerpt 2b** From video observation, meeting 8

- 
- 21 PL Yes, right, so, so again, it is the same then, so what are you l-looking for? That is why I have ... tried to look a bit at the concepts here then. Eeee, that-that we, the question is whether we should use terms that are less ambiguous?...Mm-mm. Because as you touched upon, IC1, these consequences are not about, eeee, type of injury then ((laughs)). Eeeeh, what, what... there is something about being able to distinguish between the various. Eeh right, could say 'damage', 'yes'/no', you could also, eeee, say, call it some sort of damage, and then you have the free text and can write eeee, bruise, eee, arm fracture, whatever ((overlapping laughs)). Even then, you have 'injury' 'yes'/no', 'type of injury'...even then, the question is, what about consequences in a broader perspective then...then, I am a bit like, what should we call it?
- 22 IC4 It is just, I have not seen anyone write in Gericca about consequences in a broader perspective, really.
- 23 PL No, no, they have just written type of injury, really.
- 24 IC1 Yes. But the question is whether what is in Gericca is good. There is [PL trying to speak], we must be able to ask that question because I often think we underestimate what the consequences of this will be.
- 25 PL Yes.
- 26 IC1 And the consequences can often be greater than the acute injury. Therefore, trauma is not in itself... it is important there and then, but often, it is that they do not dare to shower alone.
- 27 PL Yes.
- 28 IC1 They need facilitation. They need increased supervision.
- 29 PL Yes.
- 30 IC1 It has an outcome.
- 31 PL Yes. I am thinking...I have so many personal stories ((laughing))...but one type of consequence is typically, as you said IC1, that fall, did that one get afraid of falling, and that has quite terrible consequences. So, we have 'injury' yes/no, 'type of injury', and then maybe we have 'other consequences'. Pharmacist, I see you have...
- 32 PHA I was thinking, could it, for example, be anxiety, isolation, social, what can I say...that one does not want to be social. A result is that one might isolate oneself because one is afraid of falling.
- 33 PL Mmm, mmm
- 34 PHA ...in need of help or yes.
- 35 PL The question is if we should add 'injury' 'yes'/no', 'type of injury' and 'other consequences'.
- 36 Someone M-mm
- 37 PHA I think that is a good, a good input. That it is not only injury, but that it can also bring more...maybe something more severe than a small injury.
- 38 Participants Mmm
-

By referring to how the old system is used, IC4 shows some resistance of going beyond the here-and-now registration of a fall injury, pointing to a continuation of its current use (22). This is challenged by IC1, who argues for the inclusion of a broader set of consequences than the visible here-and-now injury of the patient (24, 26). This is done by alluding to their accountability of taking appropriate measures and following up on such consequences (28, 30). This part of the discussion closes with PL again distinguishing between different forms of categories by adding ‘other consequences’ (31, 35).

By highlighting limitations in current care practices (opportunities to analyse a broader set of consequences of falls), they began the process of imagining alternative ways of working with these issues and reached an understanding that broader consequences must in some way be accounted for in the services provided. This was concretely achieved by first separating the function of here-and-now registrations of fall injuries and then making the ambiguity of ‘consequences’ obvious, with the latter manifesting itself as *an object for further analysis*. Following up on this last point, a new issue arises in their discussion where PL asks IC4 whether it is feasible for the home-care unit, who will use the system, to register broader consequences when registering falls (39):

**Excerpt 2c** From video observation, meeting 8

- 
- 39 PL Yes, home-care unit, do you think that this... is this too much?
- 40 IC4 I might think so, or I am afraid it will. Like today, we are very bad at registering falls, and when it does happen, you start to wonder, so what is the difference; here and now, I may not see the consequence that is a bit bigger. I only see it; yes, you got a bruise, and write it down. I will register this case after one visit. I might not have been able to identify if this is how you went to the emergency room or whether there was a fracture. It is a bit here and now. Mm, so that it should be quite simple and easy to register falls, and that is perhaps the most important thing.
- 41 PL Yes, mmm. What I at least want to change is the tab that says ‘Fall description/measure proposal’. And you PHA, you...
- 42 PHA Yes, I just agree that we get...the quality increases if you just start registering falls, right, if we are going to compare with how the situation is now. But at the same time, fall research shows that falls are the start of a malfunction. Eeh, so we might perhaps ...we might perhaps not have everything in place in the beginning, but in fact, it might be a sign of the start of a dysfunction.
- 43 IC3 A bit like we talked about in our routine for registering falls: if you register falls, in a way, the measure should be that it considered at an interdisciplinary meeting. Then it is a bit more like that: you not only register a fall, and then you are done with it, but that you see that, okay, here, someone has fallen, we have to address that and discuss the causes. Then we might get a bit more with that malfunction bit.
- 44 PHA Yes.
- 45 PL Then I interpret the situation as we leave ‘consequence’ as it is; then there is, in a way, room for one to write both – immediate consequences in the form of injuries and that one can so far say that ‘now, Kari has become very afraid of falling’ ((laughs)), as a result of that fall. So, but, then we will leave it – ‘consequence’ – as it is now.
- 

In shifting the focus to the home-care unit’s context of use, PL initiates a potential problem, that is, whether it is actually feasible for them to also register other consequences of falls (39). As IC4 makes clear that this is not likely since the registration

of falls is already an issue to begin with and that falls need to be easily registerable (40), the team continues their discussion of how other consequences can be analysed within the services.

As PL seem to have reached a temporary halt with the consequence category, she proceeds to focus on the next category on the list ('fall description/measure proposal') (41) and invites PHA to contribute. PHA, however, claims that the two tasks (of registering falls and following up on falls) are interdependent (42). Thus, she aligns with IC4's account, which articulated the relevance of experience of local contingencies, but she also maintains the importance of analysing falls in the context of research (42). Having yet again distinguished the two tasks of registering and analysing falls, IC3 suggests that the two assignments can be sequenced as part of a workflow which implies referring fall cases to interdisciplinary meetings (43). PL sums this up through her interpretation of the discussion: The team decide to keep the 'consequence' category as it provides the opportunity to register information of relevance to both purposes (45). The meeting then moves on to a discussion concerning the category of 'treatment proposals'.

The team's exploration of ways of registering and following up on falls have led them to recognise that the work of analysing other consequences of falls is more extensive and can't be solved immediately at the site of the fall. Instead, their envisioning of possible category-related actions ends in an acknowledgement that the following up on a fall is an extended part of the work that can be referred to another area of the organisation (in interdisciplinary meetings) for analysis (as in Fig. 1). This interdependency implies for HCPs in the services to improve their fall registrations in terms of frequency and quality, which other colleagues are more systematically intended to follow up. The team has moved from discussing how information about fall risk can be made comprehensible and actionable through the formulation and organisation of categories at the interface of the user-system configuration (Excerpt 1), to clarifying the category boundaries of fall consequences by distinguishing and tying categories to tasks for different work contexts in the organisation of healthcare practice.

### **Distributing future tasks and assigning responsibilities**

A third issue emerging from the meetings more directly concerned the conditioning of the work of others, as the team needs to explore how tasks that are generated in one service activity should be further delegated and handled. The following excerpt is one of several examples from the data material illustrating the kind of challenge the team faces as services are to be reconfigured by future tasks, assigning them as the responsibilities of different organisational contexts. The excerpt is from part of the meeting where, according to the agenda, the discussion concerned the *solution – demo and clarifications by the developer*. The system is shared on the screen in Microsoft Teams, and the team has completed the registration of a fall on a test user. What follows in the discussion centres on what happens when a fall

case is registered. They move one step further from the actual fall registration to a discussion of following up on falls. The discussion revolves around the workflow: when registered falls need to be followed up by others in the service and how they can be assigned to the correct person or team. The discussion revolves around new and imagined workflows and how a possible design solution can function to assign responsibility for following up on falls in the services provided.

**Excerpt 3a** From video observation, meeting 7

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- 1 IC3 But the task could be directly related to the service user as it's so individual from district to district, who in a way, gathers the messages, that it might be related to the service user, that a notification is sent to the service user in a calendar function, or?
- 2 PL Yes, good question, how does that... how is it Developer?
- 3 IC3 I think maybe it is more realistic to think like that, but I do not know.
- 4 D ((Exhales)) Yes...emmmm. Fall registration, it has a date, it is defined as an activity. Therefore, we could have had it in the calendar. However, we could trigger it; the easiest way I could think of is if, now I have to come back [navigates the platform]. Let's say, when we have a fall registration, we have a kind of 'yes'/no' with a professional assessment or a register reminder or notice – a kind of slider, which you press, yes. In addition, when you press 'yes', then, ehe, for example, a reminder or task can be made in the calendar, among other activities.
- 5 PL However, the question, as I understood it from IC3, or the input from IC3, was really that, when it, when to create tasks...is it possible to create tasks that are linked to the service user without it being linked to an employee?
- 6 D All tasks must have... eem... a person who is linked to...emm, yes... because we have such a description, right. However, we eee, have patient or service user. Do you just want it open who conducts and confirms?
- 7 PL Yes, that is how I understood you, IC3.
- 8 D Is it that...
- 9 IC3 I just see that it is different. They have a team leader in City District 1; we have a coordinator. There may be different functions in the positions. So, if you'd rather have linked the task to the service user and that you can see it in the calendar function, e, so that, in a way, a fall has been registered, which solves something and is linked to a task in the calendar for that week then, e, instead of it being linked to an employee, eem, ((laughs briefly)), if that was easier to understand.
- 10 IC1/4 Mm-mm
- 

In Excerpt 3a, IC3 initiates a discussion by suggesting an alternative solution to distributing a task, that is, to not auto-assign employees to follow up on a fall registration but, instead, assign responsibility later in the workflow (1). As PL acknowledges this alternative, she turns to D to investigate the technical possibility of such a solution (2). In the unfolding discussion, the project team explores the opportunities and implications of this design solution regarding how to organise the services and its workflow.

D explains the functionality of distributing a task as an activity-tied category that requires certain actions from the system user, signalling certain obligations (4), but PL is not entirely satisfied with the answer and clarifies IC3's question of whether tasks can be designed without specific employees being made responsible (5). D



clarifies that the question concerned do *not* link the category to an employee (6), which is confirmed by PL, and a temporary agreement is reached before the floor is given to IC3 to elaborate on her idea (7). Having established this as the current premise of their discussion, IC3 elaborates on how task responsibility can be distributed differently than initially suggested (tasks are directed to a calendar instead of specific employees) (9). PL praises IC3's solution as 'very good input' and further elaborates that this is a recurring design problem they have encountered (11):

**Excerpt 3b** From video observation, meeting 7

- 
- 11 PL This is really a very good input because we are constantly encountering that, how we are going to be able to identify which, which employee will follow this up. In addition, and as you say, one thing is that we are not able to do that within the system, but another thing is that the specific role varies. Moreover, the system is unable to guess. Therefore, the question really is, in a way, about whether one can have, regarding the service user, there are a set of tasks that really are not assigned to anyone, right. Because this task: an interdisciplinary assessment has to be made here, eeh, it is a task with a deadline, but it is linked to the service user, without an employee linked to it [the task], eh. Is that possible? How is that functionality, exactly? Yes.
- 12 D Everyone with access to the service user is able to see it in activities, but no one receives an e-mail or a different kind of reminder? It will just say activities, calendar?
- 13 IC3 I think you must have internal routines, right, regarding who checks the various tasks, ee; in our case, that might be the coordinator, for example. Maybe someone might think that it is the PA [specific work role] who is responsible for checking their calendar weekly for their service users. So, this was just a thought as we are struggling a bit to catch falls when people report them, and that it is easier if something is triggered when reporting a fall, that might be, eee ...
- 14 PL But what I think, I have, should have been registered in the product queue, what we talked about last time, that is, our need to retrieve employees in the system. If we had this two-step-thing on tasks: that tasks would be created automatically, because we often know what situations trigger a task, ref what we talked about IC3 with what will happen when a patient comes home from a rehabilitation centre. We know what triggers that so that can happen automatically. And if we then could have step one: here is a set of tasks that no one is assigned to, and then someone must get the role of assigning 'this task, I'll put that one on IC1, that one I'll put on IC2', right? Then ((laughs shortly)), they get a notification.
- 

Next, as this alternative now is discussed and confirmed as a good option for solving this recurrent problem, the first suggestion (of enabling the system to automatically assign responsibility) needs redirecting. IC3 suggest internal routines as a solution to the residual task, which still has to be ironed out: that of assigning responsibility in future work services (13). PL then closes the discussion by clarifying the sequence of events implied by using this category: a task is automatically established in the system before someone assigns the task to specific employees (14). After this discussion showed here they go on to discuss how one can retrieve employees in the system so that tasks can be assigned to them.

To sum up the second and third excerpts, it became clear that the team had to distinguish two sequenced contexts of use where the analysis of a fall followed from the point of registration. The discussion in the last excerpt exemplifies how the team reached common ground in terms of how activity-tied categories in the system can be designed to either distribute tasks automatically or manually. In exploring possible system-service configurations the team has reached a functional solution as they have managed to delegate responsibilities in the workflow, in moving from

direct execution in the system, to retaining an element of professional judgement in the loop. This was achieved by establishing continuity in the category workflow of different contexts of use and by carefully managing the reconfiguration of the envisioned distribution of tasks between the system and the healthcare workers. The established relations enabled the team to further develop the system and services as they solved a recurring problem.

## Discussion

The analyses show that working on categories of patient information as objects of design is far from straightforward. In all three excerpts, the teams' work oscillated between exploring the meaning potentials of an established or suggested category and attempting to stabilise the category as a generic manifestation of the information system. Rather than resolving the issue, the process took an iterative form, in which preliminary decisions were returned to and renegotiated later. The temporary stabilisation of categories often required testing out the category on more or different contexts of use, which again challenged the category boundary and led to amendments or suggestions for alternative candidate categories.

In excerpt 1, the 'diagnosis' category was examined for its functional potential and changed to 'underlying disease', while in excerpts 2a and 2b, the 'consequence' category was tested in different contexts of use, with increasing attention paid to its consequential features regarding the requirements for those involved. The team decided to retain the 'consequence' category. However, its relevance was expanded and repurposed from a category for documenting fall injuries to a tool for improving the registration and analyses of fall incidents in broader services.

In line with the previous research, negotiating different concerns brought about underlying issues and generated new questions requiring attention (Andersen et al., 2019; Ros & Grossen, 2020). As in Lundin and Mäkitalo's (2017) study, the team established a meta-discourse about the services, which was couched in future-oriented and analytical terms, including the possible consequences of their decisions for the services. However, our analysis showed a more variegated set of purposes and contexts of use the team related to, including facilitating information sharing across care units. Hence, the type of technology matters regarding how the design process evolves. This also required an expanded understanding of other colleagues' working routines and what competencies that are available and needed to achieve a certain task. This could not be accomplished without the distributed experience and knowledge of the team.

Furthermore, the team's work on categories as objects of design was related to the wider information infrastructure through which the categories were tested and became interlinked with other standards and classification systems. As described by Bowker and Star (2000), work on categories should consider and align with established systems and knowledge practices. The more ambitious the emerging information system is regarding coordinating work and information flows across contexts of use, the stronger the demands for flexibility and adaptivity will be. Thus, the demands of multifunctional categories will increase with expanding aims for the

information system, generating tensions to address in the design process. These processes demand that participants learn through the exploration and aligning of existing practices to decide on future practices.

Our study also showed that the complexity of the work on categories increased as the design process evolved, such as dealing with the seemingly straightforward problem of terminology choice in which the interface of the information system itself created the context for their work. The focus of their discussion moved from the functionality to the complexity of the service contexts and the work practices that the system was supposed to support. The participants then assumed responsibility for how their service contexts were represented in the information system. The analysis of the third excerpt shows how their testing of categories against contexts of use generated a need to account for the workflow in these diverse contexts and engage in developing new routines in their own and colleagues' service units. Hence, their design work became consequential beyond their immediate colleagues, thus conditioning the work of others. The explorative work they engaged in both facilitated and demanded an understanding of the broader services and ways in which the flow of information to different parts of the services affect each other. This can be characterised as system thinking as the participants had to consider the wider workflows and service organisation and and explore how local practices are linked to other locations and practices.

In sum, this poses new demands for professional knowledge and learning. First, there is a need to develop a good understanding of the wider workflow and service organisation. Furthermore, this understanding goes beyond the present and includes the capacity to imagine and engage in prospective scenarios. Foreseeing the consequences of the design for a variegated group of colleagues and testing out the categories in different contexts of use implies envisioning procedural steps in the different work practices and considering how tasks and responsibilities could ideally be distributed. Third, depending on the type of categories, the HCPs needed to consider what competencies and areas of expertise were available in a specific local practice when deciding on what standards and terminology from different knowledge domains could be used. In sum, we claim that this form of design work related as much to the reconfiguration of services and technology as to technology development (cf. Marcu et al., 2021). The participants were prone to tensions between multiple interrelated design aspects, requiring explorative moves and gap bridging of conflicting facets to move on with the work. Thus, participating in design work should be recognised as a specific form of work for relatively few HCPs, with potentially major implications for many. Moreover, the way of handling such extended responsibilities cannot be learned from outside the design process. Rather, these capacities are developed through participation in the many negotiations and explorations that such design work implies.

## Conclusion

The present study was motivated by the need to enhance our understanding of what digitalisation in professional work contexts implies, moving beyond the challenges of learning to make use of digital tools. We explored how health professionals take

part in the design of information technologies and how efforts to reconfigure routines, tasks and responsibilities in multiple service contexts are initiated and negotiated through such work. The backdrop for our interest was that more key personnel from service organisations become involved in design processes that not only relate to their own work, but also increasingly involve the conditioning of work in other sites and organisational units.

By focusing on how categories of patient information were negotiated and worked upon, we showed how this work was both about accounting for and reconfiguring routines in various service contexts as it was about technology development. As categories are consequential for service work, it is important to have active involvement of professionals from various parts of the services, fostering mutual learning throughout the process. Through the exploratory work of articulating practices and concerns, professionals mobilise important knowledge for team discussions, making it possible for collective negotiation of diverging understandings and possible reconfiguration of tasks and responsibilities. Hence, professionals face expanded demands for expertise in the sense of not only developing a reflexive understanding of their own work and tasks, but also of the wider workflow comprising the service organisation. This requires a system understanding of service work and of the implications of various design choices. These demands go far beyond what is often thematised as skills requirements emerging in the wake of digitalisation.

Moreover, with the intensified digitalisation processes taking place across sectors in society, we envision that more practitioners in a range of service professions will become involved in design work. Our study contributes by analysing and describing how professionals took part in explorative processes through one specific design project. Further research should examine these issues in various technological and professional contexts in healthcare and beyond. A better understanding of what this work entails is needed so that organisations and educational programmes can support professionals in developing these capacities and further develop the services.

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## Declarations

**Competing interests** All authors confirm there are no conflicts/competing interest to declare.

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