Competence Articulation: Alignment of Competences and Responsibilities in Synchronous Telemedical Collaboration

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ABSTRACT
Many studies and concepts within CSCW deal with the temporal, spatial, social, and computational aspects of supporting collaborative work. In this paper we want to pay attention to another central aspect to the achievement of collaborative work, namely the competence of the people involved. In particular, we want to look at the dynamic quality of competences, and investigate how competence is mutually developed in coordinated work. We have termed this process competence articulation, a concept which tries to emphasize competence as well as social development of competence as part of cooperation. The concept has emerged out of a longitudinal participatory design process investigating telemedical treatment of diabetic foot ulcers using video phones. We analyze the transitions occurring with the introduction of synchronous telemedical consultations and detail how the online video facilitates communication options for competence articulation, which again improve collaboration and thus the quality of the treatment.

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Competence, Home Care, telemedicine, CSCW.

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H.5.3 Computer-supported cooperative work.

INTRODUCTION
Many studies and concepts within CSCW have addressed the temporal, spatial, social, and computational aspects of cooperative work. For example, the studies of workplace awareness, and the concepts of monitoring and displaying has been central to our understanding of collaborative work [15]. Similarly, Anselm Strauss’ concept of “articulation work” has been used to understand especially the temporal aspects of achieving the coordination of work [21];[22], and the concept of mobility work has been investigating the spatial aspects of the unfolding of cooperative work [3]. These concepts are important in understanding the unfolding and coordination of collaborative work in time, space, and organization.

However, supplementing this research on the external, objective sides of collaborative work, there is a growing body of research addressing the more relational and subjective side of collaboration. For example, studies of “knowledge management”, or “expertise sharing” [1], show how cognitive capabilities play a central role in achieving collaborative work.

In this paper, we want to focus on one important mental condition for collaboration, namely the competence of the people involved, and how this condition can be affected by changes in communicative modalities caused by technological intervention.

Competence is important to collaboration in the sense that people need to judge the competence of each other and include this competence assessment as part of how to divide work and responsibilities between them. This competence assessment, in turn, implies the need for displaying, or articulating competence – i.e. a person needs to articulate his or her competence in order to play a suitable role in a collaborative setup and take on appropriate responsibilities. One important, and very interesting, characteristic of competence and its articulation is its dynamic nature – competence evolves in collaboration; any collaborative effort holds the promise for people to learn from each other.

Our investigations of competences, their assessment, articulation, and development is based on a longitudinal participatory design process developing telemedical support for remote consultation using video phones in the home of the patient. This study showed that providing support for competence assessment, articulation, and development improves the collaboration between clinicians, and hence improves the patient treatment. The contributions of this paper are threefold: (i) it provides a framework for analyzing competences in collaborative work, and its dynamic development; (ii) it applies this framework to the
empirical results of one concrete study, and (iii) it discusses the implications for design of CSCW technologies supporting these developments in competence.

Telemedicine
It is well known that the aging population in the Western world will pose severe strain on the healthcare systems in the near future. Moving health services from a traditional hospital setting to the home is frequently presented as a core component in mitigating these challenges [17]. There are, however, some fundamental organizational as well as technical challenges associated with the establishment of a successful home-based treatment; many of them involving support for setting up collaborative systems [20]. Common for many of these efforts is that the treatment involves a team of different people with different perspectives, objectives, and competences [12]. On the one hand, the hospital clinicians are often in charge of the medical treatment and have – as specialists – the overall responsibility for the treatment of a patient. On the other hand, the generalists who work in the home of the patient – e.g. the general practitioners (GP) or a visiting nurse – are responsible for the day-to-day execution of care and treatment of the patient in the home. Hence, home-based treatment is done in cooperation between clinicians which are separated in time, space, organization, and specialty.

Telemedicine applies information and communication technologies to bridge this separation. The most frequently used communication technology in telemedicine is synchronous video communication, which allows for some of the rich modality of face-to-face dialogue without the necessity of being co-located [15]. Video communication is particularly useful when cooperating around a physical/visual “object of work” [19]. Coordination of medical responsibilities across video communication, however, is a delicate matter that has not had much attention in CSCW research. In general, only limited research exists on telemedicine’s effect on the stakeholders’ relations in terms of responsibility and competence, and none of this research addresses how the transitions and changes in the collaborative setup affect competence assessment or how the new responsibilities are negotiated and accepted.

RELATED WORK
Part of interpersonal articulation work can be said to be covered by the term “social capital”, defined as “the stock of active connections among people: the trust, mutual understanding, and shared values and behaviors that bind the members of human networks and communities and make cooperative action possible” [11].

Likewise, the terms “expertise sharing” [1] and “bias discounting” [13] have conceptualized a discussion on how expertise identification, location and selection (or “know-who”) is relevant in a setting where there are multiple experts to choose from.

Most of these concepts have been investigated from studies of people’s face to face collaboration. Communication technologies, as applied in telemedicine, often changes communicative modality, and in order to inform design it becomes essential to know how this affects the articulation work.

Based on a study of the transition of the patient-physician relationship when introducing telemedical monitoring in the home, Bardram et al. report that the telemedical setting caused a different division of work and responsibilities [4]. In general, artifact-based mechanisms for coordination try to make explicit a naturally tacit part of the human dialogue, which might optimize the coordination and make it less error prone, but on the same time impair the natural human cooperation [8].

In this paper we argue that competence articulation is an important element in obtaining professional trust between coworkers. Changes in communicative modalities have been shown to affect the establishment of trust (see e.g. [16]), but the role of competence and expertise has not been included in such investigations.

In a field study of a software technical support helpline Baker et al. [2] describe how the call taker in the beginning of every conversation needs to “calibrate for competence” in order to being able to “talk at the customer’s level”.

In general, we find it useful to distinguish between competence and expertise, following Tomlinson’s definition of competence as capacity and expertise as tendency to skillful performance [23]. In his elaboration on common information spaces in hospitals, Bossen draws a diagram showing “grey zones” in the demarcation lines of professional competences [7][p. 180]. He argues, for instance, an experienced nurse will sometimes possess higher expertise for a certain medical action than a young doctor, despite the formal competence of the doctor. This example shows the usefulness of Tomlinson’s distinction between the two words, as also supported by our findings reported in this paper.

In summary, issues regarding social competence in collaboration – articulation, negotiation, or development – may have received wide attention in the descriptive parts of CSCW, but work is missing in tying the concepts more specifically to the design of technology, in particularly when the technology causes changes in the communicative modalities.

STUDY SETTING
Our studies of telemedical collaboration have been ongoing for more than two years. We have participated in a project investigating the feasibility of a telemedical arrangement in home-based treatment of diabetic foot ulcers. The project was conducted in three phases. The first two phases were a process of participatory design, where a group of people were invited to a number of experimental workshops to explore problems and potential futures. The participants
were patients, relatives, visiting nurses and hospital clinicians – 15 people in total constituted the project group. On the basis of the workshops a prototyped system – consisting of commercial mobile video phones and a web-based record accessible from both the telephones and via a normal browser on a PC – was then deployed in a pilot test in the third phase of the project. During this pilot, five patients each received three telemedical consultations in their home instead of conventional visits to the outpatient clinic. In total we have spent more than three months effectively doing field studies by following hospital and district clinicians before the pilot test and by taking the role as technical facilitators during the telemedical intervention. Furthermore, we carried out informal interviews with all persons who had participated in the pilot test.

Treatment of diabetic foot ulcers

Foot ulceration is one of the most common late-diabetes complications, 15% of people with diabetes will develop at least one foot ulcer during their lifetime [6]. Due to damage to the vascular tissue and neuropathy, diabetic ulcers heal slowly and do not always show the normal signs of incipient infection, and treatment is a delicate matter. Obtaining expertise in treatment of diabetic foot ulcers takes years of practical experience.

The present study pivots around a set of patients with diabetic foot ulcers associated with the endocrinological department M of the University Hospital of Aarhus. At department M, diabetic foot ulcer patients are treated both as hospitalized patients and in the out-patient clinic by specialized physicians and nurses. In between visits to the outpatient clinic and after discharge from the hospital, the patient is treated by visiting nurses from so-called ‘local centers’. These local centers cover different geographical areas and the visiting nurses are not specialized in any specific kind of care but are generalists. The treatment of diabetic ulcers has only recently received some attention in the local centers where some of the visiting nurses have completed a course of supplementary training. The level of wound competence therefore varies from one visiting nurse to another, and it is not possible to schedule the nurses such that nurses with wound care skills take care of all patients with diabetic ulcers.

On the other hand the visiting nurse often has a much more personal relationship with the patient than the specialist. Seeing the patient more frequently, details of intimate and personal character are known by the visiting nurse, and this knowledge is important for deciding on a treatment that is appropriate for the patient’s situation. The difference in view from the hospital nurse to the visiting nurse is exemplified in their name - 3 - for their common client: where the hospital nurse uses the word “patient”, the visiting nurse uses “citizen” and emphasizes the importance of seeing the client as a “whole person”.

The medium for communication between the hospital and the district clinicians is currently the patient him/herself:

After a visit in the out-patient clinic, the hospital staff provides oral or handwritten treatment instructions and tells the patient to pass it on to the visiting nurse. In rare cases the clinicians also communicate directly by telephone, but getting hold of each other has shown troublesome since the working schedules at the hospital is incompatible with the one hour office time in the afternoon that most visiting nurses uphold.

Telemedical treatment in the pilot test

With the telemedical intervention in the pilot test, a new organization of work was tested. Instead of the patient going to the hospital for treatment, the visiting nurse would bring a mobile video phone (Motorola A920 using the 3G UMTS network) to the home of the patient and establish a synchronous video link to the hospital experts. Figure 1 shows pictures from one of the consultations in the home and at the hospital.

This setup enabled the experts to discuss the treatment directly with the visiting nurse, who would find him/herself better prepared to perform the treatment than if the instructions had been passed via the patient.

Time slots for the telemedical consultations were booked in the hospital’s booking system as if the patient was going to be physically present at the hospital. The first video consultation was scheduled by the researchers; the following were planned according to the need of the patient, i.e. one task during a consultation was to schedule the next consultation. The difference between the two work flows can be seen from the sequence diagrams in figure 2.

Figure 2 illustrates how the visiting nurse is involved with the patient more frequently than the hospital clinicians both in the conventional and the telemedical treatment. Typically, the visiting nurse will pay a visit to the patient every two days, e.g. for changing the bandage. The hospital is typically involved every one or two weeks, sometimes even more seldom, if the condition is stable.

Figure 1. Pictures of a consultation: (Left:) The visiting nurse and the patient in the home. (Right:) The expert doctor and an expert nurse at the hospital.
The difference between the conventional and telemedical sequence of activities is the presence of a video link between the specialist and the visiting nurse. Using the web-based, online patient record the clinicians were also able to store text and images, thus giving them opportunities for asynchronous communication as well. For instance, the visiting nurse could upload digital images of the ulcer, and the expert would normally write conclusions/instructions agreed on during the video consultation in the record, for subsequent reference.

The clinical benefits of this telemedical cooperation have been reported elsewhere [10];[18]. The goal of this paper is to understand the role of competence in collaborative clinical work as seen in the situations around the treatment of the diabetic foot ulcer. We acknowledge the importance of empowering the patient in such home-based telemedicine, but in this paper we will nevertheless mainly deal with the relationships within the group of clinicians. In particular, we want to focus on how competence changes and evolves when moving from the asynchronous communication in the present situation to the online, direct communication in the telemedical treatment. In turn we are able to understand how telemedical collaboration facilitates an increase in the primary care worker’s skill, and subsequently better patient treatment.

COMPETENCE ARTICULATION

Cooperative work means that individual people pursue a common goal in a combined effort. The way people align their individual view plays an important role in all the major theories within CSCW research. In particular the concept of “Articulation work”, as termed by Anselm Strauss and colleagues [22], has been widely adopted in the CSCW community. Articulation work is the work of alignment needed in order to cooperate, and the term is founded on the general assumption, that joint action in practice is an achievement.

Strauss illustrates the concept of articulation work with the tasks of the head nurse at a hospital department taking the lead in the coordination of the illness trajectory [22]. The coordination of interdependent activities and other phenomenon associated with a work trajectory always evolve over time. For this reason there has been a tendency to emphasize issues of temporality in the interpretation of articulation work.

In this paper we would like to put attention to aspects of responsibility and competence. Where the term articulation work is used for the different ways co-workers tacitly or explicitly align their interdependent work activities, we suggest the term “competence articulation” denoting a similar alignment, but with the focus on the effort required to judge the competence of a co-worker and to decide how responsibility is to be shared.

Alongside articulation work, Strauss et al. describe a range of other kinds of “work”, one of them being “sentimental work” [22][pp. 129-50]. Sentimental work is further composed by seven sub-categories of work: Awareness context work, biographical work, composure work, identity work, interactional work, rectification work, and trust work. It can be argued, that the concept of competence articulation, as proposed above, may be subordinate to this broader term of sentimental work. For instance, in relation to the notion of trust work, Strauss et al. state that: “The establishing of trust can be simple, involving merely an air of competence as well as concern for physical, interactional, or personal sensibilities. But, as we all know, gaining someone’s trust can be a very complex task, involving much time, much talk, demonstration of competence, many subtle gestures, and the like” [p. 135]. However, sentimental work, in the notion of Strauss and colleagues, is solely concerned with the relationship between the clinician and the patient. A more equal term than sentimentality is needed to describe the cooperation between clinicians.

Both the term articulation work and competence articulation can be used simultaneously. Most CSCW systems are aimed at reducing the amount of overhead work associated with articulation work, but at the same time they change the
communicative modalities, affecting the patterns for articulating responsibilities and competence. Thus, while the articulation work can be successfully supported, this may at the same time impact the competence articulation negatively. To address both sides of this tradeoff both terms are needed.

Based on the analysis of competence and how it plays out in collaboration, we have identified two different – but closely related – aspects of competence articulation – competence assessment and responsibility negotiation.

**Competence assessment**

A basic requirement for successful collaboration is an understanding of a fellow worker and his/her situation. Having a personal relationship with a co-worker is the best means of obtaining this understanding, but often cooperation will also have to work effectively without tight personal relations.

The most noticeable example in this context is the hospital clinicians having to judge exactly just how complicated tasks can be safely put in the hands of the visiting nurse. This involves assessing the professional and personal competences of the person in question. Much of the competence articulation is naturally related to the experience of the persons cooperating. For instance, during the interviews one of the expert nurses was asked how she could assess the competence of the visiting nurse. She responded: “You can see it almost immediately. One of the first [visiting nurses] I asked to make a cut, you could see in the way that she held the tool that she was not used to it.” Similarly, when asked whether she at times felt burdened with an unreasonable responsibility, the visiting nurse answered: “They are in tune with me.”

In order to obtain common ground without necessarily having thorough knowledge of each other, competence articulation thus becomes an important means. One way is the very direct and explicit statement, as when for instance the visiting nurse proclaims: “I have to say, I am no expert in this field.” The articulation can also be more tacit with no explicit articulation, as illustrated in the following consultation from the pilot test (translated to English and shortened):

**VN:** Visiting nurse  
**ED:** Expert doctor  
**EN:** Expert nurse  
**PT:** Patient

VN: I don’t think there’s anything to see either over the foot or under the foot. Can you see the foot?  
ED: Yes. How about the actual ulcer on the 4th toe?  
VN: There is no change.  
ED: That was our impression as well. The question is if we dare wait and see for a week or so. How often do you visit PT?  
VN: We come twice a week

ED: I think that under all circumstances PT must have respite care for the relief of the foot. He is not to walk on that foot. If he must walk he should use the therapy shoe. And then I think he should have some antibiotics too, Diclosil. We can prescribe that from here.

VN: Can you also send it to him?  
ED: We can do that.

VN: How much should he take?  
ED: 500 mg times 3. And then I think he should also have some Prepsilin.

VN: Is that because of that blister?  
ED: Yes, because it might be streptococcaceae. So we’ll add 800mg of Prepsilin, we will make sure it is sent to him. And we have checked his kidney function; it allows us to do it.

In particular the visiting nurse’s question “Is that because of that blister?” tells the doctor, that she is not aware of the gravity of the situation. Through this question the visiting nurse indicates to the doctor that a more thorough description of the problem is appropriate.

**Responsibility negotiation**

From our findings from the telemedical study, it is clear that the organizational changes impact the responsibility structures in today’s organization. In many ways it becomes more difficult to explain how exactly the responsibilities are divided in the new way of working. Consider for instance the following instruction from the doctor to the visiting nurse during one of the consultations: “Cut until it is red, but before it starts bleeding”.

Generally, the nurse has the responsibility for her own actions, and the doctor for his recommendations, but the telemedical setting is allowing the expert to supervise actions performed by the hands of a person who may not have the formal competence for it. During the interview after the pilot tests, the visiting nurse who received the above instruction gave this comment: “Of course I’m responsible for what I do myself - cutting the ulcer for example - but I had backup. I wasn’t just the amateur doing something I in fact shouldn’t have done.” However, not all nurses were so certain about the formal responsibilities.

Consider for instance this quote from the interview of another visiting nurse: “If the doctor prescribes Mepilex then I must put on Mepilex unless I can see that it is all wrong from here. I have a responsibility to say if I see or think something else. I must obey a prescription from a doctor. If it is the [expert] nurse we share the responsibility. If the doctor is standing next to the [expert] nurse and doesn’t say anything I presume he is agreeing. I think it is alright if some responsibility is delegated to me through the telephone. I see it like this: I am their extended arm, but it is still collaboration.” The many contradictions in this quote show that it is not easy to explain the division of responsibilities in one clear sentence.
For the visiting nurses, the primary role in the treatment of the citizen remains unchanged in the telemedical setting. The hospital nurses, however, were forced to reconsider their role in the treatment of the patient, characterizing it as more like a supervisor/consultant. For instance the expert nurse’s statements in the following excerpt are half instructions and half education:

EN: Regarding wound care, I think we should wrap that blister in Mepilex. Is there liquid in the blister?
VN: Yes.
EN: Then you will have to empty it and remove excess dead skin. Then put on Mepilex and tube gauze.
VN: Yes.
EN: We generally recommend that diabetic blisters be emptied.
VN: Ok.
EN: And then there will be this little skin flap that you may cut off if you can.
VN: Yes, I can do that.

Being conscious about this role as supervisor for the visiting nurse the expert nurses were often quite explicit in the negotiation of responsibility, as in the above example. In general, however, the responsibility negotiation occurred on a more implicit and unconscious level as a natural part of the clinical reasoning and planning.

**Competence articulation re-visited**

In summary, the term competence articulation covers the part of articulation work dedicated to aligning competence and responsibility between co-workers. Competence assessment is the process of obtaining knowledge about the competence of a fellow worker. The process leads towards the establishment of a personal relationship, in particular if repeated during frequent interactions. Responsibility negotiation is the process of aligning the individual competences into a division of responsibilities for the work. A changed division of work will reveal new aspects of the personal competences to be assessed.

![Figure 3, establishing personal relations and reaching a division of responsibilities form a cyclic process](image)

Therefore competence articulation can be perceived of as a cyclic process, as indicated in figure 3.

In the telemedical consultations the competence articulation was mediated by the direct dialogue between the clinicians – not because of the synchrony itself, but due to the synchrony allowing for a situated dialogue, where the different persons could combine their views and discuss a concrete situation. “Describe what you’re seeing” was a typical inquiry from the doctor to the visiting nurse when discussing an ulcer. This request for thinking out loud the perception and reasoning about the wound – even despite the fact that the doctor could see the ulcer himself on the video phone – indicates how the dialogue was used as a means for combining the eyes of the on-site physician with the experience of the expert.

In this way competence articulation is of vital importance for the work articulation in collaborative settings, where the objectives of the workers cannot be achieved without combining the individual worker’s competences. If the responsibility of an action is a matter of negotiation, it is important that the chosen communicative modality allows for the competence articulation to work.

**DEVELOPMENTS IN TELEMEDICAL COOPERATION**

Competence articulation played an important role in the clinicians’ efforts to adapt their work to the new telemedical organization. The telemedical setup, however, also enabled a learning and development process; through the synchronous cooperation both the specialist and the generalist were able to learn from each other, thereby establishing common ground and improving their individual skills, which again improved their collaborative treatment of the patient. In this section we will further illuminate the developments in the cooperation as a result of competence articulation.

By using our observations from the initial field studies as well as the observations made during the medical intervention, we are able to study the transformations occurring with the introduction of telemedicine.

For the sake of simplicity we will first focus on the activities taking place around the actual treatment of the patient, leaving out all the activities leading up to and performed after the treatment. This means the primary actor in our analysis is the visiting nurse.

**Skill development of the visiting nurse**

In the conventional (“pre-telemedical”) situation the visiting nurses seeks to perform the optimal treatment. However, often the visiting nurse experiences a lack of possibility for getting answers to questions that are not addressed in the written instructions from the hospital. During our field studies one visiting nurse stated the following on the door step of a patient she had been treating for almost a year: “I don’t know for sure [what to do]. Therefore I just do what I normally do, but inside of me I know I may be wrong”. Thus in performing the treatment of the patient, there is a contradiction between, on the one hand, the wish to treat the wound optimally and on the other hand the need to perform the treatment within the schedule. Due to the asynchronous division of labor between the hospital and visiting nurse,
the conflict does not lead to an immediate change and is allowed to persist in the subsequent treatment.

With the introduction of the telemedical cooperation the possibility of targeting the problems in direct dialogue with the specialists is now present, and the visiting nurse now has the option of targeting the problem. This motivates and enables the visiting nurse to launch a change process. In the excerpts below, it is possible to identify the exact places in the conversation where competence assessment, “(ICA)”, and responsibility negotiation, “(IRN)”, allow for this change process. The transcriptions are from three successive consultations with participation of the same team (patient, PT, expert doctor, ED, expert nurse, EN, and visiting nurse, VN). The visiting nurse and the hospital clinicians did not know each other before the first consultation.

1. Consultation:

VN: (Calling the hospital) I’m here with [PT] and I have to say I’m not an expert in this field. (ICA)

ED: Have you seen the ulcer before? And what do you think - is it better or worse?

VN: Yes, I have seen it before. I think it looks the same.

ED: No changes?

VN: No, in my non-expert opinion (ICA) there are not many changes, but I remember that there were also a small ulcer underneath and that has healed, so in that way it has healed.

ED: Is there any signs of infection?

VN: No, I did send you some pictures, did you get them? I also took a picture of the bandage which I think is a little green.

ED: ... Look, we are in the fortunate situation that [PT] has an appointment with our foot therapist tomorrow and she can cut away the callosity. You can do it, but we have qualified help tomorrow. (IRN) It is very difficult if you haven’t seen it done before.

2. Consultation (1 week later):

VN: I would like to talk to you about the ulcer, it has become smaller with a little callosity, but I think that nothing should be removed. (ICA,IRN) But on the side of the foot under the little toe, there is a kind of spot: Normally I would call it a blister but there is something white in it...

PT: It appeared yesterday.

VN: ... We haven’t seen it before. The skin around is fine but a little red. [PT] calls it a pressure-blister, but it is not blue, so it doesn’t contain blood. I can try to cut some of the callosity away: do you want me to do that? (ICA, IRN)

EN: If you feel confident - do it (IRN); a little is better than nothing. You can cut away all the loose skin so nothing is left to hide. Then take some pictures with the digital camera and put them in the record. I will look it over in the afternoon (IRN) and then I might call you on the mobile phone.

3. Consultation (again 1 week later):

ED: Do you see any signs of infection?

VN: No. I see an ulcer with callosity but otherwise it is nice and clean.

ED: Do you think some of the callosity ought to be removed? (IRN)

VN: I can do that. (ICA)

ED: I think it would be a good idea.

VN: I did it last time and I can do it again (ICA, IRN)

ED: Same procedure that will be fine

VN: The new blister do you remember that? It looks like a blister with beginning infection...

In the first consultation the visiting nurse reveals the contradiction between her skills and the needed skills, i.e. the fact that she is not an expert and has limited skills with treatment of ulcers. However, already on the second consultation the curiosity of the possibility of improving the treatment makes her bolder, and on the third consultation a new pattern has consolidated itself in her way of thinking.

The visiting nurse becomes an active part of the collaborative reasoning and negotiation of responsibilities:

“Do you remember that?” This development is made possible with the competence articulation taking place in the situated dialogue.

Collectively development of common ground

As we have argued, the competence articulation in the telemedical consultations allowed for an individual development which was particularly noticeable in the case of the visiting nurse. Apart from these individual developments, however, our findings also suggest a development on a more communal level.

In the interviews following the pilot tests both patients, hospital clinicians and visiting nurses independently stated how the telemedical arrangement had promoted a sensation of “working as a team”. One of the visiting nurses was asked about how she perceived the development in her relationship to the hospital clinicians. She responded:

“When I work on my own, I sometimes doubt if the treatment is sufficient, or if a doctor should see the ulcer, and then I sometimes send the patient to the hospital. But when the patient returns, it is still the same treatment that was prescribed as in the first place, which means that I misjudged the situation. It becomes unclear why we think differently in the situation – this would not happen in this set-up”

It seems that the direct dialogue facilitated by the telemedical arrangement is enabling the expert and visiting
nurse to establish a common ground utilizing both the clinical expertise of the hospital clinicians and the visiting nurse’s personal relationship to the patient.

While common ground, as defined by Clark [9], can also be established by other means, the conclusion to our findings is that the direct dialogue facilitates an unbroken and coherent communicative space for targeting both concrete and general issues – i.e. both “just-in-time” communication and “just-in-case” communication [14].

In one situation the clinicians were able to avoid a hospitalization of the patient by arranging a follow-up video consultation on the next day and by establishing an immediate common ground for the clinical situation:

VN: And what do you want us to look for?
ED: You should especially pay attention to the second toe. If there is any worsening we are close to a hospitalization.
VN: That is a worsening of the swelling?
ED: A worsening of the swelling or the color, especially if there is the least spreading up on the forefoot.
VN: Then I think we should draw the outline on the foot, it makes it easier to see.
ED: That is a really good idea

In the interview after finishing the pilot test the visiting nurse expressed doubts about whether it would have been possible to handle this situation with asynchronous telemedicine, for instance by sending digital images by email. The synchrony allows the clinicians to utilize both aspects of competence articulation (i.e. competence assessment and responsibility negotiation) to achieve the continuity and quality of the treatment that was the primary aim with introducing telemedicine in the treatment.

DISCUSSION

This paper argues that a core component of successful collaboration is competence articulation and development. This is especially central to collaboration across different organizations, skills, and physical location – as is the case in telemedicine. The development of skills – i.e. transferring expertise from the hospital clinicians to the visiting nurse and ultimately the patient – forms the basis for a learning and development cycle which will lead to better patient treatment while requiring less of the hospital. One could argue that the vision of home-based treatment, which is viewed as the core answer to the demographic challenges to the Western healthcare systems, basically relies on the ability to support this shift of competences. Hence, from a socio-technical point of view it becomes relevant to discuss how this competence articulation and development can be supported – and what this produces of implications for the design of telecare technology.

In our study the competence articulation was made possible by a number of different circumstances: (i) communication via situated dialogue, (ii) a familiar form factor of the technology, and (iii) organizational accommodation.

Communication via situated dialogue

Naturally, a large part of the work in the consultations was grounded in the images of the ulcer presented to the hospital clinicians meaning that both the synchrony and the visual aspects (i.e. the video) were required. In other work settings other communicative modalities may suffice for the competence articulation to work – the important issue seems, however, to be the situated dialogue grounded in the context of the concrete situation.

The case has illustrated how the development of skills and the establishment of common ground in the telemedical consultations take place as part of treating the patient. Due to the role of the hospital clinicians as specialists, the most notable example remains the visiting nurse learning from the consultations (or, to use Tomlinsson’s definition; transferring the specialist’s competence to the visiting nurse’s expertise). But the other direction is equally important. In cases where the nurse has a long relationship with the patient, the physician at the hospital might learn a lot, and similarly in cases where experienced nurses are having a consultation with a young intern at the hospital.

Hence, it is important to support learning as part of the execution of the work on both ends of the telephone connection, i.e. to establish a dual support for doing and learning. This may sound trivial, but often we see systems which are primarily targeted for only one side of this duality. Systems like medical records, web-based clinical guidelines, prescription management systems, etc. are targeted for supporting the work of a clinician. Systems like web-based training programs, instruction videos, and online books are, on the other hand, targeted for learning.

We would recommend building systems which support the articulation and development of competences as part of supporting the work. For example, the medical record documents the outcome of a treatment. This may be supplemented with some documentation of a learning process. This may include documenting how a certain treatment was concluded or describing how a small surgical procedure should be done. Strictly speaking, one could argue that the video conferencing done in this case primarily supported the articulation of the work to be done with a specific patient. In our study the same visiting nurse was benefitting from repeated interactions with the same hospital clinicians, but the technology did not benefit other visiting nurses for this patient or other patients. Combining online video conferencing with a recording of these consultations may prove to be a rich learning vehicle for other people

Familiar form factor

Both the mobile video phone and the web based ulcer record were easy to use for the clinicians who only received a short introduction to the systems. Establishing a video connection is done in the same way as making a normal telephone call (select a number in the contact list and press
(video) dial and the online ulcer record could be accessed via an internet browser.

Another advantage of this lightweight setup was the independence of installing and maintaining a technical infrastructure in the home of the patient. The form factor allowed the participants to focus on their work without attention to the technology.

The mobile phones used in the study provided a rather low quality of pictures and sound, but they nevertheless proved sufficient for all consultations. We assume that the benefits of the video communication reported in this article can also be achieved with other and more high-end solutions for synchronous video communication. However, not all systems may be as lightweight and easy to use in the consultation.

**Organizational accommodation**

The present case has been executed as a pilot study and was therefore required to adapt to existing organizational conditions. For example, time for an online consultation in the hospital was scheduled as if the patient was going to be physically present to a regular consultation in the outpatient clinic. This arrangement was needed in order to legitimate the time spent by the hospital clinicians. If this kind of telemedine consultations were to work in a larger scale, there are legal and economic issues that must be addressed before the arrangement could work in daily practice. In general, the organization around the treatment may need further elaboration to make it fit within daily practice.

Collaboration distributed across time, space, and organizations is difficult to synchronize. Setting up a meeting – or a video conference – is inherently difficult since it involves the alignment of the schedules and duties of several participants, including the hospital clinicians, the visiting nurse, and the patient. Hence, setting up a videoconference between these three parties requires a lot of coordination and hence articulation work in the traditional sense. For this reason, the few studies which have analyzed telecare from a CSCW perspective have recommended to support loose coupling [4];[20], i.e. that participants should be able to perform their work relatively independent of each other in terms of physical co-location or presence at the same time.

It is, however, quite evident from our studies that the negotiation and articulation of responsibilities and competence is best accomplished in direct dialogue using natural language. Despite the availability of a web-based medical record, our findings clearly show that a fundamental quality of a situated dialogue provided by synchronous video communication is the possibility for competence articulation and development.

Hence, there is a clear trade-off here: on the one hand the nature of the work schedules for visiting nurses seems to indicate the need for systems that support loose coupling. On the other hand, competence articulation and development requires synchronized session of collaboration which may be mediated by communication technology.

However, if the common information space supporting the treatment is given a double modality the choice between synchronous or asynchronous communication would not have to be definite. In our setup the online ulcer record provided the clinicians with possibilities for both synchronous and asynchronous communication. Therefore, based on our experience we would recommend to support loose synchronization – i.e. enable the clinicians to work independently of each other while at the same time enable them to engage in synchronous collaboration. This may happen in a number of ways and there seems to be a continuum from scheduled synchronization sessions, to ad-hoc negotiation of availability [24], to opportunistic session creation based on mutual activity awareness [5].

**CONCLUSION**

Issues of competence and division of responsibilities play an important role in collaborative work, but despite this fact much research in CSCW tends to focus on temporal aspects. In this paper we have tried to develop a concept for looking closer at the way a specific communicative modality – synchronous video communication based on mobile video phones – allows the workers to target issues related to competence and responsibility. We propose the term “competence articulation” as a supplement to Strauss’ broader term “articulation work” in order to highlight these issues.

Introducing telemedicine in the treatment of diabetic foot ulcers, as reported here, caused a transition in the cooperation patterns, most noticeably the movement of responsibility of the actual treatment to visiting nurse from the experts. We found competence articulation to be the instrument of obtaining common ground in this new collaboration, which in turn allowed the visiting nurses to develop a better understanding of the clinical situation.

The telemedical cooperation might also work using other communicative modalities than reported here, but if the situation requires movement of competence, it is necessary to choose a modality that supports competence articulation. Our findings indicate that the situated dialogue facilitated by the synchronous video communication facilitates this competence articulation and hence competence evolvement, which again improves the patient treatment.

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