

Abstract

Purpose: videoconferencing between general practitioners and hospitals has been developed to provide higher quality health care services in Norway by promoting interaction between levels of care. This article explores the use of videoconferencing for information exchange and consultation throughout the patient trajectory and investigates how collaboration affects learning and the patient's treatment.

Design/methodology/approach: interaction analysis supplemented by interviews. Medical discussions concerning the patient were observed for 15 days, creating a trajectory of seven videoconferences. Interviews were conducted to examine the collaboration.

Findings: general practitioners and specialists use a different repertoire of knowledge and experiences to report and consult throughout the course of treatment. Over time, new medical problems arose, and the treatment had to be adjusted. The activity remained continuous and contributed to an integrated knowledge and information exchange. Collaboration using videoconferencing across levels of care created opportunities for workplace learning in health services and can lead to continuity, improved coordination, and a higher quality of care.

Originality: in contrast to other studies, which state effects, the need for continuity and cooperation in health care, and the ways in which individual differences make it difficult to achieve seamless health care services, this study offers insight into how continuity and cooperation can be achieved. It includes both observations of interactions and interviews of the participants, providing analysis of collaborative work in situ. This provides insight into the content of the interaction over time as a resource for understanding the outcome of the use of technology and improving health care.

Workplace Learning Among General Practitioners and Specialists: the Use of Videoconferencing as a Tool

1.0 Introduction

Collaborative work between general practitioners and specialists is viewed as a criterion for improving the quality of health care in Norway (Ministry of Health and Care Services, 2008). Telemedicine technology is a tool used to facilitate interactions between primary and specialist care physicians. This tool may improve the quality of care, despite geographical distance between the practitioners (Ministry of Health and Care Services, 2001, Ministry of Health and Care Services, 2008, Ministry of Health and Care Services, 2004). Telemedicine, or real time videoconferencing, is a technology for collaborative work. Using it, general practitioners and specialists discuss patient treatment, which increases the information and knowledge available to each participant. Therefore, videoconferencing has the ability to support continuously collaborative work and follow the treatment trajectory of the patient. A higher quality of health care services presupposes knowledge exchange and learning.

Collaboration using videoconferences between hospitals and outlying medical centres can provide specialist services to patients where they live by promoting guidance and interaction between specialists and general practitioners. In Norway, all general practitioners in an outlying medical centre and the specialists in a medical ward use videoconferencing as a tool for collaborative work four times per week. They exchange knowledge so that the treatment may be done locally. In this way, they increase the level of information and knowledge sharing. The use of videoconferencing has the potential to strengthen treatment coordination and continuity across levels of care and to provide a more integrated trajectory of care overall. The general practitioners in the local medical centre and the specialists at the hospital discuss

information and ideas about the patients they are treating, including whether they should be transferred and how they might be threatened. In this way, the collaborative work implicitly includes workplace learning as a criterion for the improvement of health care quality.

This article explores how collaborative work using videoconferencing has an impact on the continuity, coordination, and quality of health services where the patient lives and if such collaborative work promotes an overall trajectory of care. The objective is to investigate the use of videoconferencing as a collaborative tool for interaction. How can collaborative work, using videoconferencing to exchange information and knowledge between levels of care, affect the patient's treatment and thereby the quality of health services?

Learning in the workplace can be conceptualised in a number of different ways (Malloch, 2011). In daily work, learning and practice are not separate activities, but take place in the same flow of experience (Gherardi, 2006) and contribute to the development of the individual's knowledge (Billett, 2000). Studies in workplace settings have been conducted in fields such as the control room of a Metro system (Theureau and Genevieve, 2000) and an airline cockpit (Hutchins and Klausen, 1998). There are many different approaches to the workplace, as in these two of detailed interaction studies mentioned above as well as studies focusing on innovations in the workplace (Engeström and Sannino, 2010).

In a medical context, interactions have been analysed in a hospital setting (Engeström, 2001) and as boundary crossing activity between multiple providers (Kerosuo and Engeström, 2003). Workplace studies concerned with the use of technology for learning in medical work often manage the technology as an artefact for instruction (Sutter, 2001). That is, learning is considered as a part of the process when creating tools (Kerosuo and Engeström, 2003) and

technology, such as the x-ray (Måseide, 2007a). Workplace studies concerned with interaction when using technology for collaborative activities have focused on the interaction and production of gestures in coordination with language (Heath et al., 2003, Luff et al., 2000) and focused on medical language as a resource for developing scientific knowledge and personal experiences (Måseide, 2003). Here, personal experiences among health care professionals of a varying; nurses, psychologist, general practitioners and multi professional teams.

Studies on technology in the workplace have, in many cases, been more focused on the technology used during the interaction than the interplay with remote colleagues (Nardi, 1996). In the field of telemedicine, there is an emphasis on studying the effects of the technology, i.e. improving the quality of diabetes care (Abrahamian et al., 2002), increasing patients' satisfaction compared to standard appointments (Wallace et al., 2002), and creating clinical benefits and cost effectiveness (Wootton, 2001).

This study focuses on the interaction between general practitioners and specialists, who often use referrals between them, instead of knowledge exchanges. Studies focusing on interaction and learning between general practitioners and specialists (between levels of care) are not conducted as frequently as those focused on professionals such as nurses. Workplace activities are structured by historical, cultural, and situational factors (Engeström and Miettinen, 1999), and referrals may influence the manner and the quality of learning that occurs through work. This article contributes to the field by documenting how human knowledge resources in collaborative work can be employed in practice and how interaction between historically established levels of care affects the patient's treatment as well as the opportunities for learning and thereby affects the quality of health services. The article

explores medical talk that takes place over videoconferencing, and, in this manner, examines it as a tool for quality improvement in decentralized health care, breaking an historical established referral activity. Therefore, this article provides insight into the qualitative aspects of the interactions that involve the patient. By designing a study of interactions, it is possible to explore the processes of collaborative work and the ways in which interactions constitutes a resource for learning and the understanding the quality of health care.

2.0 Theoretical framework

Collaborative work between more and less experienced physicians develops both physicians as professionals and enhances the quality of the knowledge transferred (Akre and Ludvigsen, 1997). With this in mind, the purpose of this article is to explore how the interaction between levels of care, which evolves over time, may lead to continuity and coordination, i.e. more integrated care between general practitioners and specialists in daily practice. The collaborative activity occurs as general practitioners and specialists meet to share information and knowledge. This interplay between collective and individual practices makes the communicative process essential.

Cultural historical activity theory (CHAT) is a framework for analyzing the relationship of practical activities in a wide cultural, social, and a physical context (Engeström, 1999). Separately, the general practitioner and the specialist constitute separate activity systems. In each activity system, the actions of the subject are directed toward an object, mediated by both artefacts (tools) and the humans sharing the same object, which are called the community (Engeström, 1987). The subject is related to the community by rules, and the relationship between the community and the object is mediated through the division of labour. The activity is oriented toward an outcome, which is the object and the motivation for the

activity (Kaptelinin, 2005). When the two activity systems interact, they might have a shared object. Here, the patient and his/her illness are the potentially shared object, and the motive driving the collaborative work embedded in the activity. The general practitioner and the specialists represent separate activity systems, and the object, the patient and illness, attaches them together collectively (Engeström, 1987). The general practitioner and the specialists are connected by the rules of treatment, and the relationship between them and the treatment of the patient is mediated through their traditional division of labour, i.e. referring the patient or using the telephone.

The general practitioner and the specialist have a common goal for their activity. The object that connects them (Daniels and Warmington, 2007, Engeström, 2009) is the treatment of the patient. The zone between the two activity systems is the boundary zone (Kerosuo, 2003). In the boundary zone, routines and patterns must be constructed as something new, representing the participants' own structures, behaviours, rules, and standards. Since elements from several activities collaborate in the boundary zone, the zone is regarded as a place where the object can expand. Collaborative work across boundaries is a place where understanding is negotiated (Lund et al., 2010). The focus is neither on separate, isolated activity systems nor individual differences. Rather, it is on how the general practitioner and the specialist's activity together makes meaning through their interactions with one another. The unit of analysis is the collaborative work practice, which has a potential for learning.

Shared objects involve moving knowledge, information, and practices from one activity system to others (Konkola et al., 2007). The zone between them is the intersection between individual actions and collective activities. Boundary crossing between the activity systems happens as the videoconference is to collaboratively discuss the treatment of a patient. In this collaborative work, two types of boundaries arise: the institutional boundary between the levels of care and those created by sovereignty in medical work practices (Kerosuo and

Engeström, 2003). This sovereignty refers to independence and to the boundaries between the general practitioner and the specialist in the institution.

Access to new knowledge resources leads to tension between the new and old elements, such as between traditional rules for moving the patient and the division of labour. Contradictions between the reproduction of a practice and the development of new forms generate activity and create new work practices among the existing activity systems (Engeström, 1999). This work practice, with videoconferencing, is a historical break from traditional activity and provides access to different resources and institutional practices across activity systems.

Over time, the patient's condition changes and his/her treatment must be adjusted. The progress of an illness has a past, a present, and a future, which must be discussed in order to treat the patient. Both the physiological account of an illness and the organization of the treatment shape the treatment trajectory (Strauss et al., 1997). When the general practitioner and the specialist exchange knowledge throughout the treatment process, contradictions between the individual physician's knowledge and the knowledge achieved through collaboration arise in the collaborative work regarding the treatment of the patient (Engeström, 2008). When such contradictions are solved, new work practices are established across organizational boundaries, in between levels of care. Collaboration across levels of care can, therefore, form a potential resource for content related to the patient's treatment, specifically: coordination, continuity, and opportunities for learning as ways of improving the quality of treatment.

3.0 Methods

3.1 Empirical context

The context is the Norwegian health care system, organized as two levels of care: the Community Health Care system and Specialist Services. In Community Health, the general practitioners offer services in their offices or medical centers, while the specialists offer specialized services in clinics and hospitals. By using videoconferencing four times per week, the general practitioners at medical centers and specialists at hospitals routinely hold conferences during the morning meetings of the hospitals. All of the specialists attending the morning meeting participate, and the general practitioner on shift participates also. The use of videoconferencing was initiated independent of this research, based on these practitioners' initiative and need for communication.

3.2 Empirical material

This article examines two different types of qualitative data sources: observations and interviews. All participants gave their informed consent to be observed and interviewed. During a five-month period in 2007, 42 videoconferences between the medical ward at the hospital and the medical centre were observed and videotaped by the author. The videoconferences lasted for 5 to 15 minutes, depending on the content of the meetings. In this instance, videoconferences either replaced or supplemented the use of written and telephone referrals between the hospital and the local medical center. In a previous article, I reported that discussions in the meetings served three purposes: information exchange, practical organizing, and consultation (Author, 2008). Of the content of the 42 conferences, 13 had the purpose of information exchange, 12 were for the purpose of consultation, and 17 were for practical organizing.

The purpose of the categories was to facilitate an understanding of the content of the videoconference meetings. As information exchange and consultations are the content areas that constitute patient treatment, they are the focus of this article. Information exchange consists of updating the conditions of patients that were treated earlier and information about patients transferred between levels of care. Consultation consists of discussions about, and exchanges related to, medical problems, diagnoses, and follow-ups. The purpose of the observations was to illuminate the opportunities for learning between the levels of care as the patient's condition changed over time. The use of video recordings made microanalysis of the collaborative work possible as time unfolded in the treatment trajectory.

To complement the video recordings, the general practitioners and the leading specialists participating in the videoconferences were interviewed. The interviews were semistructured. All interviews were recorded and then transcribed. In total, 8 interviews lasting 20 to 70 minutes were conducted face-to-face, from August to December of 2007. The use of two data sources offers a connection between two types of empirical data that explore the same activity. The purposes of the interviews were to give the GPs and the specialists the opportunity to express themselves regarding their use of videoconferencing and to discuss various themes on the basis of the observations.

For 15 days, the medical talk concerning one patient was followed, which constituted a trajectory of seven videoconference meetings. This specific patient case was selected for analysis because it represented a case that was discussed over several days, in which information and knowledge exchanges between the hospital and the intermediate level of care could expand the traditional use of telephone and written referrals. Table 1 summarizes all the cases, pointing out those selected here.

Videoconferences	Weeks	Content/cases
	Week 1	Information exchange case A Information exchange case B Consultation case c Consultation case c
	Week 2	Information exchange selected case (day 1) Information exchange case D Consultation selected case (day 3) Information exchange selected case (day 4)
	Week 3	Information exchange case E Consultation selected case (day 7) Consultation case E Consultation selected case (day 8)
	Week 4	Information exchange selected case (day 14) Information exchange selected case 8day 15)
	Week 6	Information exchange case F
	Week 7	Consultation case G
	Week 8	Information exchange case H
	Week 9	Consultation case I
	Week 10	Information exchange case I Consultation case J Consultation case J Information exchange case J
	Week 12	Information exchange case K Consultation case L Consultation case M Information exchange case K Information exchange case K
	Week 14	Consultation case L Information exchange case L

Table 1: Summary of all cases

The selected case also represented the general characteristics of the patients discussed: an older patient, suffering from complex illnesses that progressed quickly, and a patient who has been transferred between the levels of care several times. The patient was discussed over several days, which allowed for a trajectory to be examined. Two of the seven specific videoconferences were selected for presentation to illustrate the content in the consultations and information exchanges and to show how collaborative work between levels of care affects integrated treatment. The consultation presented in the result is representative of the 12 total consultations. Related to this specific patient, it represents the three discussions about, and

exchanges related to, medical problems, diagnoses, and follow-ups. The excerpt presented as an information exchange is representative of the 13 total information exchange meetings. Related to this specific patient, it represents one of four information exchanges regarding updated conditions and patient information.

Although there was a total of seven videoconferences held regarding this patient (Table 2), this also represents a limitation of the study. Other cases (Table 1) might also have been selected for analysis. The selected patient is not representative of all patient trajectories. Information exchanges and consultations for each patient depend on several factors, such as the patient's illness and progress, the personal knowledge of the patient, the professional's willingness to discuss or provide information about the case, and the organization of the service. The strengths of the corpus are that it represents both how information is exchanged and how consultations are held in order to treat the patient. The composed trajectory may consist of fewer or more of each category and is therefore not representative of all trajectories.

3.3 Data analysis

The observations were analyzed by interaction analysis, a strategy used when investigating talk, nonverbal interaction, and the use of artefacts in interaction among people and objects in daily work practice (Jordan and Henderson, 1995). Interaction analysis makes it possible to explore medical talk. All 42 observations were transcribed, and the video recordings and transcriptions were analyzed and discussed, both with supervisors and medical professionals. The interactions were categorized by focusing on the use of tools in the dialogue and the turns in argumentation (Jordan and Henderson, 1995). Analysis of interaction in daily practice makes it possible to understand activities as a part of locally situated contexts and institutional practices (Linell, 1998). The talk was categorized (Svennevig et al., 1995) based on traditional concepts of medical reasoning: a) descriptions (of problems and diagnosis), b)

information (to ask for and give), c) treatment (recommendations regarding, questions about, and effects of), and d) confirmation (agreement or understanding) (Ludvigsen, 1998).

Video ethnography is a tool for deliberating organizational and cultural change which offers opportunities for health professionals to engage and agree with the results (Willis, 2010). The interviews were analyzed in order to enrich the observations by giving the participants the opportunity to express themselves according to the situations and themes that I had either observed or wanted to discuss in more detail. The analysis was categorized into themes in the interviews. In this case, I analyzed utterances in which the general practitioners and specialists expressed themselves regarding their knowledge gaps and the information exchange. The interviews illustrate how they experienced the collaboration over a period of time, which goes beyond activity analysis.

The data in this article were analyzed using a theoretical selection in which the analysis is generalised in the context of a theoretical debate, instead of a larger group (Eisenhart, 2009). This was done in order to focus specifically on the theme of collaborative work using videoconferencing, which included subjective experiences about medical talk as a resource for information and knowledge sharing between levels of care as well as the knowledge gaps experienced. The study was approved by the ethical committee.

4.0 Results

For 15 days, two general practitioners and several specialists discussed the development of several diseases in a specific patient. Through seven videoconference meetings, they collaborated, employing different repertoires of knowledge and experience. Table 2 summarizes the videoconferences during the period and their content.

Videoconferences	Time	Categorization of content
	1st day	Information exchange about patient transfer
	3rd day	Consultation about the change of medical treatment (selected extract in Excerpt 1: Talk in consultation between levels of care)
	4th day	Information exchange about illness development (selected extract in Excerpt 2: Talk in information exchange between levels of care)
	7th day	Consultation about further treatment
	8th day	Consultation about illness development and further treatment
	14th day	Information exchange about illness development
	15th day	Information exchange about terminating the treatment

Table 2: Summary of the content in the selected case as a trajectory over time

The presentation of the treatment's development over time shows the process of interaction and describes the collaborative work as the patient's condition changed. The following empirical results are presented here as the content of the talk used.

The patient was 84 years old at the time and had been hospitalized several times. She suffered from stomia, kidney failure, rectum-cancer, Pyelonephritis [strong bacterial infection] with proteus [group of bacteria] in the urine, and streptococcus-A [group of bacteria] in the blood. She also had a swollen ankle. The specialists informed the general practitioner about transferring her to the local medical center for aftercare related to her Pyelonephritis [the infection in the kidney] (^{day} 1). Her level of C-reaktiv protein [CRP, sign of infection] rose and the general practitioner consulted with the specialists about additional medical treatment. The specialist recommended intravenous instead of oral treatment, and continued following her condition since it might change quickly. The general practitioner followed this advice, a case of problem solving in between two activity systems (^{day} 3). Excerpt 1 illustrates the talk of the consultations, representing tension in terms of knowledge and problem solving.

Third day : Consultation about change of medical treatment		Category
GP ^a	Her CRP [C-reaktiv protein] is still rising.	Description of problem
	Should we change the per-oral treatment to intravenous, or?	Question about treatment

S ^b	Yes, do that and if it still rises, or she becomes worse, you will have to transfer her.	Recommend treatment
	I hope it has not created any resistant bacteria, but you know how it is! Follow-up closely. She may become terribly ill very quickly.	Description of diagnosis
GP	Yes!	Confirmation
S	Great! And . . . please check her CRP[C-reaktiv protein] at noon. If it does not work, we have to treat her with something else.	Recommend treatment

Excerpt 1: Talk in consultation between levels of care

^aGP: general practitioner

^bS: specialist

The next day, the clinical condition somewhat improved, though her C-reaktiv protein levels increased. The general practitioner informs the specialist about his decision to keep the patient in the medical centre, instead of transferring her to the hospital (^{day} 4). Excerpt 2 illustrates the information exchange discussion, which kept the specialist updated on the patient's condition.

	Fourth day: Information exchange about illness development	Category
GP ^a	She responds on intravenous and antibiotics, but her CRP[C-reaktiv protein] has risen. I may transfer her.	Description of problem
	She does not want it. Maybe I'll call the night duty nurse and discuss changing the medicine and treat her here as long as possible?	Question about treatment
S ^b	She has proteus in the urine? Streptococcus-A in the blood?	Ask for information
GP	Yes! I have treated her with the same [medicine] as you did; ciprofloxacin and penicillin. I regulated it after advice from X [specialist].	Give information
S	Ok	Confirmation

Excerpt 2: Talk in information exchange between levels of care

^aGP: general practitioner

^bS: specialist

In spite of a decreasing C-reaktiv protein, its level was still abnormally high. Traditionally, the patient would have been referred to the hospital in a situation like this, but she refused.

The general practitioner consulted the specialist regarding how to continue her treatment. The specialist who treated her at the hospital provided supplementary information about the swollen ankle and reconsidered the causes of the infection and offered another diagnosis: arthritis [infection in the arterial well]. However, the general practitioner did not support the suggested diagnosis of arthritis and, referring to the medical tests, they concluded by considering several explanations, which illustrates joint decision-making (^{day} 7).

The C-reaktiv protein then increased, and the general practitioner questioned this development and consulted the specialists. This specialist explained a projection of the situation with kidney stones and suggested an X-ray as further treatment. The general practitioner pointed out the existing X-ray and asked if a new X-ray would solve the problem. The specialist explained that several X-rays might not change the results. Therefore, the general practitioner decided, based on the specialist's knowledge, to consider the situation (^{day} 8). Through the weekend, the patient's condition radically changed. At that point, it was not possible to cure the cancer. The general practitioner informed the specialists about further treatment. The patient preferred to stay near her home, so the general practitioner decided to keep her at the local medical centre (^{day} 14). The general practitioner discussed continuing with the same therapy as the previous day (^{day} 15). As the results illustrate, both information and knowledge are shared throughout the trajectory to solve medical problems.

The exchange of data collection methods, from observations to interviews, provided the general practitioners and specialists with opportunities to express themselves about the knowledge gaps and information exchange related to the use of videoconferencing. The interviews illustrate how they experienced their collaboration over a period of time. These experiences are supplementary to the analysis of the social interaction. Two general

practitioners and two specialists discussed their need for knowledge and how collaborative work throughout the treatment trajectory provided the information and knowledge that was necessary for treatment.

Excerpt 3: General practitioner 1:

- 1 If I ask about something over which
- 2 I do not have control or feel insecure about.
- 3 I have two options. Do I go left or right?
- 4 I not only get an answer like:
- 5 “Do this and that,” I get an explanation.
- 6 They take their time and explain
- 7 why they think like they do.
- 8 . . . It may happen that I later remember
- 9 something that I should asked about or said;
- 10 And then they may change their judgement.

The interviews illustrate under what circumstances the consultation may be used (i.e., when the general practitioner does not know how to treat a specific condition or needs a second opinion (1-3)). This also illustrates what I call the knowledge gap between the participants involved, which is based on a need for both scientific knowledge and personal experience (Måseide, 2006). The use of the consultation refers to either a demand for knowledge or support of a general practitioner’s existing knowledge. When the specialists suggested a treatment method, they also explained the reason for their proposed action, based on practical evidence and representations (4-7). This illustrates how the specialist bridged the gap by explaining how and on what basis they employed their reasoning. As new information and knowledge arose, the treatment had to be adjusted (8-10).

Excerpt 4: General practitioner 2:

11 You often have to have contact again.

12 It is for and against; side effects . . .

13 So you have to filter toward a solution.

14 They give acceptance and support,

15 and of course, they give good advice.

16 Mostly, the questions are specific.

17 “Should we start with penicillin?”

18 “Yes, do that!”

19 “Or, should I send him to the hospital

20 if he does not improve within a day?”

As illustrated in excerpts four and five, supplying information to the discussion might offer new directions based on the specialist’s advice. Their talk was not only directly related to a question regarding treatment at that moment, it was also a reflection on the process thereafter (11-12). The medical talk began with processes of information exchange (1st day, Table 2), but information and knowledge exchange between the physicians about the patient enriched the treatment (12-13). In this way, the regular use of videoconferencing introduces the possibility of continuous follow-up regarding patient progress and bridges the knowledge gaps between the general practitioner and the specialist.

The general practitioner indicated that this was a continuous process. As the patient’s condition changed, the possibility for gaps occurs. When the general practitioner made new decisions (9), the opportunity to consult with the specialist to gain acceptance and support instilled confidence (14-15). The general practitioner referred to the questions as rather

specific; he presented a decision that was already made due to the need to obtain the specialist's support or reflection (16-20). In this way, they improved their knowledge, presenting different voices and discussing different types of evidence from their respective spheres of activity.

Excerpt 5: Specialist 1:

20 We discuss how to continue the treatment,
21 problems or where patients have become worse.
22 It is a development . . .
23 we consider it from day to day.
24 In contrast to the use of telephone,
25 with one specialist on duty,
26 they access a whole team.

As Excerpt 5 illustrates, the specialist also regarded the treatment as a process over time, in which it was possible to discuss further treatment (20) and arising problems (21). As the illness was in development at the time of the study, new aspects of the patient's condition had to be taken into consideration as the illness progressed (22). This is an expression of continuity in collaboration. Compared to traditionally irregular telephone use, in which one specialist discussed the illness's development (24-25), the use of videoconferencing provided access to the entire medical team in the morning meeting (26).

Excerpt 6: Specialist 2:

27 It is mutual,
28 it is colleagues who want to transfer patients
29 or have transferred patients . . .

30 It is natural that they demand
31 and want to know what has happened.

The specialist pointed to the mutuality in the collaborative work (27), which refers to the need for information (28-29) and feedback between levels of care (30-31). The specialist prepared the general practitioner for the patient's transfer (28) and obtained updates on the conditions of patients who had been in the hospital, but had been moved to either the medical centre or had been discharged (29). As a result, the specialists also had the opportunity to follow the patient until she was fully recovered (30-31).

5.0 Discussion and conclusion

Following the illness trajectory that unfolded over 15 days and interviewing the general practitioners and specialists illustrates their use of different repertoires of knowledge and experience from individual activity systems to inform a patient's complex course of treatment, which creates opportunities for learning in the boundary zone. Individually, the general practitioner and the specialist represent separate activity systems, collaborating through the use of mediated tools oriented to the object. The patient is the shared object, which collectively maintains the activity through the use of videoconferencing. The videoconference is the tool that brings the general practitioner and the specialists' activity systems together in the boundary zone (Kerosuo, 2006), where they create a new, common activity which allow for learning.

Collectively, the coordination of patient treatment contributes to the transferring of knowledge, instead of the patient, between the levels of care. By developing the traditional treatment trajectory and work practices for patient treatment, the opportunity for learning affects the treatment trajectory across institutional boundaries and constitutes new work

practices between levels of care. The trajectory, which also is a concept used to understand and analyze the chronic illness trajectory as a process of past, present, and future actions (Strauss et al., 1997), is a process of phases and a sequence of tasks, in which different diseases require varying trajectories, knowledge, and resources. This indicates that there are both individual and collective aspects of work that are performed by multiple practitioners in a situation in which time connects both how the illness develops in the here and now and what kind of treatment will be necessary in the future. Contributions from both levels of activity (i.e., descriptions of problems and diagnoses, giving and asking for information, and questioning, recommending, and explaining the effects of treatment in a two-way process) all create opportunities that expand traditionally irregular communication. Regularity forms mutuality between the general practitioners and the specialists.

The activity occurs through information exchange and consultation over a period of days. Information exchange illustrates how the general practitioner makes individual decisions, and consultations illustrate how they collaborate about mutual decisions. The collaborative process starts as the specialists inform the general practitioner about transferring the patient to the local medical centre, where the general practitioner takes on the responsibility for the patient's treatment. Thereafter, a combination of information about the patient's condition and consultations regarding how to treat the patient follow. As the trajectory changes, the treatment must be considered and adjusted. The general practitioner and the specialist give information and apply for support in order to provide the best treatment to the patient. The categorization of the videoconference's content illustrates how information and consultation are both aspects of the development of the patient's treatment trajectory. Regular collaborative work supports the exchange of knowledge from both the general practitioners'

and the specialists' levels of activity and makes new forms of individual treatment for the patient possible.

A detailed analysis of the interaction is an illustration of medical work practice. The interviews described in this article provide subjective opinions about concrete questions related to the interaction, the expertise that professionals need, and the knowledge they exchange. This analysis illustrates how they share knowledge and experience as time unfolds. Although it is the general practitioner who requests knowledge and a second opinion, the specialists also benefit from the collaboration. Over time, the conditions change, and the collaborative work requires continuity. As a result, information and knowledge are exchanged among the entire team, so the previous therapist is updated on the progression of the illness, even when the patient is transferred to the local medical centre. Access to such a broad collection of medical professionals is an expansion of what irregular one-on-one phone calls have traditionally been able to offer.

This study, which was conducted as a trajectory, makes several contributions to the field. It contributes to the understanding of how the development of individual knowledge is a result of everyday work activities. Analyzing knowledge gaps and the ways in which practitioners bridge these gaps is a contribution to our understanding of how opportunities for learning are created in everyday medical practice. This work represents a contribution to the field of workplace learning. Studies of knowledge production in medical practice has previously been conducted with a focus on how technology serves as a artefact for instruction (Sutter, 2001) and as a recourse (Måseide, 2007b), and how learning may happen while creating tools (Kerosuo and Engeström, 2003). This study focuses on how collaborative work creates new

work practises and improves quality, illuminated by the opportunities for learning across activity systems.

As mentioned in the introduction, learning in the workplace is explored action by action (i.e. Heath et al., 2007), instead of, as in the case of CHAT, over time. As the practitioners use the videoconference regularly, it offers more than knowledge about the successful use of telemedical technology. It also offers insight into how the practitioners engage in meaning-making and development of knowledge across levels of care over time. Studies of trajectories are often connected to one activity system and the ways in which the use of technology is stabilised as a success or a failure, but this article contributes to the field by focusing on the trajectory as a continuous process of development in both activity systems.

In this article, I point to processes that explain how collaborative work improves coordination and continuity in treatment. In the telemedical field, previous approaches to the workplace have portrayed collaborative work among professionals as leading to conflict, reducing the power of individual therapists, resulting in fewer possibilities to control the outcome, and making planning less predictable (Allen et al., 2004). This approach reveals new insight into the field. The article contributes insight into the collaboration of general practitioners and specialists when working together on developing conditions. Information and knowledge exchange through consultation produces contradictions between what physicians manage individually and collectively and creates opportunities for learning between the general practitioner's and the specialists' activity systems. The collaborative work, patient treatment, medical tools, videoconference, journals, referrals, knowledge of the patient, and so forth, all constitute a community guided by rules and the division of labour. Tensions between the reproduction and development of new work practices generate activity in which there is a

departure from the traditional division of labour. Hence, the general practitioner and the specialists change their roles and responsibilities to the patient (Pettersen and Johnsen, 2007).

In a telemedicine context, with an emphasis on effects, this study contributes to the understanding of the content of the interaction and the ways in which the collaborative activity affects the treatment outcome of the use of the technology.

In a CHAT approach, workplace activities are structured by historical, cultural and situational factors (Engeström and Miettinen, 1999). Historically, medical practice is characterized by referrals, in which general practitioners and specialists operate on different levels of care. Nurses in home care collaborate with general practitioners in community health care, but collaboration between community health care and specialist services is not that frequent. This study expands upon previous studies in terms of its emphasis on boundary crossing activity (Kerosuo and Engeström, 2003), demonstrating how learning may occur at both levels of care. It also demonstrates how important this learning is in terms of its relationship to quality of health.

As the illness trajectory constantly changes, new medical problems can arise with the same patient or with other patients, and the activity can be maintained between the levels of care. This contributes to a continuous knowledge and information exchange, which makes the videoconference a regularly used tool. Coordination of treatment contributes to the exchange of knowledge, far more so than simply moving the patient between levels of care. A contradiction between old working methods and new methods, such as using videoconferencing, creates new work practices between the existing activity systems. This article has addressed the quality of patient care as it relates to information exchange and the opportunities to consult; so the coordination and the opportunities to workplace learning.

Overall, the collaborative work of using videoconferencing across levels of care might expand the quality of knowledge in health services as knowledge gaps represent opportunities for learning, collectively bridged as knowledge production. In addition, learning might result in an improved treatment chain, achieving political ambitions regarding better continuity, cooperation, and quality of health services where the patient reside.

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7.0 References

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