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Collaboration between Professionals:
The Use of Videoconferencing for Delivering E-Health

Line Lundvoll Nilsen

Norwegian Centre for Integrated Care and Telemedicine, University Hospital of North Norway, Box 35, N-9038 Tromsø, Norway; E-Mail: line.lundvoll.nilsen@telemed.no; Tel.: +47-95-28-07-49; Fax: +47-77-75-40-98

Abstract: This article explores the ways in which collaboration between professionals using videoconferencing affects the e-health delivered to patients. In Norway, general practitioners (GPs) and specialists routinely hold videoconferences. Observations of 42 VC meetings, each lasting from 5 to 40 min, were analysed in terms of the interactions. In addition, five semi-structured, face-to-face interviews were conducted, each lasting from 20 to 70 minutes. Statements were selected to illustrate the content of the interactions and how collaborative work affects the delivery of healthcare. Successful collaborative work provides practitioners with a new way of thinking: exchanging information and knowledge between levels of care in order to provide the best treatment for patients locally. The regularity makes the collaborative work a two-way achievement. GPs receive decision support and second opinions, and specialists receive information and opportunities to follow up. How the professionals manage their work (*i.e.*, collaborating) may benefit their patients. The regular use of videoconferencing will furnish professionals with enhanced resources for the meeting of patients' demands in the future. Regularly informing one another and exchanging knowledge, benefits the professionals by providing increased certainty with regard to their medical decisions, and it benefits the patients because they will feel satisfied with the competence of the specialists where they live.

Keywords: collaborative work; e-health; videoconference; professionals; knowledge

1. Introduction

Delivering health treatment is aimed at optimizing health outcomes for the patients. Delivering e-health means using technology as a tool to help ensure the best outcome. This article illustrates how health outcomes relate to the opportunity to receive healthcare and medical treatment whenever and wherever necessary, even if treatment is not locally available. The article focuses on a telemedicine communication system as a tool for collaborative work. In relation to this, telemedicine (specifically, real-time videoconferencing) may be considered in four contexts: medical, technological, spatial, and benefits [1], measuring how professionals collaborate in order to deliver medical diagnoses for patients. Studying how general practitioners (GPs) and specialists interact offers insight into how they collaborate in order to solve medical problems. The practitioners' statements place this interaction within a larger perspective by focusing on their motivations for collaborating: providing medical treatment to people, even if treatment is not locally available, by using videoconferencing as a tool.

Traditionally, collaborative work between GPs and specialists happens at one level of care, *i.e.*, in morning meetings [2]. In Norway, GPs and specialists interact by using videoconferencing regularly, discussing medical problems and treatments across levels of care. The goal is to increase information and knowledge sharing in order to provide better local treatment to patients. The use of videoconferencing has the potential to strengthen interactions between GPs and specialists, treatment coordination, and continuity across levels of care and to provide better health care delivery. Improvement in the delivery of healthcare may be seen in relation to the concept of e-health. E-health is a technological development, a way of thinking, a commitment to networking, and a way of improving health services locally by using information and communications technology [3]. Here, the issue is how the practitioners—the GPs and the specialists—commit and network (*i.e.*, interact and collaborate) in order to improve treatment and health services locally.

Studies of the interaction in collaborative work between levels of care have focused on the organization of the videoconference unit in the room and the number of participants as being crucial for the cases discussed [4], how the GP feels slighted when patients participate in discussions with specialists [5], and how the specialist dominates the discussion [6]. Studies regarding medical discussions between practitioners have focused on their use of language [7], how the credibility of the source affects the collaborative work [8], and how juniors and seniors contribute different types of knowledge to the discussions [9]. The studies have not focused on GPs and specialists as equals, providing information and knowledge for the total outcome of healthcare delivery, but on aspects of the outcome for them as individuals.

When collaborative work through videoconferencing between levels of care becomes a part of daily medical practice, health service providers are able to deliver new forms of health care, which may be regarded as a new method of providing e-health to the population. This article aims to link interactions via videoconferencing to the delivery of e-health by focusing on the health outcomes as related to four contexts of providing e-health: medical, technological, spatial, and benefits [1]. The research question is: How does professional collaboration using videoconferencing affect the e-health delivered to patients?

Materials and Methods

The Norwegian health care system is organized into two levels of care: community healthcare and specialist services. By using videoconference routinely, the GPs located at a medical centre and the specialists in a hospital interact. The videoconferences are held during the morning meeting at the medical department. The consultations represent opportunities to discuss medical problems without patient participation. From specialist services, all of the specialists attending the morning meeting participate, and from the medical centre, the GP on shift participates. During the period of the study, three specialists led the group at the hospital; they were in charge of the discussions with the GP on duty. There were two GPs, each of whom participated every other week.

The data were collected with qualitative research methods [10] in 42 observations of videoconference meetings, representing one or several medical discussions between GPs and specialists. Table 1 summarizes the number of meetings during the 14 weeks of observations.

Table 1. Meetings per week.

	Weeks	Meetings
Videoconferences	Week 1	3
	Week 2	4
	Week 3	2
	Week 4	2
	Week 5	3
	Week 6	2
	Week 7	1
	Week 8	4
	Week 9	4
	Week 10	4
	Week 11	2
	Week 12	4
	Week 13	3
	Week 14	4

The results from the observations have been presented previously [11,12]. The findings from the observations were discussed in terms of their reliability [10] and validity [13] in interviews with the participants. Here, five interviews are presented, with three chief physicians (specialists) in the main role in the videoconferences from the hospital and the two GPs interacting. The face-to-face interviews, each lasting from 20 to 70 min, were conducted by the author and interviewee. The purpose of these interviews was to give the GPs and the specialists the opportunity to express their opinions on the use of videoconferencing for collaborative work and the way in which their medical problem-solving affects the delivery of healthcare.

The interviews were semi-structured. All of them were recorded and then transcribed [10]. Here, statements were selected to illustrate how videoconferencing acts as a tool for interaction and how the practitioners describe its effect on the delivery of healthcare to the patient. The selected statements are structured according to the four telemedicine contexts [1]. The contexts did not structure the

interviews. Therefore, the contexts do not exclude each other and may overlap, as is characteristic of semi-structured interviews.

2. Results and Discussion

Here is a representative example of the interactions. The sample was selected to illustrate the consultations. Hence, this illustration is a foundation for the statements in the interviews. The collaborative work in the videoconferences starts with the GP describing a problem (utterance 1), here regarding the rising level of a CRP (C-reactive protein). The GP asks a question about how to treat the patient, outlining a solution for the problem (2). The specialist supports the GP by confirming the plan to change to intravenous treatment. The specialist also recommends a treatment: that the patient should be transferred if she becomes worse (3). The specialist describes a diagnosis, what may happen if resistant bacteria have been created, and comments that the patient may become very ill quickly. This requires a close follow up (4). The GP confirms this, acknowledging and agreeing with the recommendation from the specialist (5). The specialist goes into detail, recommending that the GP check the CRP at noon and make new judgments if the patient does not respond. Table 2 illustrates the talk in the consultations, representing medical decision support and problem solving.

Table 2. The medical talk in consultation between levels of care.

	Consultation	Category
GP [a]	1. Her CRP [C-reactive protein] level is still rising.	Description of problem
	2. Should we change the per-oral treatment to intravenous? Or...	Question about treatment
S [b]	3. Yes, do that, and if it still rises or she becomes worse, you will have to transfer her.	Recommend treatment
	4. 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	5. Yes!	Confirmation
S	6. Great! And . . . please check her CRP[C-reactive protein] level at noon. If it does not work, we will have to treat her with something else.	Recommend treatment

[a] GP: general practitioner; [b] S: specialist.

This is a medical discussion in a professional collaboration and illustrates the content of the videoconferences. The results also aim to illuminate how this collaboration between professionals using videoconferencing may affect the delivery of treatment. Here, I will present the collaboration in relation to the four telemedicine contexts: medical, technological, spatial, and benefits [1]. These results are presented according to the professionals' own assumptions regarding the collaborative work, as exemplified in Table 2.

2.1. Medical Context

In the medical context, videoconferencing is a tool for providing healthcare. The GPs and specialists possess diverse types of knowledge, and through medical discussions, they exchange knowledge in order to cover what the individuals are capable of doing alone and when collaborating. This offers the practitioners not only the medical knowledge necessary to perform local treatment, but

also a feeling of professional security in their decisions. The GPs describe the questions that form the medical discussion (Table 2) and the content in the videoconference when discussing medical problems.

General practitioner a (GPA): "Do you have any advice? Should I perform some new tests? Shall we start the treatment this way, or should we do something else? I get (…) an answer that is explained very well."

Specialist b (SB): "The meetings are about information about patients in the medical centre or patients who have been there and are now staying in the hospital. They are about medical and organizational questions. In what way can we handle these illnesses, and what happens if the patient develops complications?"

SA: "We may have prescribed intravenous medicaments for 2–3–4 more days, depending on blood tests. Then, we may change over to tablets. We discuss such themes. They know what we are thinking, but want to be sure that we agree with each other. The discussions may also involve medical problems that they do not know how to handle or patients getting worse, which might be transferred to us [at the hospital]."

This GP(A) explains his concrete questions and suggestions regarding the collaborative work and the fact that this method of collaborating leads to well-explained answers to the problems. The specialist (SB) describes the same content in the videoconferences by explaining that they are about how to handle illnesses and the development of medical conditions. Specialist SA deepens the discussion by referring to a concrete problem: how questions arise and how illness development brings up further questions. This confirms the consultation in Table 2. GPB supports this by describing the discussions in the context of the professional aspect of ensuring medical safety as well as the opportunity to challenge individual knowledge. In this manner, hospitalization may be avoided.

GPB: "(…) they give me the acceptance of and support for what I suggest, and I can write it in the journal. I feel confident about it [the answer], and I can record that I have conferred with XX [the specialist]. (…) I learn more about how to handle various problems, where before I would have thought that I should hospitalise [the patient]."

GPB points to the significance of a second opinion for legal and professional reasons. The exchange of knowledge and the opportunity to discuss medical problems have a positive effect on patients, as GPA describes here:

GPA: "It provides professional confidence for us and for the patient to hear that we have talked to specialists about their condition."

GPB explains that the medical discussions provide safety for the patients:

GPB: "We are able to do much more locally than we were before. It was possible to give intravenous antibiotics, but it was not possible in the same way [without guidance]. Now, for me, I've experienced it [as being] much safer than it was."

SC: Those patients we are discussing get treatment on rather high level, not far from ours [the specialist level]. It creates safety for us [the specialists].

Both GPA and GPB describe how the feedback provided by videoconferencing gives them confidence in their decisions and methods of treatment. At the same time, they also gain access to a broader spectrum of illness cases and treatment methods. SC describes how the GPs access specialist knowledge and the way in which this access also creates safety for the specialist, giving a high level of treatment to the patient from a distance.

2.2. Technological Context

In the technological context, videoconferencing acts not only as a technology per se but also as a tool for interaction that offers collaboration. The introduction of videoconferencing between levels of care provides access to information and knowledge so that referrals can be avoided and the problem can be solved locally. GPA explains how this technology is a tool that makes discussion and local treatment possible:

GPA: "We have some elderly people who we thought should not be transferred to the hospital. Maybe they need it for the sake of their illness, but they are so old that we try to spare them the burden of being sent. Then, we may do things that are a bit outside of our area of expertise."

GPA explains under what circumstances the technology is used as a tool for giving patients the best treatment while considering their total health. Videoconferencing makes more problem solving possible (*i.e.*, the GPs are able to solve problems even outside of their areas of expertise). Both GPA and GPB explain how elderly people suffer if they are transported and the fact that they are considered to be the group for whom videoconferencing provides the best value for local treatment. In addition, their relatives do not have the burden of travelling with the patient to the hospital.

GPB: "It has to do with age. If it is a young person who is seriously ill, then we send him. But an older person, we would like to save them the strain of being sent to the hospital and, yes, it is about providing the best possible care locally. Relatives feel safe. The majority of patients think it is brilliant; not very many look forward to hospitalization."

GPB and SB refer to videoconferencing as supplementing traditional distance communication methods (*i.e.*, telephone consultations) via its visual possibilities. Videoconferencing provides access to visual and non-linguistic interaction and offers opportunities to share representations such as EKGs and images, which go beyond the capabilities of the telephone.

GPB: "The advantage is that I can see them [specialists], and they give me answers then and there. I think that you get a different relationship with one another. It is something else to see one another and have the opportunity to exchange EKGs or whatever else it may be."

SB: "We have access to x-rays and everything. We may look at common EKGs. Patients may participate too."

Both GPA and GPB point to videoconferencing as a tool offering health professionals visual communication and immediate access to knowledge so that elderly patients and their relatives receive better kinds of treatment (*i.e.*, being spared the burden of being sent to another hospital farther away and being treated in their own well-known surroundings near their relatives).

2.3. Spatial Context

The spatial concept of videoconferencing refers to the geographic distance between the individuals offering and receiving medical information and knowledge, offering the opportunity for a widespread community of practitioners. GPA describes how collaborative work not only offers knowledge but also provides specialists with opportunities to follow up with patients that the specialists have previously treated.

GPA: "When the patient is transferred to us from XX [hospital], the hospital's responsibility is not complete. They follow up on their patients (…). The professional development goes both ways…"

Specialist A and Specialist B support GPA's opinion regarding the two-way outcome of the collaborative work. The discussions via videoconference allow the GP to be a part of a larger collegium, a community of several knowledge specialties. As SA describes, multidisciplinary consultations also contribute something for the specialists.

SA: "We feel that it provides some service to them, but there are also two sides. It is a very nice way to discuss, which is actually easier than by phone because you are following a complete collegium. There are different specialties here, so it is easier for anyone to give, shall we say, an answer that is helpful, than if it had only been one person on the phone."

SB: "It creates a kind of community when meeting every day (…) an expanded collegium, a kind of mutual training meeting, in which we help each other. When transferring or referring, it is also quite natural to request to know what has happened [with the patient]."

SA: "Several approaches might be good. The medical problems are often complex and diffuse. We contribute to one another from a broad professional perspective."

Regular meetings provide an extended medical community for medical problem-solving and for following up. The regularity makes the collaborative work a two-way achievement.

2.4. Context of Benefits

The benefits of telemedicine refer to the idea that medical treatment can be provided to people anytime, anywhere, even if the treatment is not locally available. This implies that there is a lack of medical resources and that the distribution of resources is a benefit. GPA claims that hospitalization is avoided by bringing the knowledge to the health care level to where the patient is, and SA emphasised how patients and relatives appreciate local treatment. Daily updates provide benefits such as better coordination and information about the patient when dealing with transferring patients between levels of care.

GPA: "We avoid hospitalization. (…) The specialists follow their patients, even though they [the patients] stay here [at the GP's centre]. We also get information about the patients we have referred. The daily updates on the patients' welfare and advice are the main benefits."

SA: I have experienced both patients and relations remaining rather engaged by staying near their homes and their relatives."

Sometimes, treatment is not performed locally, because the patient wants a second opinion from a specialist (GPB). Getting a second opinion by using videoconference shortens the waiting list at the hospital, moves the decision-making to the GP, and provides feedback about those considerations to the GP at the moment of treatment (GPB).

GPB: "The patient does not have to travel, so there are shorter waiting times. When we refer [a patient] to a specialist, it is often because we are uncertain and the patient demands it. If it is a specialist on the videoconference, we clarify a great deal. I often refer patients to a specialist, mostly to gain acceptance for what I want to do or to get advice. Most patients would have accepted it [the treatment] as long as they heard that I had considered the advice of a specialist."

Both GPA and SA point to the regularity of videoconferencing as making it possible to follow how a patient is progressing, with the added benefit of avoiding travel.

SA: "We have to consider the patient from day to day, thus saving transport. It leads to less pressure on the hospital ward, and we avoid hospitalization. If we explain that it is a professional service that ensures the quality of local treatment, it seems more positive."

SA: "It also benefits us [the hospital], placing lesser pressure on our ward. We absolutely benefit from spending our time like this [in the use of daily videoconferencing]. It is a professional offer that ensures the treatment we would have given at the hospital."

GPA, GPB, and SA address the daily updates, a discussion partner, and the quality that these bring to the treatment, here seen as benefiting a professional community. SA also describes the communication as offering the same treatment as would be given in the hospital. An extended community with diverse knowledge and expertise benefits the patient's treatment and the quality of care. SB said:

SB: "The videoconference, as compared to the telephone, relies on trust, cooperation, fellowship, and all that is really needed for a good flow of patients. The quality of cooperation in a group affects the quality of patient care."

Working collaboratively changes professional patterns, and a seamless connection between healthcare levels becomes possible. This offers a new way for professionals delivering electronic healthcare, e-health, to patients.

3. Discussion

Interaction in collaborative work has been associated with the discussion between the patient and the GP [14]. Studies of interactions among physicians at different levels of care have focused on individual achievements or the inequality between them, stressing different languages [7], different levels of credibility [8], and the hieratical structures between physicians [9]. As a result, findings have focused on how the equipment is appropriate for the interactions or on who dominates and who benefits from the interaction. Data from successful collaborative work using videoconferencing provide insight into how medical discussions between levels of care produce knowledge, affecting the healthcare delivered to the patient. Collaborative work between GPs and specialists offers decision support and problem solving (Table 2). This method of collaboration provides practitioners with a new way of thinking: exchanging information and knowledge between levels of care in order to provide the best treatment for the patient locally. The patients' age matters when interacting; instead of transporting elderly patients [GPA], the GPs gets access to specialists' knowledge for a second opinion and to support their own judgment [GPA/GPB/SA/SB/SC]. By collaborating, the GPs are able to handle a variety of problems [GPB] that are outside their individual areas of expertise, but which can be solved with guidance [GPA/SA/SB]. When the physicians think collectively, instead of individually, more treatment may be performed locally [GPB]. Because videoconferencing provides visual opportunities, access to all the specialists and feedback in the moment, the interaction goes beyond that provided by the telephone [GPB]. Collaboration over distance provides multidisciplinary meetings, which offer a broader set of expertise than traditionally meetings do [SC, GPB]. The professionals not only use personal knowledge to discuss and solve problems, but also bring in EKGs, the patients, and

x-rays [SB, GPB]. This also extends the opportunities created by using the telephone. Multidisciplinary collaboration is often underestimated or only focusing on in terms of how it helps the GPs. Here, the specialists provide perspectives on how such collaboration contributes to both the patients, relatives, the GPs, and themselves [SA, SB].

The limitation of the study is the small number of GPs and specialists interviewed. Still, they were chosen based on their years of experience with interacting via videoconferencing. Here, supported by 42 observations of the meetings. These results may increase practitioners' willingness to use telemedicine in daily medical practice because telemedicine focuses on a collective achievement. GPs gain security and support by receiving advice and second opinions. Specialists receive information and get the opportunity to follow up on patients. This method of interaction challenges the traditional method of performing healthcare, which is limited to a single level of care. Working collaboratively improves health service at the local level and offers new ways of delivering medicine and e-health to elderly people in rural areas in order to meet patients' increasing demands.

4. Conclusions

In contrast to previous research, this study demonstrates how the use of videoconferencing is a two-way process, not only solving GPs' medical problems but also providing specialists with information about patients who have been treated in the hospital and may or may not be transferred back later [GPA/SB/SA,SB]. Almost daily updates (Table 1) maintain the continuity of the collaborative work [SB/GPA]. The regularity makes the collaborative work a two-way achievement. These results differ from those of previous research, which focused on one-way achievements (from specialist to GP) [15,16].

As patients become more educated, their demands concerning treatment increase [GPB]. Collaboration is a way for practitioners to meet these demands. Working collaboratively requires a commitment to networking (*i.e.*, through regular meetings and by becoming a part of a widespread, extended medical community). An integrated collegium across specialities and levels of care shortens waiting lists [GPB], saves on travel [SA], and contributes to a good flow of patients [SC]. How the professionals manage their work (*i.e.*, collaborating) may benefit their patients. Regular use of videoconferencing for collaborative work will more effectively help professionals to meet patients' demands in the future. Regularly informing and exchanging knowledge benefits the professionals by adding security regarding their medical decisions, and the patients feel satisfied with the specialist competence where they live.

Acknowledgments

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