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USE OF TELEMEDICINE BETWEEN RIGSHOSPITALET AND BORNHOLM HOSPITAL

– Report of a pilot project

Summary

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Summary

Introduction – Background and purpose

Telemedicine is traditionally considered a health technology that can improve the accessibility of health care in sparsely populated and remote areas. Furthermore, telemedicine is considered a stopgap solution mainly focusing on patient survival that relegates quality to a secondary consideration.

The current use of telemedicine comprises a teleconference between physicians that does not involve the patients.

The purpose of this health technology assessment was to test outpatient follow-up of patients using telemedicine for the first time in Denmark. This was applied in the categories of patients that do not require physical examination and for which telemedicine enables outpatient follow-up to be carried out in their community, such as the island of Bornholm (in the Baltic Sea) or the Faroe Islands.

Thus, the purpose was to investigate the opportunities for integrating telemedicine into the existing forms of treatment in which the contact is planned as a routine outpatient consultation.

Rigshospitalet – Copenhagen University Hospital (hereafter just called Rigshospitalet) and Bornholm Hospital participated in the pilot project, which focused on two selected groups of patients who live in Bornholm.

- The first group was patients referred for surgery for knee and hip prostheses at Rigshospitalet in need of preliminary investigations or subsequent follow-up. In these consultations, the physicians of Rigshospitalet received relevant diagnostic images and other material and could discuss their assessments and recommendations directly with patients, even though they were located at Bornholm Hospital.
- The second group was patients in Bornholm referred for echocardiography by their general practitioner. These patients were examined by having them come to Bornholm Hospital, where a specially trained nurse carried out the echocardiography. The images were transmitted to Rigshospitalet so that a cardiologist there could study them. The specially trained nurse and the cardiologist at Rigshospitalet jointly prepared a description of the results to comprise the basis for deciding on any further treatment.

Even though the pilot project initially included these groups, the aim was to qualify the considerations on how to extend telemedicine to other groups of patients.

Telemedicine – Remote clinical health services

This report defines telemedicine as *"clinical health services provided remotely by using information and communication technology".*

Telemedicine is a tool for promoting equal access to health services for users regardless of where they live and for counteracting the shortage of specialist physicians. Further, it can reduce costs and still maintain or improve the quality of treatment offered to patients.

The promotion of telemedicine is part of the strategy of the Government of Denmark for high quality in public services and of the future health information technology strategy of the Capital Region of Denmark (one of Denmark's five administrative regions). The strategy of the Government of Denmark for high quality in public services implies that telemedicine has unexploited potential. The future strategy for health information technology of the Capital Region of Denmark states that continuing medical specialization and challenges in recruiting will lead to the need for developing telemedicine solutions.

Pilot project involving Bornholm Hospital and Rigshospitalet

Bornholm Hospital is geographically isolated and has difficulty in recruiting physicians. Similarly, Bornholm is very remote when patients from Bornholm need to be treated at Rigshospitalet.

Telemedicine can improve the accessibility of medical competencies and reduce transport time and costs for patients.

In addition to this pilot project, Rigshospitalet has used telemedicine in the following fields:

- X-ray imaging for Greenland and the Faroe Islands and the remaining parts of the Capital Region
- Telecardiology conferences together with Gentofte Hospital and Roskilde Hospital
- Ultrasound imaging of pregnant women, mostly involving Glostrup Hospital
- Acute eye injury teleconferences with Bornholm Hospital
- Electrocardiography from ambulances
- Second opinions on positron emission tomography (PET) imaging of children in collaboration with hospitals in London, United Kingdom and in Detroit, Michigan
- Homecontrol of pacemakers concerning the Faroe Islands, Greenland, Bornholm and the remaining parts of the Capital Region.

A great challenge was to find specialties and categories of patients suitable for integrating into a telemedicine project. Not all types of treatment or consultation are equally suitable, and telemedicine is another way of managing a consultation that challenges clinical practitioners regarding traditionally approached methods of treatment.

The project group initially hypothesized that groups of patients with cancer would be appropriate for a telemedicine project.

Nevertheless, the physicians found several barriers here, such as specialized forms of treatment (for example, radiation therapy), physical examination by the same physician carrying out the treatment and indepth discussions that are only appropriate face to face.

The selection focused on relatively large groups of patients that attended outpatient services at Rigshospitalet and for which the consultations did not include any physical examination but were based on tests and/or diagnostic imaging.

The groups of patients ultimately selected for the telemedicine project were: within surgery, *preliminary investigations and follow-up for patients undergoing hip and knee operations* and, within internal medicine, *echocardiography.*

Methods

The pilot project is described based on a perspective of assessing health technology that includes the aspects of technology, patients, organization and economics.

The methods used to assess this technology were interviews and a review of documents and the scientific literature.

The aspects related to patients were assessed through: a questionnaire survey of patients residing in Bornholm who received treatment at Rigshospitalet; observing and interviewing the patients who experienced telemedicine in a consultation; and a literature review.

The role of organization was assessed by interviewing technicians and a previous manager of the pilot project. In addition, some telemedicine and face-to-face consultations were observed. The scientific literature and documents were also reviewed for organizational aspects.

The economics of telemedicine was assessed through comparative analysis of the relevant costs and a literature review.

Technology – Telemedicine and experience with using it

The technology used for telemedicine consultations is available in the form required. The technological requirements are relatively uncomplicated, and telemedicine can be based on a broad range of videoconferencing equipment. Nevertheless, optimal audio and video quality is decisive, and the equipment must therefore be of sufficient quality to enable this. Similarly, the Internet connections must be optimal. Technical personnel are required for installation in the implementation phase.

Telemedicine uses three overall solutions:

- A store-and-forward system collects medical data and transmits them for subsequent interpretation. Such a system avoids the need for the patient and the physician to be present at the same place at the same time. The technology enhances flexibility for physicians, since the images are stored and are accessible whenever the physician has time.
- Home-based telemedicine allows clinical practitioners to monitor physiological variables and to test results, images and sound. Information is usually gathered in the patient's home or in a care institution.
- Office- or hospitalbased telemedicine enables realtime telemedicine consultations between patients and clinical practitioners that would normally have required face-to-face consultation.

The solution selected for the pilot projects for both echocardiography and knee and hip prosthesis consultations was realtime telemedicine consultation.

Two solutions were tested before telemedicine equipment was purchased. A web camera was the least expensive solution and a videoconferencing system was more expensive. The videoconferencing system was chosen due to overall quality considerations.

The devices used were a TANDBERG Edge 95/85/75 MXP and TANDBERG 880 MXP, comprising a videoconferencing box that includes a video camera, microphones,

loudspeakers, computer and monitor. An Internet connection is required in which the regional net is used, and sometimes more bandwidth is needed.

The equipment used is standard videoconferencing equipment and meets the international standards in this field.

The telemedicine echocardiography also requires Xcelera, an image storage database that requires a licence. The image storage database is user friendly and does not require information technology skills other than normal user skills.

In the telemedicine collaboration between Rigshospitalet and Bornholm Hospital, the technology functioned perfectly and the quality of the sound and images was good. Achieving the appropriate quality is naturally decisive in enabling clinical practitioners to perform their tasks optimally and substantially influences how patients experience telemedicine. There were no problems in operating the telemedicine equipment.

The telemedicine equipment at both hospitals was placed permanently in a consultation room in the outpatient clinic. The videoconferencing equipment is mobile and can function as long as a computer is available where the equipment is used.

Setting up and supporting the videoconferencing equipment requires a relatively high level of technical competence in information technology. The Department of Medical Technology carried out this function at Rigshospitalet, and Bornholm Hospital used external consultants.

Patients – Attitudes and experiences

To determine patients' attitudes towards and experiences with telemedicine, a questionnaire survey was carried out among patients who travel from Bornholm to Rigshospitalet for treatment (707 patients), and 12 patients who participated in the pilot project's telemedicine consultations were interviewed and observed.

The questionnaire survey and the qualitative investigation (observation and interviews) were thus carried out on two patient groups:

- Patients who could potentially be candidates for future telemedicine consultations, since they live in Bornholm
- Patients who tested telemedicine in practice.

The questionnaire survey focused mainly on the patients' opinions on their preferred place of treatment, inconvenience related to travelling between Bornholm and Rigshospitalet and considerations related to the possible use of telemedicine. A total of 707 questionnaires were distributed, and 75 % responded.

The survey showed that one third of the responding patients thought that travelling from Bornholm to Rigshospitalet is a problem. Among the remaining two thirds of the patients one third thought that this transport is associated with some level of inconvenience – but without considering it a problem. Two thirds of the patients preferred to be treated at Rigshospitalet. The reasons for this were "positive experiences" and that these patients associated Rigshospitalet with high quality of treatment.

The patients were asked about their overall opinion about telemedicine: 43 % of the respondents said that trying a telemedicine consultation could be interesting, 41 % said they did not know and only 16 % wanted to avoid telemedicine. These responses should be viewed in light of the fact that only 56 % had heard about telemedicine. Among the patients who had heard of telemedicine, a majority thought that trying it could be interesting.

The observations of the patients focused on:

- Situations in which the effects of the technology on the patients became clear
- The flow and content of the communication
- Any technical problems
- The collaboration between the nurses (at Bornholm Hospital), the patients (at Bornholm Hospital) and the physicians (at Rigshospitalet)
- Which roles the participants take.

The patients were then interviewed about how they experienced the consultation.

The 12 patients interviewed all had positive experiences with the consultations.

The technology had functioned without problems, and the quality of the sound and images had been satisfactory. Getting the technology to function requires showing the clinical practitioners how to operate the equipment. The patients did not consider that the telemedicine equipment interfered with the consultation.

The patients were also asked whether they considered that using the videoconferencing equipment posed a barrier to achieving a personal, confidence-inspiring relationship with the physician during the consultation. Most of the patients said that this was not a problem.

The observation showed that the collaboration between physicians and nurses functioned well during the telemedicine consultation.

Most patients said that they think that the trip to Rigshospitalet is problematic, but most still prefer to be treated there. This seems contradictory in an isolated sense but can be reconciled with advocating the use of telemedicine for some groups of patients: they can be treated while physically remaining in their community and minimize transport time and expense and insecurity, and simultaneously be treated where the necessary expertise is located.

In the qualitative investigation, all the patients involved were positive towards videoconferencing, and the patients who had been sceptical before the consultation were not so afterwards. This supports the hypothesis that knowledge of and experience with this type of consultation reduces scepticism about telemedicine.

The relatively many sceptics might further have been uncertain about who would be responsible for their treatment in telemedicine if they responded positively about trying videoconferencing in the questionnaire survey.

The patients who prefer that the physicians from Rigshospitalet take responsibility have a positive experience in a videoconference since they see that they are actually in

contact with Rigshospitalet. The patients who prefer minimizing transport have a positive experience since they do not have to travel to Copenhagen.

The very positive feedback from patients who tried a telemedicine consultation makes it relevant to consider whether the use of telemedicine can be extended to more groups of patients.

A special question related to this is engaging in sensitive discussions, in which clinical practitioners, including oncologists, emphasize the importance of meeting patients face to face. Nevertheless, another perspective is that a patient in a telemedicine consultation may have greater opportunities to have family members along and that a nurse can also provide the subsequent support patients may need.

Organization – Experience from Rigshospitalet and Bornholm Hospital

The assessment of the organizational experience with the telemedicine pilot project between Rigshospitalet and Bornholm Hospital is based in part on methods and perspectives derived from organizational sociology. This examines the relationships between technology, science and the people involved.

The analysis is based on 13 interviews conducted among health care personnel, technicians and a previous manager of the pilot project. In addition, it is based on observations of six telemedicine echocardiography sessions at Bornholm Hospital and three telemedicine consultations at Rigshospitalet with patients getting knee prostheses as well as five face-to-face consultations with patients getting knee prostheses who live in other places than Bornholm.

The telemedicine pilot project has resulted in several changes in the division of labour between Bornholm Hospital and Rigshospitalet and between professions.

In the telecardiology part of the project, the division of labour was changed between the physicians and nurses from the two hospitals, and tasks were gradually shifted from physicians to nurses at Bornholm Hospital. The working tasks of the medical secretaries also changed.

For the patients getting knee and hip prostheses, physicians at Bornholm Hospital no longer participate in the consultation – this is done by a nurse (Bornholm) and a specialist physician (Rigshospitalet). This reorganization also meant that the nurses at Rigshospitalet were no longer needed during the consultation.

For patients getting knee and hip prostheses, Bornholm Hospital's nurses now participate in the entire consultation, and this enhances their knowledge and skills. The head nurse in this field at Bornholm Hospital indicates that the work with telemedicine can be considered an independent field of responsibility that can serve as a variation in relation to other daily tasks.

The physicians at Bornholm Hospital do not think that their knowledge has changed as a result of this project since they do not participate in the consultations. They view telemedicine as a tool that can be used to develop the competencies of physicians working in peripheral areas in Denmark through conferences at which they discuss joint patients.

The telecardiology solution solely includes routine echocardiography, and a physician at Bornholm Hospital continues to carry out the acute echocardiography. This poses a risk that physicians might lose their competencies related to acute echocardiography since they never perform routine echocardiography. This needs to be considered when telemedicine is adopted permanently in this field.

This investigation assessed whether the telemedicine project has influenced the collaboration between Rigshospitalet and Bornholm Hospital. The collaborative relationships between physicians have not changed. The physicians and nurses have begun to collaborate more closely, especially in relation to the consultations with patients getting knee and hip prostheses.

The telemedicine project has shown that telemedicine consultations can be carried out within certain fields in a medically responsible manner according to the physicians. The project has thus fulfilled its objective of implementing telemedicine solutions. The next challenge is to bring the pilot project up to full operation. The experience with telemedicine services shows that only a few telemedicine projects achieve full operation.

The literature on telemedicine defines five ideal characteristics that influence whether a telemedicine project succeeds: 1) political and administrative management, 2) committed implementers, 3) technicians, 4) health care professionals and 5) patients.

It is important that the management have positive attitudes towards the project and that committed implementers be involved, but another requirement is that the management needs to formulate a purpose for the telemedicine project that can be marketed to the clinical practitioners, the patients and the public. Thus, the main purpose for telemedicine for patients getting knee and hip prostheses of minimizing patient transport is an asset. Telemedicine can reduce inconvenience and costs for patients and can be a solution for patients who are not very mobile. This may ease the transition from pilot project to full operation.

It is also important that the clinical practitioners be involved in developing the telemedicine model since they will be using this solution and their acceptance is decisive in determining whether the solution will survive the transition from pilot project to full operation. The clinical practitioners in this project found that they could influence the process and participated in selecting the patient groups they considered could be treated using telemedicine without reducing the quality of treatment.

During the project, the clinical practitioners contributed to reducing the perhaps excessively positive expectations of the managers and committed implementers towards the potential of telemedicine. This meant that the solution was narrower than what the managers and committed implementers had imagined initially. For the clinical practitioners, the experience with the pilot project and the positive course of the consultations meant that they are ready to expand the groups of patients that might be suitable for telemedicine.

One of the most important organizational challenges was that the physicians of Rigshospitalet had to be physically present in the room in which the videoconferencing system is located at the time scheduled for the telemedicine consultation. This was arranged by having the physician plan a day at the office on which the image analysis and telemedicine consultation could be coordinated with Bornholm Hospital.

The role of committed implementers is important. This also applies to this pilot project, especially in the initial phase in which most of the people involved are sceptical. However, if the organization of the telemedicine consultations is not integrated into the routines on both sides and if very few people can operate the equipment, the modality may disappear when the committed implementers leave the project.

Thus, the system is vulnerable if it is based on a few people. The current plan is that several employees will be able to facilitate the telemedicine consultations at Bornholm Hospital. At Rigshospitalet, it would be sensible to broaden the solution to several physicians so that it does not rely on one physician.

The funding for the telemedicine consultations is also important to ensure sustainability. Rigshospitalet is not reimbursed for the time clinical practitioners use on the telemedicine consultations, and this is an important obstacle to making the telemedicine solutions permanent. Preparing and implementing a model for funding the services is therefore considered a prerequisite for making these two telemedicine solutions permanent. If this is not done, the clinical practitioners may find that their departments will be financially uncompensated for participating in telemedicine.

The guidance document of the National Board of Health on the legal liability regarding telemedicine indicates that the same concept of legal liability applies as for consultations that take place face to face.

A certain volume of telemedicine is needed to make it useful in daily practice. If the volume of investigations and tests is insufficient, the telemedicine competencies may be inadequate.

Economics – Differences in the two forms of consultation

The economics of the pilot project between Rigshospitalet and Bornholm Hospital was assessed through comparative analysis comparing face-to-face consultations at Rigshospitalet with videoconference consultations at Bornholm Hospital.

The use of telemedicine in this project has a socioeconomic effect by reducing transport costs, saving time and improving comfort and convenience. The overall economic value of these aspects was not quantified, but it appears that the economic value is positive. The question of whether introducing telemedicine changed the investigations, tests and treatment chosen and the potential economic effects this would have was not analysed either.

The economic method used was to analyse the minimization of costs, focusing on the relevant costs of the two types of consultations. The method selected requires that the quality of treatment be identical. This is assumed to be the case, since the participating physicians considered the quality to be the same for the two types of consultations. The costs of the consultations for patients getting knee and hip prostheses and the echocardiography consultations were calculated. The costs were categorized as start-up costs, fixed costs and variable costs (see Table A and B below).

Strictly speaking, a telemedicine consultation is more expensive than a face-to-face consultation since personnel have to be present in two locations. Investing in and operating the technical equipment are additional costs. The economic benefits exceed the

costs when the number of telemedicine consultations attains a certain number such that the transport expenses avoided exceed the extra costs of telemedicine.

Table A Cost figures for echocardiography

Annual depreciation on the telemedicine equipment regardless of the number of consultations	€ 2,646 per year
Annual fixed costs of support for the equipment regardless of the number of consultations	€ 3,407 per year
Reduction in the variable costs per consultation through telemedicine (reduced travel costs minus nurses' salaries etc.)	–€ 90 per consultation

The analysis of costs shows that overall costs to society are reduced if more than 68 telemedicine consultations are carried out per year.

Table B Cost figures for knee and hip prostheses

Annual depreciation on the telemedicine equipment regardless of the number of consultations	€ 2,374 per year
Annual fixed costs of support for the equipment regardless of the number of consultations	€ 3,407 per year
Reduction in the variable costs per consultation through telemedicine (reduced travel costs minus nurses' salaries etc.)	–€ 117per consultation

For patients receiving knee and hip prostheses, overall costs are reduced if more than 49 telemedicine consultations are carried out per year.

In the six months during which the use of telemedicine was registered, 154 echocardiography sessions were carried out by telemedicine, equivalent to 308 over an entire year, so these consultations reduced overall costs to society. In contrast, only 26 telemedicine consultations were carried out for knee and hip prostheses, equivalent to 52 over an entire year, and telemedicine did not reduce the costs to society for this group of patients during these six months, due to the fact that initial costs and fixed costs have only been divided to these six months. The cost analysis thus shows that using telemedicine provides economic benefits for echocardiography and for preliminary investigations and follow-up in connection with knee and hip prostheses. The economic benefits will increase as Rigshospitalet expands its treatment capacity.

The economic benefits are achieved solely by reducing transport costs. If transport costs are excluded, using telemedicine increases costs. If the patients pay for their own transport, the economic basis for using telemedicine is therefore the overall economic benefit to society or the fact that the patients experience improvements in time and convenience.

Conclusion

The use of telemedicine in connection with echocardiography and preliminary investigations and follow-up for patients getting knee and hip prostheses was successful overall. The patients experienced improvements in both convenience and time saved since they did not have to travel to Rigshospitalet. Similarly, economic costs are reduced considerably by reducing the number of patient trips. This reduction means that the use of telemedicine has produced an overall economic benefit in the six months during which the number of telemedicine consultations was registered in connection with this pilot project.

The reduced travel time will also potentially provide an overall economic benefit to society, since the patients do not have to take as much time off work as they did previously. The report does not discuss this.

The attitudes of patients at Bornholm Hospital towards telemedicine became more positive as their knowledge of telemedicine increased. Both the questionnaire survey and the qualitative investigation (observation and interviews) showed this: the patients who knew nothing about telemedicine were mostly sceptical, and those who participated in a telemedicine consultation were mostly positive. Improving information on telemedicine can therefore reduce the scepticism towards telemedicine consultations.

The results of the project emphasize the importance of involving the clinical practitioners in the development process, both to ensure their acceptance and because excellent professional knowledge of each patient group is required to assess whether telemedicine consultations can replace face-to-face consultations.

The transition from a pilot project to full operation can be promoted by concentrating the telemedicine consultations at certain times to minimize the disruption to the other work of clinical practitioners. The collaboration between Rigshospitalet and Bornholm Hospital ensured this. The methods of telemedicine must also be sufficiently integrated into the organization. Further, planned telemedicine solutions must be based on the opportunities to recruit and retain employees at both hospitals with the aim of creating stable solutions.

The technology needs to function well and the equipment must not disturb the physicians and the patients if physicians are to be able to communicate properly with their patients. The equipment functioned well in this project but can still be improved. A policy on the quality of service would reduce the few disturbances that still occur. This will strengthen the potential for disseminating this technology to other fields.

The pilot project introduced telemedicine to a relatively limited number of patient groups, and telemedicine succeeded in relation to all the aspects assessed: technology, patients/clinical practitioners, organization and economics. Nevertheless, the results of the project indicate that the experience with telemedicine in the long term will result in more patient groups being considered suitable for telemedicine solutions. A small proportion of the total outpatient consultations can be carried out using telemedicine, but the project shows that this should be done where possible.

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