UiT The Arctic University of Norway

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Telemedicine in remote orthopaedic consultations:

A randomised controlled trial

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A dissertation for the degree of Philosophiae Doctor, June 2020

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It is important to remember that every patient is unique and has a different level of activity and needs.

This was demonstrated by a comment from an 81-year-old female patient on the 12-month questionnaire:

> "Note. My left hand, which the doctor (the specialist) said should become paralysed (not useful) – I have trained so much that it works very well (so even specialists can be wrong). I walk where I want. Every day, I ride my bicycle – clean the house as I have done through all years. I have trained all my joints in the fingers and arms and feet. Have a nice summer.
>
> – Yours sincerely, NN"

One patient travelled a long way to Tromsø by bus, spending the whole day for a hospital visit where he was offered a follow-up consultation at Sonjatun (the RMC). However, he chose UNN because as he said it was "better to sit on the bus all the way to Tromsø than to taking the same early bus to Storslett, then hanging around and waiting for the same bus back home in the evening."

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Abbreviations

CI	Confidence interval
CVI	Item content validity index
CEA	Cost effectiveness analysis
CT-scan	Computed tomography scan
EQ-5D	Generic descriptive system of health-related quality of life consisting of five dimensions
EQ VAS	Visual analogue scale for valuing health-related quality of life
GDB	Global Burden of Diseases, Injuries and Risk Factors study
GEE	Generalised estimating equation
GP	General practitioner
I-CVI	Item-level Content Validity Index
OPEQ	OutPatient Experiences Questionnaire (“PasOP-Pol”)
PC	Personal computer
PROM	Patient-reported outcome measure
QALYs	Quality-adjusted life years
RCT	Randomised controlled trial
RMC	Regional medical centre
TUA	Telehealth Usability Questionnaire
UNN	University Hospital of North Norway

Definitions

"**EQ-5D-3L** is a descriptive system of health-related quality of life states consisting of five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression), each of which can take one of three responses. The responses record three levels of severity (no problems, some or moderate problems and extreme problems) within a particular EQ-5D dimension. Based on preferences elicited from a general population, EQ-5D health states (e.g. 1–1–2–3–1) may be converted into utility scores (= index scores) (1-1-1-1-1 = 1.0 value for full health)" [1]. We used a value set elicited from a British population.

"EQ VAS is a standard vertical 20 cm visual analogue scale (similar to a thermometer) for recording an individual's rating for their current health-related quality of life state. The best state you can imagine is marked 100 and the worst is marked 0" [1].

QALYs were developed to compare health gains and include both quality of life and the duration of the health state. One QALY is the same as 1 year lived in perfect health. It is calculated by multiplying the change in utility value with the duration of the health state [2]. In this study, QALY gain: Δ EQ-5D x 1 year = ($EQ\text{-}5D^{12month}$ - $EQ\text{-}5D^{baseline}$) x 1 year.

Validity (accuracy) is the degree to which an assessment measures what it is supposed/intended to measure (*gyldighet/nøyaktighet*).

Reliability is the extent to which a measurement gives results that are consistent (*pålitelighet*).

Effectiveness in medicine is how well a treatment works in practice.

A **cost effectiveness analysis (CEA)** measures the benefit as a health change, for example blood glucose levels, sick days avoided and life years gained. The result is the cost per unit of effect, for example the cost per life year gained. CEA tells which of two or more alternatives are less costly for at least as much benefit, more effective for equal or lower costs, or more effective and more costly [3].

The **Cronbach's alpha** is a measure used to assess the reliability, or internal consistency, of a set of scale or test items. In other words, the reliability of any given measurement refers to the extent to which it is a consistent measure of a concept; the Cronbach's alpha is one way of measuring the strength of that consistency.

List of papers

I. **Quality of care for remote orthopaedic consultations using telemedicine: a randomised controlled trial**

Buvik A, Bugge E, Knutsen G, Småbrekke A, Wilsgaard T

BMC Health Services Research (2016)16-483. doi: 10.1186/s12913-016-1717-7

II. **Patient reported outcomes with remote orthopaedic consultation by using telemedicine: A randomised controlled trial**

Buvik A, Bugge E, Knutsen G, Småbrekke A, Wilsgaard T

J Telemedicine and Telecare. (2019) 25(8) 451-459. doi: 10.1177/1357633X18783921

III. **Cost-effectiveness of telemedicine in remote orthopedic consultations: Randomized controlled trial.**

Buvik A, Bergmo TS, Bugge E, Smaabrekke A, Wilsgaard T, Olsen JA

J Med Internet Res. (2019)21(2):e11330. doi: 10.2196/11330

English summary

Background/Aims

Decentralised services using outreach clinics or modern technology are methods to reduce the patient burden by reducing transport time and costs to the health care system. The aim of this study was to evaluate the quality of planned remote orthopaedic consultations with the help of videoconferences. Quality is measured in terms of patient-reported outcomes and clinicians' assessments.

The study hypothesis: The introduction of telemedicine service in the form of real-time videoconferences for selected orthopaedic patients will (i) not reduce the quality of the patient treatment administered by the doctor involved in the consultations, (ii) increase patient satisfaction and (iii) lower the societal costs.

Methods

We performed a randomised controlled trial (RCT) with two parallel groups: video-assisted remote consultations at a regional medical centre (RMC) as an intervention versus standard consultation in the orthopaedic outpatient clinic at the University Hospital of North Norway (UNN) as a control. The participants were patients who had been referred to or were scheduled for a consultation at the orthopaedic outpatient clinic. The orthopaedic surgeons evaluated each consultation they performed by completing a questionnaire, with five five-level questions, each measuring five categories of experience. The primary outcome measurement was the sum score calculated from this questionnaire, which was evaluated by the non-inferiority of the intervention group. The study design was based on the intention to treat principle. The secondary outcomes were patient satisfaction and cost effectiveness.

Results

The sum score of the specialist evaluation was significantly lower (i.e. "better") at UNN compared to the RMC but was within the non-inferiority margin. The orthopaedic surgeons involved evaluated 98% of the video-assisted consultations as "good" or "very good" and equal to a standard consultation. In the ancillary analyses concerning professional quality, no significant difference between the two groups was noted. We did not observe any significant difference in patient-reported health outcomes (EQ-5D; EQ VAS) between video-assisted and standard consultations, suggesting that video-assisted remote consultation can be safely

offered to selected orthopaedic patients. In terms of patient satisfaction, a significantly higher proportion of patients preferred video-assisted remote consultation as their next consultation. We found that telemedicine service in this setting is cost-effective from societal and health sector perspectives.

Conclusion

The study demonstrated that video-assisted consultations for selected orthopaedic patients is preferred to standard consultation in terms of clinician reported quality, patient-reported health outcomes and cost-effectiveness.

Norwegian summary

Bakgrunn/mål

Desentralisert tjeneste tilbudt ved ambulering eller moderne teknologi, er metoder for å redusere både belastning for pasientene ved reising til og fra konsultasjon, samt kostnadene for helsesystemet. Hensikten med dette studiet var å studere kvaliteten til planlagte desentraliserte ortopediske konsultasjoner som utføres ved hjelp av videokonferanse. Kvalitet er målt både i forhold til pasientens rapporterte «outcome» og klinikernes vurdering.

Studiehypotesen: Innføringen av telemedisinservice i form av direkte videokonferanse for utvalgte ortopediske pasienten vil: (i) ikke medføre reduksjon i kvaliteten av pasientbehandlingen; (ii) øke pasienttilfredsheten; (iii) redusere kostander for samfunnet.

Metode

Vi utførte et randomisert kontrollert studie (RCT) med to like grupper: desentralisert poliklinikk ved hjelp av videokonferanse ved et distriktmedisinsk senter (RMC) som intervensjon, mot vanlig, standard konsultasjon ved ortopedisk poliklinikk ved Universitetssykehuset Nord Norge (UNN) som kontrollgruppe. Deltagerne var pasienter ny-henvist til konsultasjon eller med planlagt kontroll ved ortopedisk poliklinikk. Hver konsultasjon ble evaluert av den utførende ortopeden ved hjelp av et spørreskjema bestående av fem fem-nivås spørsmål hver som måler forskjellige erfaringer av konsultasjonen. Primært utfallsmål var kalkulert sumskår fra spørreskjemaet. Vurderingen ble gjort ved «non-inferiority» av intervensjonsgruppen. Studiet var basert på «intention to treat» prinsippet. Sekundære mål var pasienttilfredshet og økonomiske analyser.

Resultat

Forskjellen i den beregnende skåren angitt av utførende ortoped, var signifikant lavere (dvs. bedre) for UNN sammenlignet med RMC, men innenfor «non-inferiority» marginen. De utførende ortopedene vurderte 98% av video konsultasjonene som «veldig bra» og «bra» og like god som en standard konsultasjon. Det var ingen signifikant forskjell mellom gruppene vedrørende faglig kvalitet i tilleggs analysene. Vi fant ingen forskjell mellom video og standard konsultasjon i pasientrapportert tilfredshet og selvrapportert helse (EQ-5D/EQ-VAS).

En signifikant høyere andel av pasientene foretrakk videokonsultasjon som deres neste konsultasjonsform. Vi fant i tillegg at telemedisinservice i denne sammenheng, er kost-effektiv, både fra et samfunnsmessig - og helsesektor perspektiv.

Konklusjon

Vi viste at det ut i fra et faglig-, pasient- og økonomisk perspektiv er forsvarlig å tilby konsultasjoner ved hjelp av videokonferanse for utvalgte ortopediske pasienter.

1 Introduction

Five hours after he left home, a 4-year-old boy came to see me in the orthopaedic outpatient clinic. To get to the hospital, he had travelled 320 km by car with his mom and dad. The parents had taken the whole day off from work. Just before the appointment, he had an X-ray taken of his feet. The patient was examined, and the parents could be reassured that he did not suffer from any serious disorders, and for the moment (or ever), he would not need any special treatment. Then they could travel back home again. Travelling can be boring, but it can also be a burden (e.g. if a patient has a broken leg treated with a long cast or is an older person with hip pain, which causes trouble when moving about or sitting for a long time). Not at least, travelling is costly.

According to the Global Burden of Diseases report, musculoskeletal disorders make up for three of the leading 25 causes of disability. Lower back and neck pain and other musculoskeletal disorders are among three of the top 10 global causes of years lived with disability. Disability after injuries such as fractures and dislocations is not included [4]. In Norway in 2016, musculoskeletal disorders were three of the leading causes of years lived with disability (non-fatal health loss) [5]. This is also visible in the secondary health care system. In North Norway, the inhabitants have on average 1.53 specialist consultations per year (2017). Almost every tenth consultation is an orthopaedic consultation (personal communication from Centre for Clinical Documentation and Evaluation – SKDE). There is no indication that this will dramatically change. For 10 years (2006–2016), the age–adjusted rates were stable for fall-related injuries, low back and neck pain, anxiety, depression and migraine, but the total number of years lived with disability increased. Ageing and/or growth of the population can explain this [5].

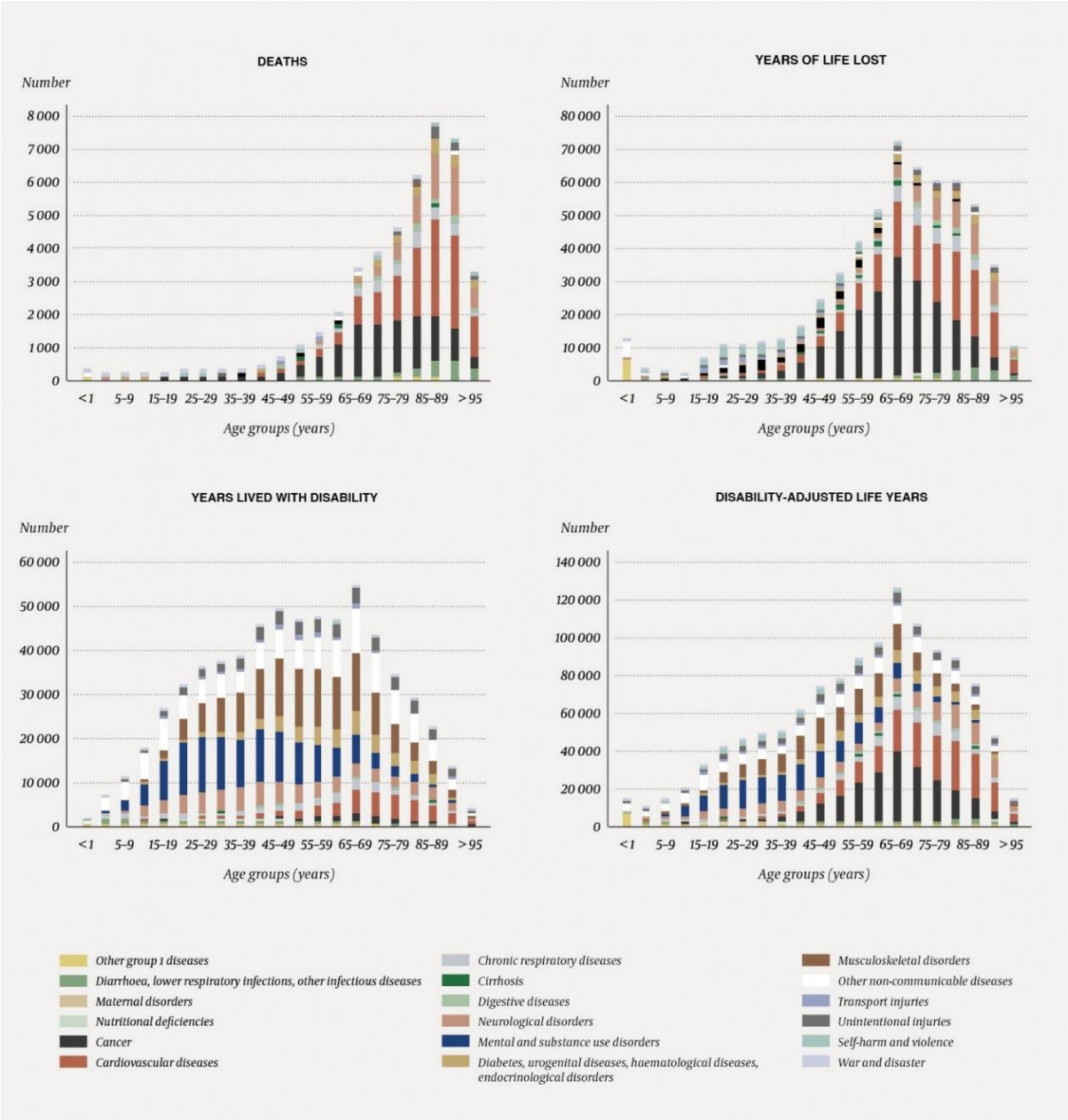

Figure 1 Disease burden in Norway 2016, estimates from the GBD project. All age groups are represented by columns, although not all of these are labelled underneath (e.g. 10–14 lies in between 5–9 and 15–19). Other group 1 diseases = HIV/AIDS and tuberculosis [5].

According to the health authorities in Norway, it is a public responsibility to provide necessary health and care services to the entire population regardless of the place of residence [6]. The topography, weather conditions and sparsely populated areas challenge both patients and the health budget. North Norway consists of 481,000 inhabitants (9.3% of Norway's population in 2015) and an area of 112,975 km² (34% of Norway's mainland). The North Norway Health Trust spent 13.7% of its total expenses on patient travelling, compared to 6.7% for all four hospital trusts in Norway (2016) [7]. Although the hospital trusts' travelling

expenses for patients include travelling both in primary and secondary health care, travelling still counts for 3.0% of the total health budget in Norway (327 309 million NOK in 2016 [8]).

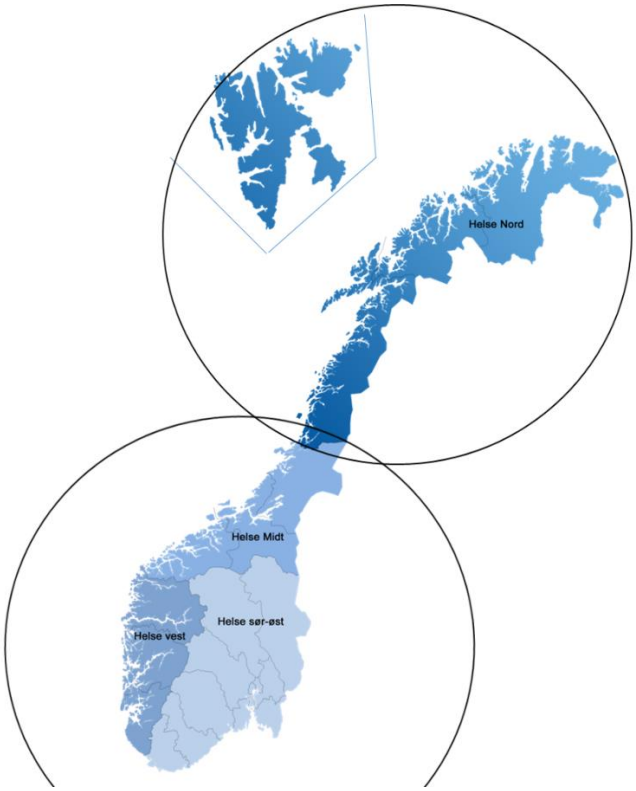

Figure 2 Norway and the different Health regions

The scattered settlements have lengthened the patient travel time to receive specialist health care. Increasing sub- and higher specialisations in the medical field and the centralisation [9, 10] of some treatments has also lead to more travelling and longer travel distances for patients. Putting the patients in focus, the heath authority has encouraged the implementation of decentralised services to move the services closer to the patients when possible [6]. This is of special importance for the treatment of common and chronic disorders, but also for emergency conditions, such as cerebral infarction (telestroke) [11] and heart attack [12].

The travel burden for ‘my’ orthopedic patients was the main motivation for this trial. In addition, as part of the health care system, we are all obligated to spend the resources well so we can treat as many patients as possible in the best and most cost-efficient way. However, in the same way as new operation surgical techniques have to be thoroughly evaluated compared to standard methods, new ways of performing consultations should be scientifically investigated. This thesis aims to answer if a video-assisted consultation can be an option for selected orthopaedic patients.

2 Background

2.1 A consultation

In 2017, *Helsedirektoratet* reported that 1 796 160 individual patients had at least one outpatient consultation that year, with a mean of 3.4 consultations per patient [13]. The indications for and consequences of a consultation in the outpatient clinic can be different, depending on the nature of the disease and the specialty. In orthopaedic surgery, consultations are partly elective (planned) and partly emergency (not planned). Emergency consultations might be due to a trauma or acute deterioration of a known condition and has to be performed more or less acutely. In 2017, emergency consultations counted for 4004 of the 13979 orthopaedic outpatient consultations at UNN Tromsø (29%) (personal communication from the Centre for Economics and Analysis, UNN). During an emergency consultation, it has to be clarified whether the patient needs to be immediately admitted to the hospital; needs a scheduled operation; can be conservatively treated with a cast; needs further examination if it is a condition that just need rest, painkillers and time to heal; and so on.

The patients can also be referred from their general practitioners (GPs) for chronic problems to get appointments within a reasonable time, depending on the severity of the known or suspected disorder - an elective patient. For patients who receive the right to specialist health care, the condition has to be evaluated as serious, and it must be considered that specialist health care will be useful and cost-effective (national priority setting criteria) [14]. In 2017, 2795 (20%) patients were seen in the orthopaedic outpatient clinic at UNN Tromsø as elective patients (personal communicated from the Centre for Economics and Analysis). The conclusions after scheduled consultations can also have a wide variation depending on the diagnosis, symptoms, complaints and the stadium of the diagnosis. This can be a referral to an operation, the need of further investigation, physiotherapy, orthopaedic aid requisitions or to no treatment at all, only information and expectations – “just wait and see”.

A third option is a follow-up consultation after a trauma or treatment. For example, subsequent to the initial consultation after a wrist fracture, in general, a patient will need two or three follow-up consultations until the fracture is healed. An X-ray has to be taken to identify any dislocation and the appearance of callus in the healing process. Sometimes, the cast has to be changed during the treatment, and it has to finally be removed after the healing

of the fracture. Others need a control after a surgical procedure to confirm the result and detect any unexpected events [15]. After some joint replacement surgery, “lifelong” regular follow-up consultations can be indicated, especially to detect implant wear [16, 17].

Finally, some patients with chronic disorders need regular follow-up consultations to get intervention in time. For example, some children with leg length differences [18] or scoliosis [19] need to be followed up to maturity. Other patient groups that need long time follow-up can be tumour patients to detect metastases or relapse [20].

2.2 Traditional orthopaedic consultation

In a traditional orthopaedic consultation, the evaluation starts from the first moment that the patient is spotted. Especially in orthopaedic surgery, the observation of how the patient moves (when not considered observed) is important when evaluating how much the actual disorder really affects the patient. It is important to detect the connection between the patients’ complains, history, clinical tests and sometimes additional diagnostic imaging or blood tests to diagnose the patient and suggest the correct treatment for the individual. The questions asked and tests performed are different between different disorders or diagnoses [21, 22]. For some disorders, physical examinations and clinical tests are important parts of the diagnostic process [23]. A conventional X-ray is an important supplementary diagnostic tool, both as part of the follow-up diagnosis in fracture treatment and as the recommended first radiological intervention for many disorders, especially when arthritis or bone changes are suspected [24, 25]. Still, an X-ray alone is not the only parameter needed to evaluate a patient with knee pain and expected arthritis [26].

2.3 Known modes to reduce patient travel

2.3.1 Specialist outreach clinic, “Ambulation”

In secondary care service, a travelling specialist has been one of the methods used to reduce patient travel and to cover for a lack of specialists. An outreach clinic can be in the form of a specialist/consultant travelling from one hospital to another to perform consultations or from one hospital to an outreach clinic or an RMC to treat or examine patients using local resources and facilities [27]. Frequency depends on the demand and available specialists who can agree to and have the possibility of travel. This depends on such factors as the workload at the consultants’ primary hospital, the family situation and the economic compensation. In

Norway, the Finnmark Hospital Trust is probably the hospital trust that delivers the most services outside the hospital walls [28].

2.3.2 Telephone

A telephone is sometimes practical to get hold of supplementary information from referred patients if the referral letters do not include sufficient information. A telephone can also be preferred as an option for some pre-anaesthesia evaluation even for patients living close to the hospital [29]. A post-operative contact by telephone has been shown to be acceptable for the patient or family when performed according to a structured post-operative protocol [15, 30]. After colorectal cancer treatment, telephone contact instead of an in-person visit is suggested as an option [31]. The introduction of the free choice of hospital for elective specialist health care in Norway may make some patients travel long distances. Some orthopaedic surgeons use telephone contact instead of a standard control in the outpatient clinic after three months (personal experience). An earlier review article by Thompson-Coon et al. found little evidence and few studies that compare follow-up consultation after surgery by telephone instead of face to face. They recommended that relevant studies should be performed before implementation in practice [32]. A more recent randomised controlled trial found that telephone follow-up after a laparoscopic appendectomy or a cholecystectomy is safe, satisfying and effective [33].

2.3.3 Electronic transmissions of patient data

With the possibility of converting from analogue to digital registration of examination methods/tests (e.g. electrocardiograms in cardiology and fundus picture in ophthalmology), the test can be performed one place and the evaluation another place, speeding up the initial treatment [12] or avoiding patient travel [34, 35]. In dermatology, digital photos support a request from a GP concerning the treatment of skin problems [36, 37]. Still, before some services are fully implemented in daily use, many legislative and technological obstacles have to be solved.

In orthopaedic and other specialties using imaging as diagnostic tools, sending images such as X-rays, CT- or MR-scans to get a second opinion, or together with the patient history to get advice for further treatment, is a highly evaluated option instead of unnecessarily sending the patient [38-40]. In 2000, UNN was the first university hospital in Europe with a fully digitalised radiological department (personal communication). Since October 2016 in the

North Norway regional health trust, evaluating images taken in North Norway (not by private institutes) has become even smoother because all the hospitals share a common digital system for picture storage and radiological patient files.

2.4 Telemedicine

The introduction of the term "tele-" in the field of medicine can be seen as part of the general development in information and communication technology in the last century, initially with the use of "telephone" and "television". Probably the first established telemedicine clinic was in 1967; Massachusetts General Hospital offered medical assistance/advice to passengers and staff at an international airport [41]. The term "telecommunication" was introduced in 1976 as a MeSH item, and "telemedicine" came later in 1993, meaning: "Delivery of health services via remote telecommunications. This includes interactive consultative and diagnostic services." With increased research in different fields, new items have been included, such as "teleradiology", "telepathology" and "remote consultation" in 1996 and, finally, "telerehabilitation" in 2016. Telemedicine can reflect a wide spectrum of technology – from simple email-based store-and-forward [42] to remote surgical technologies with the use of surgical robots [43, 44]. Telemedicine can also be used in different situations – from a remote "standard" consultation with the patient at one end and the specialist at the other [45] to complex setups/arrangements in trauma situations with more specialist "observers" at the other end [46]. The development has been rapid, and the possibilities for implementing different services are high [47]. But telemedicine is still far from routine delivery on a large scale in actual health services [48, 49]. The requirements for proven quality and safety are different from situations where you do not have other options and in situations where you can travel a little bit longer to receive standard care. Securing health support in the Antarctic [50], overcoming a limited availability of specialist service [51, 52] or avoiding unnecessary long travel distances for the patients [42] have different demands for safety, reliability, usefulness and the ease of use of the system.

In this trial, telemedicine consultation is defined as a remote consultation performed by real-time, two-way video and audio communication with patients at one end and the specialist, the orthopaedic surgeon, at the other. A connected digital X-ray system is available as standard use both at the hospital and at the remote location.

2.4.1 Telemedicine and orthopaedic surgery

At the end of 1990, some studies demonstrated the option to use telemedicine to reach out with orthopaedic care to patients at a distance as part of emergency consultation [53-55], while other studies showed that telemedicine is a feasible and valid alternative for orthopaedic outpatient clinics [56-59]. A prospective, cohort study of 100 patients found telemedicine to be a reliable method for the diagnosis and formation of treatment plans for upper extremity disorders [60]. Despite positive reporting of telemedicine and orthopaedic consultations, the implementation in clinical practice remains low. Small studies and study design limit the generalisability of the findings. In a Cochrane study, Currell et al. found various forms of telemedicine feasible, but little evidence of clinical benefits and lack of evidence of cost-effectiveness. They recommended that RCTs of telemedicine applications should be performed [61]. Whitten et al. concluded that economic evaluations of telemedicine have been limited by patient numbers and unclear economic evaluation methods [62]. Also, a review of studies on patient satisfaction with telemedicine found that the evidence concerning patient satisfaction with telemedicine is rather limited [63, 64]. At the time our trial was initiated, few published RCTs had assessed the effect of telemedicine on orthopaedic patients, and none of these trials were conducted in Norway [61, 65-67].

2.5 Evaluating health care

How can health care be evaluated? The quality of health care is in general complex and depends on many factors, including safety, feasibility, efficacy, sustainability, cost-effectiveness and the satisfaction of the users involved. Hanefeld et al. pointed out some of this complexity when evaluating health care in low- and middle-income countries compared to high-income countries. It is important to recognise the multifactorial complexity when taking in to account different social norms, relationships and values and trust within the societies and communities where care is provided. All affect the result of the health care provided and challenge the assessment of measurement of the given health care [68]. According to Donabedian, important elements are structure, process and outcome when evaluating the quality of care [69]. The structure of health care can contain both physical and staff characteristic. The process is the actual care given and received, and the outcome is the consequences of the interaction between individuals and the health care system [70]. Medical outcome is defined as the degree of patient satisfaction, consequences or outcomes of the provided care [69]. What is of main interest depends on which health service is to be

evaluated and from which view point. For example, when evaluating operative versus conservative treatment of an ankle fracture, it is relevant to use outcomes as time to union, malunion, nonunion or the validated functional Olerud Molander Ankle Score as important outcomes [71], since the main interests are the treatment of an ankle fracture union and the best possible conical /functional outcome for the patient. However, from the health provider's view, it is interesting to know which treatment methods are worth spending money on and what is most cost-effective [72]. Outcome measures in the evaluation of telemedicine services can be divided into three categories: the measures of user satisfaction and medical and financial outcomes [66]. Aarnio et al. investigated the participant satisfaction with telemedicine consultations for surgery, including surgeons, GP and patients [73]. Whitten and Lover pointed out that for participants, patients and providers, perceptions are important factors and are complex and need to be treated as such [74].

In this thesis, a pragmatic approach in evaluating the health service is taken, focusing on the specialists' evaluations of the consultation, patients' satisfaction, the economical aspects of the consultation modes and some general medical outcomes.

2.5.1 Patient satisfaction

Patient satisfaction is one of the key elements in the assessment of the quality of health care. It can be both an outcome of the health care and an element of the health status itself [69]. Whether a patient is satisfied with the health service provided can not be ascertained with a simple question: "Are you satisfied or not?" Also, patient satisfaction is not well defined. Many studies express patients' and providers' satisfaction with health care in different ways. Satisfaction can simply be defined as when an individual's expectations of treatment and care are met. Meeting the patients' expectations increases patient satisfaction [75]. Several factors influence satisfaction, related to the patient and how data are collected [76]. Some are patient-related factors, which can include age, educational level, the patient's expectations, self-interest and gratitude [77-79]. Methodological factors can include the question format, the data collection procedure, the sampling strategy and the response rate. Most important is the quality of the assessment instrument according to validity and reliability and whether the instrument actually measures what it is supposed to measure [76]. Garret et al. developed and validated the Norwegian Out-patient Experiences Questionnaire (Norwegian OPEQ) based on responses from 19 266 patient from 52 outpatient clinics in Norway [80]. This pointed out some core items for relevant questions for investigating outpatient experiences:

communication, clinical access and organisation. Other items to be included depend on the specialty: hospital standards, information and pre-visit communication.

Telemedicine studies regarding patient satisfaction have to be performed under the same requirements with accuracy. Whitten et al. pointed out different points that influence patient satisfaction, such as providers' communication skills and awareness of patients' concerns. They also suggested that the underlying reasons for patient satisfaction with a service could depend on patients' different evaluations of the setting, the type of consultation and the situation, making it difficult to generalise result from one telemedicine situation to another [81]. Also, in a telemedicine study, it is recommended that patient satisfaction be assessed using questionnaires which have been validated and have been shown to produce repeatable results and which measure what they are intended to measure [64]. At the time our study started, no validated instrument assessing patient's satisfaction about telemedicine in general was available. Later, Parmanto et al. developed and evaluated the Telehealth Usability Questionnaire (TUA) [82]. TUA offers the possibility of evaluating existing and future new technologies according to different aspects in giving health care, such as the patient's usefulness evaluations, the ease of use and learnability, the interface quality, the interaction quality, reliability, satisfaction and future use.

2.5.2 Economic evaluation and cost-effectiveness

Another important element in the evaluation of a health care is the analysis of cost-effectiveness. Economic evaluation is defined as a comparative analysis of costs and benefits of alternative options or health programs [83]. Costs are the resources used, and these are compared to the health benefits generated [84]. An understanding of the relationship between the resources used and the health benefits generated can help determine whether to implement the new service or not [85]. It is important to evaluate the costs and benefits of telemedicine and e-health services before they are put into daily practice to ensure that these services generate cost-effective resource use [3] [86].

Different approaches can be used to analyse the cost-effectiveness of health care. In a health provider perspective, only health care costs are included in the analysis. Another view is from the societal perspective, where all costs regardless of who incurs them are included [2]. Societal costs include private costs, such as travel costs, out-of-pocket user fees and time costs. In Norway, patients' travel costs are paid for by the health provider. Time costs can be

related to the patient or family member taking time off work to receive health care [2]. No consensus has been established on how to estimate production loss and time costs and if these costs should be included in economic evaluations [2, 87].

Benefits refer to the effects the service has on the patient's health – the health-related outcome. For example, such outcome measures can be changes in blood pressure and blood sugar levels, successful treatments, symptom-free days, lives saved, life years gained and quality-adjusted life years (QALYs) gained. QALY puts a value on health outcomes so that they can be compared to the costs. The advantage of the QALY as a measure of health outcome is that it includes gains from both reduced morbidity (quality gains) and reduced mortality (quantity gains) and combine them into a single measure [2]. QALY measures the value and duration of the changes in the health-related quality of life. It ranges from 0 (worst state/dead) to 1 (best state/in full health). One year in complete full health is one QALY, and one year in half normal health is 0.5 QALYs. The QALY is a preferred outcome measure [85, 88] and has also been used in telehealth evaluation [89]. EQ-5D is one of the most used descriptive systems that measure health-related quality of life [88]. It can describe different health states and is recommended in economic evaluation guidelines [87]. The advantage of using both QALYs and EQ-5D is that these measures are generic and make it possible to compare health states across different diagnoses and different health care services.

Three different types of cost-effectiveness analysis are mainly used in health care evaluations:

- **Cost-minimisation (CMA)** – The consequences (outcomes) have to be proven to be equivalent to use CMA correctly [2, 90]. The results give the least costly alternative.
- **Cost Effectiveness Analysis (CEA)** – The benefits of a health change, such as blood glucose levels, the sick days avoided and the life years gained, are measured. The result is the cost per unit of effect (e.g. the cost per life year gained). CEA discerns which of two or more alternatives are less costly for at least as much benefit, more effective for equal or lower costs or more effective and more costly [2, 3].
- **Cost Utility Analysis (CUA)** – The benefit (outcome) is valued as healthy years (e.g. QALYs). The result is cost per QALY and informs which of two or more alternatives are less costly for at least as much benefit, more effective for equal or lower costs or more effective and more costly (in a cost per QALY gained) [2, 3].

Deciding on the most cost-effective alternative includes analysing the costs relative to the benefit. This is best illustrated using the cost effectiveness plane in Figure 3. Interventions that demonstrate to have increased health benefits and costs less (situation A) can be recommended, and opposite, interventions that have less health benefits and cost more (situation D) are not to be recommended from an economic point of view. For situation B and C, it is necessary to calculate incremental cost-effectiveness ratios and to analyse whether the extra benefits are worth the additional costs, for example.

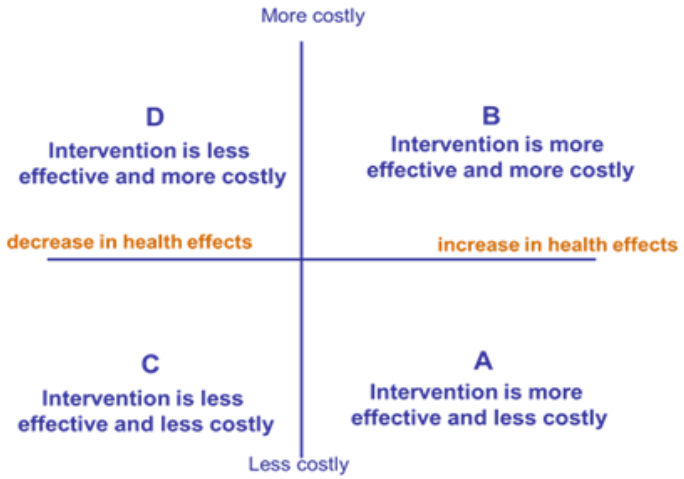

Figure 3 The Cost Effectiveness Plane based on W. Black [91]

To perform a cost-effectiveness analysis, it is necessary to make some assumptions about the costs and benefits, and this is often associated with uncertainty. It is therefore important to analyse this and address the uncertainty in a sensitivity analysis. A one-way sensitivity analysis changes one assumption at the time and determines how this change influences the cost-effectiveness result. A sensitivity analysis analyses the robustness of the results and improves the transparency of the analysis [3].

2.6 Hypothesis

The introduction of telemedicine service in the form of a real-time videoconference for selected orthopaedic patients will (i) not reduce the quality of the patient treatment administered by the doctor involved in the consultations, (ii) increase patient satisfaction and (iii) lower the societal costs.

2.7 Research questions and Aims

Paper I

Is the quality of care by orthopaedic telemedicine consultation not inferior compared to a standard consultation?

In this study, the sum score from a questionnaire of the specialists' professional evaluations of the two consultation types were compared by non-inferiority analyses. Ancillary analyses were performed to support the professional evaluation by comparing the differences in consultation times, if the patients were operated on as planned, the number of consultations, re-referrals and the complications between the two groups.

Paper II

Is the patient equally or more satisfied with an orthopaedic telemedicine consultation compared to a standard consultation?

This study compared patient satisfaction and patient-reported outcome measures (EQ-5D-3L and EQ-VAS) between the two consultation types.

Paper III

Does orthopaedic telemedicine consultation save costs compared to standard consultation at the hospital?

The aim of this study was to examine the cost-effectiveness of the telemedicine service compared to standard in-person consultations at the hospital from a societal perspective. The items included costs for health care, patient and time (measured as production loss). The health outcomes were measured as the QALYs gained.

3 Methods

3.1 Trial design

To evaluate the different aspects of video-assisted remote orthopaedic consultations we conducted a prospective, single-centre, unblinded, randomised, controlled and non-inferiority trial.

This RCT featured two parallel groups that were allocated into remote consultations at an RMC with video assistance as an intervention and into standard consultations in the orthopaedic outpatient clinic at UNN as a control.

RCT is evaluated as the gold standard for providing the highest level of evidence.

3.2 Participants

All the patients were recruited from the four northernmost municipalities in Troms County in Northern Norway: Kåfjord, Skjervøy, Nordreisa and Kvænangen. The 6500km² area is sparsely populated with approximately 12 000 inhabitants (2013), 50% of which live in five small towns. The patients were referred to or scheduled to a visit at the orthopaedic outpatient clinic at UNN Tromsø between November 2007 and August 2012, and we had no limitations regarding age. In total, 402 patients were included and randomised, and 389 attended consultations (Figure 4).

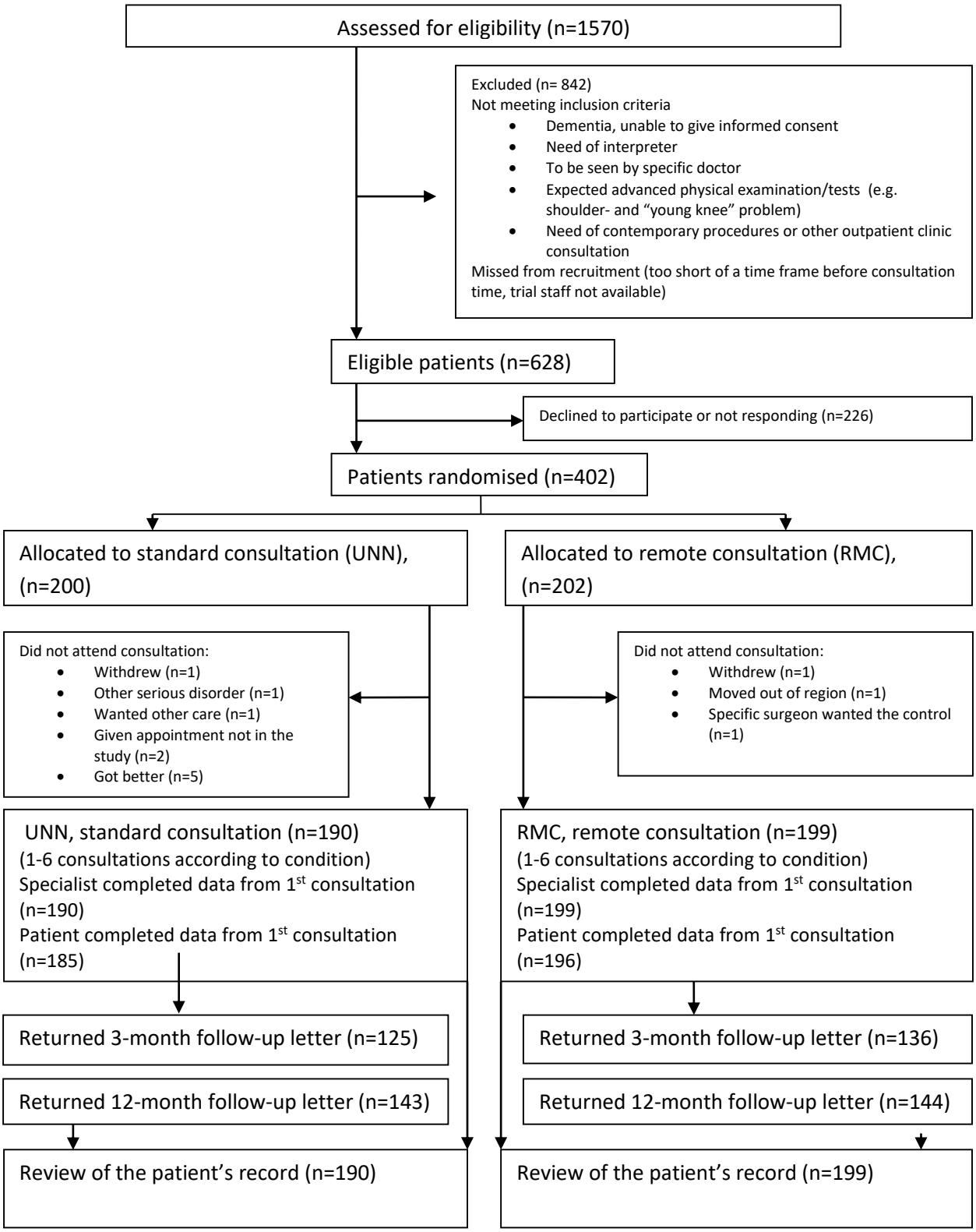

Figure 4 Flow chart of the included patients and number of return questionnaires.

3.3 Inclusion

All the patients were evaluated according to the inclusion and exclusion criteria defined by the orthopaedic surgeons running the study (Table 1). Patients were excluded if any advanced physical tests were needed during a consultation, for example an impingement test. Impingement test means injecting a local anaesthetic to identify painful points in shoulder examinations [92, 93]. Another example is young patients with chronic knee disorders – here also, specific tests are performed by the orthopaedic surgeon to get the correct diagnosis [94]. Other possible complex patient groups are patients with neck and back pain [95]. At UNN Tromsø, patients with spine problems are part of the responsibility for the neurosurgery departments, and these patients were therefore not included.

Table 1 Patients' inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
New referred to orthopaedic outpatient clinic UNN, Tromsø (e.g. knee osteoarthritis, hallux valgus)	Expectancy of advanced physical examination/tests (e.g. shoulder- and "young knee" problem)
Follow-up after orthopaedic surgery (e.g. arthroplasty of the hip)	Unable to give informed consent (e.g. Dementia, soldiers, prisoners)
Follow-up after orthopaedic trauma (operated or not)	Need of an interpreter
Follow-up of chronic orthopaedic disorders	To be seen by a specific orthopaedic surgeon
Written consent	Need of contemporary procedures (e.g. CAT-scan, ultrasound)
	Contemporary other outpatient clinical consultation

3.4 Recruitment

Before the study started, GPs in the region, secretaries at the orthopaedic department, nurses at the outpatient clinic and colleagues at the hospital were informed of the study. Some patients were directly referred to participate, and others were identified by the secretary administrating referrals and the department's waiting list. The department's electronic waiting list of patients, which refers patients for new disorders or those scheduled for follow-up consultations, was regularly searched by one of the orthopaedic surgeons (AB) to identify

eligible patients [96]. If the patient met the inclusion criteria and had not signed a consent form at the clinic, the orthopaedic surgeon (AB) sent an age-related invitation letter along with a consent form to the patient (see Appendix I and II). Additionally, a note was made on the electronic waiting list. Within a reasonable time, the patients were set "on hold" for an appointment to allow for the signed consent letter to be returned. Non-responders got one telephone reminder. Emergency patients needing an appointment the same day were not included due to delays caused by the consent process and the challenges connected to having a video consultation available at any time.

3.5 Randomisation

The randomisation of patients was performed by one of the orthopaedic surgeons running the study (AB) via a password-protected, web-based randomisation database created by the Unit for Applied Clinical Research, Faculty of Medicine, Norwegian University of Science and Technology, Trondheim. It was a blocked randomisation of unknown size and stratified by municipality and age (≤ 18 and ≥ 65 in one group and 19–64 years of age in the other). We assumed that younger and older patients were more likely to need an accompanying person. With respect to patient transport cost, equal distribution of residences was important.

3.6 Technical equipment

At the RMC, a screen (ViewSonic, Model nr VS10946-Ie) with a codec and camera situated on top (Tandberg 990MXP) was installed as a mobile device. (Figure 5) The orthopaedic surgeon at UNN controlled the camera, which could be zoomed in on the patients (e.g. to take a closer look at a post-operative wound) or follow them when walking. At UNN, in a standard outpatient clinic room, another camera, codec (Tandberg 1500MXP) and similar screen were installed. (Figure 6) These were connected to a standard personal computer (PC) to demonstrate the X-rays to the patients if they wanted to look at them (Figure 7). The Norwegian Health Network transmitted data over a secure broadband connection through two-way encrypted video and audio communication (10 Mbps full duplex).

Figure 5 Video unit at the remote location. Picture taken under training section. Ann-Sofie, one of the orthopaedic trained nurses with a cast for demonstration. Photo with permission, Lars Rye.

Figure 6 From the orthopaedic surgeon's perspective. Telemedicine Setup at the outpatient consultation room at the university hospital. Standard PC to the left connected to the Video unit to demonstrate X-ray. Actual situation demonstrating a large picture of the orthopaedic surgeon instead of the patient. Picture taken for demonstration. Private photo.

Figure 7 From the patient's perspective. The telemedicine setup at the remote location. Solveig, one of the orthopaedic trained nurses at Sonjatun, removing stitches from a patient. Video unit screen and an orthopaedic surgeon in Tromsø demonstrating X-ray. Photo with permission, Jan Fredrik Frantzen.

In the first part of the study, trouble shooting and technical assistance were delivered when needed by a specific person who could be directly contacted. Later, this service was integrated in the general IT service at the hospital.

3.7 Access to X-ray a prerequisite

The RMC had already installed a standard digital X-ray lab served by a radiograph in May 2006. Radiologists at UNN described the taken X-rays and included them in the hospital's standard X-ray records. The Norwegian Health Network has enough capacity to transmit data on a secure line, encrypted at both ends. If necessary, the radiographer could remove a cast before taking an X-ray picture.

3.8 Intervention and standard consultation

The remote consultations were performed through a real-time videoconference, where a trained nurse was with the patient at the remote location and the orthopaedic surgeon was at UNN. The set up tried to mimic a standard consultation as much as possible and imitated the real-time interaction between a specialist and a patient. The preselected orthopaedic surgeons (three consultants and two experienced registrars) carried out their daily work at the orthopaedic department and conducted the consultations as part of their daily routine. They were randomly selected according to who was available at the consultation time. The orthopaedic surgeons ran the consultation after some initial training and technical assistance (AB). Before the study was started, two nurses from the RMC attended the orthopaedic

outpatient clinic for a week. They do their daily work at the local GP office and the RMC. They attended casting courses and were trained in some clinical examination techniques. After the telemedicine equipment was installed, the training was done with video assistance, both to develop the casting skills and the skill to use the video conference equipment. For legal reasons, the two nurses were employed by UNN on an hourly basis when they assisted in the consultations. Thus, they could legally access the patients' hospital files on the UNN-connected PC at the remote location. The nurse received the patient at the remote site, assisted during the consultation, and performed various physical procedures, for example, changing a cast or removing stitches. No physician was with the patient at the remote site. Digital X-rays were taken when appropriate just before the consultation and were simultaneously available.

The standard consultations took place at the hospital outpatient clinic, where a nurse assisted when necessary. The orthopaedic surgeon picked up the patient in the waiting area.

In each of the consultation forms, the usual mandatory registration and documentation in the patient's medical records were done by the orthopaedic surgeon, including the conclusion of the consultation, agreements between the surgeon and patient regarding any follow-ups, prescriptions, referrals for operation, further investigations, physiotherapist training and/or applications for orthopaedic aid if needed. Both the remote and standard consultation took place on a fixed scheduled weekday. If necessary, according to medical indication, the consultations were conducted on other times than the scheduled days.

3.9 Data collection

Data were collected from the questionnaires filled in by the orthopaedic surgeon performing the consultations and the patients immediately afterwards (Appendix III, IV and V) and from a follow-up questionnaire mailed to the patients three and 12 months after the consultations (Appendix VI). The patients' hospital medical records were screened for additional information relevant to the study (AB) (Appendix VII). Two postal reminders were sent, and an additional telephone call reminder was placed to patients who did not return the questionnaires.

The patients' baseline data were collected via the questionnaire completed by the patients immediately after the first consultation. This included demographic variables (age, gender, occupation and education), the indicators used for measuring patient-reported outcomes and

their experiences with various specialist outpatient clinics. All questionnaires after the consultation were put in a designated mailbox at the outpatient clinic at UNN or at the RMC.

The patients could have more than one consultation in the study related to their disorders, for example to follow up on a fracture until healed or to investigate a disorder with more tests before the final diagnosis and treatment suggestions were possible. The last consultation of each individual patient in the study was defined as the consultation when the patient was (1) discharged from the outpatient clinic for the actual disorder (e.g. fracture healed, no need of further follow-ups), (2) referred to operation (inpatient or day surgery), (3) referred to regular follow-up at the outpatient clinic because of a chronic condition, (4) referred to the outpatient clinic at UNN (not properly examined at an RMC/to remove osteosynthesis implants/injections tests) or (5) referred to other outpatient clinics.

3.10 Outcome measures

3.10.1 Specialist evaluation

Following each consultation, the orthopaedic surgeon immediately evaluated the quality of the telemedicine and the standard consultation. With the lack of a standard validated questionnaire, we created one. The evaluation comprised answering a questionnaire with five five-level questions (very good, good, neither good nor bad, bad and very bad), each measuring five categories of experience: cooperation, information, examination/evaluation, treatment and an overall evaluation of the consultation (questions are presented in table 3, Paper I, and in the complete questionnaire in Appendix III). The questions regarding information and treatment included the additional option “not applicable”. All the questions were equally weighted, and a sum score was calculated. The primary outcome measurement was the sum score comparing the standard and video-assisted consultations.

Additional analyses were done to support the specialists’ evaluation of the quality of the consultation. The orthopaedic surgeon recorded the duration of the consultation as well as the agreement on further action (follow-up consultation/discharge/referrals). The patients received a questionnaire three and 12 months after the last consultation to report events or complications, including any need for additional contacts with health services (both with a list of more options presented in the Appendix VI), as well as patient-reported outcome measures (EQ-5D-3L and EQ-VAS). The patients’ hospital medical records were screened for

additional information relevant to the study two years after the last consultation in the study (Appendix VII). These included complications linked to the referred condition (yes/no) (reported or not by the patient); if referred for operation, whether operated as referred or not (yes/no); the total number of consultations for the condition for which the patient was included in the study; and if they had been referred again for the same condition over the subsequent two years (yes/no).

The orthopaedic surgeon's questionnaire after the video-assisted consultations included five additional five-level questions (very good, good, neither good nor bad, bad, very bad) regarding cooperation with other health workers, technical issues, previous experience with video-assisted consultations and expectations regarding a video-assisted consultation compared to a standard one before and after the conducted consultation.

3.10.2 Patient satisfaction

The secondary endpoint was comprised of patient satisfaction as assessed via the questionnaire given to the patients after each consultation. The questionnaire (Appendix IV and V) included many questions from the OPEQ, which was evaluated by Garratt et al. and is recommended for measuring patient experience in outpatient clinics [80]. We did not include all the items and questions of the validated OPEQ questionnaire. The items not included were the core scale clinic access (both questions), questions on "unanswered questions" (core scale communication), "background information available" and "organisation of work" (core scale organisation). As recommended, we only used relevant questions for scale information and pre-visit communication to keep the number of questions to a minimum. We used five-level questions (1 indicating very good and 5 indicating very bad) instead of a 10-point scale for maintaining uniformity in the final questionnaires. Hence, the motivation behind this scale compression was to ease the cognitive burden on respondents. We have not seen any evidence to suggest that such a simplification will impact the validity of the OPEQ. In addition, the questionnaires included questions for determining overall patient satisfaction with the received consultation (five levels), previous experience with video-assisted consultation (none, one or more) and the preference of location for the next consultation (UNN/RMC). The patients that were randomised to receive video-assisted consultations were asked supplementary questions to compare the telemedicine and standard consultations, before and after the actual consultation, and were asked questions on technical performance (five levels).

The patient-reported outcomes were additionally accessed by the questionnaires mailed to the patients three and 12 months after the last consultation (Appendix VI). All the questionnaires filled out by the patients included questions for assessing patient-reported outcomes (EQ-5D-3L and EQ-VAS). The EQ-5D was chosen because it is by far the most widely used generic preference-based instrument used in the literature [88]. Furthermore, it has demonstrated good responsiveness in patients with orthopaedic disorders [97]. As for the choice of value set, we applied the most widely used one elicited from a British population because no Norwegian set was available [98].

3.10.3 Cost-effectiveness

Another secondary outcome was costs-effectiveness. Data on costs and QALYs gained were collected alongside the trial after each consultation and at 12 months follow-up using questionnaires, patient files and consultation records. These were valued using externally collected data on unit costs and utilities. To increase generalisability and make the cost-effectiveness result useful for decision making, the resources used in the trial were valued using equipment prices, network or line rents, standard reimbursement rates, travel fares and salaries from 2017/2018. The costs estimated were only those that differed between telemedicine and standard hospital consultations.

The travel costs were directly collected from the patients during the trial. The data on travel time, distance and transportation to the consultation site were collected using a questionnaire that was handed to the patient after each consultation (Appendix IV and V). Their main occupations, if they were on sick leave and the need for an overnight stay were also included. Additionally, Google Maps was used to estimate the travel distance from the patients' home to the consultation site either at the remote centre or at the hospital (shortest and fastest) because standard rates of reimbursement from the Norwegian Patient Travel Agency depend on that. This standard rate of reimbursement was introduced in 2016. The orthopaedic surgeon decided if the patients needed a companion or extra transportation on health-related grounds (taxi or ambulance), reported the patients' main occupations, and if they needed sick leave (Appendix III). The average travel costs per patient were calculated from the need of extra transport or companion, overnight stay, travel distance and the means of travel, which related to the reimbursement from the Norwegian Patient Travel Agency (see Appendix VIII

for details). The calculating method for the travel costs was approved by the leader of the local Norwegian Patient Travel Agency. The production losses were calculated using the patients' reports of activities (full or part time) and sick leave. In situations where data were missing from the questionnaire, time off work was estimated based on what the specialist had reported in the patient records at the hospital. The actual production losses per patient were only based on the number of patients (between 16 and 67 years) that were actual working (not on sick leave) and the actual time they spent on the consultation including travel time to and from the consultation site.

The implementation costs included the costs related to the investment in videoconferencing equipment and the initial training costs for nurses and specialists (see Paper III, table 2 for details). Additional costs for running the service were line rentals, rents for a consultation room at the RMC, personnel (nurses) at the RMC and cost for a supplementary consultation at UNN. This was if the patient at the RMC needed a second consultation at UNN because of an unsatisfactory consultation.

To perform the cost-effectiveness analysis, the total cost per patient consultation and difference in heath outcome were calculated. The total costs per patient consultation included the implementation costs per consultation (estimated for 300 consultations per year and a 5-year lifetime), running costs and travel and time costs per patient. The average QALYs gained was calculated using the changes in EQ-5D utility reported by the patients at the baseline and at the 12-month follow-up. The duration of the change was one year.

3.11 Pilot

The sample size calculation was based on the primary outcome, the sum score of the specialist evaluation form. We needed at least 191 patients in each group to achieve 90% power to detect non-inferiority using a one-sided two-sample t-test, a standard deviation equal to 1.0 and a 5% significance level. The margin of non-inferiority was set at 0.30, as a difference in sum score between the groups ≤ 0.3 was rated as not clinically relevant using a questionnaire with five-level questions (1–5).

3.12 Non-inferiority trial design/power analysis

The sample size calculation was based on the primary outcome, the sum score of the specialist evaluation form. We needed at least 191 patients in each group to achieve 90% power to detect non-inferiority using a one-sided two-sample t-test, a standard deviation equal to 1.0 and a 5% significance level. The margin of non-inferiority was set at 0.30, as a difference in sum score between the groups ≤ 0.3 was rated as not clinically relevant using a questionnaire with five-level questions (1–5).

3.13 Statistical analysis

The results are presented as means (standard deviation) or numbers (percentages). The differences between the groups were analysed using two-sample *t*-tests, chi-square tests or generalised estimating equations (GEE) when appropriate. GEEs were used with an exchangeable covariance structure to control for possible dependencies between two or more repeated consultations for some patients. For the primary outcome - the sum score, GEE was used with a Gaussian response and an identity link function. For binary outcome measures, a logit link function was used. The non-inferiority test was assessed using a 90% confidence interval (CI) for the sum score difference between the groups. McNemar's test was used to assess changes in patient's evaluations of the video-assisted consultations before and after the consultations. A *p*-value of less than 0.05 was considered significant. Statistical analyses were performed using STATA version 13.1(Paper I) and version 14.0 (Paper II and III) (StataCorp LP Texas, USA).

3.14 Ethics

The study was approved by The Regional Committee for Medical and Health Research Ethics (P REK Nord 134/2006 and 2013/15/REK Nord) and approved by the Norwegian Social Science Data Services by the Data Protection Officer at UNN (*Personvernombudet*).

The inclusion of minors in a study requires special attention [99], The first Declaration of Helsinki in 1964 excluded children from taking part in clinical trials since they cannot give consent. Later revisions have permitted the inclusion of minors under certain circumstances [100]. The intervention in our study had limited risk as it contained no medication or painful tests, and the participants had the option to change to a standard consultation within a short time frame if the consultation failed. Children make up a high proportion of the patient

population at the orthopaedic outpatient clinic, and it is therefore of special interest to include minors.

All the patients signed a consent form before randomisation. For patients younger than 16 years, the patients and a parent or legal guardian signed the form (Appendix I and II). The patients could withdraw from the study at any time without any reason or consequence for further treatment or follow-up.

The patients' privacy and physical and mental integrity have been safeguarded according to the principles outlined in the Norwegian Code of Ethics for Medical Doctors (*Etiske regler for leger*)[101] and The Health Personnel Act (*Lov om helsepersonell m.v./helsepersonelloven*)[102].

The trial was registered in ClinicalTrials.gov on 4 February 2008 due to organisational delays. However, the specified study start date was November 2007 (ClinicalTrials.gov identifier: NCT00616837).

Updates on the study were reported on a yearly basis to the Norwegian Research and Management database [103, 104].

4 Summary of results

4.1 Paper I

The aim of this paper was to describe the method/study design and evaluate the quality of care of the two consultation types. The quality of care consisting of the a sum score of the specialist evaluation of the consultation and ancillary analyses regarding complications, the number of consultations per patient, operations, the patients who were referred again and the duration of consultations were performed. A total of 402 patients were web-based randomised. Of these, 199 (98%) underwent remote consultation, 190 (95%) underwent standard consultation, and 13 did not attend a consultation. The average sum score of the specialist evaluation was significantly lower (i.e. “better”) at UNN compared to the RMC (1.72 versus 1.82, p = 0.0030). The 90% confidence interval (CI) for the difference in score (0.05, 0.17) was within the non-inferiority margin. The orthopaedic surgeons involved evaluated 98% of the video-assisted consultations as “good” or “very good”. In the ancillary analyses, no significant differences were observed between the two groups.

This study supports the argument that it is safe to offer video-assisted consultations for selected orthopaedic patients. We did not find any serious events related to the type of consultation.

4.2 Paper II

In this paper, we compared patient-reported health outcomes and satisfaction between video- and standard face-to-face orthopaedic consultations. Patient satisfaction was determined using patient-completed questionnaires containing questions on patient-reported health (EQ-5D-3L and EQ VAS) and questions from the OPEQ. This study included 389 patients (199 at an RMC and 190 at UNN), with a total of 559 consultations. In all, 99% of the RMC-randomised patients and 99% of UNN-randomised patients evaluated the consultation as very satisfactory or satisfactory. If needed, 86% of the RMC and 64% of the UNN randomised patients would prefer video-assisted consultation as a next consultation. No difference was observed in patient-reported health after 12 months between the two groups. The EQ-5D index scores were 0.77 and 0.75 for the RMC and UNN, respectively (p = 0.42).

Conclusion: We did not observe any difference in patient-reported satisfaction and health (EQ-5D/EQ-VAS) between the video-assisted and standard consultations, suggesting that video-assisted remote consultation can be safely offered to selected orthopaedic patients. A significantly higher proportion of patients preferred video-assisted remote consultation for their next session, thus strengthening the findings of this study.

4.3 Paper III

The aim of this study was to examine the cost-effectiveness of the teleorthopaedic service. An economic evaluation based on 389 patients (559 consultations) referred to the hospital for an orthopaedic outpatient consultation was conducted five years after the intervention ended. The patients randomised to the intervention group received video-assisted remote orthopaedic consultations (302 consultations). The patients randomised to the control group received standard care in outpatient consultation at the hospital (257 consultations). A societal perspective was adopted for calculating costs. Health outcomes were measured as QALYs gained. Resource use and health outcomes were collected alongside the trial at the baseline and at the 12-month follow-up using questionnaires, electronic patient files and consultation records. These were valued using externally collected data on unit costs and QALY weights. An extended sensitivity analysis was conducted to address the robustness of the results.

Results: This study shows that videoconferencing for orthopaedic consultations at a remote clinic is equally effective and costs less than standard outpatient consultations at the hospital, as long as the total number of patient consultations exceeds 151 per year. For a total workload of 300 consultations per year, the annual cost savings amounted to €18,616. If costs were calculated from a health sector perspective, rather than from a societal perspective, the number of consultations needed to break even was 183.

Conclusion: The telemedicine service investigated here is cost-effective, both from societal and health sector perspectives as long as the activity exceeds 151 and 183 patient consultations per year, respectively.

5 General discussion

5.1 Professional quality

The main finding in Paper I is that the quality of care of the video-assisted consultation was not inferior to the standard consultation. The conclusion is based on the orthopaedic surgeon's evaluation of the consultations and the ancillary analyses. A more detailed description of the rationale is presented and discussed in Paper I.

To successfully implement a new procedure, such as a new consultation form, it is a prerequisite that the doctor responsible for the consultation considers it to be of sufficient quality. Therefore, we chose professional quality as the primary outcome of this study. Professional quality is defined by the specialist evaluation of the consultation and the ancillary analyses.

To our knowledge, no standardised method or tool exists to objectively measure the professional quality of a consultation. Therefore, the sum score of the five questions answered by the specialists involved in the consultations was chosen as the primary outcome. We assumed that a broader questionnaire with selected questions related to various aspects of the quality of the consultations was the relevant tool to be used to assess the specialist's evaluation of the consultations. These questions were related to the specialist's evaluation of the cooperation with the patient, how well the patient could be informed, how the patient could be examined and treated and the specialist's total impression of the consultation. We assumed these to be key elements in the evaluation of the actual consultation types, more relevant than the questions regarding how satisfied the specialist was with the consultation type in general.

This questionnaire was not a validated standard questionnaire. After the suggestion of one of the reviewers who commented on Paper I before publication, we calculated an item-level content validity index (I-CVI) for each question's relevance and for the scale-level content validity index using the universal agreement calculation method (S-CVI/Ave), as recommended by Polit and Beck [105]. The five questions forming the sum score were all related to the assessment, which could be affected by the different consultation situations. Eight orthopaedic surgeons, not engaged in the study, assessed the questions and whether they

were relevant in evaluating the consultations. They indicated the relevance on a scale from 1 to 4 (not relevant, somewhat relevant, quit relevant and highly relevant). This demonstrated excellent content validity, with an I-CVI from 0.88 to 1.0 and an S-CVI/Ave of 0.98. The calculation of the internal consistency or reliability of the same questions gave a Cronbach's alpha of 0.62. The question regarding treatment had the answer option "not applicable", and this option was chosen for 224 of the 559 consultations. If these answers were excluded from the calculation, the Cronbach's alpha was 0.82, and if we excluded the whole question, the Cronbach´s alpha was 0.80 for the remaining four questions, both being within the limit of acceptance [106].

The ancillary analyses were performed to support the evaluation of the professional quality of the consultation. Since the included patients suffered from a wide variety of disorders, acute and chronic, and were of all ages, it was not possible to find one hard clinical outcome relevant for the whole study group. Two of the questions in the ancillary analyses were chosen to meet the concerns regarding increased consultation time and the tendency towards unnecessary consultations in the telemedicine group reported by others [55, 107]. As demonstrated and discussed in Paper I, no such findings were observed in our study. Also, the ancillary analyses sought to examine whether the two groups of patients were equally followed up with regard to the possible conclusions "referred to operation" or "discharged". The latter is discussed in Paper I. A higher proportion of the UNN patients were referred to operation (UNN 17%, RMC 11%; $p = 0.074$). Speculatively, one could suspect that the reason for the higher proportion of patients referred to operations in the UNN group could be that "it is more difficult to deny a patient an operation face to face than by a video consultation".

Patients might misunderstand the questions they are asked to answer. The three and 12 month questionnaires included free text response for the question about the type of complication. The handwritten responses were checked against the patients' hospital medical records. Some of the patients had obviously misinterpreted the question and reported complications related to disorders other than the disorder that was relevant for inclusion in the present study. Such misunderstandings might to some degree have been prevented if a better evaluated questionnaire had been used. However, we wanted to include any possible complications related to the video-assisted consultation to reduce the number of missing events. In the registration done by review of the patient record files after two years compared with the three

and 12 months responses, obvious misinterpretations were corrected; for the rest, a complication was registered.

A qualitative study by Harrison et al. showed that consultations involving physical examinations may not be suitable for video-assisted remote consultation since many patients expressed a preference for a face-to-face consultation if an examination was necessary [108]. Also, Zanbelt et al. suggested in their review paper that e-consulting seemed a feasible alternative to face-to-face follow-up or telephone appointments, but was less suitable for initial consultations requiring physical examinations [109]. In our study, one exclusion criteria was the expected need of advanced physical examination. However, some basic physical examinations, such as testing and demonstrating the movements of the hip, knee or wrist, were necessary for many of the included patients. It is our clear impression that such basic physical examinations should not be a problem in combination with telemedicine consultations, but we do not have scientific data to support this. Further research could clarify this.

5.2 Patient satisfaction

The main findings concerning patient satisfaction in this study are discussed in Paper II. In our study, we found a Cronbach's alpha of 0.72 calculated by the recommended core item questions regard patient satisfaction. A Cronbach's alpha > 0.7 indicates that the questions used in the questionnaire in a relevant manner measures what it is intended to measure (i.e. patient satisfaction in the this study) [106].

Is there a reason to believe the patients at the RMC or at UNN are more satisfied than the other? If they were newly referred, the included patients got their consultation at the first available appointment at the location according to randomisation. If the consultation was a follow-up consultation, this was scheduled as planned. This meant that the patients in the study could bypass the clinic's normal waiting list. Some patients might have thought of this possibility when they were invited to participate in the study, although this was not directly communicated in the inclusion process. It is possible to assume that this could make the patients more positive towards telemedicine, but we do not know if this influenced the reported satisfaction with one or the other location. However, when evaluating the OPEQ, Garret et al. found that pre-visit waiting time was not so important [80]. In our study, the vast

majority of the newly referred patients found the waiting time acceptable (totally acceptable + acceptable; RMC 86%, UNN 84%; p = 0.23).

Participating in the study was the only way for eligible patients to get a consultation at the RMC. If the patients consented to the study because they saw this as a chance to get a consultation closer to home and thus they did not have to travel all the way to UNN, this could mean that the RMC-allocated patients were basically more satisfied. Since the planned adjustment in the three and 12 month follow-up questionnaires was not implemented, and a follow-up question on preferred location for any new consultation was not included, we could not investigate any change in opinion in the follow-up period concerning video-assisted consultation. Another telemedicine RCT trial from the region investigating non-acute headache patients did not find less satisfaction in the telemedicine group one year after the consultation. The long-term satisfaction was 85.5% in the telemedicine group and 88.1% in the traditional group [110].

The patients allocated to the RMC were received by a specially trained local nurse. The nurse remained together with the patient through the entire consultation and performed examinations and other tasks as appropriate. The questionnaire did not contain any specific question regarding the impression of the presence of the nurse. Thus, we do not know if this affected the reported patient satisfaction in the RMC group. When Sjetne et al. from the Norwegian Knowledge Centre for the Health Services created the Generic Short Patient Experiences Questionnaire, they based it on previous testing of six group-specific questionnaires (Somatic In- and Out-patient; Mental Health, In- and Out-patient service; and Psychiatric Paediatric, In- and Out-patient service). They found that the out-patient judged the "other staff" to be less relevant in the evaluation of the service [111]. This makes it less likely that the nurse's presence affected the patient satisfaction. Still, in another setting with a more "sensitive" situation, the presence of a nurse or other assisting personnel could affect the patients will to talk freely and give all relevant information to the specialist.

5.3 Cost-effectiveness

The main findings in the economic evaluation are discussed in Paper III. Some more general considerations are discussed below.

The cost-effectiveness analysis demonstrated that the video-assisted orthopaedic consultation was cost-effective from both societal and health sector perspectives. This result is based on the assumption of no difference in health outcome at 12 months between the two groups. A positive (but small) non-significant improvement was observed in EQ-5D in the RMC compared to UNN (ΔEQ-5D 0.09 and 0.05 for the RMC and UNN, respectively (p = 0.29)). Since the duration of the improved health-related quality of life was one year, the QALYs gained are 0.09 and 0.05 for the RMC and UNN, respectively (not significant).

The result shows that the cost of the teleorthopaedic service was less than travelling to the hospital for a consultation for the patients in this study. This meant that the intervention was less costly with similar health outcomes. This is illustrated with a star in the cost-effectiveness plane in Figure 8.

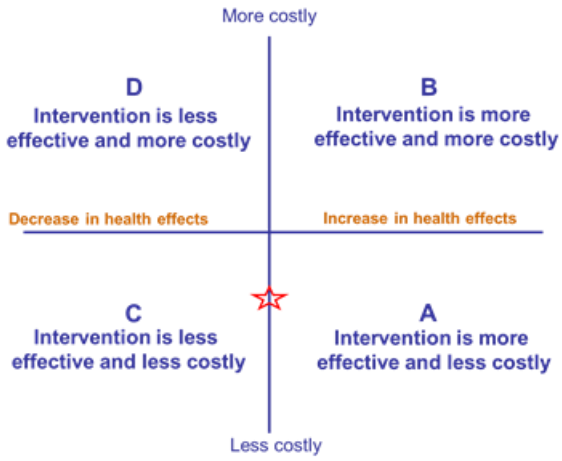

Figure 8 The Orthopaedic telemedicine study, marked by a star in the Cost-effectiveness plan.

Could this assumption have been wrong? Should the star be more to the right or to the left? The power analysis for the study was performed with regard to the sum score of the specialist evaluation of the consultation and not for other outcomes. However, the number of participants was quite high. It is reasonable to believe that merely changing the type of consultation would not affect the health outcomes. The patients received similar treatments and care in both groups. Most of the patients had only one or two consultations. Therefore, it

is not reasonable to believe that burdensome travelling to a consultation at UNN had a negative impact on the health outcome.

The strength of this study is that all the cost data were collected alongside the RCT. The estimated costs are based on actual journeys: the time spent travelling and the extra personnel costs needed to operate the service. We were able to ask the patients about the transportation mode, the time they used, if they were on sick leave, if they needed extra transportation (for example a taxi or an ambulance) or if they needed a companion. The latter two influenced the travel costs the most, apart from the distance (Appendix VIII). This demonstrated that for the patient groups with special needs, such as extra transport, a companion or both, it is important to evaluate this from an economic point of view. This is in accordance with Rowell et al. (2014), who suggested using telemedicine for orthopaedic paediatric consultations in Australia for patients with disabilities, high costs for travel and inconvenient patient transport [112]. In our study, extra transportation vehicles were taxis or private cars. No patients were in need of an ambulance or plane.

One challenge for economic evaluations of telemedicine services is generalisability. High diversity in terms of objectives, technology, and context might limit the generalisability of one specific evaluation to other settings [113]. The local context will determine the costs, such as the need for technology and infrastructure, prices and the costs of extra personnel, travel and time. The results are of most value in the local area where the evaluation was carried out. To make this study relevant outside the current setting, we emphasised a transparent calculation of all cost and effectiveness items. The same methodology can then be used in another setting and include the need for investment, travels, distance and local prices.

5.4 Implementation

The study demonstrated that cost savings can result from giving select orthopaedic patient consultations at a remote location such as Sonjatun. One big question regarding costs is not solved: Who will carry the extra annual costs at the RMC, including personnel costs? It is unclear who should be responsible for paying the extra costs that result in the saved travel costs. It is the Norwegian Travel Agency for patients which benefits from the reduced travel expenses, but it would be the hospital that carries the investment costs for the extra equipment needed. Also, it is more unclear who should carry the costs for the personnel and location rent

at the remote site. These issues have to be solved in the future. External validity is discussed later.

Not all the benefits can be measured in monetary terms. Greater job satisfaction for the nurse at the RMC was reported. Also, the telemedicine arrangement provided easier contact with a specialist for the local general practitioner, who could drop in at the end of the remote consultation session and ask questions directly to the specialist.

5.5 Videoconference technical performance

We did not collect data from the participants on the specific transmission condition (picture, sound and privacy). Even if both the patient and the specialist reported high performance quality, this was not specified. In a recommended telehealth satisfaction scale, this is included [114]. All the consultations at the RMC were conducted as planned. Due to technical problems, delays resulted for 17 of the consultations. The causes were general technical difficulties at the hospital's electronic system (n = 2), the necessity to redial (n = 3) or external help that was needed before a problem could be solved (n = 12). Causes of the latter included other users changing the setting on the equipment (n = 3), trouble at Norwegian Health Net (n = 2), technical failures of equipment (n = 4) and other trouble getting the connection (n = 3). This demonstrated the importance of having technical assistance available when needed because technical problems do occur.

5.6 Methodological consideration

5.6.1 Study design

We performed an RCT to study the differences between standard outpatient consultations versus video-assisted ones conducted at our department. All the results presented in the three papers are based on the performed RCT. RCTs are considered to be the gold standard for a clinical trial and provide the most reliable evidence when evaluating the effectiveness of an intervention [115, 116]. The randomisation minimises the risk of unmeasured and unknown confounding variables influencing the results [117]. A properly planned and performed RCT gives results that have low risks of error or bias. Bias is defined by the Cochrane training group as "systematic error or deviation from the truth". Bias can occur at each stage of the research process.

The choice of a non-inferiority study design was based on the expectation that a slightly lower quality score in the evaluation by the specialist of the video-assisted consultation would be compensated for by increased patient satisfaction and/or reduced travel expenses [118, 119]. From analyses of the data in the literature, it was not possible to select a non-inferiority margin based on relevant research. Instead, we discussed and agreed that on a scale ranging from 1 to 5 of a sum score from five questions, a mean difference of 0.3 score points was of no clinical relevance. In our power analysis, we assumed a standard deviation of 1.0 but observed it to be 0.38. Consequently, with respect to our primary outcome, our study has increased power, and we have included more patients than necessary. The increased power explains why we observed a statistically significant, but not clinically relevant, better sum score in the UNN group.

5.6.2 The randomisation

We stratified for age in addition to the patients' home municipality when randomising, assuming younger and older patients would be more likely to need accompanying persons. However, we could not demonstrate this in our study. Almost all the patients under 18 years had a companion person, but for patients older than 64 years, the need for an accompanying person was equal to that in the 18–64 years group. This finding was equal for both consultation types and did not influence the result of the economic analysis for transport cost.

5.6.3 Internal validity

Internal validity tells us with which certainty we can determine that it is the intervention that causes the effects [116]. After randomisation, only 13 patients did not attend the consultation (10 in the UNN group and three in the RMC group). The reported reasons for non-attendance were evenly distributed, except for five patients in the UNN group who reported that their condition had improved. Four of these were from the municipality where the RMC is located. If we assume that the non-attendants had less severe orthopaedic disorders and did not want to travel all the way to UNN for a consultation "just to be sure", but would have met if they were allocated to the RMC, it could have led to non-attendance bias with "healthier" patients at the RMC and "sicker" ones at UNN. Because only five patients gave this reason for not attending, a potential bias could not have had any effect on our outcome measurements.

The patients referred to the orthopaedic outpatient clinic at UNN Tromsø were (finally) screened according to the inclusion criteria by one orthopaedic surgeon (AB). This could

theoretically give a selection bias if the surgeon tended to choose “easy” patients. However, as the study was conducted at an RCT using a web-based randomisation method, this potential bias would influence both groups to an equal extent. Thus, it would not influence the internal validity of the study, although it might have an effect on the external validity.

In an optimal RCT, both the patient and the provider are blinded for the treatment given (double blind study) [120]. In this trial, this was clearly not possible because of the nature of the intervention. This could lead to the patient and specialist being more positive in evaluating the telemedicine consultations (i.e. increase the satisfaction score in the RMC group). The patients who had given consent to take part in the study might be assumed to be positive in the first place. Our finding that even among the UNN allocated patients, 64% would prefer a next consultation at the RMC might support this assumption, and 50.5% evaluated the telemedicine consultation as good as a standard consultation. By using partly a validated questionnaire, we tried to reduce this effect.

Missing data in the questionnaire can also reduce the internal validity. This is discussed later. Another concern regarding measurement bias can be related to the participants’ age [121]. Patients of all ages were included. Except for the inclusion form, the different questionnaires to the patients were equal for all the participants. When planning the study, we assumed that younger patients would be accompanied by one of their parents (or another care taking person) and thus get help filling out the questionnaire. In our study, most patients under 18 years were accompanied by a family member, and very few under 16 years reported independently completing the questionnaire. We do not know whether this influenced the answers.

5.6.4 External validity

External validity relates to the possibility of generalising the results to other locations or other patient groups [116]. First, the question is how representative the included patients are for their group. The eligible patients were directly referred to the study coordinator for inclusion or were identified by screening of the department’s waiting list, both for newly referred and follow-up patients. This should have reduced the risk of selection bias in the inclusion process.

As shown in the flow chart, the patients identified as eligible were mostly positive about participating in the study (Figure 4). During the first 15 months of the study, approximately 20% of the eligible patients did not want to participate. They were registered by gender, age, municipality and, if given, specific causes for declining to participate. Some of them declined participation because they worked, went to school in Tromsø or had a too burdensome travel to the remote location, 17%. More patients from the municipality Skjervøy did not want to take part in the study, 56%. This might be due to transportation reasons because of more demanding public transport to the RMC and because they had access to a direct high-speed craft to Tromsø. More women than men declined to participate 61% versus 39%. Regardless, the distribution of patients in the two groups was equally affected by this, and it should therefore not influence the outcomes. It is also not likely that this could have reduced the external validity.

What would be the results of a similar study in Western Norway or other parts of Norway? Our selection of orthopaedic patients should be representative for most, or all, secondary care orthopaedic hospitals in Norway. The communication between patient and specialist must be assumed to be the same. Our consultation form is based on open communication between patient and specialist. This is not the case in all countries/cultures and may influence the experience of a video-assisted consultation (from specialist and patient perspectives), and it should be considered whether this should be implemented in other countries or cultures [122]. The financial basis for the technical economical calculations is to a large extent similar all over Norway, except for tenders for equipment and the actual travel costs and travel time, which may differ between different locations [113]. The latter would influence the “break even” point. With this background, we expect the results of our study to be valid for other regions in Norway as well. With regard to the economic conclusions, it should be a prerequisite that the consultation form is approved by the health authorities and the financing institutions in the relevant settings. Also, the Norwegian system, in which the health trusts are responsible both for specialist health care and the cost of patient transportation, is an important factor in the economic evaluation in our study. In countries or systems where these costs are not seen as a whole, the economic conclusions might be different.

5.7 Missing data

Missing data is an issue for all studies to a varying degree. Incomplete outcome data could lead to attrition bias. In the patient-reported questionnaire after each consultation, this varied

from 1.8% for the reception at UNN or the RMC to 25% for the EQ-VAS question. Missing data from single questions can have different causes. One reason could be that the question is not well formulated, which makes it more difficult for the patient to interpret what is asked for. This could explain why the questions regarding the patients' opportunities to discuss examination/treatment options and the EQ-VAS were not filled out by 9.5% and 25% of the patients, respectively. "Answer fatigue" could be another reason for the high proportion of patients not answering the EQ-VAS question, as this question was the last question in the questionnaire after the consultation. For the EQ-VAS question at the 12-month follow-up, which the patients filled out at home, 9.7 % of the data were missing. Another reason can be that the patients did not want, or found it difficult, to answer the question because it was "negatively charged". One question out of the five questions forming the EQ-5D-3L which focuses on anxiety and depression presented a proportion that was about twice as high in missing answers as the other four questions (7% vs. approximately 3.5%, respectively). The missing data in the returned patient questionnaires were equally distributed between the groups.

Missing data for single questions can also derive from missing the whole questionnaire. As demonstrated in the flow chart (Figure 5), 143 of 190 (75.3 %) of the UNN patients returned the 12-month follow-up questionnaire. For the RMC, this was 144 of 199 (72.4 %). This is acceptable for external validly, according to Burns et al. [123]. As presented in table 2, the non-responders tended to be younger (especially the group under 19 years), males, in better health for two of the three parameters, workers or students. The municipality and education did not differ much between the responders and the non-responders. The descriptive characteristics were not significantly different between the groups (table 2). Others have also found non-responders to be younger [124] or younger and male [125]. To reduce the number of non-responders, the patients were asked to fill out and deliver the questionnaire directly after the consultation in a designated box.

Except for the registration of complications, the 3-month follow-up questionnaire was not used in the analysis due to initial technical errors in the data base; many 3-month questionnaires were not sent out in time, and some were missing. This was corrected after the first year of the study, and all the 12-month follow-up questionnaires were sent out on time and could be returned within two years after the last consultation.

Table 2 Descriptive characteristics at baseline in non-responders at 12 months follow-up according to location[a]

	UNN, Standard consultation (n= 47 out of 190)	**RMC, video conference consultation (n=55 out of 199)**	**P-value[b]**
Males	25 (53)	26 (47)	0.551
Age, years	35.7 ±23.8	38.1 ±24.8	0.622
Age			0.753
1-18 years	17 (36)	19 (35)	
19-64 years	24 (51)	26 (48)	
65-90 years	6(13)	10 (18)	
The patient residential municipality			0.972
Kvænangen	8 (17)	10 (18)	
Nordreisa	20 (43)	23(42)	
Skjervøy	10(21)	10 (18)	
Kåfjord	9 (19)	12 (22)	
EQ-5D-3L index (n=35+50)[c]	0.72 ±0.20	0.67 ±0.25	0.393
EQ VAS 1-100 (n=31+41)[c]	80.6 ±18	75.3 ±18.6	0.232
Patient assessment of own health in general; 5-leveled scale **(n=41+53)[c]**	1.83 ±0.70	1.98 ±0.90	0.379
Employment status (n=40+52)[c]			0.862
Full time worker	16 (40)	17 (33)	
Part time worker	4 (10)	5 (10)	
Homemaker	2 (5)	6 (12)	
Unemployed	1 (2)	1 (2)	
Retired/disability benefit	5 (13)	9 (17)	
Student/pupil	12 (30)	14 (27)	
Education (n=35+44)[c]			0.315
Primary school	17 (49)	21 (48)	
Secondary school	11 (31)	15 (34)	
University	7 (20)	8(18)	

UNN, University Hospital of north Norway; RMC, Regional Medical Centre

[a] Values are mean ±SD or number (percent)

[b] P-value calculated with t-test of chi square test when appropriate

[c] Number of item responses at baseline in UNN and RMC, respectively

5.8 Strengths

The strengths of our study are the RCT design and the fact that it was performed in a real clinical setting that has been sustainable over time. Orthopaedic patients of all ages were included. It was conducted at the only hospital in the region, making it possible to register unexpected events, but no serious events occurred. Also, the transparency in collecting data for the economic calculation is high.

5.9 Weaknesses

As discussed under the main result, the fact that we were not able to use a properly validated questionnaire created some kind of insecurity with regard to the findings.

The numbers of consultations for the different orthopaedic surgeons were not evenly distributed between the surgeons taking part in the study, with one orthopaedic surgeon being responsible for 90% of the consultations. This was mainly due to practical, organisational reasons. Still, in analysing only the other surgeon's evaluations, the sum score (our primary outcome measure) did not significantly differ between the two groups. Also, analysing the other surgeon's participant patients' general satisfaction did not demonstrate any significant difference, and a higher number of the patients wanted their next consultation, if necessary, at the RMC.

The practical experience and confidence in the video-assisted consultation increased for all the participating orthopaedic surgeons. Thus, several extra video-assisted consultations, not registered in the study, were conducted. Patients not eligible for the study who had relevant disorders were offered this option. Also, all the included patients who were discharged from the study and later needed a new consultation were offered a telemedicine consultation at the RMC.

5.10 Further research

Our intention is to implement video-assisted remote orthopaedic consultation as a routine outpatient option in our region. To secure a good solution and sustainable service, it will be necessary to follow the implementation to detect and resolve obstacles, especially when new locations are included. Telemedicine is far from being a routine service and is still not widely used in Norway [126], and it has different barriers to overcome worldwide [127]. The

increased use of telecommunications in the general population leads to familiarity for other means of communication among patients and providers. As in everyday life, convenience and ease of use are prerequisites for more widespread clinical use. It is very important to identify and solve problems early also when telemedicine is implemented in the health service of a population. In our study, not all the included patients needed treatment, X-rays or other advanced examinations. Telephone consultations are already part of the routine in our outpatient clinic. However, we also lack evidence to support this simple and practical type of patient contact. It would be of interest to compare and study several aspects of different types of remote consultations, including video-assisted, direct video and audio communications to patient homes (e.g. "Skype") and telephones. A German RCT found that follow-up consultations after hospitalisation in paediatric surgery by use of video telephony were cost-effective, time-saving and an acceptable alternative for patients and caregivers [128]. In an RCT investigating follow-up consultations of 31 Dutch patients using a real-time video connection after plastic face surgery, the patients were overall equally satisfied with the video alternative compared to traditional consultation. However, some of the patients reported that the communication with the physician was negatively influenced by the remote consultation type [129]. A RCT (pilot study) of follow-up consultations using Skype for the remote consultation after trauma found telemedicine as an appropriate alternative to in-person consultation, with the patients being equally satisfied [130].

In our study, one exclusion criterion was the expected need of advanced physical examination. However, some basic physical examinations were necessary for many of the included patients and were performed by the trained nurse at the remote location. We suggest a more specific investigation of the kind of physical examinations that are needed. This would be to standardise the pre-evaluation of relevant patients and to evaluate whether other types of health personnel who are more trained in performing physical tests (e.g. physiotherapists) should perform the actual examinations of patients with specific diagnoses. This could probably increase the number of patients who could be offered a video consultation.

6 Conclusion

This thesis showed that for selected orthopaedic patients, video-assisted consultation can be safely offered instead of a standard one at the hospital, according to professional, patient and economic perspectives. The telemedicine approach saves costs in this region, as long as the consultations exceed 151 and 183 patient consultations per year, respectively from societal and health sector perspectives. This is a realistic number of consultations from this region every year. Our findings can be valid for other parts of Norway with remote locations and comparable travel distances to the nearest hospital.

This thesis is a good foundation to support permanently offering video consultations at the studied location and provides motivation to start and implement other RMCs in remote regions. Further research in this field is needed – not least because of the expected rapid development of telemedicine in the years to come.

7 References

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Paper 1

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RESEARCH ARTICLE Open Access

Quality of care for remote orthopaedic consultations using telemedicine: a randomised controlled trial

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Abstract

Background: Decentralised services using outreach clinics or modern technology are methods to reduce both patient transports and costs to the healthcare system. Telemedicine consultations via videoconference are one such modality. Before new technologies are implemented, it is important to investigate both the quality of care given and the economic impact from the use of this new technology. The aim of this clinical trial was to study the quality of planned remote orthopaedic consultations by help of videoconference.

Method: We performed a randomised controlled trial (RCT) with two parallel groups: video-assisted remote consultations at a regional medical centre (RMC) as an intervention versus standard consultation in the orthopaedic outpatient clinic at the University Hospital of North Norway (UNN) as a control. The participants were patients referred to or scheduled for a consultation at the orthopaedic outpatient clinic. The orthopaedic surgeons evaluated each consultation they performed by completing a questionnaire. The primary outcome measurement was the difference in the sum score calculated from this questionnaire, which was evaluated by the non-inferiority of the intervention group. The study design was based on the intention to treat principle. Ancillary analyses regarding complications, the number of consultations per patient, operations, patients who were referred again and the duration of consultations were performed.

Results: Four-hundred patients were web-based randomised. Of these, 199 (98 %) underwent remote consultation and 190 (95 %) underwent standard consultation. The primary outcome, the sum score of the specialist evaluation, was significantly lower (i.e. 'better') at UNN compared to RMC (1.72 versus 1.82, $p = 0.0030$). The 90 % confidence interval (CI) for the difference in score (0.05, 0.17) was within the non-inferiority margin. The orthopaedic surgeons involved evaluated 98 % of the video-assisted consultations as 'good' or 'very good'. In the ancillary analyses, there was no significant difference between the two groups.

Conclusions: This study supports the argument that it is safe to offer video-assisted consultations for selected orthopaedic patients. We did not find any serious events related to the mode of consultation. Further assessments of the economic aspects and patient satisfaction are needed before we can recommend its wider application.

Trial registration: ClinicalTrials.gov identifier: NCT00616837

Keywords: Telemedicine, Videoconference, Orthopaedic, Outpatient clinic consultation, Randomised, Physicians, Safety, Evaluation

Abbreviations: CI, Confidence interval; CVI, Content validity index; GEE, Generalized estimating equations; RCT, Randomised controlled trial; RMC, Regional Medical Centre; UNN, University Hospital North Norway

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Background

Patients need secondary care consultations after referrals from their general practitioners (GPs), or they need follow-up consultations for earlier treatment or for chronic disease. According to the health authorities in Norway, it is a public responsibility to provide necessary health and care services to the entire population regardless of place of residence. Decentralised services using outreach clinics or modern technology are methods to reduce both patient transports and costs to the healthcare system [1]. The University Hospital of North Norway (UNN) is the tertiary referral hospital for the North Norway regional health trust, covering approximately 470,000 inhabitants (2012) and an area of 112,975 km^2. UNN is also the local hospital for Troms and northern Nordland County, covering 187,000 inhabitants (2012) and an area of 31,500 km^2. In 2014, the trust's expenses for patient travel accounted for 3.2 % of the hospital's total budget, not including expenses for ambulance transport by car, boat or air [2]. As one of the outpatient clinics with the highest number of patients, many of whom need assistance by accompanying persons when travelling or who are not able to use public transport, decentralising orthopaedic outpatient consultations is of special interest.

Telemedicine equipment is improving rapidly with regard to quality, cost and user-friendliness; these, together with the distribution of high-speed telecommunication networks, may make it tempting to implement this new technology without further investigation. However, before new methods in healthcare delivery are implemented, it is important to investigate the quality and safety of the care given as well as the economic impact of such innovation to discover any pitfalls and reduce unwanted events. An earlier non-randomised study demonstrated good accuracy by telemedicine-assisted consultation for trauma management compared to standard consultations [3]. A randomised controlled trial (RCT) found telemedicine capable of providing a satisfactory standard of care in the management of minor injuries [4]. Another RCT evaluated patients coming to an emergency department and found telemedicine to be a satisfactory treatment technique [5]. Others suggest that telemedicine is an alternative to conventional visits for orthopaedic patients in an outpatient setting [6–9]. In one study, real-time videoconference was found to suitably provide orthopaedic care to rural areas; however, further investigations, including a cost–benefit analysis, were recommended [10]. Also, telehealth via real-time videoconference was reported to be effective by connecting an Antarctic station and Japan to treat orthopaedic cases [11]. However, there are few randomised studies regarding telemedicine and orthopaedic patients, none of which were conducted in Norway [12–16]. Some of the earlier studies demonstrated the importance of transmitting X-ray images of adequate quality as a factor to improve telemedicine for remote orthopaedic consultation; this was performed with a separate document camera [8, 17]. The X-ray system at UNN is fully digitalised: digital images taken at one location are electronically available at other locations within the hospital trust.

From this background, the aim of this RCT was to study the quality of remote telemedicine consultations in an outpatient clinic as compared to ordinary consultations. The study is reported according to the consort 2010 guidelines [18]. Telemedicine in this study means the use of real-time videoconference and digitalised X-rays. Our study hypothesis was as follows: The introduction of telemedicine service in the form of real-time videoconference for the selected orthopaedic patients will cause no reduction of the professional quality of the patient treatment administered by the doctor involved in the consultations; it will also increase patient satisfaction and lower costs. The study hypothesis examines the non-inferiority of telemedicine consultation versus conventional outpatient consultation. Our choice of a non-inferiority trial design was based on the expectation that a slightly lower-quality score of the evaluation by the physician of the video-assisted consultations would be compensated by increased patient satisfaction and/or reduced travel expenses. In this paper, we present the method of the study and the analyses of the professional quality of the patients' treatment.

Methods

This RCT featured two parallel groups that were allocated into remote consultations at a regional medical centre (RMC) (3.5 h by car from Tromsø) as an intervention and into standard consultations in the orthopaedic outpatient clinic at UNN as a control.

Technical equipment

At RMC, a screen (ViewSonic, Modl nr VS10946-Ie) with a codec and camera situated on top (Tandberg 990MXP) was installed. The orthopaedic surgeon at UNN controlled the camera, which could be used to zoom in on the patients (to look at a post-operative wound) or follow them when walking, for example. At UNN, in a standard outpatient clinic room, another camera, codec (Tandberg 1500MXP) and similar screen were installed. These were connected to a standard PC to show the X-rays to the patient if he or she wanted. The Norwegian Health Network transmitted data over a secure broadband connection (10 Mbps full duplex).

Participants

All of the patients were recruited from the four northernmost municipalities in Troms County in Northern

Norway: Kåfjord, Skjervøy, Nordreisa and Kvænangen. The 6,500 km^2 area is sparsely populated with approximately 12,000 inhabitants (in 2013), 50 % of which live in five small towns. The patients, who all were referred to or scheduled a visit at the orthopaedic outpatient clinic at UNN Tromsø, were evaluated according to the inclusion and exclusion criteria defined by the orthopaedists running the study (Table 1).

Interventions

The remote consultations were performed through real-time videoconference, where a trained nurse was with the patient at the remote location and the orthopaedic surgeon was located at UNN. The preselected orthopaedic surgeons (three consultants, two experienced registrars) carried out their daily work at the orthopaedic department and conducted the consultations as part of their daily routine. They were randomly selected according to who were available at the consultation time. The orthopaedic surgeon ran the consultation after some initial training and technical assistance. Before beginning the study, two nurses from the RMC were trained at the orthopaedic outpatient clinic. They attended casting courses and were trained in clinical examination techniques. The trained nurses received the patient at the remote site, assisted during the consultation and performed physical tasks, for example, changed a cast or removed stitches. No physician was with the patient at the remote site. A digital X-ray lab served by a radiograph was available at the RMC. Digital X-rays were, if appropriate, available at the time of the consultation. Radiologists at UNN later described the X-rays and included them in the hospital's standard X-ray records. The standard consultations took place at the hospital outpatient clinic. In each consultation, the usual mandatory registration and documentation in the patient's medical records was done by the orthopaedic surgeon, including the conclusion of the consultation, agreement between surgeon and patient regarding any follow-up appointments, prescriptions, referrals for operation, further investigation, physiotherapist training and/or an application for orthopaedic aid if needed.

Outcomes

Following each consultation, the orthopaedic surgeon immediately evaluated the professional quality of the telemedicine and the standard consultation. The evaluation comprised answering a questionnaire with five five-level questions (very good, good, neither good nor bad, bad, very bad), each measuring five categories of experience: cooperation, information, examination/evaluation, treatment and overall evaluation of the consultation. (Questions presented in Table 3). The questions regarding information and treatment included the additional option 'not applicable'. All of the questions were equally weighted, and a sum score was calculated. The primary outcome measurement was the difference between standard and video-assisted consultations in the sum score.

Additional analyses were done to support the evaluation of the professional quality of the consultation. The orthopaedic surgeon recorded the duration of the consultation as well as agreement on further action (follow-up consultation/discharge/referrals). The patients received a questionnaire three and 12 months after the last consultation to report events or complications, including any need for additional contact with health services as well as patient-reported outcome measures (EQ-5D-3L and EQ-VAS). Two postal reminders were sent, and an additional telephone call was placed to non-responders. The patients' hospital medical records were screened for additional information relevant to the study. These included complications linked to the referred condition (reported or not by the patient); if referred for operation, whether operated as referred or not; total number of consultations for the actual disorder in the study and if they had been referred again for the same condition over the subsequent two years. The orthopaedic surgeon questionnaire after the video-assisted consultations included five additional five-level questions (very good, good, neither good nor bad, bad, very bad) regarding co-operation with other health workers, technical issues, previous experience with video-assisted consultations and expectations regarding a video-assisted consultation compared to a standard consultation before and after the conducted consultation.

The secondary endpoints were comprised of patient satisfaction and economic analyses, assessed via questionnaires given to the patients and specialists after each consultation and mailed to the patients three and 12 months after the last consultation in the study. The

Table 1 Patients' inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
New referred to orthopaedic outpatient clinic UNN, Tromsø (e.g. knee osteoarthritis, hallux valgus)	Expectancy of advanced physical examination/tests (e.g. shoulder- and "young knee" problem)
Follow up after orthopaedic surgery (e.g. arthroplasty of the hip)	Unable to give informed consent (e.g. Dementia, soldiers, prisoners)
Follow up after orthopaedic trauma (operated or not)	Need of interpreter
Follow up of chronic orthopaedic disorders	To be seen by a specific orthopaedic surgeon
Written consent	Need of contemporary procedures (e.g. CAT-scan, ultrasound)
	Contemporary other outpatient clinical consultation

health economic outcomes and patient satisfaction will be reported in separate papers.

Baseline data were collected via a questionnaire that the patients completed immediately after the first consultation. This included demographic variables (age, gender, occupation, education), indicators used for measuring patient-reported outcomes, cause of consultation and experience with different specialist outpatient clinics. English translations of the questionnaires used in the study can be viewed in the Additional files 1, 2, 3 and 4.

Sample size

The sample size calculation was based on the quality sum score assessed by the consulting physicians; the results indicated that we needed at least 191 patients in each group to achieve 90 % power to detect non-inferiority using a one-sided two-sample t-test, a standard deviation equal to 1.0 and a 5 % significance level. The margin of non-inferiority was set at 0.30, as a difference in sum score between the groups ≤ 0.3 was rated as not clinically relevant using a questionnaire with five-level questions (1–5).

Randomisation

Randomisation of patients was performed via a password-protected, web-based randomisation database created by the Unit for Applied Clinical Research, Faculty of Medicine, Norwegian University of Science and Technology, Trondheim. It was a blocked randomisation of unknown size and stratified by municipality and age (≤18 and ≥ 65 in one group and 19–64 years of age in the other). Blinding was not applicable.

Implementation

Some of the patients were referred directly to participate in the study by their General Practitioner (GP) or specialists at the hospital, but most of the eligible patients were contacted for inclusion after review (by a secretary or the corresponding author) of the hospitals' waiting lists or evaluation of newly referred patients. Up to two invitation letters were sent by mail. The orthopaedic surgeon running the study did the final evaluation to ensure that each patient met the inclusion criteria; the same surgeon also performed the randomisation. The study patients were thereafter given a consultation appointment according to a planned schedule.

Statistical methods

The baseline characteristics were presented as means (standard deviation) or numbers (percentages). Generalised estimating equations (GEE) were used to assess the differences between the intervention and the control group and to assess the non-inferiority of the intervention group. The exchangeable covariance structure was specified in the GEE models in order to control for two or more consultations for some of the participants. In additional models, we recoded the items regarding the evaluation of the consultation to very good (yes/no) and used GEE assuming a binomial distribution with a logit link function. The study design was based on the intention to treat principle, but the analyses of the primary outcome – the sum score – were not strictly by intention to treat principle, since 3.2 % of the randomised patients did not meet for a consultation (5.0 % in the control and 1.5 % in the intervention group). The ancillary results were presented as means (standard deviation) or numbers (percentages) and analysed using two-sample t-tests or chi-square tests, as appropriate. Statistical analyses were performed using STATA version 13.1 (StataCorp LP Texas, USA).

Results

Eligible patients from the four municipalities were recruited between November 2007 and August 2012 and were seen at the outpatient clinic at the first available slot after randomisation, or for follow-up patients, when scheduled. The last consultation in the study was conducted in October 2012. A review of the patient files was performed between May 2013 and October 2014. The baseline characteristics are shown in Table 2; they did not reveal any significant differences between the groups. Figure 1 shows the flow chart, including the data collection points. A total of 559 consultations (257 at UNN and 302 at RMC) from 389 patients (190 at UNN and 199 at RMC) were included. The specialists' evaluation questionnaires were completed for all of the consultations (100 %); one consultation in each group missed all of the questions, forming the sum score (0.5 %). A total of 547 (98 %) of the patients completed the questionnaire (249 at UNN and 298 at RMC). One patient in each group did not attend their follow-up appointments due to other more serious disorders. A total of 125 (66 %) of the UNN-allocated patients versus 136 (68 %) of the RMC participants returned the 3-month questionnaire, and 143 (75 %) and 144 (73 %) returned the 12-month questionnaire. All 389 participating patients' electronic medical records were reviewed as planned. Four patients from UNN and two from RMC died of other disorders within two years after their last consultation.

Outcomes and estimation

The reasons for discharge from the study were as follows: patient did not need further follow-up ($n = 216$, RMC 113 [57 %]/UNN 103 [55 %]); patient was referred for surgery ($n = 55$, RMC 22 [11 %]/UNN 33 [17 %]); patient was referred to another outpatient clinic ($n = 8$, RMC 3 [2 %]/UNN 5 [3 %]); patient required further follow-up at the orthopaedic department for chronic conditions ($n = 74$, RMC 41 [21 %]/UNN 33 [17 %]);

Table 2 Descriptive baseline characteristics from 1st consultation according to location [a]

	UNN, standard consultation ($n = 190$)	RMC, video conference consultation ($n = 199$)
Males	75 (39)	82 (41)
Age, years	46.7 ± 24.9	48.8 ± 24.0
Age		
1-18 years	46 (24)	43 (22)
19-64 years	86 (45)	91 (46)
65-90 years	58 (31)	65(33)
The patient residential municipality		
Kvænangen	25 (13)	26 (13)
Nordreisa	82 (43)	90 (45)
Skjervøy	47 (25)	45 (23)
Kåfjord	36 (19)	38 (19)
Cause of consultation		
New referral	69 (36)	81 (41)
Control after elective surgery	25 (13)	22 (11)
Control after trauma surgery	33 (17)	35 (18)
Control after trauma, no surgery	55 (29)	50 (25)
Chronic disease	8 (4)	11 (6)
EQ-5D-3 L index (n = 165 + 178)[b]	0.70 ± 0.25	0.68 ± 0.26
EQ VAS 1–100 ($n = 140 + 150$)[b]	75 ± 18	73 ± 19
Patient assessment of own health in general; 5-leveled scale ($n = 180 + 191$)[b]	2.00 ± 0.83	2.05 ± 0.83
Employment status (n = 177 + 190)[b]		
Full time worker	45 (25)	56 (30)
Part time worker	23 (13)	20 (11)
Homemaker	12 (7)	19 (10)
Unemployed	2 (1)	2 (1)
Retired/disability benefit	55 (31)	61 (32)
Student/pupil	40 (23)	32 (17)
Education ($n = 158 + 176$)[b]		
Primary school	85 (54)	92 (52)
Secondary school	39 (25)	54 (31)
University	34 (21)	30(17)
Number of outpatient consultations last 6 months before 1st consult. (n = 180 + 188)[b]		
Only the actual consultation	109 (61)	128 (68)
2 to 3 times	64 (36)	52 (28)
4 times or more	7 (4)	8 (4)

UNN University Hospital of North Norway, *RMC* Regional Medical Centre
[a] Values are mean ± SD or number (percent)
[b] Number of item responses in UNN and RMC respectively

patient required follow-up with his or her own GP ($n = 6$, RMC 2 [1 %]/UNN 4 [2 %]); patient needed a consultation specific to the orthopaedic outpatient clinic at UNN ($n = 27$, RMC 16 [8 %]/UNN 11 [6 %]); patient was referred for admission to the ward (RMC 1 [0.5 %]/UNN 0 [0 %]) ($p = 0.424$). The reasons that 27 patients needed follow-up consultations specific to UNN (standard consultation) were as follows: the physician was not satisfied with the examination at the remote location ($n = 3$); patient needed removal of osteosynthesis implants ($n = 13$); patient needed diagnostic anaesthetic injection tests ($n = 3$); patient needed a CAT scan ($n = 5$); other causes ($n = 3$). Except for 'not satisfactorily examined at the remote location', these causes were equally distributed between both groups.

The primary outcome – the sum score of the orthopaedic surgeon's evaluation – was significantly lower, in other words, 'better', at UNN compared to RMC (1.72 versus 1.82, $p = 0.0030$). However, the 90 % CI for the difference in score (0.05, 0.17) was within the non-inferiority margin (Fig. 2). Subgroup analyses restricted to the first consultation of newly referred patients ($n = 150$) and the first follow-up consultation of those who were not newly referred ($n = 238$) showed similar results with slightly wider CIs (−0.02, 0.18) and (0.03, 0.20), respectively. When the five different questions forming the sum score were assessed separately, the questions regarding how the orthopaedic surgeon evaluated the examination/evaluation of the patient and the overall evaluation of the consultation demonstrated significantly higher scores in the RMC group (Table 3).

There were a few missing values in the five questions forming the sum score from 6 up to 26 (1.1–4.7 %). A sensitivity analysis, in which the missing values were replaced with the highest score in the intervention group and the lowest score in the control group, still demonstrated a difference in sum score that was within the non-inferiority margin (90 % CI 0.14–0.27).

Ancillary analyses

Additional analyses are shown in Table 4. The mean consultation duration was not significantly different between the groups ($p = 0.60$). In the subgroup analyses restricted to patients who required casting, we observed

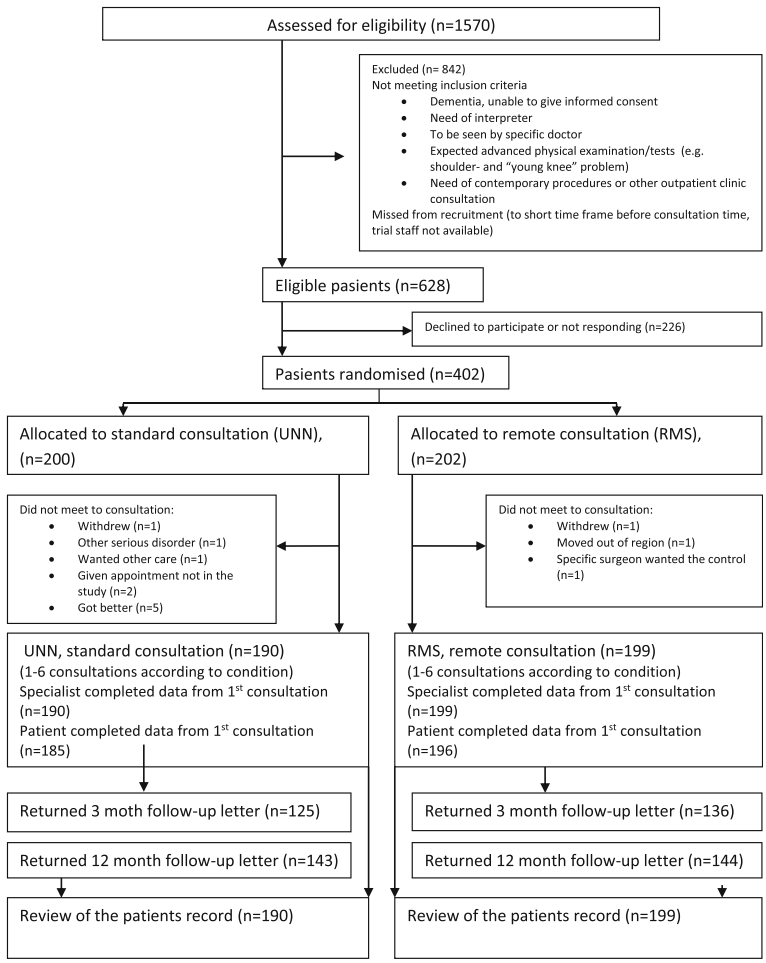

Fig. 1 Flow diagram of the enrollment, allocation, follow- up and data collections points

a significantly longer mean consultation time in the RMC group (29.0 min) compared to the UNN group (22.6 min, $p = 0.0063$). Casting was performed in 11 % of the consultations. All of the patients at the RMC underwent their planned operation. In the UNN group, two patients were not operated on due to the occurrence of other serious disorders, four patients improved during the waiting time and did not need the planned surgery and one did not appear for an unknown reason. There were no significant differences in the number of

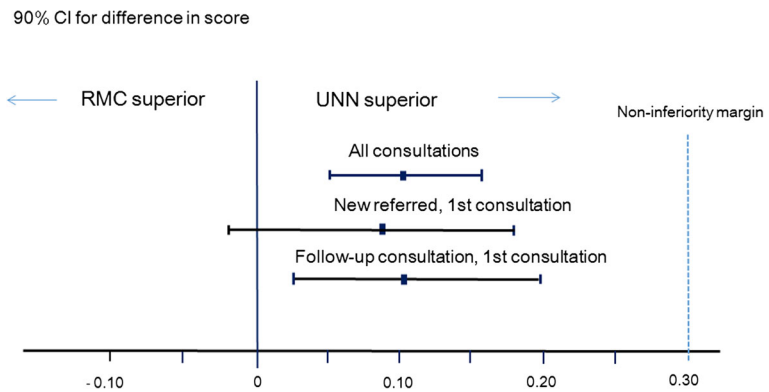

Fig. 2 Observed treatment differences for video-assisted consultation (RMC) minus standard consultation (UNN) for sum-score of the specialist evaluation of the consultation. Blue dashed line = 0.3 non-inferiority margin, CI = Confidence interval

Table 3 Orthopaedic surgeon's evaluation of the consultation per allocation[a]

	UNN, standard consultation	RMC, video conference consultation	*p*-value[b]	*p*-value[c]
How well did you perceive the patient cooperated during the consultation? (254 + 299)[d]			$p = 0.58$	$p = 0.75$
Very good	95 (37)	105 (35)		
Good	157 (62)	190 (64)		
Neither good nor bad	2 (1)	3 (1)		
Bad	0 (0)	1 (0)		
Very bad	0 (0)	0 (0)		
How well could you evaluate/examine the patient? (243 + 290)[d]			$P < 0.001$	$P < 0.001$
Very good	98 (40)	57 (20)		
Good	144 (59)	225 (78)		
Neither good nor bad	1 (0)	7 (2)		
Bad	0 (0)	1 (0)		
Very bad	0 (0)	0 (0)		
How well could you treat the patient? (246 + 292)[d]			$p = 0.068$	$p = 0.039$
Very good	23 (16)	12 (7)		
Good	119 (83)	155 (91)		
Neither good nor bad	1 (1)	2 (1)		
Bad	0 (0)	1 (1)		
Very bad	1 (1)	0 (0)		
Other (not applicable)	102	122		
How well could you inform the patient? (254 + 298)[d]			$p = 0.106$	$p = 0.28$
Very good	54 (22)	50 (17)		
Good	191 (77)	233 (79)		
Neither good nor bad	4 (2)	12 (4)		
Bad	0 (0)	0 (0)		
Very bad	0 (0)	0 (0)		
Other (too young)	5	3		
Overall how well could you assess/treat/checking the patient? (254 + 293) [d]			$p = 0.0047$	$p = 0.040$
Very good	56 (22)	43 (15)		
Good	198 (78)	242 (83)		
Neither good nor bad	0 (0)	7 (2)		
Bad	0 (0)	1 (0)		
Very bad	0 (0)	0 (0)		
Sum score, mean(SD)	1.72 ± 0.38	1.82 ± 0.38	$p = 0.0030$	NA

UNN University Hospital of North Norway, *RMC* Regional Medical Centre
[a] Values are number (percent) or mean ± SD
[b] Test for equality between UNN and RMC using generalised estimating equations (GEE)
[c] Test for equality between UNN and RMC using GEE with a logit link function and a binary response very god (yes/no)
[d] Number of item response in UNN and RMC respectively

operated patients between the two groups ($p = 0.432$). Of the 190 patients allocated to UNN, 147 had one consultation, 27 had two, 11 had three, three had four, one had five and one patient had six consultations before discharge from the study. Of the 199 patients allocated to the RMC, 135 had one consultation, 39 had two, 15 had three, seven had four, two had five and one had six consultations. There was a tendency toward more consultations in the RMC group, but this was not statistically significant ($p = 0.057$). Also, the subgroup analyses of the number of consultations per patient according to the cause of the consultation did not demonstrate any significant differences. The patients who had their appointment at the RMC were not more likely to be

Table 4 Ancillary results according to location[a]

	UNN, standard consultation ($n = 190$)	RMC, video conference consultation ($n = 199$)	P- value[**]
Consultation durations, minutes[b]	20.9 ± 7.47	20.5 ± 8.9	0.603
Operation			
Referred to surgery	33 (17 %)	22 (11 %)	0.074
Operated	26 (14 %)	22(11 %)	0.431
Referred again within 2 years			
Overall (n = 190 + 199)	19 (10 %)	21 (11 %)	0.858
Among "discharged patient" (n = 145 + 159)[c]	12 (8 %)	18 (11 %)	0.373
Number of consultations per included			
Overall (n = 190 + 199)	1.35 ± 0.78	1.52 ± 0.91	0.057
New referred[d] (n = 69 + 81)	1.06 ± 0.29	1.17 ± 0.44	0.067
Control patients[e] (n = 121 + 118)	1.52 ± 0.91	1.75 ± 1.01	0.071
Complication			
Overall (n = 190 + 199)[g]	40 (21 %)	33 (17 %)	0.259
Patient reported at 3 month,(n = 109 + 119)[f]	15 (14 %)	16 (13 %)	0.095
Patient reported at 12 month, (n = 132 + 133)[f]	23 (17 %)	14 (11 %)	0.105

UNN University Hospital of North Norway, *RMC* Regional Medical Centre
[a] Values are mean ± SD and number (percent)
[b] 553 consultations, missing data: 4 of 257 in UNN and 3 of 302 in RMC group
[c] Patient with no appointment at orthopedic department within 6 month for the actual disorder, presented according to location. (Patient neither referred to operation nor to a required standard consultation or follow-up for chronic disorder)
[d] One patient in each group did not meet to follow up consultation
[e] Cause of consultation – control after elective surgery, trauma or chronic diseases
[f] Denominator/number differs due to non-item response, presented according to location
[g] Evaluation of the patient's records and patient reported at 3 and 12 months, presented according to location
[**] P-value calculated with t-test or chi square test when appropriate

referred again within two years for the same disorder ($p = 0.858$). Furthermore, no significant difference was observed in the subgroup of 'discharged patients' (i.e. in those who were not referred for operation, a standard consultation or any follow-up appointment for chronic disorders with the orthopaedic department within six months). The patient-reported outcome measure at three and 12 months and the change from the baseline to 12 months did not demonstrate any difference between the two groups. This will be analysed in a separate paper.

The telemedicine consultation

For the video-assisted consultations, the orthopaedic surgeon evaluated the cooperation with other health workers as 'very good' (99 %) and 'good' (1 %) and the technical performance as 'very good' (14 %), 'good' (78 %), 'neither good nor poor' (7 %) and 'poor' (<1 %). There was no change in the orthopaedic surgeons' evaluation of a video-assisted consultation compared to a standard consultation before and after the actual consultation, which were evaluated as equal (98–99 %). All of the video-assisted consultations were conducted as planned. Due to technical trouble, 17 consultations were delayed – two subsequent consultations for 75 and 60 min, the rest for 17 min (mean).

Discussion

The main finding in our study is that the orthopaedic surgeon evaluated the video-assisted consultations as not being inferior to the standard consultations. The sum score was significantly lower in the control group compared to the intervention group, but the difference was within the non-inferiority margin. The difference in sum score was 0.1 on a scale from 1 to 5, which is lower than the assumed accepted difference of clinical relevance. A total of 98 % of the remote consultations versus 99 % of the standard consultations were evaluated as 'good' or 'very good' for all of the questions in the questionnaire, except for the question regard information to the patient which for 96 % of the consultations at RMC were evaluated as 'good' or 'very good'. X-rays are an important part of an orthopaedic consultation. In our study, X-rays were performed immediately prior to the consultations in 88 % (UNN) and 87 % (RMC) of the cases. This might contribute to the orthopaedic surgeons' positive evaluations. At an orthopaedic consultation, it is important to reach a conclusion for a further treatment plan based on the patient's history, the clinical examination/evaluation and any additional tests or investigations (mainly X-rays). Therefore, it is expected that a consultation without the possibility of physically examining the patient directly will be evaluated as less

optimal than a standard consultation. This could explant the significant difference in evaluation of question regarding evaluation/examination of the patient. The overall question of how well the orthopaedic surgeon could assess/treat/check the patient is also influenced by the latter.

Due to the lack of a standard validated questionnaire for the orthopaedic surgeons' evaluation of the consultations, we created one. The five questions relevance were evaluated by eight, not in the study engaged, orthopaedic surgeons, item content validity index, CVI = 0.976, calculated and reported as recommended by Polit and Beck [19]. All of the questions were related to assessment, which could be affected by the different consultation situations. Others have used similar questions. For example, Brennan et al., who evaluated emergency physicians' ability to use telemedicine to evaluate and treat patients with pre-selected chief complaints in an emergency department, reported a mean of 3.8 (1 = not very satisfied, 5 = very satisfied) in the physicians' comfort level in making diagnoses and performing treatment in the telemedicine group. They did not report any mean in the control group or p-values, but they concluded that telemedicine was a satisfactory technique for the chosen group of patients [5]. A similar result was reported by Wan et al. They evaluated the feasibility of remote consultation for pain management, orthopaedics and general surgery using telemedicine. They had a mean score of 3.6 for the physicians' satisfaction with seeing the patient via videoconference [20]. Aarnio et al. found that 23 out of 29 (six missing) orthopaedic surgeons responded with 'good' or 'very good' as their level of overall satisfaction with teleconsultations, and 20 evaluated the physical examination with aid as 'good' or 'very good' [8]. In another study regarding remote surgical consultations by videoconference, Aarnio et al. demonstrated that 92 % of the consulting surgeons fully agreed that their decisions were as good as they would have been in a usual outpatient clinic consultation [21].

In this study, we did not find any serious events related to the mode of consultation. This finding is strengthened by the fact that our institution is the only hospital in this region, thereby allowing us to discover serious events that the participants do not report, as long as these resulted in contact with the hospital. The patient-reported complications included a wide variety of causes, many of which were not related to the treatment or patient evaluation at the consultations. The complications, evaluated based on the patients' reports, and total complications, which also include complications revealed from the patients' medical records, were not different between the two groups.

Because of the lack of a standard questionnaire for measuring orthopaedic surgeons' satisfaction of consultations, we performed additional analyses to support the evaluation of the quality of care of the consultation. We did not find any significant difference between the two groups concerning referral to operation, regardless of whether the planned operations were performed or not. This was also the case when the analysis was restricted to the new referred patients (data not presented), which is in conjunction with the findings of another follow-up study on videoconferencing with orthopaedic outpatients [9].

Another important finding in our study is that the mean consultation duration was not significantly different between the groups. This is in contrast to what others have reported, where the duration of telemedicine consultations was significantly longer than that of standard consultations [4]. Our data does not give a clear explanation for this finding, although our consultations' duration of 20 min generally was longer [8, 22]. The scheduled duration for each consultation (including consultation, documentation and study registration) was 30 min, which may have influenced the overall amount of time. Another factor could be that all of the consultations in our study were scheduled. Urgent consultations, which represented the largest proportion of consultations in other studies, were not included [4, 10, 23].

One could expect that if the patients were not satisfied with the outcome of the consultation, they would be more likely to be referred again if they still had problems or pain. We did not find any difference between the groups regarding re-referrals, or when analysing subgroups according to different causes of inclusion or how they were discharged from the study. These findings support that, in our study, videoconference consultations are not inferior to standard care. To our knowledge, others have not reported this.

Even if there was a tendency toward a higher number of consultations per patient in the video-assisted group, the difference between the two groups was not significant. After the first consultation, 32 % of the patients in the RMC group were discharged compared to 36 % in the UNN group ($p = 0.389$). Wallace et al. reported that patients in the virtual outreach group were offered follow-up appointments to a larger degree compared to patients receiving standard consultations, especially orthopaedic and ear, nose and throat (ENT) patients [24]. Another study reported that a significantly higher proportion of patients assessed by an emergency medicine specialist using telemedicine were offered a follow-up consultation compared to patients assessed by an on-site emergency medicine specialist [4]. One possible explanation for this difference could be our thorough evaluation of the participants' orthopaedic condition before their inclusion in the study. For example, we did not include the first visit for emergency patients and excluded patients with an expected need for advanced

clinical examination or treatment. Two of the three patients who were not satisfactorily evaluated at RMC had a combination of back and hip pain. Another study has also reported inadequate assessment of patient histories that present with back problems at telemedicine consultations [6].

Our telemedicine approach might be improved if it was an option to have another trained health worker together with the patient at the remote site than the trained nurses used in our study. For example, in a further study on video assisted remote consultations for orthopaedic patients it could be tested whether the possibility to have a physiotherapist together with the patient could increase the potential for examining/testing the patients, and thus both increase the quality of the telemedicine consultations and expand its use to a wider range of patients.

Conclusions

This study found that it was safe to offer video-assisted remote consultations for selected orthopaedic patients. The strengths of this study are that is was conducted in a real-life clinical setting. We did not find any serious events related to the mode of consultation. Further assessments of the economic aspects and patient satisfaction are needed before we recommend a wider application.

Additional files

Additional file 1: Questionnaire for UNN allocated patients, English translation. English translation of questionnaire for patients allocated to standard consultation, immediately after the consultation. (DOCX 24 kb)

Additional file 2: Questionnaire for RMS allocated patients, English translation. English translation of questionnaire for patients allocated to telemedicine consultation, immediately after the consultation. (DOCX 30 kb)

Additional file 3: Questionnaire for the orthopaedic surgeon performing the consultation, English translation. English translation of questionnaire for the orthopaedic surgeon performing the consultation, immediately after the consultation. (DOCX 16 kb)

Additional file 4: Follow up questionnaire for patients participating in the study, at 3 and 12 months, English translation. English translation of questionnaire for the participating patients at 3 and 12 months follow up. (DOCX 27 kb)

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Availability of data and material

Regional Committee for Medical and Health Research Ethics, Northern Norway approved the study. Due to ethical and legal restriction related to confidentiality, the data cannot be deposited online as the study participants have not explicitly been informed about, nor approved data sharing when data were gathered in 2007 – 2014.

Authors' contributions

AB contributed to the study design, data collection, data analysis, interpretation and writing of the manuscript. EB contributed to the study design, interpretation and writing of the manuscript. GK contributed to data collection, interpretation and writing of the manuscript. AS contributed to the study design, data collection, interpretation and writing of the manuscript. TW contributed to the study design, data analysis, interpretation and writing of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate

The Regional Committee Research Ethics, Northern Norway approved the study protocol in 2007 (P REK NORD 134/2006). All patient signed a consent form. For patients younger than 16 years, the patient as well as a parent or legal guardian signed the consent form.

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Paper 2

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Patient reported outcomes with remote orthopaedic consultations by telemedicine: A randomised controlled trial

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Abstract

Introduction: Decentralised services through outreach clinics or modern technology reduce patient travel time and cost to society. Telemedicine consultation through videoconference is one such modality. Here, we compared patient-reported health outcomes and satisfaction between video-assisted remote and standard face-to-face orthopaedic consultations.

Methods: This randomised controlled trial included two parallel groups: (1) patients receiving video-assisted remote consultation at a regional medical centre (RMC); and (2) patients receiving standard consultation at the orthopaedic outpatient clinic of the University Hospital of North Norway (UNN). This study included patients referred to or scheduled for a consultation at the orthopaedic outpatient clinic. After each consultation, patient satisfaction was determined using patient-completed questionnaires containing questions on patient-reported health (three-level European quality of life five-dimension index (EQ-5D-3L)/European quality of life visual analogue scale (EQ-VAS)) and questions from a validated OutPatient Experiences Questionnaire (OPEQ).

Results: This study included 389 patients, of which 199 received remote consultation and 190 received standard consultation (total of 559 consultations). In all, 99% RMC-randomised patients and 99% UNN-randomised patients evaluated the consultation as very satisfactory or satisfactory. Moreover, 86% RMC-randomised patients preferred video-assisted consultation as the next consultation. No difference was observed in patient-reported health after 12 months between the two groups. EQ-5D index scores were 0.77 and 0.75 for RMC- and UNN-randomised patients, respectively ($p = 0.42$).

Discussion: We did not observe any difference in patient-reported satisfaction and health (EQ-5D/EQ-VAS) between video-assisted and standard consultations, suggesting that video-assisted remote consultation can be safely offered to some orthopaedic patients. Moreover, a significantly high proportion of patients selected video-assisted remote consultation as their next consultation, thus strengthening the findings of this study. However, economic aspects should be assessed before widely recommending video-assisted consultation.

Keywords

Telemedicine, patient satisfaction, remote consultations, outpatients, videoconference, randomised controlled trial, orthopaedic, quality of life

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Introduction

Patients require secondary-care consultation after referral from general practitioners or follow-up consultation for previous treatments or chronic diseases. Health authorities in Norway indicate that it is a public responsibility to provide necessary healthcare services to the entire population irrespective of their region of residence. Decentralised services through outreach clinics or modern technology reduce patient travel and cost to the healthcare system.[1] The University Hospital of North Norway (UNN) is a tertiary referral hospital of the Northern Norway Health Trust, covering approximately

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470,000 inhabitants (2012) and a 112,975 km^2 area. UNN also functions as a local hospital for Tromsø and northern Nordland County, covering 187,000 inhabitants (2012) and a 31,500 km^2 area. In 2014, the authority's expenses for patient travel, excluding expenses for ambulance transport by car, boat or air, accounted for 3.2% of the hospital's total budget.[2] As one of the outpatient clinics with the highest number of patients, many of who require assistance by accompanying persons during travel or who cannot use public transport, it is of special interest to decentralise orthopaedic outpatient consultations.

The quality, cost and user-friendliness of telemedicine equipment are improving rapidly. These, along with the distribution of high-speed telecommunication, make it tempting to implement telemedicine without any further investigation. However, assessment of the quality and safety of given care, including patient satisfaction and economic impact of the intervention, is important in order to determine any pitfalls and to reduce unwanted events before employing this technology in routine healthcare. A previous non-randomised study showed good accuracy of telemedicine-assisted consultation for trauma management compared with that of standard consultation.[3] A randomised controlled trial (RCT) showed that telemedicine provided a satisfactory standard of care for managing minor injuries.[4] Another RCT found that telemedicine was a satisfactory technique for managing patients visiting an emergency department.[5] Other studies suggest that telemedicine can be used as an alternative to standard consultation for orthopaedic patients in an outpatient setting.[6–9] One study showed that real-time videoconferencing was suitable for providing orthopaedic care in rural areas; however, further investigations, including cost–benefit analysis, were recommended.[10] Another study showed that telemedicine through a real-time videoconference effectively connected an Antarctic station to a medical centre in Japan for treating orthopaedic patients.[11] However, few RCTs have assessed the effect of telemedicine in orthopaedic patients, and none of these trials have been conducted in Norway.[12–16] The quality of healthcare in general is complex and depends on many factors, including patient satisfaction. A review of studies on patient satisfaction with telemedicine found that the evidence concerning patient satisfaction with telemedicine is rather limited.[17–19] An observational study regarding various paediatric surgical consultations at a children's hospital found that both patients and clinicians reported great satisfaction with a telehealth consultation.[20] A pilot RCT conducted in 2012–2013 found that telemedicine (Skype) may be an alternative to some follow-up consultations for orthopaedic trauma patients, and patients reported similar levels of satisfaction as in-person visits.[21] There are few resent studies regarding telemedicine, patient satisfaction and out-patient clinics.

The present study compared the patient-reported quality of remote telemedicine consultation in an outpatient clinic with that of standard consultation during a prospective RCT that took place from 2007 to 2012. In this study, telemedicine refers to the use of real-time videoconferencing and digitalised radiography. Our hypothesis was that the introduction of telemedicine through a real-time videoconference in selected orthopaedic patients did not decrease the perceived quality of treatment administered by doctors involved in the consultation. The second hypothesis was that telemedicine increased patient satisfaction. A previous study from our group reported the professional quality of telemedicine in the same setting.[22] In the present study, we compared patient satisfaction and patient-reported outcome measures (European quality of life five-dimension index (EQ-5D) and European quality of life visual analogue scale (EQ-VAS)) between video-assisted remote orthopaedic consultation and standard consultation.

Methods

This RCT included two parallel patient groups that were randomised to receive remote consultation at a regional medical centre (RMC; intervention) and standard consultation at the orthopaedic outpatient clinic of the UNN (control). The study method, technical equipment, randomisation, sample size calculation and performance have been described in detail elsewhere.[22] Study patients were recruited from the four northernmost municipalities in Troms County in Northern Norway. Eligible patients were referred to or scheduled for a follow-up visit at the orthopaedic outpatient clinic at UNN, Tromsø. All the study patients provided informed consent and had orthopaedic conditions meeting the inclusion/exclusion criteria defined by the orthopaedists running the study (e.g. new referred, follow-up after surgery, trauma or chronic disorders).[22]

Remote consultation was performed through real-time videoconference, with a trained nurse and patient at the remote location and an orthopaedic surgeon at UNN. No physician was present with the patient at the remote site. Standard consultation was performed at the orthopaedic outpatient clinic.

Patient satisfaction was assessed by administering questionnaires to the patients and orthopaedic surgeons after each consultation; in addition, a questionnaire was mailed to the patients at three and 12 months after the final consultation. The questionnaires that were answered immediately by the patients after the consultation included many questions from the Norwegian OutPatient Experiences Questionnaire (OPEQ), which was evaluated by Garratt et al. and is recommended for measuring patient experience in outpatient clinics.[23] We did not include all the items and questions of the validated OPEQ questionnaire, not including the core scale clinic access (both the questions) and questions on 'unanswered questions' (core scale communication), 'background information available' and 'organisation of work' (core scale organisation). As recommended, we only used relevant questions for scale information and pre-visit communication to keep the number of questions to a minimum. Besides, we used

five-level questions (1 indicating very good and 5 indicating very bad) instead of a 10-point scale for maintaining uniformity in the final questionnaires. Hence, the motivation behind this scale compression was to ease the cognitive burden on respondents. We have not seen any evidence to suggest that such a simplification will impact on the validity of the OPEQ. In addition, the questionnaires included questions for determining overall patient satisfaction with the received consultation, previous experience with video-assisted consultation, preference of location for the next consultation, extent of agreement among different reasons for the preferred location (shortest travel time, give support to local offer, direct face-to-face meeting with orthopaedic surgeons or combination with other activity), travel distance and who completed the questionnaire. The patients randomised to receive video-assisted consultation were asked supplementary questions before and after the consultation to compare between telemedicine and standard consultations and were asked questions on technical performance. Both the questionnaires – that is, those given to the patients immediately after the consultation and those mailed to the patients at 12 months – included questions for assessing patient-reported outcomes (EQ-5D-3L and EQ-VAS). The EQ-5D was chosen because it is by far the most widely used generic preference-based instrument used in the literature.[24] Furthermore, it has demonstrated good responsiveness in patients with orthopaedic disorder.[25] As for the choice of value set, we applied the most widely used value set elicited from a British population, because no Norwegian value set was available.[26] English translations of the patients' questionnaires used in the study can be viewed in the Supplementary materials in a previous publication.[22]

Baseline data were collected using the questionnaire that was completed immediately after the first consultation. These included demographic variables (age, gender, occupation and education), indicators for measuring patient-reported outcomes and experience with different specialist outpatient clinics.

Results are presented as mean (standard deviation) or number (percentages). Differences between the groups were analysed using two-sample *t*-tests, chi-square tests or generalised estimating equations (GEEs). GEEs were used with an exchangeable covariance structure to control for dependence between two or more repeated consultations for some patients. McNemar's test was used to assess changes in patient evaluation of video-assisted consultation. A *p*-value of less than 0.05 was considered significant. All statistical analyses were performed using STATA version 14.0 (StataCorp LP, TX, USA).

Results

Between November 2007 and August 2012, the trial randomised 402 patients, of whom 190 patients allocated to UNN (95%) and 199 allocated to RMC (98%) received consultations. A total of 559 consultations (257 at the UNN and 302 at the RMC) were conducted. At UNN the mean number of consultations was 1.35 (range 1–6) per patient, and at RMC the mean number was 1.52 (range 1–6). Across both arms, 547 questionnaires (249 UNN and 298 RMC) were completed immediately post-consultation (98% of the total consultations). In all, 143 (75%) UNN-randomised patients and 144 (73%) RMC-randomised patients returned the 12-month follow-up questionnaire. Missing data for single questions ranged from 0% to 12%, except for EQ-VAS at baseline, which was 25% for both UNN- and RMC-randomised patients. Flow chart and baseline characteristics, which were not significantly different between the groups, have been published previously.[22]

Patients' evaluation of the consultations is presented in Table 1. Overall, the patients were equally satisfied with both the consultations, with 99% RMC-randomised and 99% UNN-randomised patients indicating that they were very satisfied or satisfied ($p = 0.57$). After the first consultation, 86% RMC-randomised patients reported that they preferred RMC as the location for their next consultation compared with 63% UNN-randomised patients who preferred RMC ($p < 0.0001$). The patients were asked to rate their agreement with statements outlining reasons for their choice of location (e.g. shorter travel time). Shorter travel time (82%, very high and high degree) and want to support a local offer/activity in general (87%, very high and high degree) were the main reasons for the patients preferring RMC. The patients preferring standard consultations at UNN wanted to meet the specialist face to face (86%, very high and high degree) and combine the consultations at UNN with other activity (40%, very high and high degree). No significant difference was observed between the groups with respect to patient satisfaction at 12 months. In all, 49%, 37%, 12%, 2% and 1% RMC-randomised patients reported that treatment at the outpatient clinic was very satisfying, satisfying, either satisfying or dissatisfying, dissatisfying and very dissatisfying, respectively, compared with 46%, 43%, 9%, 2% and 1% UNN-randomised patients, respectively ($p = 0.83$).

There were no significant differences between the groups with respect to all the questions used from the validated OPEQ questionnaire (Table 2), except for the core item 'staff collaboration' and supplementary item 'information about self-care'. In all, 85%, 13% and 1% RMC-randomised patients reported staff collaboration to be very good, good and neither good nor poor, respectively, compared with 61%, 34% and 5% UNN-randomised patients, respectively ($p < 0.00001$). For the question regarding information on self-care – that is, whether the patients knew about their own contribution after the consultation – 94% RMC-randomised patients responded 'yes' compared with 88% UNN-randomised patients ($p = 0.019$). RMC-randomised patients had significantly shorter pre-consultation waiting time at the clinic, with 70% patients reporting a wait time of < 15 minutes compared with 44% UNN-randomised patients

Table 1. Patients' evaluation of the consultation per allocation.

	UNN	RMC	*p*-value[c]	*p*-value GEE[d]
Patient's overall satisfaction with the consultations[a]			0.57	0.35
Very satisfied	188 (78)	233 (81)		
Satisfied	50 (21)	51 (18)		
Neither satisfied nor unsatisfied	4 (2)	3 (1)		
Patient's overall satisfaction with the first consultation[a]			0.79	
Very satisfied	136 (76)	150 (79)		
Satisfied	40 (22)	37 (19)		
Neither satisfied nor unsatisfied	3 (2)	3 (2)		
Want a next consultation at RMC				
Wanted at RMC ($n = 171 + 184$)[b]	107 (63%)	159 (86%)	<0.0001	
Question asked to the patients after first consultation				

UNN: University Hospital of North Norway, standard consultation; RMC: Regional Medical Centre, videoconference consultation; GEE: Generalised estimating equations.
[a]Number (percent).
[b]Number of item response in UNN or RMC respectively.
[c]Test for equality between UNN and RMC using chi^2 test.
[d]Test for equality between UNN and RMC using GEEs with a logit link function and a binary response very satisfied (yes/no).

($p < 0.00001$). In all, 27% RMC-randomised patients waited between 15 and 60 minutes compared with 49% UNN-randomised patients.

No significant differences were observed in patient-reported health at baseline and after 12 months with respect to the EQ-5D index and EQ-VAS in the two groups (Table 3). Also, changes in the EQ-5D index or EQ-VAS from baseline to 12 months were not significantly different between the two groups. To reveal any difference within each dimension forming the EQ-5D index, the partial distribution across levels in each dimension is shown in Table 4. None of the dimensions were significantly different between the groups at baseline or at 12 months. When analysing a possible change in these dimensions from baseline to 12 months, a significant difference was observed between the groups with respect to the dimension 'pain/discomfort' from baseline to 12 months ($p = 0.025$), suggesting that RMC-randomised patients showed higher pain reduction after 12 months than UNN-randomised patients.

No significant difference was observed with regard to questionnaire completion between RMC- and UNN-randomised patients; completion by patients (77% and 76%, respectively) and by guardians (11% and 15%, respectively) ($p = 0.60$).

Telemedicine consultation

RMC-randomised patients were asked to express their thoughts about telemedicine and standard consultations before and after the consultation. Before the consultation, 23 (12%), 27 (14%), 82 (43%) and 14 (8%) patients graded video-assisted consultation to be much better, better, as good as the standard consultation and worse, respectively. After the first telemedicine consultation, these numbers changed to 28 (15%), 34 (18%), 120 (63%) and 8 (4%), respectively. In all, 44 (23%) patients did not have any opinion regarding the consultation type before the consultation. No significant change ($p < 0.86$) was observed in patient evaluation before and after the first consultation. Furthermore, six patients had previously received telemedicine consultation.

In all, 67%, 32% and 1% patients evaluated the technical performance to be very good, good and neither good nor bad, respectively. No video-assisted consultations were cancelled. Seventeen consultations were delayed (two consultations delayed for 75 and 60 minutes and the remaining consultations delayed for 17 minutes (mean)) because of technical problems.

Discussion

We did not observe any difference in patient satisfaction after video-assisted and standard consultations. However, we did not completely investigate the reasons underlying patient satisfaction or dissatisfaction with the consultations. We used the available validated Norwegian OPEQ because of the lack of a validated patient satisfaction questionnaire for video-assisted consultation in the outpatient setting in the initial phase of the study. We did not observe any significant difference in the core items, except for questions on 'staff collaboration' and 'information-self-care'. Video-assisted consultation relies on a collaboration between the present persons. A nurse at a remote location retrieves a patient in the waiting area and plays an active part during the consultation. In contrast, a nurse was present in only 32% of the standard consultations. In addition, questions on support personal staff did not have the option 'not relevant', thus making it difficult to evaluate patient response on staff cooperation. In the question on 'information-self-care', patients were asked whether they were informed about their own

Table 2. Patients' response to questions from OPEQ regarding the consultation per allocation.[a]

	UNN $n = 217–243$[b]	RMC $n = 273–292$[b]	p-value[c]	p-value GEE[d]
Communication				
Enough time for dialogue			0.27	0.27
Yes	238 (100)	292 (100)		
No	1 (0)	0 (0)		
Person understandable (range 1–5)[e]	1.13 ± 0.35	1.13 ± 0.34	0.94	0.95
Person competent (range 1–5)[e]	1.21 ± 0.41	1.18 ± 0.38	0.35	0.65
Opportunity to give sufficient information (range 1–5)[e]	1.27 ± 0.49	1.26 ± 0.53	0.80	0.80
Person caring (range 1–5)[e]	1.19 ± 0.43	1.13 ± 0.34	0.12	0.13
Organisation of work				
Staff collaboration (range 1–5)[e]	1.44 ± 0.60	1.16 ± 0.42	<0.0001	<0.0001
Person well prepared (range 1–5)[e]	1.32 ± 0.48	1.27 ± 0.46	0.27	0.59
Information				
Information-self-care			0.019	0.031
Yes	209 (88)	266 (94)		
Partial	25 (11)	12 (4)		
No	3 (1)	5 (2)		
Information-examination/test results (range 1–5)[e]	1.28 ± 0.64	1.24 ± 0.50	0.36	0.49
Information-condition/prognosis			0.86	0.56
Yes	202 (86)	236 (85)		
Partial	28 (12)	34 (12)		
No	5 (2)	8 (3)		
Consulted about examination/treatment			0.89	0.69
Did not want	127 (59)	167 (60)		
Yes	20 (9)	25 (9)		
Partial	4 (2)	7 (3)		
No	32 (15)	33 (12)		
Does not apply	34 (16)	46 (17)		
Pre-visit communication				
Acceptability of appointment waiting time (range 1–5)[e,f]	2.15 ± 1.30	1.87 ± 1.07	0.17	NA

OPEQ: OutPatient Experiences Questionnaire; UNN: University Hospital of North Norway, standard consultation; RMC: Regional Medical Centre, video-conference consultation.

[a]Values are number (percent) or mean ± standard deviation.

[b]Number of item responses in UNN and RMC respectively. The number of responses to each item/question varies with a range of 217–243 at UNN and 273–292 at RMC.

[c]Test for equality between UNN and RMC using t-test or chi^2 test as appropriate.

[d]Test for equality between UNN and RMC using generalised estimating equations (GEEs). A logit link function was used for binary responses (yes/no; no = No or Partial) and an identity link function for ordinal responses. For the question 'Consulted about examination/treatment', the answers 'Did not want' and 'Does not apply' were not included.

[e]Five-level question (1 best, 5 worst).

[f]New referred patient only ($n = 55$ UNN, $n = 69$ RMC) first consultation.

contribution after the consultation. This was perceived better by RMC-randomised patients, which may be a coincidence. No significant difference was observed with respect to other questions on information or ease of understanding orthopaedic surgeons.

Patient satisfaction may be associated with short waiting time at the clinic.[27] In the outpatient clinic, delay may be caused by the need for the consultant to assist junior doctors asking for help. When having consultations with patients at remote locations by video-assistance, we do not leave the room to get the next patient and we are therefore less likely to be interrupted. Our experience is that the junior doctors also do not interrupt during a video-assisted consultation. Short waiting time at the clinic for remote consultation may be explained by this, in addition to a general desire of punctuality because of the new consultation form. This may stabilise with an increase in the use of video-assisted consultation. However, it is difficult to predict how this might influence patient satisfaction.

Quintana et al. showed that receiving assistance to complete the questionnaire may influence patient satisfaction.[28] In the present study, no significant difference was observed in questionnaire completion between RMC- and UNN-randomised patients.

Table 3. Patients' self-reported health at baseline and 12 months per allocation.[a]

	Standard consultation at UNN of 190 patients		Video-assisted consultation at RMC of 199 patients		
	n[b]		n[b]		p-value[c]
EQ-5D-3L index at baseline	165	0.70 ± 0.25	178	0.68 ± 0.26	0.33
EQ-5D-3L index at 12 months	131	0.75 ± 0.26	122	0.77 ± 0.20	0.42
ΔEQ-5D-3L index at 12 months-baseline	120	0.05 ± 0.27	108	0.09 ± 0.24	0.29
EQ-VAS (1–100) at baseline	140	74.7 ± 18.3	150	73.0 ± 18.6	0.42
EQ-VAS, (1–100) at 12 months	131	76.5 ± 18.1	128	71.6 ± 21.8	0.053
Δ EQ-VAS at 12 months-baseline	103	1.3 ± 17.9	103	−1.0 ± 20.3	0.40

Note: EQ-ED-3L index value is elicited from a UK population.

EQ-5D-3L: three-level European quality of life five-dimension index; EQ-VAS: European quality of life visual analogue scale; UNN: University Hospital of North Norway, standard consultation; RMC: Regional Medical Centre, video-assisted consultation; Δ: difference.

[a]Mean ± standard deviation.

[b]Number differs due to non-completion of particular question.

[c]Test for equality between UNN and RMC using *t*-test.

Patients reported high overall satisfaction with the consultations, which was consistent with that reported in other studies on the satisfaction of orthopaedic patients.[5,8,21] Nielsen et al. concluded that 'effective communication is the key to patient satisfaction'.[29] We observed high positive values for all the questions concerning communication and information, and these values were high independent of the consultation type (Table 2). Wallace et al. observed higher treatment satisfaction among virtually treated patients than among conventionally treated patients.[30] However, their study included a different setting and specialities. A survey study on paediatric surgery telehealth conducted by Shivji et al. reported a high satisfaction rate among both patients and clinicians.[20] High patient satisfaction with telemedicine consultation is consistent with that observed in the present study which showed that a high proportion of patients receiving video-assisted remote consultation prefer this consultation in the future.

We reported earlier that the orthopaedic surgeons evaluated the consultation at UNN as very good (22%), good (78%) and neither good nor bad (0%) compared to at RMC 15%, 83% and 2%, respectively.[22] In our study, the patients were more satisfied with the consultation than the orthopaedic surgeons, which was consistent with that reported in another study.[31] In this other study, this is partly explained by an assumption that the fact that patients evaluated their own physician, on whom they are dependent for receiving care, made their evaluating more positive.[31] However, in our study, this situation was independent of the consultations form. We did not investigate the orthopaedic surgeons' willingness to use video-assisted consultations in our study. This could be subject to further research since the actual physician's viewpoint or attitude forms an essential part of when a wider implementation of telemedicine is planned.[32]

The appropriate implementation of an RCT decreases unknown factors that may influence patient satisfaction. Randomisation is suggested to create a control group that maintains a balance between known and unknown confounding factors without selection bias.[33] We did not observe any significant difference between the groups, except for travel distance, which resulted because of allocation. The RMC is located 148 km from UNN and is the hub site for the region. Only 3.6% of UNN-randomised patients travelled < 150 km compared with 100% of RMC-randomised patients. One study reported that orthopaedic patients travelling < 50 miles (~80 km) reported decreased satisfaction;[34] however, this was not observed in the present study.

Our study suggested increased pain reduction after 12 months in RMC-randomised patients (Table 4). Our study included patients showing different levels of acute deterioration of quality of life and patients with different degrees of chronic diseases. This might explain the small difference in reported pain reduction. However, our study showed reduced EQ-VAS score at 12 months in RMC-randomised patients (Table 3). This might explain the lack of improvement in patient-reported health at 12 months, although this question had a low response rate.

One limitation of our study is that we did not include all the recommended core scale/item questions to determine the most important aspects of patient experience with outpatient consultation.[23] We did not include questions on clinic access. At both the RMC and UNN, the waiting area was on the same floor and was not far from the main entrance. In addition, the patients were not asked directly whether they had any unanswered questions after the consultation.

Some studies indicate that questions on patient expectation of the consultation affect patient satisfaction. We did not include these questions in the present study; however, we believe that our study might have been strengthened by the inclusion of these questions.[29,35,36] Another possible limitation is that our study did not include questions on transmission condition (picture, sound and privacy). When establishing the study design, we assumed that the video technology used would be satisfactory. This was true because 99% of patients and 92% of specialists

Table 4. Distribution of EQ-5D-3L dimensions at baseline, 12 months, and difference between 12 months and baseline.[a]

	UNN		RMC		*p*-value[b]	
	Baseline	12 months	Baseline	12 months	Baseline	12 months
Mobility					0.87	0.45
I have no problems in walking about	99 (55)	86 (61)	106 (56)	78 (57)		
I have some problems in walking about	76 (43)	54 (39)	80 (43)	59 (43)		
I am confined to bed	3 (2)	0 (0)	2 (1)	0 (0)		
Change in mobility[c]						0.77
Improved		25 (19)		20 (15)		
Same		93 (69)		93 (72)		
Worse		16 (12)		17 (13)		
Self-care					0.86	0.09
I have no problems with self-care	145 (82)	133 (95)	152 (81)	121 (90)		
I have some problems washing or dressing myself	30 (17)	7 (5)	33 (18)	14 (10)		
I am unable to wash or dress myself	1 (1)	0 (0)	2 (1)	0 (0)		
Change in self-care[c]						0.27
Improved		16 (12)		20 (16)		
Same		113 (86)		101 (79)		
Worse		3 (2)		7 (5)		
Usual activities					0.07	0.86
I have no problems with performing my usual activities	92 (53)	85 (60)	77 (41)	78 (57)		
I have some problems with performing my usual activities	75 (43)	54 (38)	96 (52)	54 (40)		
I am unable to perform my usual activities	7 (4)	0 (0)	13 (7)	0 (0)		
Change in usual activities[c]						0.26
Improved		29 (22)		37 (29)		
Same		85 (63)		77 (61)		
Worse		20 (15)		13 (10)		
Pain/discomfort					0.62	0.10
I have no pain or discomfort	48 (27)	48 (34)	44 (24)	46 (34)		
I have moderate pain or discomfort	115 (65)	78 (56)	121 (66)	86 (63)		
I have extreme pain or discomfort	14 (8)	14 (10)	19 (10)	5 (4)		
Change in pain/discomfort[c]						0.025
Improved		29 (22)		27 (21)		
Same		84 (63)		93 (73)		
Worse		21 (16)		7 (6)		
Anxiety/depression					0.15	0.21
I am not anxious or depressed	148 (86)	122 (88)	152 (82)	112 (88)		
I am moderately anxious or depressed	22 (13)	14 (10)	33 (18)	16 (13)		
I am extremely anxious or depressed	2 (1)	3 (2)	0 (0)	0 (0)		
Change in anxiety/depression[c]						0.22
Improved		11 (8)		7 (6)		
Same		115 (88)		103 (87)		
Worse		4 (3)		9 (8)		

UNN: University Hospital of North Norway, standard consultation; RMC: Regional Medical Centre, video-assisted consultation.
[a]Values are number (percent).
[b]Test for equality between UNN and RMC using chi^2 test.
[c]Change from baseline to 12 months.

reported very good or good technical performance. None the less, we recommend that problems concerning transmission should be considered in similar future studies because these problems represent three out of 10 items in the evaluated telehealth satisfaction scale.[37]

In conclusion, we did not observe any difference in patient satisfaction and patient-reported health (EQ-5D) between video-assisted and standard consultations. This suggests that video-assisted remote consultation can be offered safely to selected orthopaedic patients. This

conclusion was strengthened by the finding that a significantly high proportion of patients selected video-assisted remote consultation for their next consultation. However, various economic aspects should be assessed before recommending wide application of this consultation type.

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Authors' contributions

AB contributed to the study design, data collection, data analysis, interpretation and writing of the manuscript. EB contributed to the study design, interpretation and writing of the manuscript. GK contributed to data collection, interpretation and writing of the manuscript. AS contributed to the study design, data collection, interpretation and writing of the manuscript. TW contributed to the study design, data analysis, interpretation and writing of the manuscript.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics approval

This study was approved by the Regional Committee Research Ethics, Northern Norway, in 2007 (P REK NORD 134/2006).

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Trial registration

ClinicalTrials.gov identifier: NCT00616837. Because of organisational delays, this trial was registered on 22 January 2008. The specified study start date in ClinicalTrials.gov is November 2007.

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Paper 3

Original Paper

Cost-Effectiveness of Telemedicine in Remote Orthopedic Consultations: Randomized Controlled Trial

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Abstract

Background: Telemedicine consultations using real-time videoconferencing has the potential to improve access and quality of care, avoid patient travels, and reduce health care costs.

Objective: The aim of this study was to examine the cost-effectiveness of an orthopedic videoconferencing service between the University Hospital of North Norway and a regional medical center in a remote community located 148 km away.

Methods: An economic evaluation based on a randomized controlled trial of 389 patients (559 consultations) referred to the hospital for an orthopedic outpatient consultation was conducted. The intervention group (199 patients) was randomized to receive video-assisted remote orthopedic consultations (302 consultations), while the control group (190 patients) received standard care in outpatient consultation at the hospital (257 consultations). A societal perspective was adopted for calculating costs. Health outcomes were measured as quality-adjusted life years (QALYs) gained. Resource use and health outcomes were collected alongside the trial at baseline and at 12 months follow-up using questionnaires, patient charts, and consultation records. These were valued using externally collected data on unit costs and QALY weights. An extended sensitivity analysis was conducted to address the robustness of the results.

Results: This study showed that using videoconferencing for orthopedic consultations in the remote clinic costs less than standard outpatient consultations at the specialist hospital, as long as the total number of patient consultations exceeds 151 per year. For a total workload of 300 consultations per year, the annual cost savings amounted to €18,616. If costs were calculated from a health sector perspective, rather than a societal perspective, the number of consultations needed to break even was 183.

Conclusions: This study showed that providing video-assisted orthopedic consultations to a remote clinic in Northern Norway, rather than having patients travel to the specialist hospital for consultations, is cost-effective from both a societal and health sector perspective. This conclusion holds as long as the activity exceeds 151 and 183 patient consultations per year, respectively.

Trial Registration: ClinicalTrials.gov NCT00616837; https://clinicaltrials.gov/ct2/show/NCT00616837 (Archived by WebCite at http://www.webcitation.org/762dZPoKX)

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KEYWORDS

telemedicine; orthopedics; videoconferencing; remote consultation; outpatients; randomized controlled trial; economic evaluation; cost-effectiveness analysis; QALY

Introduction

Similar to many other countries' publicly funded national health services, a key principle in Norway is that people should have equal access for equal need irrespective of their income or region of residence [1,2]. Thus, patients' travel expenditures on public transportation are reimbursed, except a small user fee. In 2015, total reimbursement of patients' travel expenditures accounted for 2.4% of the total budget for the specialist health services [3]. In particular, patients in the northern and western part of Norway have to travel long and often burdensome journeys to receive specialist care.

Musculoskeletal injuries are the most common causes of disability and chronic pain. Surgery for orthopedic conditions is witnessing some of the greatest growth rates in developed nations across the world [4]. Decentralizing orthopedic outpatient consultations is of special interest when a large number of patients live in remote areas, many of whom are not able to use public transport, or they need assistance by accompanying persons.

Decentralized services using outreach clinics or modern information and communication technologies have the potential to improve access, avoid patient travels, and reduce health sector costs. One such technology is telemedicine consultations using real-time videoconferencing. Today, the use of telemedicine to facilitate treatment and care over a distance has been investigated in almost all clinical specialties [5-7]. Several studies have demonstrated the feasibility of using telemedicine to provide orthopedic consultations to patients living in remote areas [8-11]. Teleorthopedics involve the delivery of specialist services across a distance, usually between an orthopedic surgeon and a patient [12]. It has been reported that teleorthopedics in an outpatient setting is safe and without serious adverse events [13], and that it has increased patient satisfaction [14,15], reduced travels and saved time for the patients [16,17], and reduced costs [18]. Teleorthopedics can also improve the effectiveness of rehabilitation after orthopedic surgery [4]. A study of pediatric orthopedic patients found that even greater benefit can be obtained from telemedicine consultation for patients with a disability where the cost and inconvenience of patient transport are considerably increased [19]. Videoconferencing has also successfully been used for distance training and educational purposes in the field of orthopedics [20,21]. Despite positive reporting of telemedicine studies, the uptake in clinical practice remains low [5,12,22,23].

There exist few randomized controlled trials (RCTs) evaluating telemedicine used in orthopedic outpatient clinics [24], and even fewer that have analyzed if teleorthopedic services are cost-effective compared with traditional outpatient consultations. The main arguments for introducing telemedicine services have been to reduce costs, improve efficiency, and increase quality of and access to health care services [5,25]. Hence, there is a need to determine the extent to which teleorthopedics proves to be cost-effective. Economic evaluation provides information about the costs and benefits of the alternatives under consideration [26]. Health care costs represent the value of resources used, such as staff, equipment, and consumables. Resources outside the health system can also be included such as the patients' travel time and costs. Benefits refer to the value of changes in health outcomes. These changes can be negative and worsen health or positive and improve health [25].

In this study, we report the results from an economic evaluation. The primary objective of this study was to examine the cost-effectiveness of the telemedicine service, compared with standard in-person consultations at the hospital from a societal perspective. The secondary objective was to assess the robustness of the results by conducting sensitivity analysis. The costs included were health care costs, patient costs, and time costs measured as production loss. Health outcomes were measured as quality-adjusted life years (QALYs) gained.

Methods

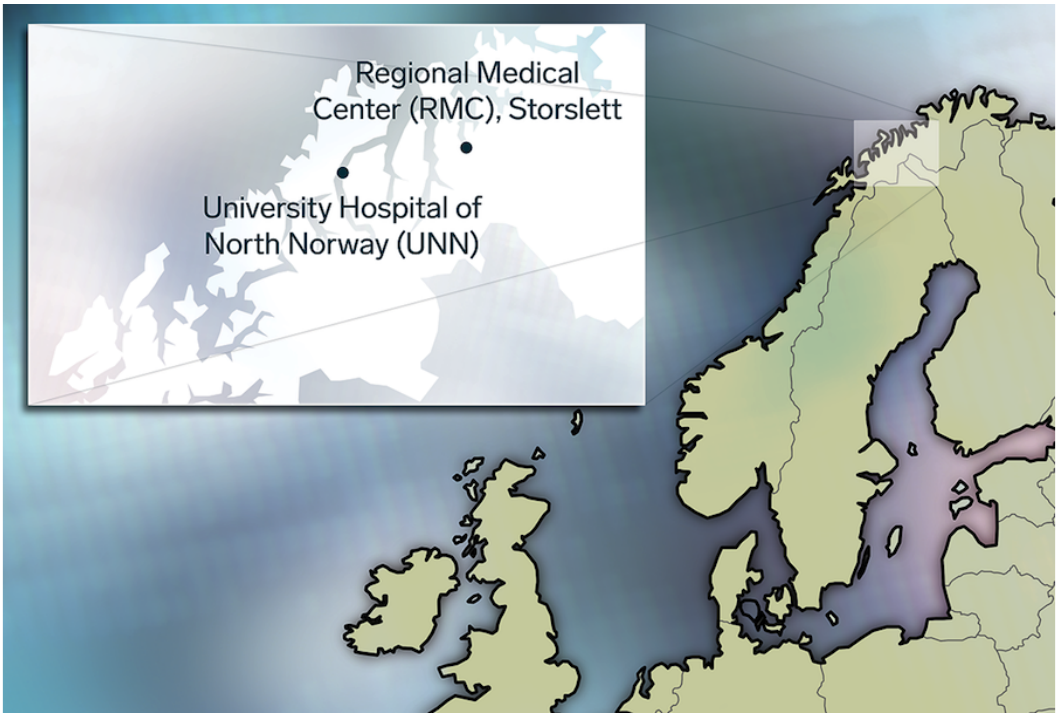
Study Design and Recruitment

The economic study was based on a prospective RCT. This trial was conducted to assess if remote consultations using videoconferencing in orthopedic consultation was as safe and effective as in usual in-person care. Patients were recruited from the 4 northernmost municipalities in Troms County (Figure 1). All participants had been referred to or had scheduled a visit at the orthopedic outpatient clinic at the University Hospital of North Norway (UNN) and found to be suitable for a video-consultation. Patients were excluded if they were in need of any of the following: an advanced physical examination, a computed tomography scan, an ultrasound, an interpreter, seeing a specific surgeon, or if unable to give informed consent. Of the 402 patients who were randomized into 2 groups, 13 withdrew from the study or did not meet for the consultations. This left 389 patients in the study. Patients randomized to the intervention group received remote orthopedic video-consultations at the Regional Medical Center (RMC) (n=199). Patients randomized to the control group received standard outpatient consultations at the hospital (n=190). Informed consent was obtained from all the participants. The study was approved by the Regional Committee for Medical and Health Research Ethics.

Equipment and Training

The remote consultations were performed through real-time videoconferencing. Both the remote center and the hospital used the Cisco TelePresence System and the Norwegian Health Network for secure data transmission (Screen: ViewSonic, Modl nr VS10946-Ie; at the remote center: Tandberg 990MXP; at the hospital: Tandberg 1500MXP). The orthopedic surgeons had some initial training and technical assistance in the beginning of the trial. Registered nurses were operating the service at the remote center. Before the trial, 2 nurses from the remote clinic received intensive training both to operate the technical equipment and to assist in treating the patients locally. They attended casting courses and were trained in clinical examination techniques.

Figure 1. Norway and the area where the study patients were recruited and location of the University Hospital of North Norway and Regional Medical Center (inserted).



The Remote Consultation

The patients were scheduled for an appointment at the local center by the surgeon at the hospital. The orthopedic surgeons (3 consultants and 2 experienced registrars) were randomly selected to conduct the video-consultations if they were available at the specific time. The surgeon made the videoconference call to the remote center.

The patients showed up and were welcomed by one of the trained nurses who set up the videoconferencing at the remote site. The nurses assisted during the consultation and performed physical tasks, for example, changed a cast or removed stitches. No physician was present during the video consultations at the remote site. An existing digital X-ray lab served by a local radiographer was available at the remote clinic. Digital X-rays were, if needed, available and shown to the patients at the time of the consultation.

Usual Care

In the control group, patients received standard consultations at the hospital outpatient clinic. In 32% of the standard consultations, the orthopedic surgeons needed assistance from a nurse [13].

In both the standard and the video consultation alternatives, the usual mandatory registration and documentation in patients' medical records were carried out by the orthopedic surgeon. This involves the conclusion of the consultation, agreement between surgeon and patient regarding any follow-up appointments, prescriptions, referrals for operation, further investigations, physiotherapy, and an application for orthopedic aid if needed. The average number of consultations per patient was 1.5 (range 1-6). For more details of the trial method, see Buvik et al [13].

Economic Evaluation

The economic evaluation consisted of trial-based analyses following the guidelines for health economic evaluation [27,28]. The cost and effectiveness data used in the economic study were based on actual investments, personnel costs, patient travels, and health outcomes collected during the trial described above. A societal perspective was adopted for calculating costs including health care costs, private costs, and production loss. Effectiveness was measured in terms of QALYs gained.

Data on costs and QALYs gained were collected alongside the trial at baseline and at 12 months follow-up using questionnaires, patient charts, and consultation records. These were valued using externally collected data on unit costs and utilities. To increase generalizability and make the cost-effectiveness result useful for decision making, the resources used in the trial were valued using equipment prices, unit costs, travel fares, and salaries from 2017/2018. An extended sensitivity analysis was conducted to address the robustness of the results.

Costs

Three types of costs were included: (1) costs associated with implementing and running the telemedicine service in clinical practice, (2) travel costs, and (3) production losses.

Costs Associated With Implementing and Running the Service

The implementation costs included the costs related to the investment in videoconferencing equipment (codec, screen, and camera) at the remote center and the hospital, and an extra computer and printer at the remote center. The remote center already had a broadband connection for other purposes. The computer at the remote center provided the nurse access to the patients' hospital records, and the printer was used to give patients a paper copy of the records on request. In addition,

costs related to running the service at the remote center were estimated. This included a registered nurse in a 20% position. Other costs associated with setting up the service included initial training sessions and travel costs related to these activities, line rent, and rent associated with the extra space needed at the local center. No extra technical support was needed as they used existing resources at the hospital. The costs estimated were only those that differed between telemedicine and hospital consultations, that is, the incremental costs. The time costs for the orthopedic surgeons were the same for both consultation forms [13]. The consumables, X-ray, and administrative costs were assumed to be similar for both groups. The cost of the nursing assistance during the standard consultations was also included. Equipment prices and line rent for both the remote clinic and the hospital were collected from the purchasing department at the hospital. A one-time equipment cost can be spread over the expected lifetime of the equipment by annuitizing the cost using a discount factor. The investment costs including equipment, installation, and training were annuitized into an equivalent annual cost assuming a 3% discount rate and a 5-year lifespan for the equipment. The costs of the extra space and other facilities at the local center were collected from financial and administrative records at the hospital. Official salary for nurses was used to estimate the costs of the extra nurse position. The costs are presented as total annual costs and costs per patient consultation (unit costs).

Travel Costs

Travel costs were collected directly from the patients during the trial. Data on traveling time, distance, and mode of transport to the consultation were collected using a questionnaire that was handed to the patient directly after each consultation. Main occupation, if they were on sick leave, and the need of overnight stay were also included. Additionally, Google map was used to estimate the travel distance from the patients' home to the consultation site either at the remote center or at the hospital (shortest and fastest). The orthopedic surgeon decided if the patient needed a companion or extra transportation on health-related grounds, reported the patients' main occupation, and if they needed sick leave. The travel costs were calculated using regulations and official travel fare rates by the Norwegian Patient Travel Agency in 2018 [29].

Production Losses

Production losses were estimated for patients in full- or part-time employment who had to take time off from work to attend the orthopedic consultations. Part-time employment was set to 50%. Time costs for the patients who were unemployed or on sick leave benefits were not included. If the information about working status was missing from the self-reported questionnaires, the orthopedic surgeons' registration forms were used. Official Norwegian average wages were used to value absence from work to estimate the production losses.

Only 3 of the 199 patients who were offered a video consultation at the remote center had a new consultation at the hospital, because of their need for a face-to-face consultation to carry out examination that is not possible over the video link. The cost of these second consultations was also included in the analysis. Based on the resources available at the hospital and the experiences from the trial, we assumed that for 300 patient consultations annually, 5 would need a second consultation.

Quality-Adjusted Life Years Gained

Health outcomes were measured in QALYs gained, a composite measure incorporating both quantity and quality-of-life impacts of treatment [26]. As a patient-reported outcome measure, we applied the EQ-5D which is the most widely used generic preference-based instrument for valuing QALYs [30]. EQ-5D questionnaires were collected at baseline and at 12 months follow-up. The questionnaires were handed to the patients immediately after the first consultation and sent by mail 12 months after the last consultation during the trial. The scoring algorithm estimated for a sample of the general population in United Kingdom was used to calculate utility values from the utility scored in the EQ-5D instrument (the EuroQol health states) [31]. Utility values were calculated only if all 5 of the EQ-5D dimensions were answered. Finally, QALYs were then calculated by multiplying the change in utility value with the duration of the health state (1 year) [26].

Statistical Analysis

Results are presented as means (SDs) or numbers (percentages). Differences between the groups were analyzed using 2 sample *t* tests, chi-square tests, or generalized estimating equations (GEEs). GEEs were used with an exchangeable covariance structure to control for dependence between 2 or more repeated consultations for some participants. All statistical analyses were performed using STATA version 14.0 (StataCorp LP Texas, USA).

Sensitivity Analysis

One-way sensitivity analyses were conducted to assess the robustness of the results. Parameters have been varied one at a time to assess the effect on the cost-effectiveness and to determine breakeven values. We recalculated the cost analysis in 3 separate scenarios: one included a less costly Skype for Business solution, the second assumed a shorter distance to the main hospital, and a third scenario includes the expenditure to the hospital excluding patients' own travel expenditures and production losses. The number of consultations needed to break even was calculated for all scenarios.

Results

Table 1 provides characteristics of the participants at baseline.

Table 1. Descriptive baseline characteristics from first consultation according to location.

Baseline characteristics of the participants (n)	UNN[a] standard consultation (n=190)	RMC[b] telemedicine consultation (n=199)
Males, n (%)	75 (39.5)	82 (41.2)
Age (years), mean (SD)	46.7 (24.9)	48.8 (24.0)
Age group (years), n (%)		
1-15	42 (22.1)	29 (14.6)
16-66	94 (49.5)	117 (58.8)
67-90	54 (28.4)	53 (26.6)
Patient residential municipality, n (%)		
Kvænangen	25 (13.2)	26 (13.0)
Nordreisa	82 (43.2)	90 (45.2)
Skjervøy	47 (24.7)	45 (22.6)
Kåfjord	36 (18.9)	38 (19.1)
Cause of consultation, n (%)		
New referral	69 (36.3)	81 (40.7)
Control after elective surgery	25 (13.2)	22 (11.1)
Control after trauma, surgery	33 (17.4)	35 (17.6)
Control after trauma, no surgery	55 (28.9)	50 (25.1)
Chronic disease	8 (4.2)	11 (5.5)
Employment status (n=177+190)[c], n (%)		
Full-time worker	45 (25.4)	56 (29.5)
Part-time worker	23 (13.0)	20 (10.5)
Homemaker	12 (6.8)	19 (10.0)
Unemployed	2 (1.1)	2 (1.1)
Retired or disability benefit	55 (31.1)	61 (32.1)
Student or pupil	40 (22.6)	32 (16.8)
EQ-5D-3L index (n=165+178)[c], mean (SD)	0.70 (0.25)	0.68 (0.26)
EQ VAS 1-100 (n=140+150)[c], mean (SD)	75 (18)	73 (19)

[a]UNN: University Hospital of North Norway

[b]RMC: Regional Medical Center.

[c]Number of item responses in UNN and RMC, respectively.

Costs

Costs Associated With Implementing and Running the Service

The costs of setting up the teleorthopedic service are presented in Table 2. Total costs of investing in standard videoconferencing units at both sites were €16,511 (1 Euro=9.60 Norwegian krone, April 10, 2018). The total annual costs including annuitized investment costs (equipment and initial training), line rent, extra personnel costs, and rent for extra office space at the regional center were €20,684. The largest cost component is the extra nursing costs at the local health center. Nearly, two-thirds of the total annual cost of the teleorthopedic service are extra personnel costs. If a less costly Skype for Business alternative had been used, the annual costs would have been reduced to €17,535 (see Table 2 for more details).

Table 2. The costs of setting up a video-assisted outpatient clinic (in Euro).

Cost elements	UNN[a] standard consultation	RMC[b] telemedicine consultation	Total (Euro)[c]	Annual cost
Alternative A[d]				
Videoconferencing equipment	5104	6250	11,354	—
Personal computer (PC)	—	463	463	—
Screen	—	156	156	—
Printer	—	114	114	—
Initial training of nurse and physician	—	—	4424	—
Total investment A			16,511	3605[e]
Additional costs alternative A				
Line rental, Norwegian Health Net	—	104[f]	—	1250
Sum alternative A				4855
Alternative B[g]				
Camera	96	937	1033	—
Screen	—	833×2	1666	—
Microphone	111	—	111	—
PC	—	463	463	—
Printer	—	114	114	—
Initial training of nurse and physician	—	—	4424	—
Total investment B			7811	1706[e]
Additional costs alternative A and B				
Technical support[h]	—	—	—	—
Rent for local RMC	—	—	—	3542
Nurse at RMC[i]	—	—	—	12,083
In need of a second consultation at the hospital[j]				204
Total additional costs				15,829
Total annual cost alternative A				20,684
Total annual cost alternative B				17,535

[a]RMC: Regional Medical Center, remote location.

[b]UNN: University Hospital of North Norway, standard consultation.

[c]1 Euro=9.60 Norwegian krone, exchange rate from the Norwegian Bank on April 10, 2018.

[d]Alternative A: Videoconferencing units: UNN—Cisco TelePresence System EX90; RMC—Cisco TelePresence MX200 G2 (prices obtained from the purchasing department at the hospital).

[e]Annual cost has been calculated using a 3% discount factor and a 5-year lifetime of the equipment.

[f]Per month.

[g]Alternative B: Skype for Business: UNN—Camera Logitech: Webcam C930e—net camera; Tablemicrofon: Jabra SPEAK 510+MS (already installed 1 PC and 2 screens for standard consultations); RMC—2 screens Philips Signage Solutions Q-Line BDL5535QL+camera/microphone Logitech GROUP+PC (prices obtained from the purchasing department at the hospital).

[h]Technical support—no extra costs included as this support has been covered by existing support at the hospital.

[i]20% part time, including social costs.

[j]Three patients needed a second consultation at UNN because of an unsatisfactory consultation at the RMC during the trial (out of 199 patients) [13]. Since we have assumed 300 patients a year in the teleconsultation alternative, costs of a second consultation have been included for 5 patients per year.

Travel Costs

Table 3 shows details on patients' modes of transport. Most patients in the remote group traveled by private car. The chosen mode of transportation reflects the lack of available public transportation in the area. In the group of patients traveling to the hospital, 26% needed extra transportation facilities because of their health condition. This number was 30% for the patients in the telemedicine group (*P*=.31). In addition, the need for travel companions was the same in both groups (30% in the hospital consultation group and 27% in the telemedicine group; *P*=.45). The time spent on traveling was 6 times higher for patients traveling to the hospital. Patients in the telemedicine group saved an average 7 hours and 40 minutes on traveling (see Table 4 for more details). The average travel cost per patient is €148.65 for the standard consultations at the hospital, as compared with €40.73 for the video consultations, including user fees for the patients (€31.04; see Multimedia Appendix 1).

Table 3. Patient transport mode to each consultation per allocation. Of the 389 patients participating in this study, some attended more than 1 consultation; consequently, the total number of consultations in this study was 559 (257 at UNN and 302 at RMC).

Transport mode	UNN[a], n (%)	RMC[b], n (%)	*P* value[c]	*P* value, GEE[d]
Taxi[e]	55 (21.4)	60 (19.9)	.57	.77
Taxi, as main transport	47 (18.3)	60 (19.9)	.71	.56
Airplane	3 (1.1)	0	N/A[f]	N/A
Bus[g]	72 (28.0)	6 (2.0)	<.001	<.001
Bus, as main transport	66 (25.7)	6 (2.0)	<.001	<.001
Private car[h]	106 (41.2)	211 (69.9)	<.001	<.001
Private car, as main transport	98 (38.1)	209 (69.2)	<.001	<.001
Express boat	28 (10.9)	0	<.001	N/A
Ferry[i]	19 (7.4)	7 (2.3)	.004	.01
Other[j]	0	15 (5.0)	<.001	N/A
Not reported or Missing	16 (6.2)	13 (4.3)	.31	N/A

[a]UNN: University Hospital, standard consultation.

[b]RMC: Regional Medical Center, remote location.

[c]Test for equality between UNN and RMC using chi-square test.

[d]Test for equality between UNN and RMC using generalized estimating equations (GEEs) with a logit link function and a binary response, transport (yes or no).

[e]Including taxi as shuttle to other transport (bus, express boat, or airplane).

[f]N/A: not applicable, few or no observations.

[g]Including bus as shuttle to other transport (airplane or express boat).

[h]Including private car as shuttle to other transport (bus, express boat, airplane, or taxi).

[i]Always in combination with other transport (bus, private car, express boat, or taxi).

[j]Walking, bicycle, or working car.

Table 4. Patients' travel details and working status.

Patients' travel and working status	UNN[a] standard consultation	RMC[b] telemedicine consultation	*P* value[c]
Travel distance in kilometers, shortest distance[d] (n=257+302)[e], mean (SD)	148 (31)	46 (17)	<.001
Travel distance one way in kilometers[f] (n=224+284)[e], mean (SD)	248 (59)	47 (28)	<.001
Travel time one way in minutes[f] (n=243+293)[e], mean (SD)	277 (94)	47 (43)	<.001
Need of companion, (n=245+294)[e], n (%)	73 (29.8)	79 (26.9)	.45
Need of extra transport[g], (n=249+297)[e], n (%)	64 (25.7)	88 (29.7)	.31
Working full time[h], (n=136+179)[i], n (%)	59 (43.4)	75 (41.9)	.68
Working part time[h], (n=136+179)[i], n (%)	29 (21.3)	28 (15.6)	.68
Sick leave—all[j], (n=138+180)[i], n (%)	60 (43.5)	71 (39.4)	.47
Actual working[k]—full time, (n=76+109)[i], n (%)	20 (26.3)	36 (33.0)	.09
Actual working[k]—part time, (n=76+109)[i], n (%)	15 (19.7)	13 (11.9)	.09

[a]UNN: University Hospital North Norway, standard consultation.

[b]RMC: Regional Medical Center, remote location.

[c]Test for equality between UNN and RMC using *t* test or chi-square test as appropriate.

[d]Calculated road between allocation and municipality center using Google Map, one way. The travel distance for the patient in the municipality, where the RMC is located, is replaced with the mean value of the municipalities' patients reported travel distance.

[e]Number of item responses in UNN and RMC, respectively.

[f]Patients reported distance or time used to travel to the consultation.

[g]Need extra transport, as patient was not able to use public transport.

[h]Patient reported (age between 15 and 67 years), missing value adjusted by doctors reported value.

[i]Number of item responses in UNN and RMC, respectively, age between 15 and 67 years.

[j]Including unemployed and homemakers.

[k]Working—patient not with sick leave.

Production Losses

Production losses for patients who had to be away from work to attend the consultations, the total average costs of the patient transfer amounted to €182.50 per patient for the standard consultations and €51.77 for the teleconsultations. The calculation of travel and time costs for the patients is presented in detail in Multimedia Appendix 1.

Quality-Adjusted Life Years Gained

The average QALYs gained per patient in the telemedicine group was .09 which was not significantly different to the .05 gain in the standard consultation group, *P*=.29.

Cost and Effectiveness

Table 5 presents the costs and effects in each of the 2 alternatives. Among patients in the intervention group, 3 needed a second face-to-face consultation that was not possible to carry out over the video link. The cost of these second consultations was also included in the analysis (Table 5). In total, the telemedicine service costs €65 less per patient than standard consultations at the hospital. Thus, the remote teleorthopedic service is less costly and produced no difference in health outcome, that is, the teleorthopedic service as described in this study is cost-effective. The number of patient consultations needed for telemedicine and standard consultation to be equally costly (breakeven) is 151 patients per year (see Figure 2).

Table 5. Costs and effectiveness for standard and remote consultations (1 Euro=9.60 Norwegian krone, exchange rate from the Norwegian Bank on April 10, 2018).

Costs and effectiveness	UNN[a] standard consultation	RMC[b] telemedicine consultation	Difference
Consultation costs[c] (Euro)			
Investment cost videoconferencing[d]	0	3605	3605
Line rent	0	1250	1250
Room rent	0	3542	3542
Personnel costs (nurse)[e]	906	12,083	11,177
In need of a second consultation at the hospital[f]	0	204	204
Total annual costs	906	20,684	19,778
Cost per consultation[g]	3	69	66
Time and travel costs (Euro)			
Travel costs	149	41	108
Time costs[h]	34	11	27
Total time and travel costs per consultation	183	52	131
Total costs per patient consultation	186	121	65
Effectiveness (QALYs[i] gained)	.05	.09	.04[j]

[a]UNN: University Hospital of North Norway.

[b]RMC: Regional Medical Center.

[c]Consultations cost which are different between the 2 groups.

[d]Total investment costs have been annuitized using 3% discount factor and a 5-year lifetime.

[e]The extra personnel costs at the remote location included a nurse in 20% position. At the standard consultation, a nurse was present in 32% of the consultations, corresponding to 25 hours by 300 consultations a year.

[f]Three patients needed a second consultation at UNN because of an unsatisfactory consultation at the RMC during the trial (out of 199 patients) [13]. Since we have assumed 300 patients a year in the teleconsultation alternative, costs of a 2nd consultation have been included for 5 patients per year.

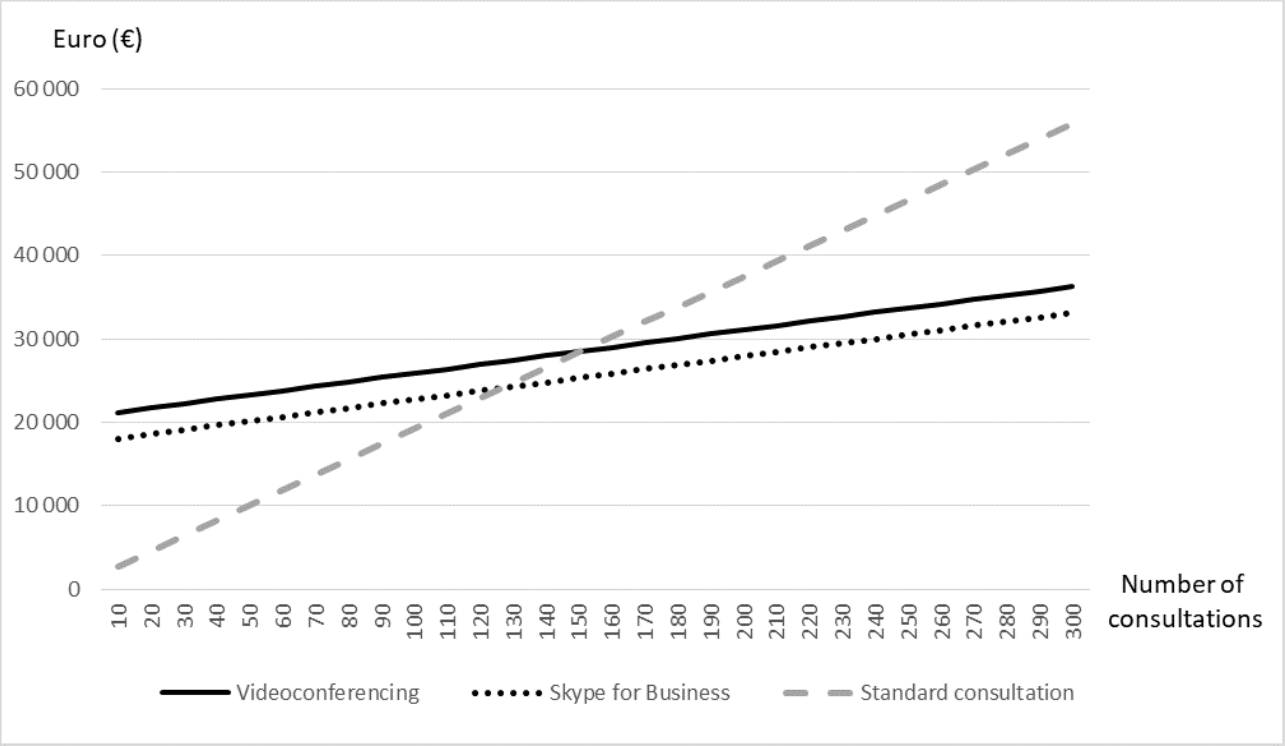
[g]The annual load for this service is estimated to be 300 telemedicine consultations per year.

[h]Production loss because of absence from work to receive orthopedic consultation.

[i]QALYs: quality-adjusted life years.

[j]The difference in QALYs gained was not significant (P=.29) t test.

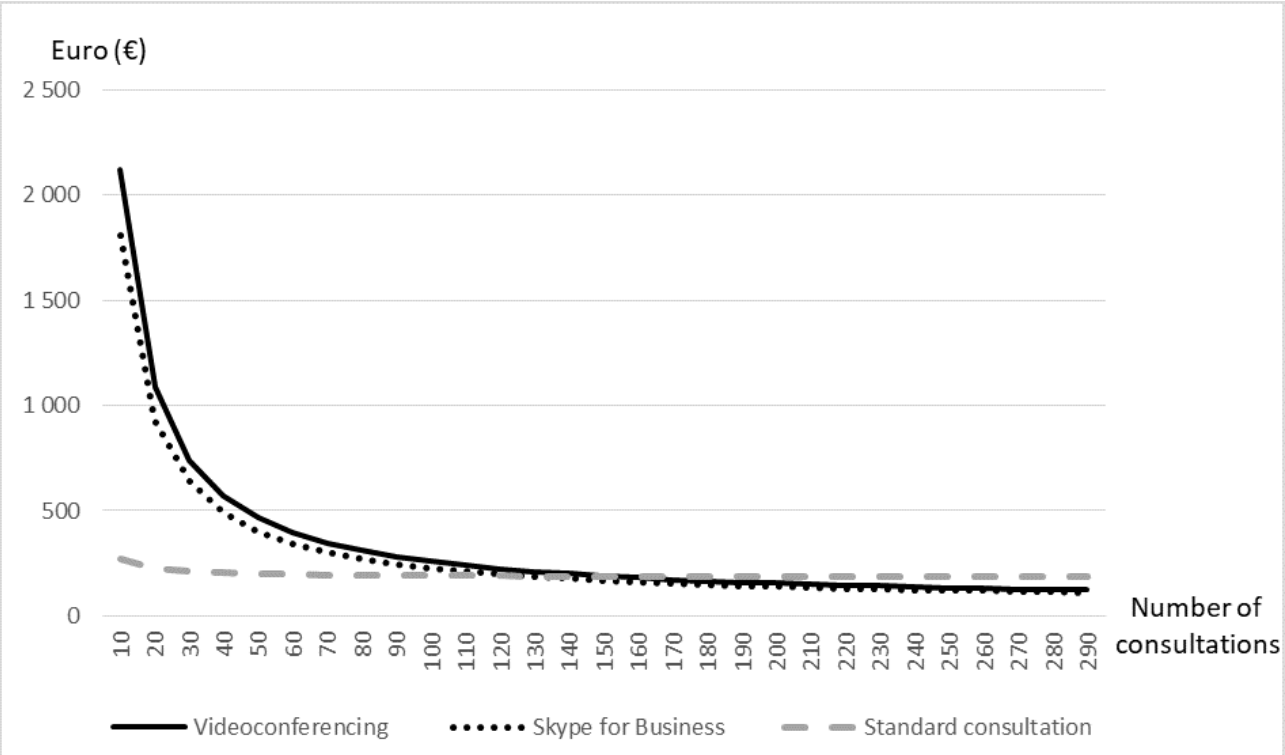
Figure 2. Total annual costs of the teleorthopedic service including the Skype for Business alternative.



Sensitivity Analysis

The different scenarios in the sensitivity analyses are illustrated in Figures 2 and 3. The main case alternative described above is represented by the solid black curve (videoconferencing) and the gray dotted line (standard consultation at the hospital). The first scenario included a less costly Skype for Business alternative. The total annual cost of this alternative was €17,535, and the number of patient consultations needed to break even was 127 per year (dotted black line). The second scenario, assuming a shorter distance (90 km) between the remote clinic and the hospital, needed 314 patient consultations to breakeven using videoconferencing units (not shown). The third scenario included only expenditures to the hospital excluding production losses and patients' own travel expenditures. This made telemedicine cost-effective for an activity of at least 183 patient consultations a year (not shown).

Figure 3. Cost per patient for base case and the Skype for Business alternative.



Discussion

Principal Findings

The results of this study showed that using videoconferencing to offer orthopedic consultations to patients at the remote clinic costs less than standard outpatient consultations at the specialist hospital, as long as the activity exceeds a minimum of 151 patient consultations per year. For a total workload of 300 patients per year, the annual cost savings amounted to €19,500. With a health care sector cost perspective, the number of patient consultations needed to break even was 183, and the total annual savings amounted to €12,600. Thus, teleorthopedics is cost-effective from both a societal and health care provider perspective. A shorter distance to the hospital was the only scenario that altered the conclusion. Reducing the travel distance by 50 km made the standard consultation more cost effective for up to 314 patients per year.

Assuming a less expensive Skype for Business alternative reduced the cost of telemedicine with €3149 annually, this alternative became cost-effective when including more than 127 patient consultations per year. The reduction in costs by investing in a cheaper videoconferencing solution was relatively modest. One of the reasons is that the equipment cost was less compared with the other cost components such as the extra personnel needed at the remote site. The quality of the videoconferencing might also be reduced using Skype for Business, and more patients would need a second consultation at the hospital making the cost advantage even less. We have not evaluated if a Skype for Business alternative will reduce the quality in picture and/or sound transmission. Other options to reduce the equipment costs are to increase utilization and share the videoconferencing units with other specialties/other use (eg, teaching or meetings) [32]. These possibilities should be considered before setting up video consultations in a specific field.

In most of the published literature, a physician (eg, a general practitioner [GP], a general surgeon, or a resident) has been present at the remote site together with the patient [8,10,11,33,34]. Some studies reported that a nurse at the remote site and a specialist at the hospital could provide satisfactory remote consultations in emergency medicine [35-37]. Wallace et al recommend to include a nurse to host the teleconsultations in place of the GP to reduce the cost of telemedicine [38]. In this study, a nurse was hosting the teleconsultations at the remote site. To our knowledge, no other studies have reported a similar setting when studying the use of teleorthopedics for newly referred patients or follow-up consultations. However, the extra personnel costs still consist of nearly two-thirds of the total annual cost of the teleorthopedic service even if a nurse is hosting the teleconsultations.

Whether to include production losses measured as time off work is controversial [39]. The patients may already be off work, because they are retired or because of their health condition. Health visits of a shorter duration might not represent production losses at all. Some types of work can be postponed until the person is back or one's colleagues can take over. The time costs are important in telemedicine and eHealth, and one should find a way to include these costs [25]. In this study, production loss has only been included for those who reported that they took time off work to attend the consultation. From a societal perspective, these costs are relevant, but not from a health care provider perspective. Excluding the production loss does not change the cost-effectiveness as shown in the sensitivity analysis. Another way is to report the time (hours or days) lost or gained separately without putting a value on it [26]. Our results show that patients receiving standard consultations spent almost 8 hours more per consultation traveling than the patients in the telemedicine group.

Other studies have reported a reduction in the number of referrals to the specialist because of a learning effect and included this as part of the cost savings [32,40]. In this study, the nurse at the remote center reported an increase in the number of patients treated locally mostly because of their newly acquired casting skills. This was seen for patients with a stable fracture (not displaced). If this effect had been included in our analysis, the service would have reduced the need for specialist referrals and incurred additional cost savings.

A third option to prevent the patient from traveling long distances is to have the specialist travel from the hospital to the remote location. However, because of a lack of orthopedic specialists at the central hospital in this region, the opportunity costs of their travel time would be too high. However, in other institutional contexts, this might be another alternative to consider.

In this study, we demonstrated that significantly less public transport such as a bus or boat was used in the remote consultation group (Table 3). This can be explained by the lack of available public transport in the rural area, something that explains the frequent use of taxi and private cars. Expensive and long travels imply that fewer patients are needed to make remote consultations cost-effective.

Strengths and Limitations

The main strength of this study is that the costs and effects have been collected alongside an RCT. The estimated travel costs included in the analysis are based on the actual journeys undertaken by the participants in the trial. The time and travel cost calculation was based on actual travel distances, modes of transportation, how many in need of a companion, time spent on traveling, and the working status of each patient. Official travel fares reimbursed from the Norwegian Patient Travel Agency were used as unit costs. Some of the patients' journeys were organized by the Norwegian Patient Travel Agency (most of the taxi trips and flights). The patients had to apply for reimbursement for additional expenses.

Official travel fares reimbursed by the Norwegian Patient Travel Agency were used to calculate the travel costs. If the patients chose to travel by a more expensive alternative than the travel agency's reimbursement (eg, by plane), the patients had to pay for the difference themselves. This makes the true travel costs for the patients potentially higher than estimated in this study. It is also possible that the actual travel costs for the health care sector are lower than calculated. Some patients did not apply for travel refund, either because they forgot or simply because

they found it too troublesome to fill out the forms. One study from Norway demonstrated that 26% of the patients and 70% of the accompaniers did not apply for a travel refund [41].

Another limitation of this study is that production loss for the persons accompanying the patients on travels was not included. The main reason for this was the lack of information about their working status, and it was considered important to avoid overestimating the benefits of the service. About 28% of the patients needed a travel companion. If these time costs were included, it would have made the teleorthopedic service even more cost-effective.

Training costs have been included as a one-time cost at the startup of the teleorthopedic service. However, training should be included as an ongoing part of the service to promote and sustain use. Training is necessary because of staff turnover, particularly at the hospital. Casting courses and training in clinical examination techniques must also be arranged if there is a change in the nursing staff locally. Telemedicine services are often sensitive to changes in key personnel [42]. Successfully sustaining telemedicine services is about integration and effective change management [43].

Generalizability

One challenge for economic evaluations of telemedicine services is generalizability. High diversity in terms of objectives, technology, application, and context might limit the generalizability of specific evaluations to other settings [44]. The local context will decide the cost parameters such as the need for investment in technology and infrastructure, prices, the costs of extra personnel, and travel and time costs. The results of an economic evaluation are of most value for decision makers in the local area where the evaluation was conducted. It is important to assess if the assumptions, cost parameters, and context can be compared between settings.

To make this study relevant outside of the current institutional setting, we have emphasized a transparent calculation of all cost and effectiveness items, based on 2 costing perspectives. The same methodology can then be generalized, however, based on local prices.

Conclusions

This study showed that providing video-assisted orthopedic consultations at a remote clinic, rather than having patients travel to a centrally located hospital for consultations is cost saving. This conclusion holds from both a societal and a health sector perspective and as long as the activity exceeds 151 and 183 patient consultations per year, respectively.

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Authors' Contributions

AB contributed to the study design, data collection, data analysis, interpretation, and writing of the manuscript. TB contributed to the study design, interpretation, data analysis, and writing of the manuscript. EB contributed to the study design, interpretation, and writing of the manuscript. AS contributed to the study design, data collection, and writing of the manuscript. TW contributed to the study design, data analysis, interpretation, and writing of the manuscript. JAO contributed to the study design, interpretation, and writing of the manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Calculation of patients cost for videoconferencing and standard consultations (in Norwegian kroner and Euro).

[PDF File (Adobe PDF File), 228KB - jmir_v21i2e11330_app1.pdf]

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Abbreviations

GEE: generalized estimating equation
GP: general practitioner
QALY: quality-adjusted life year
RCT: randomized controlled trial
RMC: Regional Medical Center
UNN: University Hospital of North Norway

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Appendix I

Invitation letter and consent form for children < 16 years of age and parents (Norwegian).

Prosjekt: ”Desentralisering av ortopediske konsultasjoner ved bruk av telemedisinske løsninger”

Informasjon og spørsmål til barn under 16 år om å være med i et forsknings prosjekt.

Du skal til undersøkelse hos lege ved ortopedisk poliklinikk. Vi ønsker å spørre deg om du samtidig vil være med i et forskningsprosjekt. Det vi ønsker å finne ut er om noen kan slippe å reise helt til sykehuset i Tromsø for å bli undersøkt., og i stedet bli undersøkt nærmere sitt bosted.

Mange som kommer fra Nord-Troms og skal til undersøkelse hos oss blir spurt om de vil være med. For deg som ønsker å være med blir det gjort en form for loddtrekning. Du blir trukket ut til å komme enten til undersøkelse ved sykehuset i Tromsø, eller til Sonjatun på Storslett. Du kan ikke selv velge hvor du skal bli undersøkt hvis du sier ja til å være med.

Blir du trukket ut til å komme til Tromsø møter du legen som skal undersøke deg. Hvis du skal komme til Sonjatun snakker du med legen ved hjelp av kamera og fjernsyn. Der er det en sykepleier som tar i mot deg og hjelper til under undersøkelsen. Hvis du skulle trenge en gips legger sykepleieren den. Skulle det være nødvendig med røntgenbilder, kan det også gjøres på Sonjatun. De tar like gode røntgenbilder på Sonjatun som det gjøres i Tromsø. Du får sett på røntgenbildene sammen med legen enten du er i Tromsø eller på Sonjatun.

For å vite hvordan du syns en slik undersøkelse er, trenger vi å stille deg noen spørsmål etter at du har vært hos legen. Du vil derfor få spørsmål på ark som du må fylle ut sammen med den som følger deg. Dette gjelder både om du kommer til Tromsø eller til Sonjatun. Dette er for at vi skal kunne sammenligne de som kommer til undersøkelse på begge stedene. Spørreskjemaet leverer du før du går. For å vite hvordan det går med deg vil du få sendt et nytt spørreskjema etter 3 måneder og 1 år. Dette sender du tilbake til oss i konvolutten som du får tilsendt.

Du kan selvfølgelig bestemme helt selv om du vil være med på dette. Skulle du først si ja og så ombestemme deg kan du også gjøre det. Du behøver ikke si hvorfor. Hvis det er planlagt videre kontroller kommer du til undersøkelse i Tromsø og får den videre behandlingen som du trenger der.

De opplysningene vi samler inn spesielt for forskningen blir lagret i en sikker database så lenge vi holder på med forskningen. Når vi er ferdig vil alle opplysninger som knyttes til deg i databasen bli fjernet. Det vil være senest i 2012. Dersom du velger å ikke være med i forskningen før den er ferdig, vil alle opplysninger i databasen bli fjernet når du trekker deg. Vi vil også lese i din journal som er ved sykehuset i Tromsø for at vi ikke har oversett noe i løpet av samme tidsrom.

Når vi skal skrive om hva vi finner ut i undersøkelsen vil det bare bli brukt opplysninger som er anonyme. Det vil si på en slik måte at en ikke vet at de kommer fra deg. Du vil få en rapport om hva vi finner ut til slutt.

Prosjekt: ”Desentralisering av ortopediske konsultasjoner ved bruk av telemedisinske løsninger”

Informasjon til foresatte og forespørsel om deltagelse for barn i forskningsprosjekt

Ditt barn er henvist ortopedisk poliklinikk for undersøkelse. I den forbindelse ønsker vi å forespørre om deltagelse i et forskningsprosjekt. Vi ønsker stadig å bli bedre i vår pasient behandling. Samtidig er det stadig et sterkere fokus på om utytter de økonomiske resursene så godt som mulig. Som et ledd i dette, ønsker vi å se på om en desentralisering av ortopediske konsultasjoner ved bruk av telemedisinske løsninger er et reelt alternativ. Telemedisinsk løsning betyr i denne sammenheng konsultasjon ved Sonjatun via videokonsultasjon med ortoped som sitter i Tromsø.

De fleste fra Nord-Troms som blir henvist til undersøkelse ved ortopedisk poliklinikk blir forespurt om deltagelse. For de som ønsker å delta betyr det at det blir gjort en form for loddtrekning hvor man enten blir satt opp til undersøkelse ved ortopedisk poliklinikk eller en telemedisinsk konsultasjon. *Man kan dermed ikke selv velge det ene eller den andre*. Telemedisin vil i denne sammenheng bety bruk av videokonferanse og digitaliserte røntgen bilder. Røntgen bilder er av samme kvalitet om de taes ved Sonjatun eller ved UNN, da digitaliserte bilder er det som har vært brukt siste 7 år ved UNN. Ved Sonjatun er det en sykepleier som har fått ekstra opplæring i videokonsultasjon som tar i mot barnet ditt og er til stede under konsultasjonen.

Dere vil bli forelagt et spørreskjema i forbindelse med konsultasjonen uansett om den er i Tromsø eller ved Sonjatun. Dette ber vi dere fylle ut og levere i postkassen før dere går. Etter at behandlingen er avsluttet vil du få tilsendt et spørreskjema etter 3 måneder og sannsynligvis også etter 1 år for å kartlegge hvordan barnet ditt har det og om han/hun fortsatt har plager.

Det presiseres at det er frivillig å delta i studien, og man trenger ikke å begrunne hvorfor man eventuelt ikke ønsker å delta. Selv om man først har sagt ja, kan man likevel trekke seg senere. Dersom dere ikke ønsker å delta eller senere trekker dere, vil dette ikke få noen konsekvenser for forhold til ortopedisk avdelingen. Barnet ditt vil uansett få nødvendig behandling og bli fulgt opp ved ortopedisk poliklinikk ved UNN i Tromsø hvis det er planlagt poliklinisk konsultasjon. Dersom dere velger å trekke dere fra studien på et senere tidspunkt, vil innsamlede data om barnet ditt i databasen bli slettet.

Innsamlede data vil bli lagret i en egen database, og oppbevart så lenge studien pågår.
Når studien er avsluttet, vil alle data bli anonymisert, senest i 2012. For å få et best helhetlig bilde av forløpet til skaden/plagen til barnet ditt vil vi gjøre en tidsbegrenset journal gjennomgang. Kun anonyme data vil bli publisert i form av oppsamlingsdata, tabeller og kurver der pasienters identitet ikke kan spores. En sammenfatning av resultatene vil bli sendt alle deltagere etter at prosjektet er avsluttet.
Deltagerne er på vanlig måte forsikret gjennom ordningen med norsk pasientskadeerstatning.
Prosjektet er godkjent av Regional etisk komité for forskningsetikk samt Datatilsynet ved personvernombudet ved UNN.

Kontaktperson for prosjektet:
Prosjekt leder assistentlege Astrid S. Buvik, ortopedisk avdeling UNN, telefon 77 62 60 00,
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Solveig Nørgaard, Sonjatun telefon 77 77 08 02

Prosjekt: ”Desentralisering av ortopediske konsultasjoner ved bruk av telemedisinske løsninger”

Samtykkeerklæring

Et eksemplar underskrives og sendes prosjektleder i vedlagte frankerte og adresserte konvolutt. Det andre eksemplaret beholder du selv.

- Jeg har lest informasjonen om prosjektet og samtykker i å delta/ samtykker at mitt barn deltar.

Sted:……..Dato:…….

Underskrift:……
(Barnet)

Underskrift:……
(Foresatte)

Appendix II

Invitation letter and consent form for patients >16 years of age (Norwegian).

Juli 2007

Prosjekt: ”Desentralisering av ortopediske konsultasjoner ved bruk av telemedisinske løsninger”

Informasjon og forespørsel om deltagelse i forskningsprosjekt

(Over 16 år)

Du er henvist ortopedisk poliklinikk for undersøkelse. I den forbindelse ønsker vi å forespørre deg om deltagelse i et forskningsprosjekt. Vi ønsker stadig å bli bedre i vår pasient behandling. Samtidig er det stadig et sterkere fokus på om utytter de økonomiske resursene så godt som mulig. Som et ledd i dette, ønsker vi å se på om en desentralisering av ortopediske konsultasjoner ved bruk av telemedisinske løsninger er et reelt alternativ. Telemedisinsk løsning betyr i denne sammenheng konsultasjon ved Sonjatun via videokonsultasjon med ortoped som sitter i Tromsø.

De fleste fra Nord-Troms som blir henvist til undersøkelse ved ortopedisk poliklinikk blir forespurt om deltagelse. For deg som ønsker å delta betyr det at det blir gjort en form for loddtrekning hvor du enten blir satt opp til undersøkelse ved ortopedisk poliklinikk eller en telemedisinsk konsultasjon. *Du kan dermed ikke selv velge det ene eller den andre*.
Telemedisin vil i denne sammenheng bety bruk av videokonferanse og digitaliserte røntgen bilder. Røntgen bilder er av samme kvalitet om de taes ved Sonjatun eller ved UNN, da digitaliserte bilder er det som har vært brukt siste 7 år ved UNN. Ved Sonjatun er det en sykepleier som har fått ekstra opplæring i videokonsultasjon som tar i mot deg og er til stede under konsultasjonen.

Du vil bli forelagt et spørreskjema i forbindelse med konsultasjonen uansett om den er i Tromsø eller ved Sonjatun. Dette ber vi deg fylle ut og levere i postkassen før du går. Etter at behandlingen er avsluttet vil du få tilsendt et spørreskjema etter 3 måneder og sannsynligvis også etter 1 år for å kartlegge hvordan du har det og om du fortsatt har plager.

Det presiseres at det er frivillig å delta i studien, og man trenger ikke å begrunne hvorfor man eventuelt ikke ønsker å delta. Selv om man først har sagt ja, kan man likevel trekke seg senere. Dersom du ikke ønsker å delta eller senere trekker deg, vil dette ikke få noen konsekvenser for ditt forhold til ortopedisk avdelingen. Du vil uansett få nødvendig behandling og bli fulgt opp ved ortopedisk poliklinikk ved UNN i Tromsø hvis det er planlagt poliklinisk konsultasjon. Dersom du velger å trekke deg fra studien på et senere tidspunkt, vil innsamlede data om deg i databasen bli slettet.

Innsamlede data vil bli lagret i en egen database, og oppbevart så lenge studien pågår.
Når studien er avsluttet, vil alle data bli anonymisert, senest i 2012. For å få et best helhetlig bilde av forløpet til skaden/plagen din vil vi gjøre en tidsbegrenset journal gjennomgang. Kun anonyme data vil bli publisert i form av oppsamlingsdata, tabeller og kurver der pasienters identitet ikke kan spores. En sammenfatning av resultatene vil bli sendt alle deltagere etter at prosjektet er avsluttet.
Deltagerne er på vanlig måte forsikret gjennom ordningen med norsk pasientskadeerstatning.
Prosjektet er godkjent av Regional etisk komité for forskningsetikk samt Datatilsynet ved personvernombudet ved UNN.

Juli 2007

Kontaktperson for prosjektet:
Prosjekt leder assistentlege Astrid S. Buvik, ortopedisk avdeling UNN, telefon 77 62 60 00,
E-mail: astrid.buvik@unn.no, sykepleier Kerstin W. Aune, UNN, telefon 77 62 71 95,
Solveig Nørgaard, Sonjatun telefon 77 77 08 02

Prosjekt: ”Desentralisering av ortopediske konsultasjoner ved bruk av telemedisinske løsninger”

Samtykkeerklæring

Ett eksemplar underskrives og sendes prosjektleder i vedlagte frankerte og adresserte konvolutt. Det andre eksemplaret beholder du selv.

- Jeg har lest informasjonen om prosjektet og samtykker i å delta.

Sted:……..Dato:…….

Underskrift:……

Appendix III

Orthopedic surgeon's questionnaire (Standard and telemedicine consultation in Norwegian. English version available online as additional files 3 for Paper 1)

(gjøres oppmerksom på at det visuelle utformingen av skjemaet ikke er ferdig. Vil bli omarbeidet)

Navnelapp med fødselnr.
og adresse til pas.

Spørreskjema til undersøkelse av poliklinisk pasient ved UNN eller Sonjatun:

(fylles ut av legen)

Dato for utfylling OO OO OO (dag mnd år)

Telemedisinsk konsultasjon O Direkte poliklinisk konsultasjon O

Årsak til den polikliniske konsultasjonen?
O Henvist elektivt
O Ø-hjelp
O ½ Ø-hjelp
O Kontroll pasient etter elektiv operasjon
O Kontroll pasient etter ø-hjelps operasjon
O Kontroll pasient etter skade uten operasjon

Konsultasjon funnet sted?
Ja Nei I så fall årsak …….

Hva er gjort ved konsultasjon (eventuelt flere kryss)
O Fjernet gips
O Gipset
O Røntgen tatt
O ”Undersøkt pasienten”
O Sykemelding
O Resept
O andre skjema/erklæringer

Pasientens hovedaktivitet? *(sett ett kryss)*
 Yrkesaktiv heltid, O tungt fysisk arbeid O kontorarbeid
 Yrkesaktiv deltid
 Hjemmeværende
 Arbeidsledig
 Pensjonist/trygdet
 Student/skoleelev

Sykemeldt
O Sykemeldt p.g.a. aktuelle, eventuelt _ _ %, Annen årsak _ _ _ _ _ _ _
Hvor lenge_ _ uker

Hvem var til stede ved konsultasjonen
(totalt for både UNN og Sonjatun ved telemedisinsk løsning)
Sykepleier _ Fysioterapeut _ Lege _

Medisinsk indikasjon til ekstra skyss
Nei O Ja O Drosje O Ambulanse O

Medisinsk indikasjon til ledsager
Nei O Ja O

Tidsbruk for selve konsultasjonen (hvor lenge var pasienten inne)
_ _ minutter

Videre tiltak:

O Kontroll (Sojatun/ortopedisk poliklinikk)
O videre utredning (f.eks MR)
O behandling (f.eks for fractur tilhelning)
O fast kontroll opplegg (f.eks års kontroll protese)
O Ortopedisk poliklinikk UNN, Årsak _ _ _ _ _ _ _ _ _ _
O Innleggelse,
O Dagkirurgi
O Annen poliklinikk/institusjon
O Egen lege
O Avsluttet

Hvor godt oppfattet du pasienten samarbeidet ved undersøkelsen/konsultasjonen:
O Meget godt
O Godt
O Verken godt eller dårlig
O Dårlig
O Meget dårlig
O Annet_ _ _ _ _ _ _

Hvor godt kunne du vurdere/ undersøke pasienten:
O Meget godt
O Godt
O Verken godt eller dårlig
O Dårlig
O Meget dårlig

Hvor godt kunne du behandle pasienten:
O Ikke aktuelt

O Meget godt
O Godt
O Verken godt eller dårlig
O Dårlig
O Meget dårlig

Hvor godt fikk du informert pasienten om sin tilstand/sykdom/skade:
O Meget godt
O Godt
O Verken godt eller dårlig
O Dårlig
O Meget dårlig
O Annet _ _ _ _ _ _ _ _ _ _ _ _ _ _

Totalt sett hvor godt kunne du utrede/behandle/kontrollere pasienten.

O Meget godt
O Godt
O Verken godt eller dårlig
O Dårlig
O Meget dårlig

Hvor godt fikk du informert ledsager om pasientens tilstand/sykdom/skade:
O Ikke aktuelt

O Meget godt
O Godt
O Verken godt eller dårlig
O Dårlig
O Meget dårlig

Hvordan opplevde du at samarbeidet med annet helse personell fungerte:
O Ikke aktuelt

O Meget godt
O Godt
O Verken godt eller dårlig
O Dårlig
O Meget dårlig

Kun for video konsultasjon:
Hvor godt fungerte det teknisk?:
O Meget godt
O Godt
O Verken godt eller dårlig
O Dårlig
O Meget dårlig

Hvor mange video konsultasjoner har du vært med på tidligere:
O ingen
O 1-5
O 5-15
O 15-30
O mer en 30

På forhånd **hvordan trodde du en telemedisinsk konsultasjon ville være sammenlignet med en vanlig konsultasjon:**
O Mye Bedre
O Bedre
O Like god
O Dårligere
O Meget dårligere

Hvordan tror du *nå* en telemedisinsk konsultasjon er sammenlignet med en vanlig konsultasjon:
O Mye Bedre
O Bedre
O Like god
O Dårligere
O Meget dårligere

Appendix IV

Patients questionnaire (Standard consultation) (in Norwegian. English version available online as additional files 1 for Paper 1)

Teleortopedi studiet

Randomiseringsnr ☐☐☐ Skjema ☐

(Fylles ut av studieleder.)

Navnelapp med fødselsnr. og adresse til pasienten.

Spørreskjema om pasientens erfaringer ved ortopedisk konsultasjon ved UNN.

(vanlig konsultasjon) (Fylles ut av pasient)

Hensikten med spørreskjemaet er å undersøke hvordan du som pasient (hvis du er barn, sammen med din(e) foresatt(e)) opplever konsultasjonen ved ortopedisk avdeling. Spørsmålene gjelder ditt siste besøk på poliklinikken.

Informasjon om utfylling av spørreskjema:

Skjemaet blir lest av en maskin. Det er derfor best om du krysser av midt i ruta,

☒ slik ☐ X ikke slik

Utfylt skjema legges i vedlagt adressert konvolutt og legges i postkassen ved "sekretæren i luka" (UNN) før du går. Alle svar blir behandlet fortrolig.

Hvis du vil kontakte prosjektgruppa kan du ringe prosjektleder Astrid S. Buvik, ort.avd. UNN, telefon 77 62 60 00, evt. e-post astrid.buvik@unn.no.
Eller sykepleier Solveig Nørgaard, Sonjatun, telefon 77 77 08 02
eller Kersti W. Aune, UNN, telefon 77 62 71 95.

Randomiseringsnr (Fylles ut av studieleder) ☐☐☐ Skjema ☐

Før du kom til poliklinikk - UNN

1. Fra du ble henvist til du fikk time, hvor akseptabel synes du ventetiden var?

- ☐ Jeg ventet ikke, kom til fastsatt kontroll
- ☐ Helt akseptabel
- ☐ Akseptabel
- ☐ Verken uakseptabel eller akseptabel
- ☐ Uakseptabel
- ☐ Helt uakseptabel

2. Hvor viktig hadde du tenkt at denne timen på poliklinikken skulle være?

☐ Svært viktig ☐ Litt viktig ☐ Ikke viktig

3. Hvor lang reisetid brukte du hjemmefra til UNN?

- ☐ Under 1 time
- ☐ Ca. 1-2 timer
- ☐ Ca. 3-4 timer
- ☐ Ca. 5-8 timer
- ☐ Mer enn 8 timer

4. Hvor mange kilometer er det?

- ☐ Under 150 km
- ☐ 151 - 200 km
- ☐ 201 - 250 km
- ☐ 251 - 300 km
- ☐ 301 - 350 km
- ☐ Mer enn 350 km

5. Måtte du overnatte på grunn av reiseveien?

☐ Ja ☐ Nei

6. Hvordan kom du til poliklinikken? (her kan du sette flere kryss)

- ☐ Privatbil
- ☐ Drosje
- ☐ Buss
- ☐ Annet .....
- ☐ Ferge
- ☐ Hurtigbåt
- ☐ Fly

7. Hadde du med deg ledsager? (ett eller flere kryss)

- ☐ Ja
- ☐ Nei
- ☐ Familiemedlem
- ☐ Hjemme- eller ledsagertjenesten
- ☐ Bekjent

Mottakelse på poliklinikken - UNN

8. Hvor fornøyd var du med måten du ble møtt på?

- ☐ Svært fornøyd
- ☐ Fornøyd
- ☐ Verken fornøyd eller misfornøyd
- ☐ Misfornøyd
- ☐ Svært misfornøyd

9. Hvor lenge måtte du vente før du kom inn?

- ☐ Under 15 min.
- ☐ Ventet 15-30 min
- ☐ Ventet 30 min til 1 time
- ☐ Ventet mer enn 1 time

Konsultasjonen

10. Fikk du time hos en lege som du har vært hos tidligere?

- ☐ Ja
- ☐ Nei
- ☐ Har ikke vært til undersøkelse før

11. Hvordan opplevde du at personalet på poliklinikken samarbeidet i forbindelse med timen din?

- ☐ Meget godt
- ☐ Godt
- ☐ Verken godt eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

12. Synes du det var nok tid til samtale under konsultasjonen?

☐ Ja ☐ Nei

13. Synes du vedkommende lege var godt *forberedt* på ditt aktuelle besøk?

- ☐ Meget godt
- ☐ Godt
- ☐ Verken godt eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

14. *Snakket* denne personen til deg slik at du forstod ham / henne?

- ☐ Meget godt
- ☐ Godt
- ☐ Verken godt eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

Randomiseringsnr (Fylles ut av studieleder) ☐☐☐ Skjema ☐

15. Hvor god oppfattet du legens faglige dyktighet til å være?

- ☐ Meget god
- ☐ God
- ☐ Verken god eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

16. Ble du møtt med høflighet og respekt?

- ☐ Ja, meget godt
- ☐ Ja, godt
- ☐ Verken godt eller dårlig
- ☐ Nei, dårlig
- ☐ Nei, meget dårlig

17. Fikk du fortalt alt det du syntes var viktig om din tilstand?

- ☐ Ja, alt
- ☐ Mesteparten
- ☐ Tilstrekkelig
- ☐ Lite
- ☐ Ingen ting

18. Har du fått vite det du syntes var nødvendig om resultater av prøver og undersøkelser?

- ☐ Ja, alt
- ☐ Mesteparten
- ☐ Tilstrekkelig
- ☐ Lite
- ☐ Ingen ting
- ☐ Det var ingen prøver eller undersøkelser

19. Ble det gjort klart for deg hva du skulle gjøre av egeninnsats i etterkant av timen?

☐ Ja ☐ Til en viss grad ☐ Nei

20. Fikk du vite det du syntes var nødvendig om hvordan tilstanden din kunne utvikle seg i den nærmeste framtid?

☐ Ja ☐ Til en viss grad ☐ Nei

21. Hvis du ønsket det, ble du tatt med på råd i forbindelse med utredning eller behandling?

- ☐ Ønsket det ikke
- ☐ Ja
- ☐ Til en viss grad
- ☐ Nei
- ☐ Ikke aktuelt

22. Har du hørt om telemedisinsk konsultasjon?

☐ Ja ☐ Nei

23. Har du tidligere vært til en telemedisinsk konsultasjon?

☐ Nei ☐ En gang ☐ Flere ganger

24. Jeg tror telemedisin er *mye bedre* enn vanlig konsultasjon?

- ☐ Mye bedre
- ☐ Bedre
- ☐ Like god
- ☐ Dårligere
- ☐ Mye dårligere
- ☐ Ingen formening

25. Hvis du kunne velge, hvor ville du ønske neste kontroll/konsultasjon?

☐ Ved UNN ☐ Ved Sonjatun

26. Hvordan stemmer utsagnene nedenfor for ditt valg?

Jeg ønsker kortest mulig reisetid til/fra konsultasjon:

- ☐ I svært stor grad
- ☐ I stor grad
- ☐ I noen grad
- ☐ I liten grad
- ☐ Ikke i det hele tatt

Jeg ønsker å kombinere konsultasjonen med andre gjøremål:

- ☐ I svært stor grad
- ☐ I stor grad
- ☐ I noen grad
- ☐ I liten grad
- ☐ Ikke i det hele tatt

Jeg ønsker å støtte opp om lokale tilbud:

- ☐ I svært stor grad
- ☐ I stor grad
- ☐ I noen grad
- ☐ I liten grad
- ☐ Ikke i det hele tatt

Jeg ønsker å møte legespesialisten direkte:

- ☐ I svært stor grad
- ☐ I stor grad
- ☐ I noen grad
- ☐ I liten grad
- ☐ Ikke i det hele tatt

Randomiseringsnr (Fylles ut av studieleder) ☐☐☐ Skjema ☐

27. Alt i alt, hvor fornøyd eller misfornøyd er du med selve konsultasjonen ved UNN?

- ☐ Svært fornøyd
- ☐ Ganske fornøyd
- ☐ Verken fornøyd eller misfornøyd
- ☐ Ganske misfornøyd
- ☐ Svært misfornøyd

Bakgrunnsspørsmål

Opplysningene nedenfor skal brukes til å undersøke om pasientgrupper har forskjellige erfaringer med konsultasjon ved UNN, og det er viktig at du besvarer spørsmålene.

28. Kjønn og alder

Kjønn: ☐ Mann ☐ Kvinne Alder: ☐☐ år

29. Har du norsk som morsmål?

☐ Ja ☐ Nei

30. Hvor mange ganger i løpet av siste 6 måneder har du totalt hatt poliklinikktime?

- ☐ Bare denne ene gangen
- ☐ 2 - 3 ganger
- ☐ 4 eller mer

31. Hvordan vurderer du din egen helsetilstand sånn i alminnelighet?

- ☐ Meget god
- ☐ God
- ☐ Verken god eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

32. Hva er din høyeste fullførte utdanning? (sett ett kryss)

- ☐ Grunnskole 7-10 år, framhaldsskole eller folkehøyskole
- ☐ Yrkesfaglig videregående, yrkesskole eller realskole
- ☐ Allmennfaglig videregående skole eller gymnas
- ☐ Høyskole eller universitet (mindre enn 4 år)
- ☐ Høyskole eller universitet (4 år eller mer)

33. Hva er din hovedaktivitet? (sett ett kryss)

- ☐ Yrkesaktiv heltid
- ☐ Yrkesaktiv deltid
- ☐ Hjemmeværende
- ☐ Arbeidsledig
- ☐ Pensjonist/trygdet
- ☐ Student/skoleelev

34. Er du sykemeldt? (ett eller flere kryss)

☐ Ja ☐ På grunn av aktuell lidelse ☐ Annen årsak

☐ Nei

☐ Friskmeldt fra aktuell lidelse

Dato ☐☐ . ☐☐ . ☐☐☐☐
dag måned år

Hvor lenge var du vært sykemeldt p.g.a. aktuelle skade/lidelse? ☐☐☐ uker

35. Hvor høy var husholdningens samlede bruttoinntekt siste år? Ta med alle inntekter fra arbeid, trygder, sosialhjelp og lignende.

- ☐ Under 125 000 kr
- ☐ 125 000 - 200 000 kr
- ☐ 201 000 - 300 000 kr
- ☐ 301 000 - 400 000 kr
- ☐ 401 000 - 550 000 kr
- ☐ 551 000 - 700 000 kr
- ☐ 701 000 - 850 000 kr
- ☐ Over 850 000 kr

36. Hvem bor du sammen med? (sett kryss for hvert spørsmål og angi antallet der vi spør om det)

			Antall
Ektefelle/samboer	☐ Ja	☐ Nei	
Andre personer over 18 år	☐ Ja	☐ Nei	☐☐
Personer under 18 år	☐ Ja	☐ Nei	☐☐

37. Har du søkt om erstatning fra folketrygden/ forsikring (evt. yrkesskadeerstatning) vedrørende ditt helseproblem?

- ☐ Ja
- ☐ Nei
- ☐ Planlagt å søke
- ☐ Er allerede innvilget

Randomiseringsnr (Fylles ut av studieleder) | | | | Skjema | |

38. Hvem fyller ut skjemaet?

- ☐ Selv
- ☐ Foresatte da pasienten er for ung
- ☐ Med hjelp av ledsager
- ☐ Med hjelp av ansatt ved poliklinikken
- ☐ Av ledsager da pasienten ikke er i stand til å fylle ut selv

Beskrivelse av helsetilstand (EQ-5D)

Vis hvilke utsagn som passer på din helsetilstand i dag ved å sette ett kryss i en av rutene utenfor hver av dimensjonene nedenfor.

1. Gange

- ☐ Jeg har ingen problemer med å gå omkring
- ☐ Jeg har litt problemer med å gå omkring
- ☐ Jeg er sengeliggende

2. Personlig stell

- ☐ Jeg har ingen problemer med personlig stell
- ☐ Jeg har litt problemer med å vaske meg eller kle meg
- ☐ Jeg er ute av stand til å vaske meg eller kle meg

3. Vanlige gjøremål (f.eks. arbeid, studier, husarbeid, familie- eller fritidsaktiviteter)

- ☐ Jeg har ingen problemer med å utføre mine vanlige gjøremål
- ☐ Jeg har litt problemer med å utføre mine vanlige gjøremål
- ☐ Jeg er ute av stand til å utføre mine vanlige gjøremål

4. Smerte og ubehag

- ☐ Jeg har verken smerte eller ubehag
- ☐ Jeg har moderat smerte og ubehag
- ☐ Jeg har sterk smerte og ubehag

5. Angst og depresjon

- ☐ Jeg er hverken engstelig eller deprimert
- ☐ Jeg er noe engstelig og deprimert
- ☐ Jeg er svært engstelig og deprimert

Helsetilstand

For at du skal kunne vise oss hvor god eller dårlig din helsetilstand er, har vi laget en skala (nesten som et termometer), hvor den beste helsetilstanden du kan tenke deg er markert med 100 og den dårligste med 0.
Vi ber deg om at du viser din helsetilstand ved å trekke ei linje fra boksen nedenfor til det punkt på skalaen som passer best med din helsetilstand.

Best tenkelige helsetilstand

100
90
80
70
60
50
40
30
20
10
0

Nåværende helsetilstand

Verst tenkelige helsetilstand

Tusen takk for at du tok deg tid til å svare.
Er det andre spørsmål eller temaer du synes vi burde spurt om i dette skjemaet?

.....

.....

Dato | | | . | | | . | 2 | 0 | | |
dag måned år

Appendix V

Patients questionnaire (Telemedicine consultation) (in Norwegian. English version available online as additional files 2 for Paper 1

Teleortopedi studiet

Randomiseringsnr | | | | Skjema | |

(Fylles ut av studieleder)

Navnelapp med fødselsnr. og adresse til pasienten.

Spørreskjema om pasientens erfaringer ved desentralisert ortopedisk konsultasjon ved Sonjatun.

(telemedisinsk konsultasjon) (Fylles ut av pasient)

Hensikten med spørreskjemaet er å undersøke hvordan du som pasient (hvis du er barn, sammen med din(e) foresatt(e)) opplever konsultasjonen ved ortopedisk avdeling gjort ved videokonsultasjon. Spørsmålene gjelder ditt siste besøk på poliklinikken.

Informasjon om utfylling av spørreskjema:

Skjemaet blir lest av en maskin. Det er derfor best om du krysser av midt i ruta,

☒ slik ☐ X ikke slik

Utfylt skjema legges i vedlagt adressert konvolutt og legges i postkassen ved "Ortopedi-rommet" (Sonjatun) før du går. Alle svar blir behandlet fortrolig.

Hvis du vil kontakte prosjektgruppa kan du ringe prosjektleder Astrid S. Buvik, ort.avd. UNN, telefon 77 62 60 00, evt. e-post astrid.buvik@unn.no.
Eller sykepleier Solveig Nørgaard, Sonjatun, telefon 77 77 08 02
eller Kersti W. Aune, UNN, telefon 77 62 71 95.

Navn: .....

Fødselsnummer: | | | | | | | | | | |

Randomiseringsnr (Fylles ut av studieleder) ☐☐☐ Skjema ☐

Før du kom til poliklinikk - Sonjatun

1. Fra du ble henvist til du fikk time, hvor akseptabel synes du ventetiden var?

- ☐ Jeg ventet ikke, kom til fastsatt kontroll
- ☐ Helt akseptabel
- ☐ Akseptabel
- ☐ Verken uakseptabel eller akseptabel
- ☐ Uakseptabel
- ☐ Helt uakseptabel

2. Hvor viktig hadde du tenkt at denne timen på poliklinikken skulle være?

☐ Svært viktig ☐ Litt viktig ☐ Ikke viktig

3. Hvor lang reisetid brukte du hjemmefra til Sonjatun?

- ☐ Under 1/2 time
- ☐ Ca. 1/2 - 1 time
- ☐ Ca. 1 - 2 timer
- ☐ Mer enn 2 timer

4. Hvor mange kilometer er det?

- ☐ Under 50 km
- ☐ 51 - 100 km
- ☐ Mer enn 100 km

5. Måtte du overnatte på grunn av reiseveien?

☐ Ja ☐ Nei

6. Hvordan kom du til poliklinikken? (her kan du sette flere kryss)

☐ Privatbil ☐ Ferge
☐ Drosje ☐ Hurtigbåt
☐ Buss ☐ Fly
☐ Annet .....

7. Hadde du med deg ledsager? (ett eller flere kryss)

☐ Ja ☐ Familiemedlem
☐ Nei ☐ Hjemme- eller ledsagertjenesten
☐ Bekjent

Mottakelse på poliklinikken - Sonjatun

8. Hvor fornøyd var du med måten du ble møtt på?

- ☐ Svært fornøyd
- ☐ Fornøyd
- ☐ Verken fornøyd eller misfornøyd
- ☐ Misfornøyd
- ☐ Svært misfornøyd

9. Hvor lenge måtte du vente før du kom inn?

- ☐ Under 15 min.
- ☐ Ventet 15-30 min.
- ☐ Ventet 30 min til 1 time
- ☐ Ventet mer enn 1 time

Konsultasjonen

10. Fikk du time hos en lege som du har vært hos tidligere?

- ☐ Ja
- ☐ Nei
- ☐ Har ikke vært til undersøkelse før

11. Hvordan opplevde du at personalet på poliklinikken samarbeidet i forbindelse med timen din?

- ☐ Meget godt
- ☐ Godt
- ☐ Verken godt eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

12. Synes du det var nok tid til samtale under konsultasjonen?

☐ Ja ☐ Nei

13. Synes du vedkommende lege var godt *forberedt* på ditt aktuelle besøk?

- ☐ Meget godt
- ☐ Godt
- ☐ Verken godt eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

14. *Snakket* denne personen til deg slik at du forstod ham / henne?

- ☐ Meget godt
- ☐ Godt
- ☐ Verken godt eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

Randomiseringsnr (Fylles ut av studieleder) ☐☐☐ Skjema ☐

15. Hvor god oppfattet du legens faglige dyktighet til å være?

- ☐ Meget god
- ☐ God
- ☐ Verken god eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

16. Ble du møtt med høflighet og respekt?

- ☐ Ja, meget godt
- ☐ Ja, godt
- ☐ Verken godt eller dårlig
- ☐ Nei, dårlig
- ☐ Nei, meget dårlig

17. Fikk du fortalt alt det du syntes var viktig om din tilstand?

- ☐ Ja, alt
- ☐ Mesteparten
- ☐ Tilstrekkelig
- ☐ Lite
- ☐ Ingen ting

18. Har du fått vite det du syntes var nødvendig om resultater av prøver og undersøkelser?

- ☐ Ja, alt
- ☐ Mesteparten
- ☐ Tilstrekkelig
- ☐ Lite
- ☐ Ingen ting
- ☐ Det var ingen prøver eller undersøkelser

19. Ble det gjort klart for deg hva du skulle gjøre av egeninnsats i etterkant av timen?

☐ Ja ☐ Til en viss grad ☐ Nei

20. Fikk du vite det du syntes var nødvendig om hvordan tilstanden din kunne utvikle seg i den nærmeste framtid?

☐ Ja ☐ Til en viss grad ☐ Nei

21. Hvis du ønsket det, ble du tatt med på råd i forbindelse med utredning eller behandling?

- ☐ Ønsket det ikke
- ☐ Ja
- ☐ Til en viss grad
- ☐ Nei
- ☐ Ikke aktuelt

Etter konsultasjonen på Sonjatun

22. Hvordan tenkte du at en telemedisinsk konsultasjon ville være sammenlignet med en vanlig konsultasjon før du kom i dag?

- ☐ Mye bedre
- ☐ Bedre
- ☐ Like god
- ☐ Dårligere
- ☐ Mye dårligere
- ☐ Hadde ingen formening på forhånd

23. Hvordan tror du nå en telemedisinsk konsultasjon er sammenlignet med en vanlig konsultasjon?

- ☐ Mye bedre
- ☐ Bedre
- ☐ Like god
- ☐ Dårligere
- ☐ Mye dårligere

24. Fungerte det bra teknisk sett slik du oppfattet det i dag?

- ☐ Meget godt
- ☐ Godt
- ☐ Verken godt eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

25. Hvis du kunne velge, hvor ville du ønske neste kontroll/konsultasjon?

☐ Ved UNN ☐ Ved Sonjatun

26. Hvordan stemmer utsagnene nedenfor for ditt valg?

Jeg ønsker kortest mulig reisetid til/fra konsultasjon:

- ☐ I svært stor grad
- ☐ I stor grad
- ☐ I noen grad
- ☐ I liten grad
- ☐ Ikke i det hele tatt

Jeg ønsker å kombinere konsultasjonen med andre gjøremål:

- ☐ I svært stor grad
- ☐ I stor grad
- ☐ I noen grad
- ☐ I liten grad
- ☐ Ikke i det hele tatt

Jeg ønsker å støtte opp om lokale tilbud:

- ☐ I svært stor grad
- ☐ I stor grad
- ☐ I noen grad
- ☐ I liten grad
- ☐ Ikke i det hele tatt

Jeg ønsker å møte legespesialisten direkte:

- ☐ I svært stor grad
- ☐ I stor grad
- ☐ I noen grad
- ☐ I liten grad
- ☐ Ikke i det hele tatt

27. Alt i alt, hvor fornøyd eller misfornøyd er du med selve konsultasjonen ved Sonjatun?

- ☐ Svært fornøyd
- ☐ Ganske fornøyd
- ☐ Verken fornøyd eller misfornøyd
- ☐ Ganske misfornøyd
- ☐ Svært misfornøyd

Bakgrunnsspørsmål

Opplysningene nedenfor skal brukes til å undersøke om pasientgrupper har forskjellige erfaringer med konsultasjon ved Sonjatun, og det er viktig at du besvarer spørsmålene.

28. Kjønn og alder

Kjønn: ☐ Mann ☐ Kvinne Alder: ☐☐ år

29. Har du norsk som morsmål?

☐ Ja ☐ Nei

30. Hvor mange ganger i løpet av siste 6 måneder har du totalt hatt poliklinikktime?

- ☐ Bare denne ene gangen
- ☐ 2 - 3 ganger
- ☐ 4 eller mer

31. Har du tidligere vært til en telemedisinsk konsultasjon?

☐ Nei ☐ En gang ☐ Flere ganger

32. Hvordan vurderer du din egen helsetilstand sånn i alminnelighet?

- ☐ Meget god
- ☐ God
- ☐ Verken god eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

33. Hva er din høyeste fullførte utdanning? (sett ett kryss)

- ☐ Grunnskole 7-10 år, framhaldsskole eller folkehøyskole
- ☐ Yrkesfaglig videregående, yrkesskole eller realskole
- ☐ Allmennfaglig videregående skole eller gymnas
- ☐ Høyskole eller universitet (mindre enn 4 år)
- ☐ Høyskole eller universitet (4 år eller mer)

Randomiseringsnr (Fylles ut av studieleder) ☐☐☐ Skjema ☐

34. Hva er din hovedaktivitet? (sett ett kryss)

- ☐ Yrkesaktiv heltid
- ☐ Yrkesaktiv deltid
- ☐ Hjemmeværende
- ☐ Arbeidsledig
- ☐ Pensjonist/trygdet
- ☐ Student/skoleelev

35. Er du sykemeldt? (ett eller flere kryss)

☐ Ja ☐ På grunn av aktuell lidelse ☐ Annen årsak

☐ Nei

☐ Friskmeldt fra aktuell lidelse

Dato ☐☐ . ☐☐ . ☐☐☐☐ (dag / måned / år)

Hvor lenge var du vært sykemeldt p.g.a. aktuelle skade/lidelse? ☐☐☐ uker

36. Hvor høy var husholdningens samlede bruttoinntekt siste år? Ta med alle inntekter fra arbeid, trygder, sosialhjelp og lignende.

- ☐ Under 125 000 kr
- ☐ 125 000 - 200 000 kr
- ☐ 201 000 - 300 000 kr
- ☐ 301 000 - 400 000 kr
- ☐ 401 000 - 550 000 kr
- ☐ 551 000 - 700 000 kr
- ☐ 701 000 - 850 000 kr
- ☐ Over 850 000 kr

37. Hvem bor du sammen med? (sett kryss for hvert spørsmål og angi antallet der vi spør om det)

			Antall
Ektefelle/samboer	☐ Ja	☐ Nei	
Andre personer over 18 år	☐ Ja	☐ Nei	☐☐
Personer under 18 år	☐ Ja	☐ Nei	☐☐

38. Har du søkt om erstatning fra folketrygden/ forsikring (evt. yrkesskadeerstatning) vedrørende ditt helseproblem?

- ☐ Ja
- ☐ Nei
- ☐ Planlagt å søke
- ☐ Er allerede innvilget

Randomiseringsnr (Fylles ut av studieleder) | | | | Skjema |

39. Hvem fyller ut skjemaet?

- ☐ Selv
- ☐ Foresatte da pasienten er for ung
- ☐ Med hjelp av ledsager
- ☐ Med hjelp av ansatt ved poliklinikken
- ☐ Av ledsager da pasienten ikke er i stand til å fylle ut selv

Beskrivelse av helsetilstand (EQ-5D)

Vis hvilke utsagn som passer på din helsetilstand i dag ved å sette ett kryss i en av rutene utenfor hver av dimensjonene nedenfor.

1. Gange

- ☐ Jeg har ingen problemer med å gå omkring
- ☐ Jeg har litt problemer med å gå omkring
- ☐ Jeg er sengeliggende

2. Personlig stell

- ☐ Jeg har ingen problemer med personlig stell
- ☐ Jeg har litt problemer med å vaske meg eller kle meg
- ☐ Jeg er ute av stand til å vaske meg eller kle meg

3. Vanlige gjøremål (f.eks. arbeid, studier, husarbeid, familie- eller fritidsaktiviteter)

- ☐ Jeg har ingen problemer med å utføre mine vanlige gjøremål
- ☐ Jeg har litt problemer med å utføre mine vanlige gjøremål
- ☐ Jeg er ute av stand til å utføre mine vanlige gjøremål

4. Smerte og ubehag

- ☐ Jeg har verken smerte eller ubehag
- ☐ Jeg har moderat smerte og ubehag
- ☐ Jeg har sterk smerte og ubehag

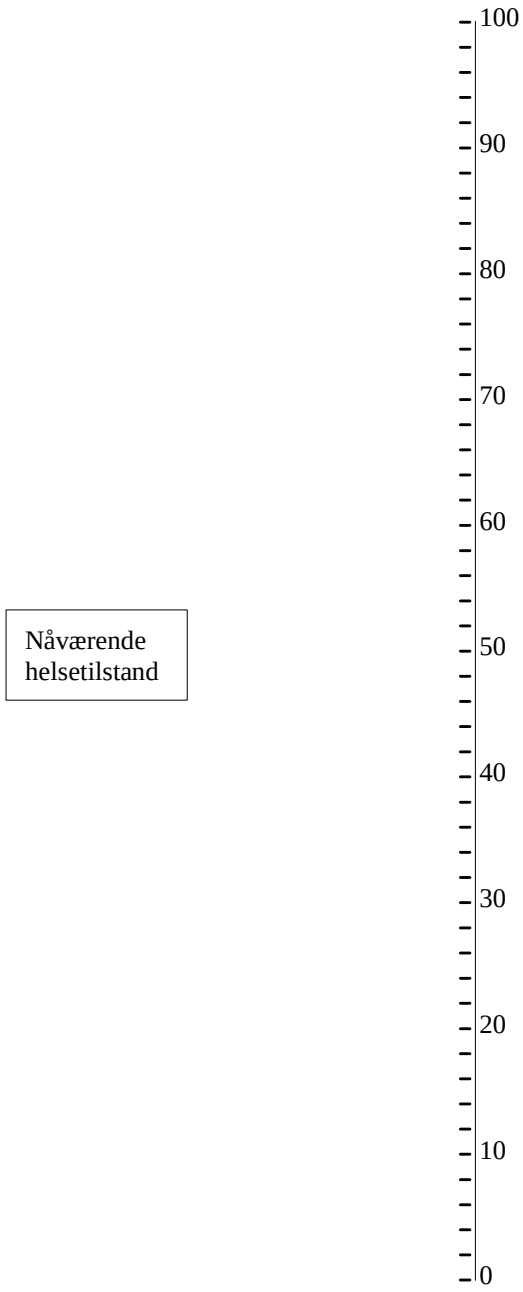
5. Angst og depresjon

- ☐ Jeg er hverken engstelig eller deprimert
- ☐ Jeg er noe engstelig og deprimert
- ☐ Jeg er svært engstelig og deprimert

Helsetilstand

For at du skal kunne vise oss hvor god eller dårlig din helsetilstand er, har vi laget en skala (nesten som et termometer), hvor den beste helsetilstanden du kan tenke deg er markert med 100 og den dårligste med 0.
Vi ber deg om at du viser din helsetilstand ved å trekke ei linje fra boksen nedenfor til det punkt på skalaen som passer best med din helsetilstand.

Best tenkelige helsetilstand



Nåværende helsetilstand

Verst tenkelige helsetilstand

Tusen takk for at du tok deg tid til å svare.
Er det andre spørsmål eller temaer du synes vi burde spurt om i dette skjemaet?

.....

.....

Dato | | | . | | | . | 2 | 0 | | |
dag måned år

Appendix VI

Patients questionnaire at 3 and 12 months (Standard and telemedicine consultation) (in Norwegian. English version available online as additional files 4 for Paper 1)

Randomiseringsnr ☐☐☐ Skjema ☐

☐ 3 mnd ☐ 12 mnd

(Fylles ut av studieleder)

Navnelapp med fødselsnr. og adresse til pasienten.

Pasienten har vært til konsultasjon ved ortopedisk poliklinikk (fylles ut av studieleder)

☐ UNN

☐ Sonjatun

Spørreskjema nr 2 til pasient som har vært til konsultasjon ved ortopedisk poliklinikk UNN eller Sonjatun.

(Fylles ut av pasient)

Hensikten med spørreskjemaet er å undersøke hvordan du har det nå, om det har oppstått noen komplikasjoner til behandlingen du har fått hos oss. Det er viktig å finne ut hvilken type behandling pasientene foretrekker. Din utfylling av skjemaet er derfor av stor nytte for framtidig kontroll form.

Skjemaet har 2 deler. Første del omhandler din opplevelse av behandlingen du fikk av oss og eventuelle oppståtte problemer. Deretter 2 ulike måter for å vurdere din nåværende helse. En som måler din helserelaterte livskvalitet (kalt EQ-5D), mens den neste er en skala der du skal merke av hvor god eller dårlig din helse tilstand er.

Informasjon om utfylling av spørreskjema:

Skjemaet blir lest av en maskin. Det er derfor best om du krysser av midt i ruta,

☒ slik ☐ X ikke slik

Utfylt skjema returneres i vedlagte, ferdigfrankerte og adresserte konvolutt. Alle svar blir behandlet fortrolig.

Hvis du vil kontakte prosjektgruppa kan du ringe prosjektleder Astrid S. Buvik, ort.avd. UNN, telefon 77 62 60 00, evt. e-post astrid.buvik@unn.no.
Eller sykepleier Solveig Nørgaard, Sonjatun, telefon 77 77 08 02
eller Kersti W. Aune, UNN, telefon 77 62 71 95.

Randomiseringsnr ☐☐☐ Skjema ☐

☐ 3 mnd ☐ 12 mnd

(Fylles ut av studieleder)

1. Dato for utfylling ☐☐.☐☐.20☐☐

dag måned år

2. Hvor lenge er det siden operasjon eller skaden?

☐☐ (måneder) ☐ Uaktuelt

3. Hvor stor nytte mener du at du har hatt av operasjonen?

- ☐ Stor nytte
- ☐ Liten nytte
- ☐ Ingen nytte
- ☐ Er blitt verre
- ☐ Uaktuelt

4. Hvor fornøyd er du med behandlingen du har fått på ortopedisk poliklinikk (UNN eller telemedisinsk Sonjatun)?

- ☐ Svært fornøyd
- ☐ Fornøyd
- ☐ Verken fornøyd eller misfornøyd
- ☐ Misfornøyd
- ☐ Svært misfornøyd

5. Har det oppstått komplikasjoner etter behandlingen du fikk?

☐ Ja ☐ Nei

Hvis ja, hvem har du fått behandling hos (ett eller flere kryss)**?**

- ☐ Ikke hos noen
- ☐ Fastlegen
- ☐ Legevaktslege
- ☐ Hjemmetjenesten
- ☐ Poliklinisk konsultasjon på sykehus
- ☐ Innlagt på sykestue/sykehjem
- ☐ Innlagt på sykehus

Hvor alvorlig synes du komplikasjonen(e) er?

☐ Svært alvorlig ☐ Alvorlig ☐ Ikke alvorlig

Type komplikasjon/problemer (ett eller flere kryss):

- ☐ Blødning
- ☐ For trang eller ubehagelig gips (jeg har fått den skiftet p.g.a det)
- ☐ Infeksjon
- ☐ Økte smerter
- ☐ Oversett skade
- ☐ Annet (spesifiser) .....

Randomiseringsnr ☐☐☐ Skjema ☐

☐ 3 mnd ☐ 12 mnd

(Fylles ut av studieleder)

6. Hvordan vurderer du din egen helsetilstand sånn i alminnelighet?

- ☐ Meget god
- ☐ God
- ☐ Verken god eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

7. Hva er din hovedaktivitet? (sett ett kryss)

- ☐ Yrkesaktiv heltid
- ☐ Yrkesaktiv deltid
- ☐ Hjemmearbeidende
- ☐ Arbeidsledig
- ☐ Pensjonist/trygdet
- ☐ Student/skoleelev

8. Er du sykemeldt? (ett eller flere kryss)

☐ Ja ☐ På grunn av aktuell lidelse ☐ Annen årsak

☐ Nei

☐ Friskmeldt fra aktuell lidelse

Dato ☐☐.☐☐.☐☐☐☐
dag måned år

Hvor lenge var du vært sykemeldt p.g.a. aktuelle skade/lidelse? ☐☐☐ uker

9. Har du søkt om erstatning fra folketrygden/ forsikring (evt. yrkesskadeerstatning) vedrørende ditt helseproblem?

- ☐ Ja
- ☐ Nei
- ☐ Planlagt å søke
- ☐ Er allerede innvilget

10. Hvem fyller ut skjemaet?

- ☐ Selv
- ☐ Foresatte da pasienten er for ung
- ☐ Med hjelp av pårørende
- ☐ Av pårørende da pasienten ikke er i stand til å fylle ut selv
- ☐ Bekjent

Randomiseringsnr ☐☐☐ Skjema ☐

☐ 3 mnd ☐ 12 mnd

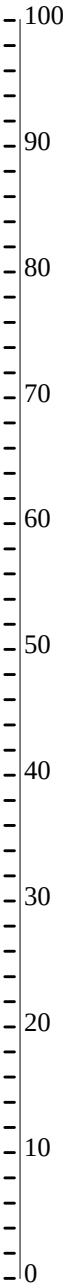
(Fylles ut av studieleder)

Helsetilstand

For at du skal kunne vise oss hvor god eller dårlig din helsetilstand er, har vi laget en skala (nesten som et termometer), hvor den beste helsetilstanden du kan tenke deg er markert med 100 og den dårligste med 0.

Vi ber deg om at du viser din helsetilstand ved å trekke ei linje fra boksen nedenfor til det punkt på skalaen som passer best med din helsetilstand.

Best tenkelige helsetilstand



Verst tenkelige helsetilstand

Nåværende helsetilstand

Beskrivelse av helsetilstand (EQ-5D)

Vis hvilke utsagn som passer på din helsetilstand i dag ved å sette ett kryss i en av rutene utenfor hver av dimensjonene nedenfor.

1. Gange

☐ Jeg har ingen problemer med å gå omkring

☐ Jeg har litt problemer med å gå omkring

☐ Jeg er sengeliggende

2. Personlig stell

☐ Jeg har ingen problemer med personlig stell

☐ Jeg har litt problemer med å vaske meg eller kle meg

☐ Jeg er ute av stand til å vaske meg eller kle meg

3. Vanlige gjøremål (f.eks. arbeid, studier, husarbeid, familie- eller fritidsaktiviteter)

☐ Jeg har ingen problemer med å utføre mine vanlige gjøremål

☐ Jeg har litt problemer med å utføre mine vanlige gjøremål

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4. Smerte og ubehag

☐ Jeg har verken smerte eller ubehag

☐ Jeg har moderat smerte og ubehag

☐ Jeg har sterk smerte og ubehag

5. Angst og depresjon

☐ Jeg er hverken engstelig eller deprimert

☐ Jeg er noe engstelig og deprimert

☐ Jeg er svært engstelig og deprimert

Tusen takk for at du tok deg tid til å svare!

Er det andre spørsmål eller temaer du synes vi burde spurt om i dette skjemaet?

.....

.....

.....

Appendix VII

Registration form used for patient journal review.

Navne lapp med fødselnr.
Og adresse.

Registreringsskjema etter avsluttet* polikliniske konsultasjoner ved UNN eller Sonjatun

(fylles ut av lege)

1. Dato for utfylling OO OO OO (dato, måned, år)

2. Antall polikliniske konsultasjoner totalt for aktuelle lidelse** OO

3. Behandlingsplan gått som planlagt? O Ja O Nei

4. Hvis pasient ble henvist til opr. var diagnose riktig? O Ja O Nei

5. Komplikasjoner (ett eller flere kryss)**: ******
O Ingen
O Sårinfeksjon
O Blødning
O Osteosyntesesvikt
O Oversett skade
O Ikke akseptabel gips
O Annet (spesifiser). . . . .

Har pasienten vært i kontakt med helsevesenet p.g.a. komplikasjoner i så fall med hvem?
O nei
O fastlege
O legevakts lege
O hjemme tjenesten
O ortopedisk poliklinikk UNN
O annen poliklinisk konsultasjon på sykehus
O innlagt på sykestue/sykehjem
O innlagt på sykehus

6. Ble komplikasjonen(e) registrert ved avtalt poliklinisk konsultasjon
O Nei O Ja O Usikker

7. Har pasienten vært til ekstra poliklinisk konsultasjon relatert til diagnosen?
O Ja O Nei
Årsak: . . . .

8. Har pasienten vært innlagt etter sist konsultasjon?
O Ja O Nei.
Årsak:. . . . . .

9. Hvis nyhenvist/utredet hvor mange konsultasjoner før ferdig utredet.
OO O Ikke aktuell

10. Nyhenvist for samme lidelse ***
O Ja O Nei

11. Diagnose

ICD 10…… Tekst:……..

Forklaring:

*Avsluttet poliklinisk kontroll menes her de som er blitt henvist til operasjon (innlagt eller dagkirurgi) eller overført annen poliklinikk; Fraktur-/skade behandling er avsluttet eller Postoperative kontroller som går over i ett fast kontroll opplegg (f.eks. hofte- og kne-proteser som går kontroll etter 1 år, 5 år, 8år og videre årlig, eller oppfølging med tanke på skade av epifyseskiven)

** Antall polikliniske konsultasjoner totalt for aktuelle lidelse: - sett gjennom elektronisk journal for 2000-2013, talt alle polikliniske konsultasjoner med aktuell diagnose. (antall kontroll-oppfølging av proteser, fraktur tilheling, oppfølginger)

***
Sett på hele registreringsperioden (minimum 2 år for de sist inkluderte)

****
Komplikasjoner ???
Ingen - hvis ikke registrert i journal eller /og på 3-12 mnd svarskjema fra pasienten

Appendix VIII

Supplementary table for patients cost for the outpatient visit.

Supplementary Table. Calculation of patients cost for videoconferencing and standard consultations (in Norwegian krone and Euro[a])

	UNN					RMC			
	n 257	Mean distance/ number/time	Fare price/ unit price, NOK	Total costs	Total costs per patient	n 302	Mean distance /time	Fare price/ unit price, NOK	Total Costs	Total costs per patient
Travel costs without companion	**184**					**223**				
Using standard rate[b]	114	x 144km[c]	x 2.40 x 2	78,797		143	x 44km[c]	x 2.40 x 2	30,202	
Extra transport – private car	12	x 254km[d]	x 2.40 x 2	14,630		28	x 45km[d]	x 2.40 x 2	6,048	
Taxi –round trip	35	x 227km[e]	x 12.50[f]	99,313		52	x 52km[e]	x 16.50[f]	44,616	
Taxi- waiting		x 4 h	x 190[f]	26,600			x 1 h	x 253[f]	13,156	
Airplane	2		x 713 x2	2,852						
Express boat	21		x 430 x 2	18,060						
Overnight stay; >12 h[g]	10		x 220	2,200		2		x 220	440	
Travel costs with companion	**73**					**79**				
Using standard rate[b]	38	x 151km	x 2,40 x 2	27,542		59	x 45km[c]	x 2.40 x 2	12,744	
Extra transport – private car[b]	4	x 275km[c]	x 2.40 x 2	5,280		12	x 46km	x 2.40 x 2	2,650	
Bus (distances differ between the four municipalities listed)	13									
Kvænangen	4	x 212km[c]	x 2.40 x 4	8,141						
Nordreisa	7	x 140km[c]	x 2.40 x 4	9,408						
Skjervøy	1	x 160km[c]	x 2.40 x 4	1,536						
Kåfjord	1	x 113km[c]	x 2.40 x 4	1,085						
Taxi – round trip	12	x 226km[e]	x 16.50[f]	44,748		8	x 46km	x 16.50[f]	6,072	
Taxi - waiting		x 4 h	x 253[f]	12,144			x 1 h	x 253[f]	2,024	
Airplane	1		x 713 x 4	2,852						
Express boat	5		x 430 x 4	8,600						
Overnight stay; >12 h[g]	7		x 220 x 2	3,080						
Total travel costs, NOK(**€**)				**366,868**	**1,427 (148.65)**				**117,952**	**391 (40.73)**
Patient's charge for the journey, NOK(**€**)			149 x 2		298(31.04)			149 x 2		298(31.04)
Total travel cost health system, NOK(**€**)					**1,129 (117.60)**					**93(9.69)**
Time costs										
Lost working hours - full time[h]	20	x 8h	x 380[i]	60,800		36	x 0.93h x 2	x 380[i]	25,445	
Lost working hours - part time[h]	15	x 4h	x 380	22,800		13	x 0.65h x 2	x 380	6,422	
Lost working hours total, NOK(**€**)				**83,600**	**325 (33.85)**				**31,867**	**106 (11.04)**
Total travel costs and lost working hours for society, NOK (€)					**1,752 (182.50)**					**497 (51.77)**

UNN – University Hospital, standard consultation; RMC – Regional medical center, remote location; n= number of traveling to consultation, missing value is replaced with lowest estimated value/distance/time according to travel-distance.

[a] 1 Euro = 9.60 Norwegian krone (NOK), Exchange rate from the Norwegian Bank on April 10th2018

[b] Standard rate refunded 2.40 NOK per kilometer according to Pasientreiser HF (the National Patients Transport) for 2018. Non responder is included as standard rate refunded

[c] Mean distance (the shortest distance using Google Map)

[d] Mean distance (patient reported distance)

[e] Mean distance (the shortest and fastest - no ferry)

[f] Adjusted for estimated number of patient in the same taxi, reported from the UNN's Patient Travelling Agency

[g] Stay overnight, refunding 220 NOK (undocumented) subsistence allowance

[h] Directly waiting time before consultation and consultant time is not included. The difference between the location in pre-consultation waiting time is small (7 minute longer at UNN, p-value <0.001). There was no significant difference in mean consultation time (20.9 and 20.5 minutes)

[i] Average income all sectors per hour, 150 hours per week, 2017 + 30% social taxes according