

Telemedicine Survey in the County Council of Västerbotten

- An analysis of the present situation, conditions and areas of improvement



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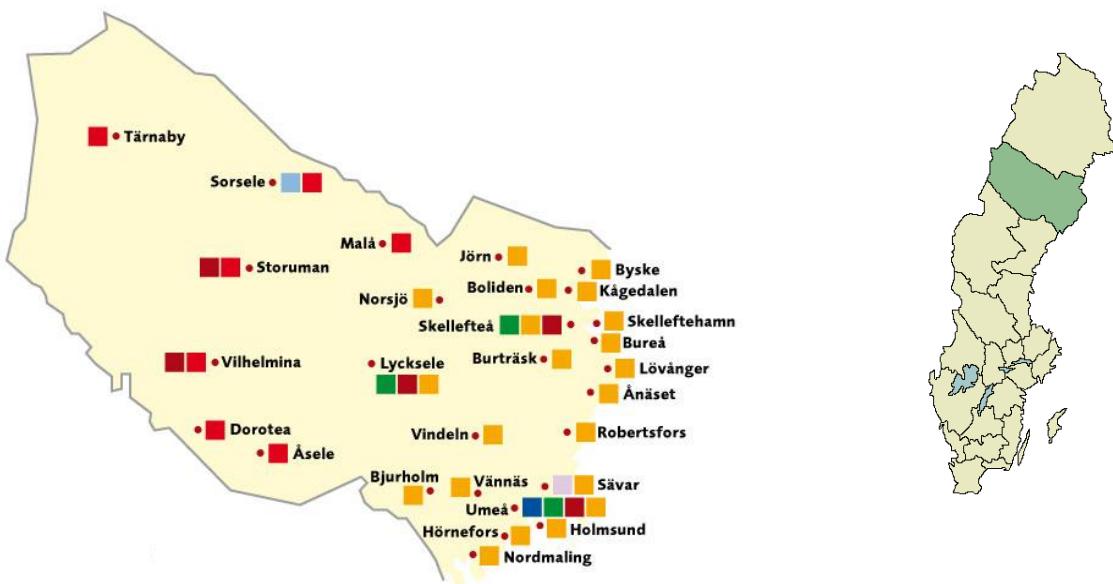
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▪ The Swedish health system

The healthcare in Sweden is decentralised and mainly organised by the politically governed County Councils and regions (20 in total). The 290 municipalities also provide some health and social services, including home healthcare and elderly care. Healthcare in Sweden is largely tax funded and there are private as well as public actors providing services under the same regulations. The services are provided either at primary care level or at hospital level, depending on the complexity of the condition. Primary care consists of outpatient facilities responsible for, e.g., health promotion, non-acute complications and minor surgeries, whereas all inpatient care and most emergency care is provided at the hospitals. However, in Västerbotten and a few other northern counties, there is a third, intermediate option, called cottage hospitals. These units are organised under primary care but are equipped with inpatient facilities and provide emergency care in addition to other extended services, including x-ray imaging and management of simple fractures. Historically, cottage hospitals were common throughout the whole country but owing to a systematic centralisation of specialised health services during several decades, they only remain in rural areas where the distance to specialised care is long.

Healthcare facilities in Västerbotten

The map below shows all healthcare facilities in Västerbotten County, including public as well as private actors. There are 32 primary care facilities in total, including seven cottage hospitals (light red) and 25 ordinary primary care units (yellow), two regional hospitals (green) and one University hospital (blue). The University hospital, located in the city of Umeå, provides specialised care to the four northern-most county councils and regions in Sweden, namely Norrbotten, Västerbotten, Västernorrland and Region Jämtland-Härjedalen, which together cover approximately 50% of Sweden's area and 10% of its population. In addition, there are specific rehabilitation units (grey), psychiatry units (dark red) and a rehabilitation facility (blue) organised under the division for behavioural medicine at the university hospital, although located outside the hospital facilities.



The county of Västerbotten and location of all healthcare facilities (left) and Sweden with Västerbotten County highlighted in green (right)

■ Summary

Since the mid-1990s, Västerbotten County Council (VLL) uses telemedicine to make health care more accessible to the county residents. However, there is still a certain lack of systematic strategies aiming to ensure the quality of such work models, which might slow down the development and dissemination to new application areas, professions and patient groups. Therefore, a survey of the field was initiated in late 2014. The goal of the survey was to develop a solid foundation for strategies aiming to standardize and support up-scaling and implementation of high quality telemedicine services in the county. The results are presented in this report along with areas for improvement based on specific needs raised during the survey.

The survey is primarily based on structured interviews with representatives from units that work with telemedicine in VLL. The report also contains information about additional service models based on discussions and incomplete interviews with clinical and technical staff. These are, however, not included in the compilation of the results.

The structured interview guide contained 31 questions in the following areas:

- Description of the telemedicine service/work model, technical equipment utilized and target groups addressed
- The status, scope and potential of the work model
- Driving forces, impacts and benefits, and need of support to estimate impacts and benefits
- Access to administrative routines, financial procedures and compensation models, and need of support to establish routines and compensation models
- Access to training and instructions for staff and patients, and need of support in the matter
- Technical challenges and need of further support on technical issues
- Visions for the service/work model and foreseen obstacles for reaching these visions

The result includes some 40 different work models of which 29 have been identified through structured interviews with representatives from a total of 24 unique clinical units or departments. Together, these services and work models involve some 20 occupations, mainly in health care, education and social services, in addition to patients and relatives. The status of the 29 systematically addressed services vary, but the majority

are classified as routine practice and ready for wider implementation, meaning that they are considered to have good potential to be transferred to other units or patient groups.

It is clear that telemedicine has been developed with the patients' best interest at heart, but the respondents in addition report a number of positive co-benefits of this work. However, only a few of these beneficial effects have been systematically evaluated and documented.

Some units state that they have administrative and financial procedures established, that they have access to the necessary training and believe that the technology fulfils their needs. A majority of the respondents, however, request support in one or more of the above-mentioned areas and describe a lack of coordination between units that work in similar ways. This lack of coordination applies to documentation and booking routines as well as other general administrative procedures. In addition, training to use the equipment is requested.

As the survey delivers evidence of an extensive need for assistance in a variety of areas, five concrete areas of improvement have been identified and discussed. These include the generation and dissemination of evidence regarding the benefits of telemedicine; establishment and spread of routines for administration, documentation, economic compensation models and education; quality assurance and adaptation of technology and physical environments; and attitudes and values.

The survey is the first of its kind in VLL. The primary target audience is policy and decision makers but the report can serve as inspiration to other units or health authorities interested in implementing telemedicine services and work models. The report does not claim to be complete and has certain limitations, especially regarding the selection of interviewees. Hence, included in the discussion are suggestions of strategies to address these constraints aiming to generate a more complete picture of the strengths, weaknesses, challenges and opportunities of telemedicine in Västerbotten. Finally, we discuss how the mapping can complement other ongoing initiatives in the County Council.

The conclusion of the survey is that telemedicine is an important contribution to a sustainable health care, with benefits for patients, staff and society.

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▪ Introduction

Since the mid-1990s, the County Council of Västerbotten, VLL, has been at the forefront of the development of telemedicine services, both nationally and internationally. Telemedicine is defined by the World Health Organization as “The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities”. In Västerbotten, telemedicine is considered a distinct part of e-health, which includes all information and communication technology used to facilitate healthcare provision.

In Västerbotten, early development of telemedicine focused on new technical solutions and work models aiming to strengthen healthcare in rural areas. One of the first applications was consultations in real time within the specialties of ear, nose, throat, skin and orthopaedics. Via video conference, a specialist at the hospital met patients and physicians in primary care and assessed patients with the support from a digital endoscope.

Videoconferencing technology remains a central component and is widely used in various clinical applications, as well as for all types of administrative meetings. There are currently 230 videoconferencing systems in the organization and about 1500 employees have webcams installed on their personal computers.

The rural perspective is still important, but far from the only motivating factor to offer services with the support of information and communication technology. Increased accessibility, equality perspectives and access to competence and skills set of specialists are all important driving forces, and not necessarily linked to long distances.

Historically, the development of telemedicine services was mainly driven by people with a personal engagement at individual units, which is not unique to our county. However, since the late 1990s there has been a concerted effort to encourage development and establishment of telemedicine work models in VLL and a small grant has been reserved for such activities ever since. In 2015, telemedicine was established as a prioritized area within the recently founded e-health department at the Strategic Development Office. The support and trust offered by politicians and county council officers through the years of telemedicine development has been instrumental for reaching the prominent position that VLL holds today.



■ Aim

Over the years, Västerbotten County Council has seen a steady growth of various telemedicine services with benefits for patients, staff and the organization as a whole. However, there is still a lack of strategies for a systematic introduction of quality-assured work models in a time and cost effective manner.

To address this challenge, a survey was initiated in 2014 to describe the current situation from the

perspective of healthcare workers and managers, and to address the unexplored potential, opportunities and challenges for further expansion of telemedicine services. The aim was to develop a solid foundation for policies that enables the county council to standardize and implement high-quality telemedicine services on a broader scale in the whole county.

■ Method

Most of the survey has been carried out through structured interviews with managers and frequent users of telemedicine services. A total of 29 unique work models have been mapped in detail.

In addition to the structured interviews, the report also describes applications based on incomplete interviews and dialogue with clinical and technical personnel involved in telemedicine service delivery in various areas. These are not included in the compilation of the results but contribute to the section “areas of improvement” and in the discussion. These applications are marked with an asterisk (*) in the section “Mapped areas”.

The structured interviews were based on 31 questions and addressed the following areas:

- Description of the telemedicine service/work model, technical equipment utilized and target groups addressed
- The status, scope and potential of the work model
- Driving forces, impacts and benefits, and need of support to estimate impacts and benefits
- Access to administrative routines, financial procedures and compensation models, and need of support to establish routines and compensation models
- Access to training and instructions for staff and patients, and need of support in the matter
- Technical challenges and need of further support on technical issues
- Visions for the service/work model and foreseen obstacles for reaching these visions

The survey contained closed and open-ended questions. The closed ended questions, primarily multiple

choice questions with yes/no/don't know answers, have been compiled and presented in pie charts whereas answers to the open ended questions have been coded and grouped into categories to reduce the complexity and facilitate the presentation and evaluation of the results. In addition, the interviewers have encouraged personal reflection and dissemination of free associations and arguments relevant to the topic. The results are summarized along with a contemporary description of telemedicine status in Västerbotten and suggestions for overall improvement. Written notes from all interviews are compiled in an excel document and the larger part of the interviews are audio recorded and available for further processing and analysis.

Delimitations

The definition of telemedicine used in this survey includes applications where digital images are used to diagnose disease. However, interpretation of radiology images taken at a different location is excluded from the survey, as this has been routine practice for decades. This includes dentistry/odontology, which is largely based on the assessment and diagnosis using X-ray and digital images integrated in the patient's dental records. Moreover, video conferencing is widely used for administrative purpose and opportunities and potential for such applications are often mentioned in the interviews. The report will nonetheless include only applications with direct clinical association.

The survey does not claim to be complete. Completeness of the data has been compromised by time limitations as well as restricted by the boundaries and definitions applied, thus certain work models might have been overlooked.

Mapped areas

Some 40 applications are included in this report. The applications are grouped into six categories where similar practices are applied. These are,

- Multi-disciplinary conferences and rounds with remote participation
- Treatment in and near the home
- Virtual medical appointments
- Professional consultant services and on-call support
- Self-measurement and point-of-care testing
- Networks, teamwork and other virtual support

Below is a summary of these categories and their underlying approach followed by a brief description of the applications.

Multi-disciplinary conferences and rounds with remote participation

Multidisciplinary conferences, also called multi-disciplinary rounds, belong to a work model in which different professionals jointly decide on the best treatment strategy for individual patients. Such conferences are conducted extensively at the University Hospital of Umeå, henceforth called Nus. Many rounds are local, but more and more frequently they have come to involve participants from other hospitals in the northern healthcare region joining the conference using videoconferencing technology. Some conferences are also national in character.

Participants typically connect to these conferences using advanced videoconferencing system enabling sharing of information from multiple sources, such as X-ray images, pathology specimens and health record entries. The majority of all conferences address cancer and participants represent a wide range of specialties, including surgery, oncology, radiology, pathology, medicine, orthopaedics, ear nose and throat, dental

care, pulmonary medicine, endocrinology, gynaecology and clinical physiology. There are also rounds involving single professionals within a specific field, such as dermatology. Many of the conferences are similar in character and only a small selection is included in this survey.

• Carcinoid round

Regional round established since many years that addresses patients from Northern Sweden with neuro-endocrine tumours. Frequent participants are Nus, Östersund Hospital and Uppsala Academic Hospital, although several other hospitals in the northern healthcare region are also invited. Among the Swedish university hospitals, the Academic Hospital is most experienced with this type of tumours. Participation in the conferences is enabled through videoconference and allows the participants to view x-rays and pathology specimens simultaneously. The round involves endocrinologists, radiologists, oncologists, surgeons and pathologists who discuss patient cases in order to reach consensus on best treatment strategy.

• Pulmonary/oncology/thorax round

This is a regional round involving patients in Northern Sweden with tumours in the lung and thorax. Since 2009, the lung clinics at Nus, Sunderby, Östersund and Sundsvall hospitals participate in the round with professionals in the fields of oncology, thoracic surgery, radiology, pathology and pulmonary medicine. Patients are brought up on this round both before and after surgery. The benefits of this approach includes investigation times for patients being reduced, that each hospital will have the opportunity to discuss their patients and that the responsibility for feedback to patients becomes clearer. The round is a forum where all relevant knowledge is collected and discussed, thus contributes significantly to improving the quality and assuring equal treatment for all patients in the region.

• Haematology round

The Pathology Department at Nus participates in about 60 rounds every week in different areas. The haematology round, held twice a month via video, is coordinated by the centre for laboratory medicine at Nus and is part of the normal routines since the late 1990s. Hospitals in the northern region notify the managers of the round when they have patients to include in rounds. Regular



* Service model that has not been mapped through structured interviews.

participants are physicians from the Pathology Department and haematoma-pathologists at Nus, and haematologists from, for example, Sunderbyn, Östersund and Skellefteå. Occasionally, biomedical scientists and geneticists also join the round.

• **Breast conference ***

The multidisciplinary breast conference is managed from Nus and includes Skellefteå hospital. The conference started already in the late 1990s and is one of the first rounds that allowed remote participation. The conference deals with patients with breast cancer or suspected breast cancer, and all patients are discussed at the conference before and after surgery/treatment in accordance with national guidelines. The round primarily addresses patients from Västerbotten but also includes patients referred from other parts of the northern healthcare region when needed.

At the managing hospital, radiologist, pathologist, oncologist, surgeon, contact nurse, surgical planner, research nurses and students are attending and in Skellefteå usual participants are surgeon, contact nurse and secretary. An important benefit of this work model is the multi-disciplinary character of the discussion leading to a better conference decision. Other advantages are skills development, improved dialogue between different medical disciplines and hospitals, and improved adherence to national guidelines.

• **Dialysis rounds ***

There is a lack of full-time nephrologists at the dialysis unit in Lycksele Hospital, thus specialists at Nus regularly perform rounds remotely with support from the local staff in Lycksele. The rounds are enabled through mobile videoconferencing equipment, which makes it possible to carry out rounds wherever it is best suited. The approach is now part of the routine services. During holiday season, the specialists also support the dialysis unit in Skellefteå Hospital, although to a limited extent. The work model was established in 2011 with



support from the EU-funded project “Implementing Transnational Telemedicine Solutions” (ITTS) in which all three dialysis departments in the county participated.

• **Renal pathology round**

For more than a decade, the Centre of Medicine at Nus carries out joint rounds in renal pathology together with Karolinska University Hospital in Stockholm. Kidney biopsy specimens from patients in Umeå are prepared and sent to the pathologist at Karolinska. Once a month, renal pathologists at Karolinska connects to Umeå using video conference and discusses specimens and patient cases with local kidney physicians, residents and candidates. All patients in this diagnostics area are brought up on the rounds. Benefits include faster preparation, shorter lead times to diagnosis and skills development for staff at Nus participating in the rounds. Since 2014, Östersund Hospital is included in the round.

• **Renal transplantation round**

Since many years, Nus and Sahlgrenska University Hospital holds joint rounds for patients from the Northern Healthcare Region who has undergone kidney transplantation at Sahlgrenska. The rounds are held every two months and currently include Östersund hospital as well. In case of clinical indications, renal biopsies are sampled from the patient at Nus followed by a discussion of the case with nephrologist and transplantation nurse from Nus, and specialized transplant physicians from Sahlgrenska Hospital. On occasion, resident physicians and candidates are also involved. Main benefits of this work model are faster (and higher quality) processes, reduced lead-time to test results, and competence improvement of local staff.

• **Sarcoma round ***

In Sweden, there are five sarcoma centres responsible for diagnosing and treating tumours mainly in the extremities, abdominal and trunk wall, and pelvis. In addition, they handle certain tumours of the abdomen and underlying organs as well as the spine, chest, neck and shoulder region. Sarcoma rounds are held locally at Nus once a week for patients from the Northern healthcare region. About 400 patients are referred annually to the orthopaedic clinic at Nus and most of these are discussed in this round.

At these rounds, representatives of oncology, paediatric oncology, orthopaedics, radiology and pathology participate on a regular basis whereas contact

nurses and candidates participate occasionally. Depending on the nature of cases, other specialties, such as ear, nose and throat, hand surgery, vascular surgery or general surgery are also engaged.

To enable participation of pathologists at every round, a sarcoma pathologist currently takes part in rounds from his home in Gothenburg. The pathologist connects via video using two computers to enable visualization of information from multiple sources. This solution permits full participation in the round, as well as the ability to view histo-pathological images scanned by pathologists at Nus and accessed remotely via a VPN connection. The pathologist also participates locally from Nus on a monthly basis. The other hospitals of the Northern healthcare region can also connect to this round but have not used this opportunity at the time of this survey.

• Colorectal conferences

Within the colorectal area, i.e., colon, rectal and anal cancer, multidisciplinary rounds have been carried out for a long time. The rounds engage pathologists, oncologists, surgeons, radiologists, contact nurses, and all patients from Umeå and Skellefteå are brought up on the round. Since 2009, it is possible to join the round remotely which is used frequently by participants from the hospitals in Skellefteå and Östersund. Thanks to these joint conferences, all patients are given the same conditions for treatment decisions, regardless of their place of residence. In addition to the equality perspective, an advantage of these rounds is that the patient is evaluated simultaneously by all relevant medical disciplines and is fully investigated before the decision on treatment or surgery is made.

• Radiotherapy round

In conjunction with the construction of the radiotherapy unit at Sundsvall Hospital in 2000, a multidisciplinary round known as distributed radiotherapy was established between Nus and Sundsvall Hospital. The aim was to make use of the experience from Nus radiotherapy and support the dose planning for patients to be treated in Sundsvall. Today, Sundsvall has a fully independent radiotherapy unit but the round remains, partly because it contributes to professional development of everyone involved. All patients planned to receive radiotherapy are brought up on the round, thus it contributes to a more equitable care. The round is held twice a week primarily with oncologists, nurses and physicians at both locations, and occasionally students.

In the field of radiation therapy there is also a national round for all children in need of radiotherapy. All hospitals in the country offering this treatment are involved. Rounds are held every second week and aims to ensure that all children have access to the best possible expertise and treatment. As it often concerns rare diseases, these rounds contribute to skills development among attendants, improved quality of care and patient safety by offering the possibility of a second opinion to the suggested treatment plan.

Common telemedicine rounds are also an important part of the National Centre for advanced radiation therapy, Skandionkliniken, in Uppsala. Skandion offers treatment with proton radiation to patients from across the country with tumours close to sensitive organs, for example head, chest and abdomen. The centre builds on distributed expertise and is a joint venture between Sweden's seven counties with teaching hospitals. Skandion offers, in addition to a national meeting place, a joint system for information and treatment planning to facilitate cooperation between hospitals further.

• Regional dermatology round

Once a month, a regional dermatology round is held by the dermatology clinic at Nus with participation from the hospitals in Östersund, Sunderbyn and Sundsvall. The round utilizes videoconference with ability to simultaneously show clinical images and focuses on complex cases where the specialists want to discuss how to manage and treat the patient. Benefits include faster processing of patients and a more equitable healthcare in the region. The round is routine practice since January 2014.

• Dialysis access meetings*

In the dialysis area, so-called access meetings are held via video conferencing and involve physicians and biomedical scientists from the physiology lab (fyslab), doctor and nurse from the dialysis unit and vascular surgeon and doctors from the IR lab. Activities include Nus, Skellefteå and Lycksele Hospitals. The aim of the access meetings is to plan access to the dialysis patient's bloodstream, and to share news and discuss new or updated procedures. The work model was established in 2010 and meetings are held four times a year, with 4-5 patients addressed each time. Better cooperation between professional categories and improved access care for dialysis patients are some of the benefits.

* Service model that has not been mapped through structured interviews.



Treatment in and near the home

Telemedicine has had a major impact on teams offering rehabilitation and non-pharmacological treatment and a growing number of rehabilitation units offer parts of their services to patients in their homes or at their nearest healthcare centre.

Cognitive behavioural therapy (CBT), hand rehabilitation after injuries or surgery, speech therapy for patients with voice and speech disorders, and pain rehabilitation individually or in groups are activities included in this survey. All these services are based on video conferencing, either advanced video conferencing systems, personal computers with webcams or tablet computers. (Hand rehabilitation and speech therapy are currently offered to patients at home, either by mobile video conferencing systems or iPad borrowed from the rehab unit, or via their own personal computer or tablet). Most of the rehabilitation units provide telemedicine services to the county residents, particularly to sparsely populated municipalities. The hand rehabilitation team, however, has a larger catchment area and provides rehabilitation services, including telemedicine services, to patients throughout the Northern Healthcare Region.

• Cognitive behavioural therapy (CBT)

Storuman cottage hospital provides CBT treatment via video to patients in several municipalities in the sparsely populated areas of Västerbotten. The therapist connects to the meeting using an ordinary webcam and the patient joins either from the closest primary healthcare facility or by using a similar equipment at home. The first meeting takes place face-to-face and subsequent meetings via video. In addition to increased availability to the CBT therapist, this work model can reduce the vulnerability of the healthcare system by reducing negative impact caused by shortness of local staff, e.g., owing to illnesses or vacancies. In addition, the patient and the therapist reduce the need for long journeys, which have positive effects on the individual as well as the society as a whole through reduced risk of non-attendance, lower travel costs and reduced environmental impact. The service started as a pilot but is now implemented within the framework of the rehabilitation guarantee. In addition, since 2016 Storuman cottage hospital is participating in a pilot project in which patients receive CBT treatment by video in their homes via the national platform for support and treatment.

• Hand rehabilitation

At the Hand and Plastic Surgery Clinic, patients in need of rehabilitation after injury or surgery of the hand and arm are offered treatment using video conferencing in their home or at the nearest healthcare centre. Occupational therapists and physiotherapists utilize a video conferencing system or a webcam solution, whereas the patients join from their home using their own computer or tablet. Patients in need of assistance, or those lacking access to required technology, participate using the videoconferencing system at the nearest primary healthcare facility. Remote support is offered to selected groups of patients, as well as to patients with long-term rehabilitation needs in both Västerbotten and other counties in the unit's catchment area.



The service is considered routine practice since 2009 and about 10 percent of the patients treated at this clinic receive at least parts of their rehabilitation remotely. The clinic also monitors initiated treatments and provides consultancy support to colleagues at healthcare centres and cottage hospitals.

Some of the highlighted benefits are more equitable rehabilitation, as rehabilitation can be offered to all patients regardless of their place of residence, and that the patients are given a greater opportunity to fit rehabilitation into their everyday life. Environmental benefits and reduction in costs for travel and overnight stays are other important outcomes of this work model.

• Pain rehabilitation

Ten percent of the Swedish population suffers from chronic pain, which represents almost 60 percent of all long-term sick leaves. Pain involves suffering on many levels and can cause physical as well as psychological and social problems.

Each year about 320 people, mostly in the age of 18-65, with chronic non-cancer-related pain are referred to the Pain Rehabilitation Clinic at Nus. About 80 of these participate in rehabilitation programs. The program builds on various coping strategies, ergonomics and physical training and Basic body awareness is

one of the methods used. The method has good evidence for lasting improvement of painful conditions, especially during group therapy. However, several long-distance patients refrain from participating in these programs as they find it difficult to be away from home for longer periods.

In 2011-2014, the Pain Rehabilitation Clinic participated in the EU-funded project ITTS by evaluating physiotherapy using video technology. This approach was new and the method is currently being adapted for introduction into the routine rehabilitation programs. As a result of the project, long-distance patients are now offered virtual participation in team-based or individual meetings with physiotherapists, psychologists, occupational therapists or social workers.

• Speech therapy

In the very beginning of the 21st century, the Speech Pathology Clinic at Nus developed a novel concept for remote rehabilitation of patients with voice and speech disorders. The concept originally came about as the speech therapists were too few to cover the needs of the county. Today, this work model is well integrated in clinical practice and meeting patients via video is considered as natural as meeting them at the clinic. Remote rehabilitation is also a routine part of the speech therapy student curriculum.

Speech therapy is offered remotely to patients of all



ages and for a large number of diagnoses, including aphasia, dysarthria and dyslexia. The location of the treatment can be the patient's home or the nearest pri-

* Service model that has not been mapped through structured interviews.

mary healthcare facility and thus offers a more equitable care as the availability is the same regardless of where the patient lives.

In addition, the speech therapists work more effectively and can equalise the queues to various treatment facilities by accepting patients from the entire county. Moreover, this work model permits a more intensive treatment regime, which has positive impact on the clinical outcomes. Remote speech therapy was part of the EU project ITTS and has since 2014 been established in several European countries, including parts of Scotland, Ireland and Northern Ireland.

Virtual medical appointments

Virtual medical appointments supported by video-conferencing and medical equipment with ability to transfer digital images, video or audio are today offered at many units. The number of such services is rapidly increasing in scope and frequency, and this survey includes areas, such as rheumatology, cardiology, dermatology and paediatrics. Remote appointments are offered mainly for residents in the county but are also available in some clinics providing nation-wide services or services to patients from the Northern Healthcare Region.

• Adjustment of hearing aids *

In Northern Sweden, there are about 170 adults with cochlear implant, CI. A cochlear implant is a high-tech tool that can restore hearing to deaf and severely hearing impaired. The implant, which consists of both implanted and external components, is inserted and tested at Nus for all adult patients in northern Sweden whereas children are treated at Karolinska University Hospital in Stockholm. After surgery, testing and adjustment of the tool is performed iteratively by local engineers and may result in up to ten patient visits during the first year after insertion. Since some time back, patients from Sunderby hospital is offered adjustment remotely. The patient and engineer connect using videoconferencing and the patient's implants are connected via an interface box to a computer that can be remotely controlled by the engineer to make the adjustment. This approach allows patients to have their aids adjusted at their local hospital leading to lower costs and environmental impact through reduced travel for patients and hearing engineers, who previously executed some of their work locally at Sunderby hospital. The approach can be extended to other hospitals in the region but also to the Karolinska University Hospital concerning children with CI.

• Planned receptions for children with suspected heart conditions

The Paediatric Cardiology Clinic at Nus offers virtual appointments to children with suspected heart conditions at Sunderby and Gällivare hospitals. The approach started as a pilot in 2014 and will be implemented in regular activities in 2016. The procedure and technical solution is the same as in a work model for addressing acute heart conditions in children based on cardiac ultrasound examinations, an approach that was established with Sunderby and Gällivare hospitals al-



ready in 2009. This work model builds on the ability to stream ultrasound images in real time. The cardiologists at Nus can thus guide a paediatrician at the child's local hospital through an ultrasound examination during a regular phone call. The video output of the ultrasound equipment is connected to a streaming server, which in turn is connected to the network. The cardiologist at Nus logs on to a secure website and can thus take part of the ultrasound images in real time. The examination can in addition be complemented by showing previously conducted ultrasound examinations for comparison. In the current state, the scope of the work model extends to half a day's reception and on average three patients per week.

- **Nursing appointments for patients on peritoneal dialysis ***

The renal unit at Nus offers remote support to patients with peritoneal dialysis (PD) at the patients nearest primary care unit. The service was established in 2011 as part of the EU project ITTS and is now routine practice. The plan is to develop the concept further to be able to offer services also to the patient's home. It is mainly patients with long distances to travel that utilize the service and primarily meets with specialist nurses. Appointments where the patient needs to meet with both doctor and nurse remains as face-to-face visits, but on account of the virtual visits with the nurse, the physical visits has been reduced from every sixth to every twelfth week.



In good time before the appointment, the patient leaves a blood sample at the primary care clinic that is later assessed by the PD nurse at the renal unit. Blood pressure and weight is also recorded at this time. At the time of the appointment, the patient utilizes the videoconferencing system at the primary care facility and the visit is then carried out in much the same way as a physical visit.

In addition to the benefits for the patient in terms of timesaving and increased quality of life, this concept is also a significant economic advantage for the county thanks to reduction in subsidised taxi services. Patients with physical disabilities are also given the opportunity to choose peritoneal dialysis when they are not hindered by long journeys to the same degree.

Transplantation nurses for kidney transplant patients have also tested the approach, which is planned to be introduced on a large scale shortly.

- **Haematologic appointment ***

The Haematology Section at Nus is responsible for delivering highly specialized haematology care to all patients in Northern Sweden. Activities include regular follow-ups and drug recommendations, which today is also offered directly to patients in their homes using

video services. Some patients need follow-ups as frequently as twice a week and many need follow-ups for life.

Before the visit, the patient leaves a blood sample at their nearest primary care unit and at the time of the appointment, connects using their personal computer and webcam to the specialist at Nus. Replacing some of the face-to-face visits for remote visits has proven beneficial for both the patient and the healthcare provider. Many of the patients are vulnerable to infection, and avoiding travel means avoiding unnecessary risk of infection. However, the model also results in financial benefits as patients otherwise have to travel alone in a taxi subsidised by the county council. Moreover, for some patients a routine visit to Nus requires over 100 km of travel and two to three days absence from home and work. The service was run as a pilot project in the fall of 2014 with support from the Regional Cancer Centre and is now introduced in routine practice.

- **Family appointments and genetic guidance in cardiovascular genetics**

The Centre for Cardiovascular Genetics, CKG, is a research centre operating within a partnership between the Heart Centre, the Centre for Medicine, the Child and Youth Clinic and Laboratory Medicine. The vision of CKG is to prevent morbidity and mortality in hereditary cardiovascular disease by offering families diagnostics, genetic counselling, monitoring and treatment. Today, CKG offers family receptions to many parts of the country for individuals with known hereditary cardiovascular disease and their relatives. On these occasions, a whole family is invited to a meeting together with referring physicians from their own hometown. Participants from Nus are generally clinical geneticist, cardiologist, cardiologists specialised in children and/or adults, genetic counsellors, and where appropriate, child cardiac nurse and counsellor. As family



* Service model that has not been mapped through structured interviews.

members are often dispersed geographically and that there is no need for physical examination during such meetings, video conferencing has been identified as a highly suitable solution for the family meetings. The main advantage of this approach is that everyone, including referring physicians at the family residence, receives the same information and at the same time, which increases patient safety. It also brings major time and cost savings as neither the family nor the team needs to travel.

The centre also offers genetic counselling to individuals or organisations, particularly to inhabitants of the northern healthcare region but also to individuals living in other counties and organisations, such as the National Board of Forensic Medicine in Linkoping.

by a dermatologist but also that primary care physicians were given the opportunity to develop his or her own expertise. Similar operations are today established with Lycksele and Skellefteå hospitals. Skin lesions/changes are photographed by a nurse at any one of the hospitals and images are stored in the patient's medical record. Thereafter, the patient schedules an appointment with a dermatologist, a meeting that is carried out using videoconference with support from a local nurse. Today, approximately five percent of all new and return visits to the dermatology unit are held remotely via video. Benefits of the work model include increased access to specialist for patients visiting hospitals in Skellefteå and Lycksele, reduction in waiting times to dermatologist and timesaving for patients who avoid travelling to the Umeå-based clinic.

• **Teledermatological visits**

Teledermatological visits were introduced in 1996 at the Dermatology Clinic at Nus in collaboration with some of the primary care driven cottage hospitals in the sparsely populated western parts of the county. Physicians and patient in primary care consulted a specialist at the Dermatology Clinic during a video meeting and still images of the patient's symptoms shown in real time. Today, this work model has largely been replaced by "image referrals", as described in the section Consultations and on-call support. The main benefits were that the patients did not have to travel to be evaluated

• **Rheumatologic doctor's visits**

Rheumatology patients on heavy medication need to be examined regularly to evaluate the pharmacological treatment, possible side effects and general wellbeing. To reach all the patients in the county, medical specialists in rheumatology placed at Nus previously staffed also the rheumatology departments of Skellefteå and Lycksele Hospitals once a week. A large part of the time was thus spent on travels instead of working with patients. Therefore, a rheumatology surgery was established in Skellefteå hospital in 2010 followed by



Lycksele Hospital in 2014, both staffed remotely by specialists at Nus. The target group is patients with stable rheumatologic disease, those in need of regular control of anti-rheumatic drug therapy and those in need of short-term follow-ups. For this purpose, special rooms have been equipped with videoconferencing systems and a high-resolution video camera on a flexible stand. The operation is made possible by specially trained nurses and physiotherapists in the local hospitals, who work in a team with the rheumatologist at Nus. The local staff receives the patient and performs a routine examination before the connection to Nus is established. The specialist thereafter communicates with the patient via video and if needed, further examinations can be carried out with support from the local staff with or without using the high-resolution camera.

Besides leading to a more efficient use of the specialists, this work model contributes to skills development for nurses. For example, with this approach it becomes the nurses' role to listen to the heart and lungs and to investigate the status of the patient's joints, which is an important part of the follow-up. It also leads to increased availability of specialist as several patients can be managed in the context of the local services. Virtual visits cannot completely replace face-to-face appointments, but works well for many patient groups and types of appointments.

• **Virtual GP appointments**

Many sparsely populated municipalities in the Västerbotten County have difficulties recruiting medical professionals to the primary care. The problem is also evident in urban primary care facilities, but to a lesser extent. These units are thus often dependent on temporarily hired physicians, a situation which entail unnecessary high costs, affect continuity and compromise the benefits of an established relationship between doctor and patient.

In 2014, the potential of implementing a “virtual” GP was evaluated in one of the rural municipalities of Västerbotten. The concept depends on GPs in primary care facilities with higher staffing, typically in urban areas, serving patients in the sparsely populated areas on a regular basis. During the pilot study, GPs from two urban primary care centres in Umeå staffed the virtual clinic. During appointments, the GP has support from a local nurse assisting the patient as well as the physician by facilitating necessary examinations and sampling. The concept was evaluated in a cottage hospital, where a room was equipped for the purpose. The room contains, in addition to standard equipment, a video conferencing system and a medical camera that can transmit images of e.g., skin and throat in real time

to the GP. A digital stethoscope for heart and lung auscultations with real-time streaming capabilities will also be part of the solution. Evaluation of the concept shows that there are many types of patients and visits suitable for virtual meetings and patients who participated in the study had a generally positive attitude. Among other things, patients highlighted the advantage of meeting the same doctor during return visits, even if this meant a virtual appointment. The dependence of temporary staffing in the sparsely populated areas results in patients being used to meeting doctors they have never seen before. The goal is to deploy the concept in 2016.

• **Robot-assisted echocardiography**

Ultrasound examination of the heart, known as echocardiography, is of major importance to establish or rule out certain heart diseases. Echocardiography is only offered at the county's hospitals and to address this limitation, researchers from Skellefteå hospital have developed a method whereby a cardiac ultrasound examination can be executed from a distance in conjunction with a cardiologist consultation. This is made possible by a robotic arm holding the probe of an ultrasound system located in Storuman cottage hospital, which can be remotely controlled by an experienced biomedical scientist at Skellefteå hospital with support from several video cameras. During the ultrasound examination, the patient is accompanied by a local nurse and can communicate with the operator through one of the video screens. When the examination is complete, the patients GP and the cardiologist join the meeting to evaluate and discuss the results. All communication, including video communication and control of the robot goes via the County Council's network. The image from the ultrasound system, along with the video from three cameras in the room, is sent to the operator via streaming technology.

The concept was developed within an EU project called HeartNet (2001-2006) and has subsequently been further developed and evaluated both in projects as well as in ordinary operations. The approach has been thoroughly evaluated and shows, among other things, a sensible use of economic resources and quality gains through significantly shorter lead times to diagnosis and treatment compared to traditional care. In 2014, a randomised controlled study with 38 subjects was published in the prestigious Journal of the American College of Cardiology.

* Service model that has not been mapped through structured interviews.

Professional consultations and on-call support

Consultation between health professionals based on video conferencing was the first example of modern telemedicine in Västerbotten County. Today, structured consultations are common in a variety of areas and include services between hospitals as well as between hospitals and primary care. In addition, consultant services and emergency support is provided between some of the primary care driven cottage hospitals in the more sparsely populated areas with limited GP staffing. The survey includes applications such as emergency assistance at childbirth, tele-dermatoscopy, psycho-geriatric specialist consultations and consultations for children with isolated cleft palate. The technology used is primarily videoconferencing in various forms and medical devices that can store and/or transfer digital photos, video and audio in a store-forward or real-time manner. Consultation services are provided to units within the county, but certain units offer services also to healthcare facilities in the northern healthcare region or nationally.

- **National network for children with suspected heart conditions**

In 2012, a National Children's Heart Network, Gertrude, was established to improve the support for children and new-borns with suspected heart conditions. Thanks to the Swedish Heart and Lung Foundation, 35 of the Swedish hospitals with paediatric cardiology units have received an advanced video conferencing

system with the ability to share stored ultrasound examinations during a video meeting. Gertrud gives newborn babies all over Sweden the opportunity to be assessed by specialists who can detect cardiac abnormalities early, recommend treatment or decide on emergency transportation to specialised units. Cardiac ultrasounds can even be performed on foetuses with suspected heart conditions to be able to discuss and conclude on the best strategy together with the experts. As a University Hospital, Nus is one of the nodes providing support to other hospitals, but this solution also allows paediatric cardiologist at Nus to consult colleagues in case of uncertainties.

- **Emergency support for new-born with suspected heart failure**

Since 2009, the paediatric cardiology unit at Nus supports Sunderby and Gällivare Hospitals with emergency assessments of cardiac ultrasound in children and newborns. The child is cared for by a local paediatrician where the ultrasound investigation is performed. The cardiologist at Nus views the ultrasound images in real time via their computer and, if needed, guides the ultrasound operator during the investigation and assists in the assessment. The video output of the ultrasound system is connected to a streaming server and the cardiologist at Nus accesses the images through a secure website via an ordinary computer. The service is provided 2-3 times per month, on average.





- **Emergency support for birth complications**

At the regional hospital in Lycksele, there is a maternity ward but paediatricians are only available during normal work hours. To support the unit in case of complications during childbirth, specialists at the neonatal unit at Nus are available around the clock for video consultations. For this purpose, a resuscitation table has been equipped with a high-resolution video camera to provide detailed images of the child, as well as a video conferencing system that makes it possible for obstetric staff or anaesthesiologists to communicate with paediatricians and neonatologists in Umeå. The technology makes it possible for specialists to assess the child's condition, suggest treatments or preparations for intensive care transport. The clinic delivers about 300 children annually and approximately one in a hundred experiences complications in need of external support.

The neonatal department is, in addition, evaluating the possibility of using tablet computers for maintaining a video connection also during intensive care transports. There are about 160-170 such transports annually.

- **Assessment of suspected heart murmurs**

During 2005-2007, engineers at the Department of Biomedical Engineering and Informatics, R&D at Nus developed a system for remote auscultations that can stream or store signals from a digital stethoscope. Assessments were thereafter done either during a video consultation or by recording and storing the sound for future assessment. The system was evaluated by specialists at the paediatric cardiology unit at Nus and the paediatric clinic in Skellefteå hospital. Evaluation of the trial showed that the system reduced the need for ultrasound examination of children with physiological heart murmurs, and made time for the specialists to address children with more severe cardiac disease. The service also contributed to shortening the waiting lists, reducing the need for staff and patients to travel, thus improving the overall resource utilization. Another important aspect identified was competence improvement of the paediatrician in Skellefteå with respect to assessment of heart murmurs.

Due to technical challenges, the system was idle for many years, but in 2016 an updated solution has been deployed and will make it possible for several units to further improve their telemedicine services.

* Service model that has not been mapped through structured interviews.

- **Image referrals in dermatology**

In 2005, the Dermatology Clinic at Nus began evaluating the possibility to assess skin conditions such as acne, psoriasis and eczema remotely through referrals supplemented by digital images. This evaluation was the start of a large-scale expansion of image-based diagnostics and today, the clinic offers consultations based on digital images to all primary care units. Diagnostics is based on a regular primary care visit where the skin condition is photographed by local staff and the image is stored in the patient's medical record. The GP thereafter sends a referral to the dermatology clinic with reference to the image. A dermatologist at Nus assesses the image and decides whether or not the patient needs to be referred to a dermatologist at Nus, or if the patient can be managed in primary care. In about 90 percent of the cases, a physical visit is judged unnecessary.

The approach results in faster assessment of patients and better use of healthcare resources. It also contributes to a more accessible and equitable care as specialist assessment is offered to all, regardless of place of residence. Other benefits are saved time and increased cost-efficiency thanks to a reduction in unnecessary travel and specialist appointments.



- **Teledermatoscopy**

Early diagnosis is of great importance for the survival of patients with malignant melanoma. Until 2012, Nus offered referral-free appointments with dermatologists to assess moles, but it was concluded that the service only reached a limited number of people, primarily from nearby municipalities. To offer a more equitable service across the county, the clinic therefore launched a pilot study in 2012 to evaluate the opportunity to photograph suspected melanoma in primary care and have the images assessed by a specialist at Nus.



The mole is photographed through a mobile phone attached to a dermatoscope, which is a magnifying glass with light reflecting the skin in detail. Images are stored in the patient's medical record and a referral with reference to the images is sent to the Dermatology Clinic. Based on the images, the dermatologist judges whether or not the condition needs surgery or if it is best left unattended. The number of unnecessary surgeries has thus decreased and the lead times to correct diagnosis and treatment have been shortened considerably. Fewer physical visits has also led to less travel for the patients with environmental as well as economical gains. Another major benefit is an equitable treatment for the county's residents. The method was implemented in all healthcare centres in northern Sweden in 2014.

- **Emergency support in rural areas**

The towns of Tärnaby, Storuman, Sorsele and Malå in the inland of Västerbotten have access to extended primary care through the cottage hospitals. These units have since many years a video solution in the emergency rooms that allows external support or guidance during emergencies. Physicians on call at home or at another healthcare facility connect via a computer and a simple video streaming server. Through a controllable camera, they can get a good overview of the room. The communication is today facilitated by phone but the solution will be upgraded in 2016 to bi-directional audio and video communication.



- **Visits for children with isolated cleft palate**

The most common form of facial malformation in newborns is a gap in lip, jaw or palate, known as cleft palate. In Sweden, there are six units that manage these patients, including Nus who are responsible for all babies born in Northern Sweden.

Since 2011, the so-called lip, jaw and palate team (LKG team) at Nus offers long-distance patients with isolated cleft palate their first visit via video or webcam. Östersund Hospital was the first to test the

approach. These first visits, which should be held within 1-4 weeks of the child's birth, aims to inform parents and give the team an opportunity to observe the child and gather information needed to plan future treatment. These visits usually involve speech therapists, plastic surgeons and coordinators from the LKG team and nursing staff from the referring unit at the home hospital, usually the ear-nose and throat or paediatric unit. Approximately 80 percent of all first visits for children with isolated cleft palate, 5-10 patients annually, are managed via video.

The main benefits are reduction in travel, better transfer of information to the local medical staff, but also improvement of the skills of the local staff and their capacity to provide professional support to the parents. On occasions, the LKG team in addition provides parental dialogs and follow-ups via video calls.

- **Psycho-geriatric consultations**

The Centre for Geriatrics at Nus offers psycho-geriatric assistance via video or webcam to primary care facilities in southern Lapland and the Umeå region. The approach has been applied by Skellefteå Hospital to a limited extent since 2004 and by Nus since 2009. In recent years, the concept has been developed further as part of the EU project PrimCareIT (2012-2014), which involved seven countries in the Baltic region and aimed to address opportunities and barriers for tele-consultation and tele mentoring in primary care. The approach, now in routine practice, offers primary care staff support in the diagnosis, treatment and follow-up of psycho-geriatric problems, including dementia and other suspected cognitive disorders. Support is also provided to nursing of behavioural and psychological symptoms. Assistance is provided by psycho-geriatric specialists and, on occasions, specialist dementia nurses from the geriatric clinic and those receiving support are typically primary care GPs, district nurses, occupational therapists and nurses from special accommodations.

The approach contributes to increased availability to specialists and a more equitable health care as staff in primary care is given access to skills, which they had not had otherwise. In addition, the quality of assessment, diagnosis, treatment and care increases. This model also contributes to increased efficiency at the geriatrics department as this aid was previously offered face-to-face to primary care units in the urban areas. There are currently about 20 healthcare centres in the county who use the support. The Centre for Geriatrics at Nus also offer team conferences with nurses at Lycksele Hospital on a regular basis.



Point-of-care testing

One area that is considered having great potential to increase access to care and make the patient more engaged in their care is point-of-care testing in various forms. For many years the County Council has offered a technological solution that permits patients the possibility to measure, for example blood pressure, coagulation (INR), glucose, haemoglobin and weight either unattended or with limited support from staff or relatives. This service has been available in a few municipalities and so far been used only to a limited extent.

• Self-measurement in primary care

A number of primary care facilities in the county provide patients with equipment to measure blood pressure and coagulation (INR) unsupervised, or with limited support from the staff. Traditional monitoring of anticoagulant therapy is based on venous blood sampling, which is time consuming for both patient and staff. The alternative of self-testing is based on a point-of-care device that needs only a simple capillary sample. The test result appears directly on the instrument and is, in addition, automatically transferred to the patient's medical record where it can be assessed by the unit responsible for the prescription, either primary care or the anticoagulant reception at Skellefteå hospital or Nus. The concept contributes to considerably shorter time between sampling and ordination, reduces costs for sample management, saves time for the staff and patients are offered the freedom of performing measurements at their own convenience. Since 2016, the County Council is, in addition, subsidizing not only laboratory-based monitoring but also point-of-care equipment for certain patient groups to monitor INR at home.

Networks, teamwork and other virtual support

The survey includes a number of applications that do not fit well within the above-mentioned categories. Common for many of these is that they involve multiple stakeholders or offer services beyond traditional healthcare. One such example is care appointments in psychiatry, which can involve insurance agencies as well as social services in addition to care providers and patients. Another example is community-based health rooms, which creates proximity to care in communities with considerable distances to traditional healthcare facilities.

• Support in child and adolescent psychiatry

In the late 1990s, child and adolescent psychiatry in Northern Sweden began utilizing videoconferencing in their work. Today, such technology is used in many different applications, primarily administrative but also in family conversations and start-up conversations before treatment and, to a limited extent, in personal meetings with patients and families. Video support is also used for planning and monitoring efforts together with children and parents, in collaboration with schools and social services. Professional groups concerned are, e.g., social workers, psychologists, nurses, attendants and doctors. Video conferencing is also used for tutoring or consultations between staff in relation to individual patient cases.

Some of the benefits identified are reduced travel and the ability to have more meetings, leading to better quality and collaboration management for doctors and other groups of staff. It also provides access to specific competences, such as dieticians supporting treatment of eating disorders. Skills transfer within the team is another advantage mentioned.

• Telemedicine in psychiatry *

Already in 2000, the Department of Psychiatry in Västerbotten began utilizing videoconferencing in contacts with neighbouring units and non-healthcare partners. Organisational changes resulted in a significantly larger catchment area and the management realized that telemedicine was the only option to maintain good working relationships and proximity to patients and families.

Today videoconferencing is used widely among outpatient facilities, cottage hospitals and district hospital clinics for to facilitate conferences where local staff discusses referrals together with responsible psychiatrist in Skellefteå, and during treatment conferences with doctors participating from their home unit.

In inpatient care, videoconferencing is used to facilitate meetings between the patients and their regular therapist or for planning of discharge. As the distance to inpatient facilities can be considerable, videoconference is also offered to family members that wish to participate in the meetings. Other collaborators using this technology are social insurance providers, unemployment offices and social services.

Although less common, some patients can also meet the doctor during emergencies and to some extent, therapy is provided to individual patients using this technology.

- **Child and adolescence habilitation**

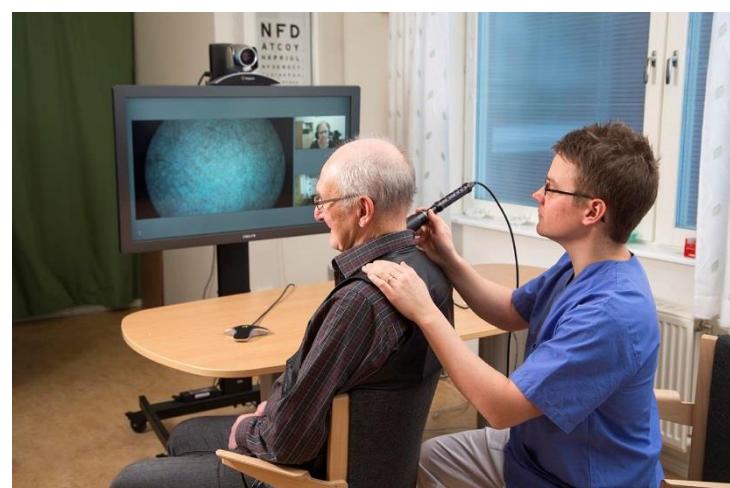
The child and adolescence habilitation in Västerbotten offers advice, support and rehabilitation to children and adolescents with mental retardation, autism, physical disabilities or other severe disabilities. As the unit has a clear focus on removing barriers for people in their everyday life, video conferencing is used extensively to avoid unnecessary travel. Above all, it is used for transfer conferences and habilitation conferences that previously meant travels for some of the participants. Video meetings have also been used in the follow-up of acquired brain injuries and since a few years back, such an approach is also employed in the education of parents of children with cognitive and communication impairments. In addition to patients and parents, some of these activities in addition involve staff from schools (principals, student health), psychologists, social workers and physiotherapists. This work model saves time for the staff, which improves the availability and gives more time for follow-up of the patients. Moreover, as the unit has a county responsibility, the opportunity to use videoconference directly increases the availability of specialist teams to the county inhabitants.

- **Community-based health rooms***

The Centre for Rural Medicine, GMC, in Storuman has developed a new concept for improving proximity to healthcare for residents in rural and sparsely populated areas. In December 2013, the first health room was inaugurated in the small village of Slussfors, midway between the primary care facilities in Storuman and Tärnaby. In this unmanned health room, residents can measure blood pressure, glucose, haemoglobin, weight and INR. The results are automatically directly accessible via the patient's record. The room is also equipped with a video conferencing system that enables meetings with, for example, doctor, nurse, speech therapist or

physiotherapist. A medical camera for closer examination of skin and throat can deliver support for assessments, and in 2016, the system will be complemented with a stethoscope that can stream heart and lung sounds in real time. A few hours every week, the citizens are offered assistance by municipality home care staff, who can facilitate the sampling and help with, for example dressing of wounds. The room is also a meeting place for many other professional and patient groups.

Today there is a policy decision that health rooms shall be established in 20 municipalities in the northern health region. In 2015, there are rooms available in Storuman municipality in Västerbotten and Ragunda and Bräcke municipalities in the county of Jämtland.



- **Collaborative care planning**

The aim of collaborative care planning is management of information transfer and planning of a patients' future care after admission from inpatient facilities. Already in the late 1990s, the first projects with video conference supported care planning were executed in Västerbotten County. Since then, this work model is routine practice in the entire county and has been further developed both as part of the ordinary care and within externally funded projects.

Typically, care planning engages nurses from the inpatient care unit, and when needed other staff categories, such as physiotherapist, dietician, therapists and physicians joins the conference. Municipal health and social care is represented by assistance officers and occasionally district nurses and rehabilitation staff, whereas primary care is represented by GPs or other staff categories when delegated this task. The patient typically participates in the care planning together with staff from the discharging clinic. Relatives sometimes join these meetings by visiting either of the participating units, or remotely by phone or video conference.

* Service model that has not been mapped through structured interviews.

Units that work routinely with care planning using virtual technology has their own videoconferencing equipment whereas municipal or primary care staff use



equipment at the healthcare centre. It is also becoming more and more common for the municipalities to acquire their own videoconferencing equipment.

Managing the care planning via video conference prevents unnecessary travels, mainly for staff from the municipality and primary care who usually have had to travel to the hospitals to participate in care planning using traditional methods. Hence, main benefits is time saved through reduction in travel and that more professional categories can join the meetings. Hence, all co-workers have the opportunity to share information that can be of major importance for the quality of care provided after discharge. Moreover, this work model reduces the administrative load, as fewer stakeholders have to be informed afterwards.

• Transfer meetings in neonatal care

The Neonatal Unit at Nus cares for children in need of extra support and monitoring during early life. The unit has the whole Northern Healthcare Region as catchment area and many of the children need care for long periods, sometimes a long way from home. Before leaving the neonatal unit and returning home to the family or to the local hospital after a prolonged stay, a so-called transfer meeting is held to inform parents and local staff thereby facilitating home going. Today, such meetings are sometimes held using video conferencing, particularly for children affiliated with Sundsvall regional hospital. Video conferencing helps parents, local staff and the specialist team at Nus to meet and share important information aiming to provide support to the parents during their first time at home. The work model is based on a research study executed in collaboration with Sunderby hospital, aiming to investigate what factors influences the experience of bringing home an infant that has been hospitalised for a long time. The major benefit is increased feeling of safety for the children, the parents and the staff.

• Remote interpretation

The Interpretation Centre in Västerbotten offers support to people with deafness and blindness, and those suffering from a hearing impairment. In the middle of the 1990s, this centre started a project to offer writing interpretation remotely. The interpreter utilizes a video conferencing system or web cam and the patient watches the interpretation on a computer, tablet or video conferencing system. Information is transferred using a fixed or mobile broadband network.

Remote interpretation is typically carried out during a two-part conversation, for example during a visit to a physician or a psychologist but also during other types of meetings, including meetings with more than two participants. The current work model involves writing, sign as support and sign language interpreters.

As Västerbotten is a large county an important benefit of working with distance technology is that the interpreters reduces their time on the road and have more time for assignments. Having the interpreter at a distance also seems to be better for certain patients, as this means fewer people in the room. Another advantage is that the county council can service other county councils with interpretation services.



▪ Results

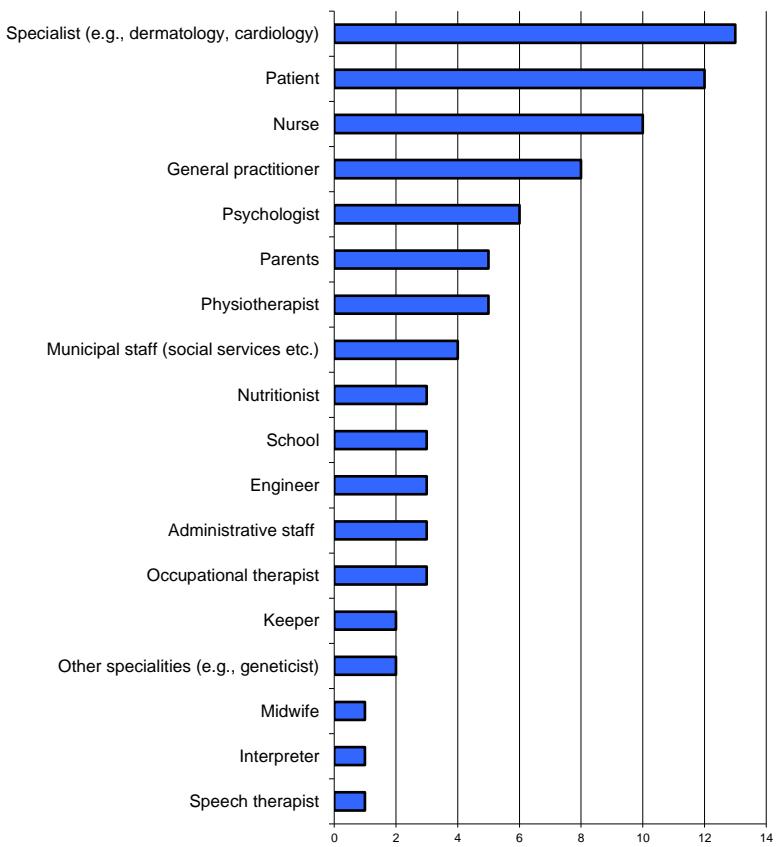
The results are based on complete interviews with representatives for 24 units and comprise in total 29 unique work models or applications. Together, these work models engage more than 20 different stakeholders from healthcare, education and municipal health and social services, in addition to patients and relatives.

Status, scope and potential

The work models included in this review have different status and levels of maturity, implying varying potential to be spread to other units or patient groups. For work models assessed through interviews, status has been described according to the three categories; project/pilot/trial, routine practice or ready for broad-scale implementation. The majority of the mapped applications are already used in routine practice or ready to be implemented also in other units.

The units have also been asked to estimate the level of maturity of their work models using a 7 level Likert scale, taking into account factors such as technical performance, attitudes, routines, patient safety and usefulness for patients and staff. 27 applications were assessed from this viewpoint and resulted in an average maturity level of 5.5, and 64% of the applications have a readiness level of 6 or above and are thus considered completely or nearly completely scaleable to other units or patient groups. However, some interviewees were of the opinion that even the most mature of the work models are in need of certain modifications or improvements to harmonise with local routines and information systems.

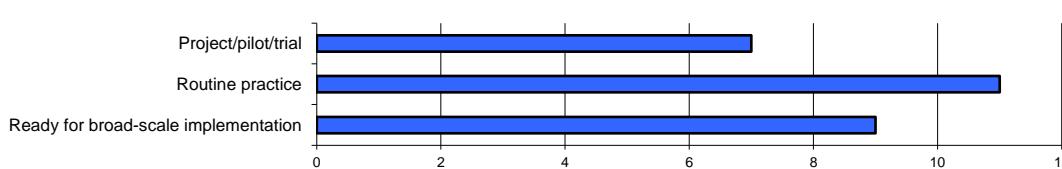
The utilization rate of the various applications in routine use varies significantly – from a fraction of its full potential, e.g., self-sampling of INR for patients on anticoagulant treatment, to nearly 100% within some of the multidisciplinary conference activities where essentially all patients are addressed today. Also within certain units providing remote rehabilitation or doctor's visits, a majority of suitable patients are offered



this service whereas other applications are limited by, e.g., lack of staff or access to technology, or poor attitudes among co-workers or managers.

Many of the interviewees judge that there is a great potential for further development of telemedicine, both within their own unit as well as in other areas. Hence, on the question whether the particular work model could be offered to other patients within their own units, 68% answers yes. For those answering no on this question, the predominant reason was that it was already applied to all relevant patients or diagnoses, or that the work model would not be suitable for other groups. On the question whether the work model could be transferred to other units, 84% answered yes.

According to the interviews, there are some 20 different professions using telemedicine to some extent. Many of the work models in addition involves municipal staff, patient and their relatives

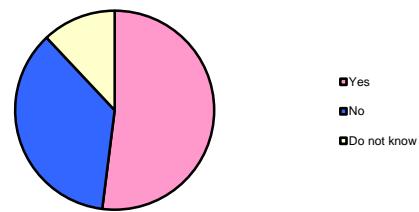


74% of the work models are considered to be routine practice or ready for implementation in a larger context

Driving forces and benefits

Although the reason for developing telemedicine work models vary among the units included in the survey, approximately half of the interviewees claimed that an equitable healthcare was the main driving force. Other motivating factors were reduced need for travelling, competence transfer, improved care quality, increased accessibility to health services, improved work processes, value-creating time, safety and inclusion, skilling of staff and economic benefits.

The interviewees were also asked to reflect upon what outcomes that the introduction of telemedicine has resulted in, in addition to the ones expected or aimed for. Among the effects mentioned, increased care quality, value-creating time, competence improvement, reduction in travel and economy were the most frequently occurring. In addition, telemedicine was by some considered to have positive effects on the environment, their work processes and work environment,

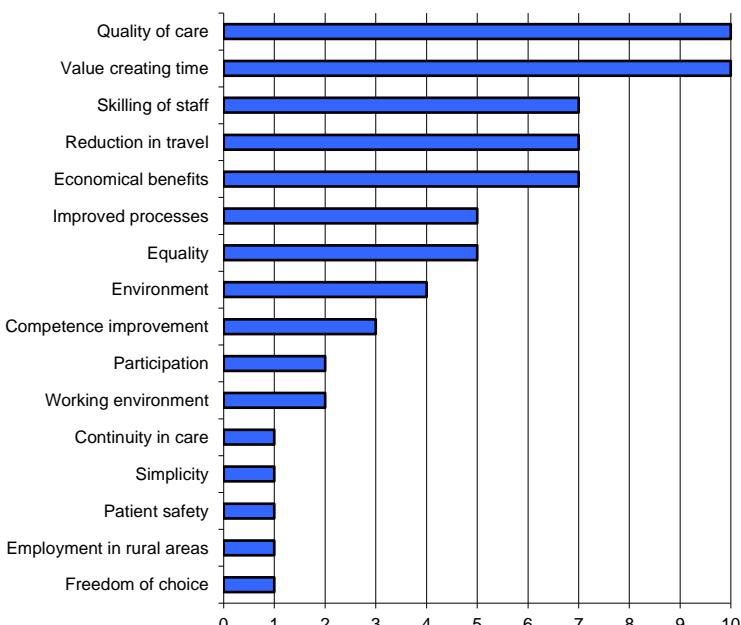
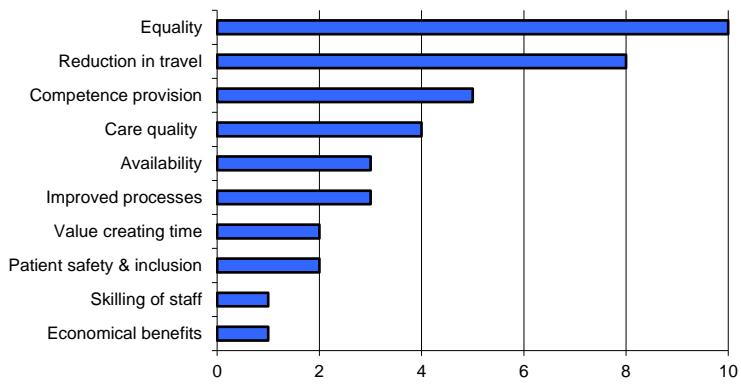


On the question whether there is need of support to generate evidence e.g., regarding the work models efficiency or environmental and economical outcomes, 52% answers yes, 36% no and 12% do not know.

whereas others highlighted inclusion and better opportunities for providing qualified employment in rural areas as positive side effects.

Empirical evidence for these benefits is, however generally lacking with few exceptions. Speech therapy, hand rehabilitation and interpretation services are activities that have been assessed from various viewpoints, including their role in reducing travel and in maintaining a high care quality at reduced cost. A few other work models can lean on international research evidence, including teledermatoscopy and self-measurement of INR during warfarin treatment whereas others have been included in local research studies. Examples of such applications are self-measurement of blood pressure, robot-assisted echocardiography and multidisciplinary cancer rounds. There is also research evidence declaring that telemedicine has a potent carbon reduction potential based on data from the speech therapy and hand rehabilitation units. Finally, some units declare that there is data available to assess certain outcomes and others are already about to analyse their data.

On the question if there is a need of support to evaluate the effects of their telemedicine work models, 52% answers yes, including representatives for units where these work models are already routine practice and those that have already initiated such evaluations. Among those who gave a negative response, 36% argues that they can perform such assessments on their own, that the benefits are so obvious that it is only an organisational matter, or that it is a novel service model that cannot be compared with anything else. The remaining 12% answered that they do not know.



The interviewees have answered questions on what motivated the introduction of telemedicine in their units (upper chart) and what additional outcomes that has been observed (lower chart). It is clear that benefit for the patient is the main driving force, thus equitable care, increased quality of care, value-creating time and reduced travel were the most frequent answers on the two questions.

Administration, routines and economical models

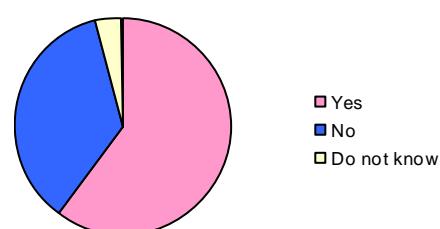
The majority of the units included in this survey have established administrative routines specifically developed to manage the telemedicine work model in question, although to varying degree. Several units mention routines for management of the videoconferencing equipment and meeting rooms. Other routines established to various extent are booking of appointments and rooms, technical troubleshooting, recording of visits, referrals and response, health record documentation, criteria for selection of suitable patients and documentation of outcomes. Units working with multidisciplinary conferences, rehabilitation, and virtual visits have in general well established routines. However, coordination is lacking and only a few of the interviewees indicate that their units exchange experiences and routines for their telemedicine work models. Access to routines for health record documentation and coding vary extensively. A few units encodes systematically, for example in their planning forms, records of visits/visit registration, documentation of medical decisions or meeting notes, but only about 25% of the units use coding in such a way that it is possible to trace the telemedicine activities. Moreover, there is a significant uncertainty concerning how to use the already established routines for coding of various telemedicine applications, for example how to record that a patient visit has taken place virtually. In addition, for some consultation services, particularly those concerning acute consultations, there are no documentation at all, as all records are kept where the patient is.

For activities where it is relevant (16 units), the interviewees have answered the question on whether or not there are economic reimbursement routines established for patients visiting the clinic virtually. 56% of these 16 units answered yes and 44% answered no. Among those that answered no, a majority did not motivate their answer, whereas others responded that they were awaiting a management decision or that they had not taken a position on the issue, as the scope so far was limited. The majority of those who answered not relevant have no direct patient contact and some declare that the service concern children, for whom healthcare is free regardless.

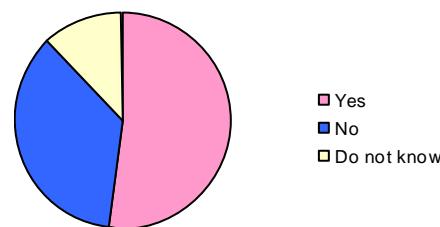
Finally, the interviewees have answered the question if there is a need of support for establishing routines for administration, documentation or economical reimbursement models. 60% express a need for administrative routines and nearly half of these ask specifically for routines for booking of videoconference systems and telemedicine premises. Other concrete suggestions were better integration between information

systems, both within and between the County Councils, and better information systems and routines for managing images used for diagnostics. 52% express a need of support to establish routines for health record documentation, such as improved template for coding, standardisation and classification of images used for diagnostic purposes, automatic storage of information from digital instruments, and increased digitalisation and integration of information and referrals from other County Councils when relevant. Some of those who answered that there is no need of support argued that they have a meticulous administrator at the unit, that the records are kept "on the other side" (where the patient is), that it is up to each unit to decide how to work or that they don't expect any support to be provided.

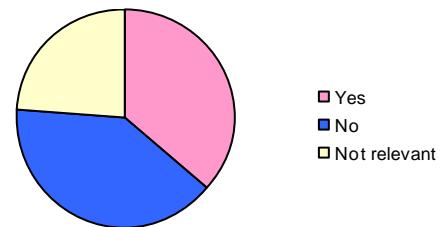
On the question whether or not there is a need of support for establishing economical routines or reimbursement models, 47% of those where this question is relevant (19 units) answered yes and 53% no. Reasons for answering yes were, for example, that it was not clear how to manage measurements sampled in the patients home and uncertainties with respect to whether or not the regional agreement actually reimburses the unit for the work. As a comment, reimbursement schemes might also be politically and strategically important to create incentives for further development of telemedicine work models.



On the question is there a need of support for establishing general administrative routines, 60% answered yes, 36% no and 4% do not know



On the question is there a need of support for establishing routines for health record documentation, 52% answered yes, 36% no and 12% do not know

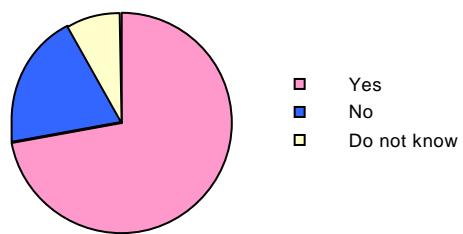


On the question is there a need of support for establishing economical routines, 36% answered yes, 40% no and 24% that it is not relevant

Education and instructions

On the question whether necessary educational routines, instructions or handbooks are available, from staff as well as patient perspective, 56% answered yes or partly, 36% no and the rest do not know. Half of those who answered positively specified that there are instructions available for connecting a video call. Some units have their educations provided by third parties, for example to assess dermatoscope images and for how to manage the equipment used to measure INR values during warfarin treatment. There are also instructions available on how to take and store dermatoscope images, and how to perform echocardiographic examinations using the ultrasound robot. A handful of units said that there were material available for the staff but not for the patients. A common challenge appears to be that the material was developed locally and that there is a general lack of coordination and transfer of experiences concerning educational material. Among those that answered that there is no need for support in the matter argues that they have learned through trial-and-error, or that it is not necessary, as it is possible to guide participants live during the call.

On the question whether or not there is a need of support for establishing educations or instructions, 71% answers yes, 21% no and the rest do not know. Explanations vary; several units expressed that in case of further development and spread of the work model, education might be needed to ensure capable practitioners. Several units pinpoint the need for education to better manage existing technology and one interviewee highlighted the need to educate staff in how to communicate and collaborate across distances to ensure a good patient experience. For some, education is also an economical matter, as staff might need further education to be able to perform their new duties, such as dermatologists judging dermatoscope images or nurses performing investigations of rheumatological joints.

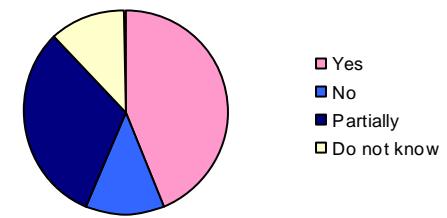
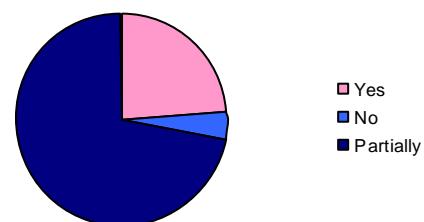


On the question whether there is a need of support for establishing educations or instructions, 71% answered yes, 21% no and 8% do not know.

Technical issues and requirements

Among all units that have recorded answers to the question if the technology is satisfactory with respect to quality, function and usability, 24% answered yes, 72% partly and 4% (one unit) no. The unit that answered no stated that the image quality is poor and that the technology is outdated and inadequate. Among the units who answered partly pointed out several weaknesses in sound and image quality, particularly during video calls. Two interviewees said that it is especially common during meetings with participants from other county councils. Problems with usability is also mentioned, for example during storage of images and management of image sources. Other challenges specified were integration problems between technology and information systems, poor accessibility to video equipment and rooms, in addition to challenges with respect to logistics and equipment for services provided directly to the patient's home. A couple of units also state specific challenges with mobile video solutions, such as tablets.

Regarding standards and patient safety, the technology was considered satisfactory by 44%, whereas 20% answered partly, 4% no and 32% that they did not know. Amongst those who answered no or partially, about half stated that mobile video clients could be a security issue. Other challenges mentioned were poorly designed videoconference rooms and use of rooms that were not designed for the purpose, and where protection of sensitive information cannot be ensured.



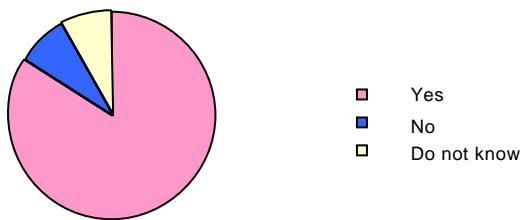
On the question whether the technology meets the user's needs in regard of quality, function and usability, 24% answers yes, 72% partially and 4% no (upper chart).

In the question whether the technical support functions satisfactorily, 44% answered yes, 32% partially, 12% no, and 12% do not know (lower chart).

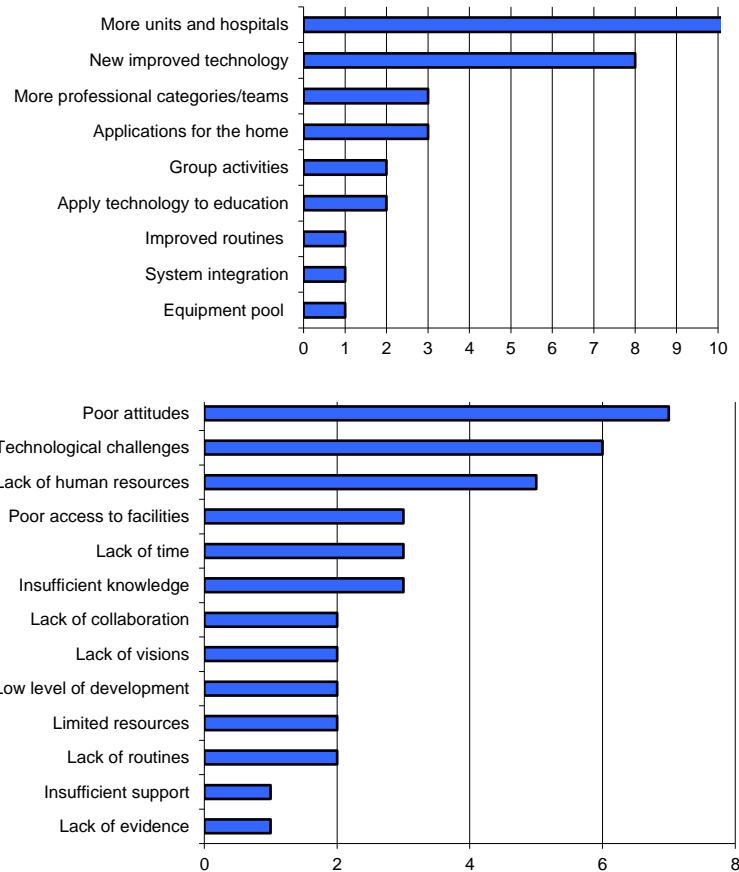
Poor sound and image quality was considered to interfere with the ability to make proper judgments, which might compromise the patient safety. Moreover, there seems to be uncertainties regarding how video recordings are transferred and stored, and with respect to regulations concerning sharing of patient information with other caregivers, which is the case during multidisciplinary conferences. Finally, mix-up of information was pointed out as a risk when many different information systems are used simultaneously and one interviewee expressed insecurity regarding requirements for CE conformity marking of the technology used in assessment and diagnosis.

The status of current user/technical support was also assessed in this survey. On the question whether the current technical support was considered satisfactory, 44% answered yes, 12% no, 32% answered partially and the rest answered no. The majority of the negative answers came from a dissatisfaction with delays in the support during ongoing meetings, which is especially critical when technical difficulties arises during emergency consultations. Several units also expressed that the current support function (Servicedesk) is not satisfactory, and several units stated that they often choose to call a well-known technician directly instead of going through the proper channels.

On the question whether there is need of further technical support, 84% answers yes, 8% no and the rest do not know. Arguments vary, but several units requested technical development support and new or better routines for support cases. Other wishes were equipment better suited for use in the patient's home, better integration between information systems and improved technical support, for patients as well as staff. For those answering no or do not know, the majority said that they are not responsible for technical issues and that the question should be directed to someone else. One such example is multidisciplinary conferences where the radiology department normally is in charge of the technical operation.



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Visions

Regarding visions, a majority of the interviewees said that they wish for the work models to be implemented on a broad scale and engage new units, patient groups or professional categories. For nearly half of the units, broadening the collaboration to engage other hospitals and county councils was also high on the wish list. Many also raised the need of better technical solutions. Other visions were good integration between information systems, equipment pools, and new technical solutions, such as digital stethoscope with streaming capability and tools supporting communication when speech is not sufficient. Methods for facilitating therapeutic conversations in the mother tongue of foreign or immigrant patients were another example that came up during the interviews.

Finally, the interviewees answered a question about the greatest obstacles for reaching their visions. Several of the units answered poor attitudes, insufficient technology and lack of resources in terms of staff as threats to the progression and implementation of telemedicine services. Answers touching upon attitudes mentioned, among other things, colleagues and managers lacking in interest or

The survey included questions about visions for the work models in question, and the predominant answers were spreading the work model to more units or hospitals and technology improvements (upper chart)

Potential obstacles for reaching these visions were poor attitudes among colleagues and managers, insufficient or poorly adapted technology and lack of resources (lower chart)

ability to move from ideas to action. Regarding technology, the units stressed that the technology needs further development and is insufficient with respect to, for example, functionality and accessibility, not least when other county councils and partners with a lower development level are concerned. Lack of human resources was considered to affect the possibility of

increased use, but also to slow down the development of new applications. Other examples of obstacles were lack of insight into what is possible to do using telemedicine, incompatible information systems and lack of economical incitements that could motivate growth of such services.

▪ Areas of improvement

An important aim for the survey was to identify areas for improvement to ensure the quality of already established work models. This means, for example, ensuring that the technology meets the needs and fulfils the patient security regulations. Another important aspect is to ensure that there are sufficient routines available for documentation and coding, which is required to enable follow-up of the work and facilitate management of payment and compensation. Moreover, responsibilities need to be clarified and support for implementing and disseminating successful work models has to be ensured.

This quality assurance will lead to structured routines that can give support during establishment of new work models. The units will therefore be able to avoid unnecessary mistakes and reduce the time from idea to established service.

Based on the units' specific needs of support, five categories of improvements have been defined. This includes the needs of all units, not only those included in the structured interviews.

Generation and dissemination of evidence

Most of the telemedicine applications or services included in this survey have emerged gradually as part of ordinary clinical practice. Hence, only a few have been evaluated with a systematic approach and there is limited documentation on the effect these work models have on, e.g., health economy, accessibility or clinical outcome. This fact does not influence the motivation of the unit themselves to keep using telemedicine, but complicates the transfer of the work models to new target groups or units. Evidence regarding the impact of telemedicine services on residents and the healthcare business as a whole should therefore be strengthened through systematic evaluations. Even work models that can draw on research evidence have shown challenging to implement. Consequently, support for generating such evidence was asked for by half of the units included in the interviews. Evidence on the benefits of a

work model is likely to contribute to increased deployment, but an active implementation and operational support is nonetheless foreseen to be required to achieve a sustainable change.

Establishment and spreading of routines and economical models

A significant portion of the service models addressed in this survey is in routine practice or ready for broad-scale implementation in other units or patient groups. This implies that important routines are already established. However, it is clear that coordination between units is lacking and that most routines, handbooks and checklists had been developed locally. This includes routines for booking of telemedicine facilities and equipment, and routines for calling patients that are to consult a care facility in a different hospital or town. Yet another example is PMs for multidisciplinary conferences where several units, without coordination, have quality-assured their local routines through systematic improvements. One exception is the compendium "*Connect – An introduction to video-assisted speech therapy*" developed in 2007, which has provided invaluable support to other telemedicine initiatives in their infancy. This document contains practical advice on how to plan and execute a video meeting, in addition to information addressing specific patient groups in speech therapy.

Many units depend on skilled administrators and local routines, which complicate the transfer of work models to other units. Hence, better coordination between similar units or work models is needed, and so is the establishment of general telemedicine policies and routines.

Among the concrete and recurring needs expressed by the interviewees, we find routines for booking of equipment and facilities, which is indeed a challenge when the facilities belongs to another unit, organisation or care level. Another example is policies for systematic documentation and coding in various information system to facilitate monitoring and evaluation of the

telemedicine activities. Moreover, economical ambiguities and challenges remain for a number of telemedicine services. Examples are challenges with payment and reimbursement schemes when the service is provided to patients outside the local organisation, or how to handle patient fees when they receive the treatment at home.

When addressing telemedicine from an economical viewpoint, it is important to ensure that the overall budget of the county council is considered, not only the budget of individual clinics. Investments as well as operational costs and potential savings often arise in different locations during telemedicine operations. One example is travel costs for subsidized taxi services, which can be substantial for patients living in the sparsely populated areas. This cost is avoided when a physical visit is replaced by a virtual, but it is a separate budget and does not compensate for any costs arising as a result of the alternative service model. Hence, the county council needs to establish economical models that do not counteract the development of work models with capacity to improve the situation for the patient while reducing the overall costs of the entire operation.

In summary, a majority of the units providing telemedicine services expressed a need of support for establishing administrative and economical routines. To systematize this work would significantly help all employees and units that wish to provide telemedicine services, in addition to eliminating barriers that easily create resistance and delay the process of gaining acceptance for new service models.

Education

Many units in this survey have stressed the importance of education as an important contributor to successful telemedicine implementation. These needs can be ordered into three categories.

The first regards structured education and instruction to staff and patients to manage the technology, primarily video conferencing systems.

The second is education for staff that are to perform examinations and diagnostics from a distance. Examples from this survey are rheumatological appointments, where a nurse has been educated to perform certain examinations to support the specialist and dermatology, where specialists need a special education to be able to diagnose potential melanomas through dermatoscopic images. Both are costly for the unit providing the service, but a necessity to be able to ensure the quality of the work.

The third regards education on how to communicate and interact during a video meeting. This is essential for the staff to feel safe, for effective cooperation

and for giving the patient a positive experience despite the physical distance.

Many educational needs are the same for numerous units and the County Council would gain a lot from co-ordinating educational efforts for those who wish to introduce or develop telemedicine services. For any other care situation, it is taken for granted that the staff has completed the required education, and is given the opportunity to continue training to keep developing their skills. With very few exceptions, this does not hold true for telemedicine services. The staff thus needs to be



given a better opportunity to train in environments and situations they encounter in their daily lives with telemedicine. Examples are training aiming to make the staff confident in managing the video technology or other gadgets, such as cameras or endoscopes. Another important and often neglected aspect is to practice interacting and communicating with colleagues or patients through this media. Opportunities to practice should be given to students as well as staff in clinical practice. It is also desirable that general knowledge on the prerequisites and benefits of telemedicine is conveyed in the programs, and the content of this information should be developed in dialogue between caregivers with hands-on experience and academic institutions.

Technology and facilities

The survey has shown that many units are demanding a more suitable technology that has higher quality, are more accessible and easier to use. Another significant improvement potential mentioned concerns about the facilities used for telemedicine activities.

Regarding technical improvement, most needs expressed during the survey can be met by systems available on the market. The county council can thus improve the situation merely by ensuring that the units have access to this technology and that these needs are considered when the old systems are replaced. There

is, in addition, evidence that investments in telemedicine technology, particularly video conferencing systems, pays off relatively quickly.

Weaknesses in the facilities concern their placement and design and the fact that the environment and the technology within do not meet their needs in the actual care situation. One example is the design of environments for telemedicine in primary care, where neither the rooms, nor the technology is designed for the purpose. Simply put, the facilities and the technology has not been designed with telemedicine in mind, which has been pointed out by several of the interviewees. There is a long tradition on how to design healthcare facilities, but telemedicine is rarely taken into account, even when new facilities are constructed. The county council thus has an opportunity to utilize its long telemedicine tradition and optimise existing facilities, in addition to contributing to the development of telemedicine facilities suited for existing as well as completely new telemedicine service models in collaboration with important stakeholders, including patients and their relatives. A concrete example of such multi-faceted co-creation process is the development of community health rooms by the Centre for Rural Medicine in Storuman, which involves patients and relatives, in addition to caregivers, private sector and academic researchers.

Another important technological requirement raised in this survey is improved integration between information system and extended support for existing systems. One concrete example is tele dermatoscopy, where the management of the digital images is judged complicated and impose a possible threat to the patient safety. Another example is multidisciplinary conferences, which typically displays multiple information sources, hence increases the risk of mix-ups. To address challenges on this level requires an overarching ICT-strategy that defines what solutions and investments that are best suited and is thus the responsibility of the central County Council management. Moreover, many interviewees have expressed that the current system for obtaining technical support is insufficient and that it is difficult to obtain support during ongoing activities, which in case of emergency consultations can be detrimental for the patient. Technical troubles during, for example conferences, will affect individual patients in addition to resulting in an economic loss to the county council for a large number of participants losing important work. To improve the technology and improve the efficiency of technical support functions

would thus positively influence the daily work, the economy as well as attitudes among staff and patients.



Attitudes and values

Positive attitudes have the capacity to contribute to change and development, which is clear from this survey. Many of the interviewees are enthusiasts who on their own initiative have driven or contributed to the development of telemedicine in Västerbotten. During this survey, negative attitudes have thus been raised as an obstacle that threatens to slow down development and even prevent implementation. Factors contributing to these poor attitudes are lack of insight into the benefits of telemedicine; that people tend to see the additional workload rather than the benefits, lack of interest and limited flexibility amongst the co-workers. Another aspect raised by one interviewee is the generation issue, that many are unfamiliar with technology, while others maintain that there is an uncertainty about the technology and what patients, especially the elderly, says. In contrast, an interviewee with extensive experience from telemedicine claimed that the patient is never an issue. It is thus judged that the resistance can be counteracted with better information regarding benefits and outcomes, more user-friendly systems, improved routines and extended support during implementation and operation.

It should also be noted that the units within the county council are relatively autonomous and that there is a freedom of choice regarding whether or not, and for whom and to what extent to provide telemedicine services. Clear directions should thus be established by the management, which would make it easier to implement cost-efficient and high-quality telemedicine service models on a broader scale while reducing the impact of individual co-worker's potentially poor attitudes.

■ Discussion

This survey is the first of its kind in Västerbotten County Council. Representatives for approximately 40 applications and 30 individual units have had the opportunity to make their voices heard. The result shows that the knowledge about telemedicine in the county is high, and that many service models are sophisticated enough to be part of routine practice. The strongest motivating factors identified were quality and equality, although many other positive effects are also evident. It has also become evident that many challenges remain, which is an important source of information for local stakeholders in their work to systemize and ensure the quality of telemedicine implementation and operation. The report is thus mainly directed to managers and decision makers, but can become a source of inspiration for those counties - or countries, that wish to expand their telemedicine service portfolio. Moreover, most interviews are audio recorded and brief summaries of the answers have been compiled for further analysis and can be used as a basis for general improvements as well as to address the needs of individual units.

The survey does not claim to be complete. There are work models that have not been included, e.g., due to time constraints, and there are reasons to believe that there is a significant number of unknown applications that have not even been considered. In addition, there are limitations that are important to take into account when evaluating the validity and generalisability of the results. Firstly, the choice of people and units to involve was not systematic. To a high degree, the interviewees represent individuals that on their own initiative have driven the development of telemedicine in their respective units. Their knowledge, attitudes and practice are thus not necessarily representatives for the whole unit.

For those work models that involve more than one unit, hospital, care level or county, interviews were typically conducted with representatives from one unit only. This was the case for work models that includes other hospitals and county councils, but also for applications including stakeholders in primary care. Important information about needs, technical challenges, existing routines or lack thereof might thus have been overlooked.

The survey has only addressed staff and does not take into account the patient perspectives. Their opinions and needs are obviously critical to assess to generate a complete picture of the strengths and weaknesses of various telemedicine work models from a

wider perspective. Moreover, the survey does not take into account the growing number of telemedicine research and innovation projects in the county. There are a number of ongoing initiatives, aiming to generate technology and service concepts for improved health among people with e.g., cardiovascular disease, diabetes, obesity and chronic obstructive pulmonary disease. These projects are closely monitored to capture promising work models for the future.

For the last 20 years, Västerbotten County Council has been at the forefront of telemedicine development, although we evidently still have challenges to address. The establishment of the new e-health unit was a step in the right direction for a holistic approach, which is needed to improve integration between information systems. E-health is becoming increasingly important for providing quality care, and overarching strategies based on the real needs of the patients and the clinical staff is a necessity if we are to keep providing a high-quality care to our citizens.

Another strategically important unit is the Centre for Rural Medicine, GMC, in Storuman, which since 2014 is a research and development unit within the Primary Care. One of the many duties of GMC is research, development and education within areas, such as telemedicine and e-health. Through strong regional collaboration and partnerships with researchers, authorities and organizations on five continents, GMC has quickly established itself as a key player in the field. However, the line between e-health, telemedicine and what is considered ordinary care is becoming increasingly vague, and eventually all the technical solutions have to become seamlessly integrated into the everyday activities.

The conclusion from this report is that telemedicine is an important contribution to a sustainable health system in Västerbotten and there are good reasons to believe that this holds true also outside the county. By taking advantage of the positive experiences from existing practices and systematize the work on the improvement areas identified, there are good prospects for the council to take the next step in the development of telemedicine, with the county's residents as the big winners.