TTL - Tromsø Telemedicine Laboratory
Centre for Research-based Innovation

Annual report 2008

Innovative and sustainable technologies for geriatric, chronic, and lifestyle-related diseases
Although TTL is only at the end of its second year, the projects have started to produce publishable results, and some of the projects show promising value for innovation.

We are on target for all our goals for production of papers, and we have been able to recruit good PhD candidates. The Board of Directors has worked actively to contribute to the collaboration and development of TTL.

Lars Vorland, Chairman of the Board
TTL:

Research and innovation in telemedicine

Tromsø Telemedicine Laboratory (TTL) is a Centre for Research-based Innovation, built around the cluster of companies and institutions making up the telemedicine and eHealth research and innovation community in Tromsø.

TTL is located in the Research Park in Tromsø in Northern Norway. The host partner is the Norwegian Centre for Integrated Care and Telemedicine (NST) at the University Hospital of North Norway (UNN HF).

Research aims
- To develop technologies for personalised health
- To empower elderly people and people with chronic illnesses
- To promote technological self-help to reduce lifestyle-related diseases
- To enable treatment at the lowest effective level of health care

Research areas
- Sensor-Based Systems
- Extended Decision Support Systems
- Computer-Supported Cooperative Work

Results from 2008
- 21 publications in peer-reviewed journals
- 5 papers published in international conferences
- 52 other types of presentations or publications
- 12 registered prototypes

Photo: Northern Norway Regional Health Authority
Board Members
- Chairman: Lars Vorland, Northern Norway Regional Health Authority
- Vice Chairman: Toralf Hasvold, Norwegian Centre for Integrated Care and Telemedicine (NST), University Hospital of North Norway
- Sigurd From, DIPS ASA
- Morten Thorkildsen, IBM Norway AS
- Lars Vognild, Northern Research Institute
- Hans Christian Haugli, Telenor R&I
- Trygve Derås, University of Tromsø

Managers
- Research Manager: Professor Gunnar Hartvigsen, University of Tromsø
- Administrative Manager: Per Hasvold, Norwegian Centre for Integrated Care and Telemedicine

International Collaboration
Many of the TTL partners collaborate with international partners through EU projects, academia, standardisation work and the World Health Organization (WHO).

In 2008, partners established new relations with international communities and institutions through the projects or dissemination work at TTL. These are the international research partners working with the laboratory:

- Prof. Björn Pehrson KTH, Kungliga Tekniska Högskolan, Stockholm, Sweden
- Assoc. Professor George Demiris, University of Washington, Seattle WA, USA
- Prof. Ole Hejlesen, Ålborg University, Denmark
- Professor Alexander Horsch, Technical University of Munich, Germany
- Mats Lundqvist, Director, Chalmers School of Entrepreneurship, Göteborg, Sweden
- Associate Professor Paul J. M. Havinga, Electrical Engineering, Mathematics and Computer Science, University of Twente, The Netherlands
- Assistant Professor Vicente Traver Salcedo, ITACA-TSB & Univ. Politècnica de Valencia, Spain
- Professor Jose Luis Sevillano, Department of Computer Architecture and Technology, University of Sevilla, Spain
- Lambros Lambrinos, Lecturer, Cyprus University of Technology, Cyprus
- Anders Lindgren, Researcher, Swedish Institute of Computer Science (SICS), Sweden
- Jim Tufano, University of Washington, Seattle, USA
- Professor Peter M. Yellowlees, UC Davis, California, USA
- Professor Roland Bal, Erasmus University Rotterdam, the Netherlands
- Professor Robin Williams, The University of Edinburgh, United Kingdom
- Professor Ellen Balka, Simon Fraser University, Canada
- Professor Ina Wagner, Vienna University of Technology, Republic of Austria
- Assistant Professor Signe Vikkelsø, Copenhagen Business school, Denmark
- Assistant Professor Jesper Simonsen, Roskilde University, Denmark
- Assistant Professor Pernille Bjørn, IT University of Copenhagen, Denmark
- Associate Professor Brit Winthereik, Umeå School of Business, Sweden

Funding (NOK)

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<th>Organization</th>
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<td>10 567 000</td>
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<td>The Norwegian Centre for Integrated Care and Telemedicine (NST)</td>
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<td>IBM Norway</td>
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<td>The University of Tromsø (UIT)</td>
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TTL Partners

Tromsø Telemedicine Laboratory (TTL) has eight partners, ranging from hospitals and research institutions to companies developing technologies for the health services. The Norwegian Centre for Integrated Care and Telemedicine is the host organisation for TTL.

**Norwegian Centre for Integrated Care and Telemedicine (NST)**
NST is a national research centre for telemedicine, eHealth and integrated care. NST has a regional, a national and an international mandate, organised as a department at the University Hospital of North Norway (UNN) and a WHO Collaborating Centre.

**University Hospital of North Norway (UNN)**
UNN is the host of TTL located at NST. The University Hospital of North Norway (UNN) consists of hospitals located in Tromsø, Harstad, Narvik and Longyearbyen (Spitzbergen) including all medical specialities. UNN is responsible for advanced medical treatment of patients in the northern part of Norway and is the local hospital for patients from 31 surrounding municipalities.

UNN takes pride in TTL for its research aimed at developing products that will make medical treatment safer, more advanced and complete, and increase patients’ ability to participate actively in solving health problems.

**Northern Research Institute (NORUT)**
Norut is a research company working with technology, social sciences and innovation. Norut has been involved in technological eHealth research since 1990, focusing on personal health technology during the last few years.

**DIPS ASA**
DIPS is a leading Norwegian eHealth company, supplying hospitals with electronic patient records (EPR). Development of the EPR called DIPS is the company’s core product and was started in 1987. In 2008, DIPS bought the Tromsø-based company Well Diagnostics, which was also a member of TTL.

**The Norwegian Health Net**
The Norwegian Health Net was formed in 2004 and provides secure digital lines of communication for the Norwegian health services. The Health Net also provides services like secure email, video-conferencing and Internet connection.

**University of Tromsø (UiT)**
The University of Tromsø was opened in 1972 and has been very important in the development of Northern Norway during the last 30 years. Two faculties at the University are involved in TTL projects: the Faculty of Science and the Faculty of Medicine.

TTL has already proved to be essential for further development of research in telemedicine and eHealth at the University of Tromsø. With TTL the number of PhD students and postdocs in telemedicine and eHealth has doubled. The funding from TTL allows UiT to cooperate with excellent research groups in the US, Europe and Asia.

**Helse Nord ICT**
The company delivers ICT solutions to hospitals and medical specialities within the area covered by the Northern Norway Regional Health Authority.

**IBM Norway AS**
Today IBM spends 6 billion USD each year on R&D, with 3000 researchers around the world, also within the area of Healthcare and Life Sciences. In close cooperation with partners IBM delivers IT solutions, which support efficient work processes and information flow, to help unite and connect the Health care industry. With a focus on security, mobility and safe exchange of information IBM aim to provide higher standards of patient-centric care.

**Telenor Research and Innovation (R&I)**
Telenor is an internationally leading telecommunications company, and its R&I department has a strong focus on innovation. The company was the initiator of telemedicine in Tromsø and has been an active partner in the development of this field for many years.
Everything goes to the cloud

- even your health...

"The way we think of health information systems will be changing dramatically, as net-based systems such as Google Health and Microsoft Health Vault gain ground and your health information is stored on the Internet", says the administrative manager of TTL, Per Hasvold.

Both systems are now fully operational and used by individuals, general practitioners and hospitals in the US. And they reflect a trend in which individuals take control over their own health information: personalised health.

You decide

"When you create your own account at Google or Microsoft, you are in charge of who has access to your health information. As it is now, the hospital owns the information about the treatment it has provided and keeps it in the EPR," Hasvold continues.

When health institutions start using personal health systems like Google Health, the patient authorises who can access that information. In other words, the ownership of information and access control regime will be turned upside down.

For example, Kaizer Permanente – one of America's biggest hospitals – exports data from its electronic health records (EPRs) to Google Health to inform and keep contact with their patients.

Hackers' biggest prize?

But could there be something rotten in the state of Denmark? Large companies such as Microsoft are notoriously prone to attacks by computer hackers and viruses.

Without the proper security systems, the information about your heart condition or other illnesses could be out in the open. And you wouldn't want that...

Another important question is whether health researchers will have to pay global corporations to gain access to health information to do research.

"After all, these companies want to make a profit out of their knowledge, and they will be controlling the largest health information databases in the world. If we don't watch out, research could be the loser in the new health world," Hasvold says in closing.
Patients go Web 2.0

All over the world, millions of users are generating their own health information on the Internet, both on blogs and on YouTube. A new survey shows that patients feel that they learn a great deal in this way, and that they can trust the information they find.

Patients with a variety of diseases such as diabetes and multiple sclerosis blog about their illness and post videos to YouTube. A quick search on the website finds 23,000 matches for the search term “diabetes”, for example.

And patients say that they find this very useful. Have we come to a crossroads where patients take more and more responsibility for their own health, or is privacy going over the precipice when no fewer than 86% of the respondents have posted their diagnosis on the Net?

**Much to learn from other patients**
Together with researchers from the Norwegian Centre for Integrated Care and Telemedicine, the University of Tromsø, and the Technical University of Valencia in Spain, Luis Luque from the research institute Norut and Tromsø Telemedicine Laboratory (TTL) has conducted a small-scale Internet survey to find answers to these questions.

The study reveals that 96% of the respondents read health information generated by other patients. What’s more, they feel that this information is both useful and informative.

The majority also find that reading other people’s stories is a source of support. And the information is useful when they prepare for doctor’s appointments and in helping them to take better care of their own health.

**Change their own treatment programme**
It is also interesting that 64% of patients say that they had discussed what they found on the Internet with their doctor, and a third of the patients said that doctors were positive to this approach.

What’s more, most patients had even used health information from other patients to change their own treatment programme.

"Internet users often create their own netiquette for what information to post and how to relate to others on the Net. But we must also work on promoting ethical guidelines among patients."

Luis Fernandez Luque, PhD-student
Exercise is by far the best way to keep lifestyle-related diseases like overweight, diabetes and heart disease at bay. But you and I often don’t spend as much time moving around as we should.

Helping people to keep fit

“More and more hospital treatment is given to people with lifestyle diseases that are basically caused by inactivity. Helping people keep themselves fit will be one of the major challenges in the years to come,” says project manager Gunnvald Svendsen at Telenor R&I.

The point is, we need motivation to get moving. And in Tromsø Telemedicine Laboratory, Telenor is developing a brand new system to get us going. To achieve this, they are putting a personal trainer into your mobile phone.

Based on behavioural psychology

With their new Lifestyle system, you can sign up for the service on the web, where you submit information like your age, gender and phone number. Based on this information, you regularly get reminders and health tips sent directly to your phone by SMS.

For example, did you make a note in your web calendar that you are going for a 30-minute walk on Tuesday? Your phone will remind you.

“We know from behavioural psychology that we can change an individual’s behaviour. But it requires close follow-up, and the mobile phone is the easiest way to do this because we carry it with us all the time.”

Heading for Facebook

Now the researchers are adjusting the system so that the service can be integrated with Facebook, the world’s biggest meeting place on the Internet.

“You can already compete physically with your friends online, but launching the system on Facebook will bring these exercise tools even closer to your digital daily life.”

“More and more hospital treatment is given to people with lifestyle diseases that are basically caused by inactivity. Helping people keep themselves fit will be one of the major challenges in the years to come.”

Gunnvald Svendsen, Project Manager at Telenor

That will make it even easier to change your behaviour and increase your activity levels. And improve your health,” Svendsen concludes.
Sensors not good enough

André Serra Dias from Portugal is doing important research on the relationship between people’s activity levels - and how much they are affected by the chronic diseases with which they live. But the collection of research data is hampered by unsuitable sensors...

Battery life too short

But the research conditions are not ideal. Dias has had 10 patients using heart rate sensors and motion sensors on their ankles or waist, but the approved medical sensors that exist don’t quite cut it.

‘The ideal sensor would have power and memory capacity for six months, but today they don’t last more than two weeks before they need recharging. And users don’t recharge them, they just stop using them when the battery runs out,’ he explains.

In addition, most sensors are awkward to wear. Heart rate sensors that are attached to the body can irritate the skin, causing discomfort for the patient. In short, they disturb your daily life as well as running out of batteries.

But then again, hospital sensors are not meant to be worn for more than hours at a time, unlike equipment for research.

Motivating with sensors

Dias’ PhD project is concerned with how useful sensors can be to motivate users to increase their activity level. For people with chronic diseases it is especially important to keep up their activity when they come home from rehabilitation. Otherwise the effect of rehabilitation is nullified within weeks.

‘If you wear a sensor over a longer period, it could give you useful feedback on how your health develops over time and in relationship to your activity levels. Our research aims to find out just how effective this could be.’

André Serra Dias, PhD-student
"We applied Jonathan Grudin’s eight challenges to our project on ‘symptom-based surveillance systems’, where we want to give GPs a better tool for detecting and managing infectious disease outbreaks at an early stage,” says TTL researcher Johan Gustav Bellika.

Primary concern: critical mass!
The most important of the challenges proved to be that every system has to be simple enough and provide useful data, in order to achieve a critical mass of users.

In other words, if not enough people start using it, the system will go down in technological history as useless window dressing.

“In our case, we have to get enough GPs to use our system. If they don’t see its usefulness the whole point is gone. And there are numerous examples of projects and ICT systems that have failed this way.”

8 challenges and 3 strategies
After analysing the project according to the eight challenges, Bellika and his fellow researchers developed three strategies to make sure that their symptom-based surveillance system would get adopted by the users.

“First of all, we’ve put a lot of effort into automatisation of work processes because we don’t want to put an extra workload on the GP’s shoulders.”

Secondly, the researchers have included useful features like direct messaging between users and a search function to extract data for research. Lastly and perhaps most importantly, they want to integrate the system closely with the electronic patient record, so that the GP doesn’t have to log into an extra system to receive information about infectious diseases in the local patient population.

“Integrating telemedicine systems into the EPR seems vital in order to get the system into everyday use by health personnel,” Bellika concludes, and recommends Grudin’s challenges to other telemedicine researchers.

Scientific reference
Filling out the blanks

Nursing care plans and classifications integrated with the patient records are rapidly being adopted by the hospital services in order to provide better care. But how much is the system really used, and how? We honestly don’t know...

As large parts of the Norwegian health service are adopting electronic nursing care plans and nursing classifications, knowing how nurses actually use the system is vital to ensure the quality of the system and to develop it further.

But it has until now been an unexplored field, and nobody really knows how much it is used in everyday work. Does it even fit into the nurses’ work schedule? Luckily, PhD candidate Torbjørg Meum is here to find out.

She is trained as a nurse in intensive care, and together with years of experience and a master thesis in health informatics, she should be in a good position to find any flaws in the design of the nursing plans.

“Our research at TTL will be an important tool in the evaluation of the system and further development by the EPR suppliers,” says Meum.

Better documentation of patient treatment

At present, Meum is observing the use of nursing care systems at two Norwegian hospitals. And in a couple of years we will have a much clearer picture of how - and even if - the system is used. But already she has some good indications...

“We don’t know what we will find in other departments and in other hospitals. Maybe the system needs major changes, or it might do the job perfectly,” she says in closing.

Project title:
’Use of nursing care plans and classifications in the Electronic Patient Record’

"Our research at TTL will be an important tool in evaluation of the system and further development by the EPR suppliers."

Torbjørg Meum, PhD-student

By Jan Fredrik Frantzen, NST

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Torbjørg Meum, PhD-student
Driving force as researcher

"The application of mathematics to medicine is a very fascinating, interesting and innovative area that I want to contribute to! There has been especially great progress in the field of statistical image analysis during the last few years."

Currently working on...

Mathematical and statistical analysis of CT and MR images of the lower abdomen, focusing on the prostate. The application of innovative statistical techniques, such as statistical shape analysis, to segment the prostate automatically when calculating the size and shape of the prostate in preparation for radiation treatment.

Today doctors have to analyse as many as 130 CT and MR images per patient, and radiologists draw up the edges of the prostate on each image by hand. Schulz’ research aims at creating algorithms to automate this process and ease the workload for radiologists and physicists.

'It is difficult and time-consuming to manually segment the prostate from the soft tissue surrounding it. Making this process automatic will significantly reduce the amount of unnecessary work for doctors working with prostate cancer, making more time available for patient care.'

The research project is scheduled to be finished by the end of 2011. It is carried out in close cooperation with the University Hospital of Northern Norway.

By Jan Fredrik Frantzen, NST

18 PhD students from 6 nations...

• Andre Serra Dias, Portugal
• Bernt Ivar Olsen, Norway
• Eirik Aasand, Norway
• Eli Larsen, Norway
• Jörn Schulz, Germany
• Kajsa Møllersen, Norway
• Kevin Thon, Norway
• Klaske van Vuuren, Holland
• Kristian Hindberg, Norway
• Kristoffer Reed, Norway
• Liv Karen Johannessen, Norway
• Luis Fernandez Luque, Spain
• Marc Geilhufe, Germany
• Monika Johansen, Norway
• Naoe Tatara, Japan
• Rune Pedersen, Norway
• Terje Solvoll, Norway
• Torbjørg Meum, Norway
Interaction in systems development

Born in Tromsø and educated in applied physics at the University of Tromsø. Started working at TTL in 2007 as a PhD candidate in telemedicine.

Driving force as researcher

"I am curious by nature. And I have a strong wish to contribute to making better systems for the health services! It's inspiring to interview health personnel who are struggling to get hold of the right information. And I want to help them."

Currently working on...

The interaction between suppliers of ICT systems and their customers in the health services. Why do so many projects fail or become more expensive and time-consuming than originally calculated?

"The systems are very complex and intertwined. That makes development of new systems and components very demanding, because changing one part of the system will certainly affect other parts and sometimes bring the whole thing tumbling down."

Besides, the health authorities introduce regulations that affect the ICT systems in healthcare, and these regulations further affect systems development both according to functionality and available resources. The result is a very complex process that needs to be assessed critically to find room for improvement.

The project is due to be finished in 2011 and is sponsored by the Northern Norway regional health authority. The research is being conducted in collaboration with the Faculty of Medicine at the University of Tromsø.
Scientific articles

Olsen BI, Dhakal SB, Eldevik OP, Hasvold P, Hartvigsen G.

Botsis T, Heljesen, Bellika JG, Hartvigsen G.

Vuurden K van, Hartvigsen G, Bellika JG.

Årsand E, Olsen O-A, Varmedal R, Mortensen W, Hartvigsen G.

Burkow TM, Vognild LK, Krogstad T, Borch N, Ostengen G, Bratvold A, Risberg MJ.

Bellika JG, Johansen MA, Nystad J, Bakkevoll PA, Hartvigsen G.

Divine D, Polzehl J, Godtliebsen F.

Pedersen CA, Godtliebsen F, Roesch A.

Olsen LR, Chaudhuri P, Godtliebsen F.

Ellingsen G, Monteiro E.

Gammon D, Johannessen LK, Sørensen T, Wynn R, Whitten P.

Botsis T, Demiris G, Pedersen S, Hartvigsen G.

Johansen MA, Scholl J, Aronsen G, Hartvigsen G, Bellika JG.


Proceedings


TTL Projects 2008:

Detection of malignant melanoma based on lesion images
Workflow across organisational borders
The Diabetes ICT Health Motivation Project 2008 - 2010
Using display walls for improved treatment of patients with chronic diseases
Automatic detection of infectious diseases
Telemedicine in private homes
Net-based medication record
Correlation between pathological conditions and biometric data
Detection and prediction of spreads of disease outbreak based on syndromic data
MyHealthService - personal healthcare technology and services for elderly people with chronic illnesses
Designing DIPS nursing plans
eHealth System for Oral Anticoagulation Therapy (TeleWarf)
Symptom-based surveillance
Context-sensitive systems for mobile communication in hospitals

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