Operating Room of the Future
St. Olavs Hospital HF, Department of Surgery
Faculty of Medicine, Department of Circulation and Medical Imaging, NTNU

Annual Report 2012
Summary
The Operating Room of the Future is collaboration between St. Olavs Hospital HF, University Hospital of Trondheim and the Norwegian University of Science and Technology (NTNU), Trondheim, Norway. The management of the facility is a responsibility shared between Department of Surgery, St. Olavs Hospital and Department of Circulation and Medical Imaging, The Medical Faculty, NTNU. The Operating Room of the Future is an arena for research and development designed to develop, test and apply new technology and new treatment modalities.

The tasks of the University Hospital is defined in the specialist health care act and include treatment of patients, teaching of patients and their relatives as well as teaching of health care personnel.

The aim of FOR should fulfil these goals. Trondheim has a particular responsibility for research within the field of medical technology.

The principal activity at FOR is research to provide safer and better treatment, more efficient logistics and flexible architecture in the construction of new operating rooms. FOR has also become a centre of competence for the construction of operating rooms outside St. Olavs Hospital. An agreement with our industrial partners has made it possible for the Health Care Trust of Central Norway, St. Olavs Hospital and NTNU to promote research and development in central Norway. FOR has a close collaboration with National Centre for Advanced Laparoscopic Surgery (NSALK), SINTEF and National Centre for Ultrasound and Image Guided Therapy. FOR is now on the national roadmap for research infrastructures in connection with the norMIT cooperation with the Intervention Centre at the National Hospital, Oslo.

FOR are a multidisciplinary project and an arena for clinical research and development with focus on medical technology. Prototypes can be developed and tested in safe and controlled environments. FOR is set up to promote a close collaboration between clinicians, technologists, researchers and industrial partners. State of the art equipment is available at FOR.

The operating rooms are equipped for image-guided minimally invasive therapy. During the first years the main focus was key-hole surgery of the abdomen (laparoscopic surgery) and endovascular therapy for diseases of the blood vessels. Minimally invasive therapy is now used in all surgical disciplines and FOR is now including ENT, orthopaedic surgery, gynaecology and neuro surgery etc. Minimally invasive therapy is less traumatic than traditional open surgery and will become more and more important in the future.

The ”old” FOR unit has been moved to Røros Hospital where it is used for day surgery. FOR has its basis in six operating rooms at the new St. Olavs Hospital; one at each of the operating departments. The FOR concept demonstrates synergy effects in letting representatives from various disciplines and medical specialists use equipment, areas and competence together. FOR has excellent facilities for research projects based on multidisciplinary approach. Investigations are performed by PhD-candidates, scientists, students and clinicians. FOR with
this technical equipment and design is perfect for teaching and education of students, doctors and nurses.

New methods of teaching have been tested and transmission of images from the operating rooms with to-way communication has been used on several occasions. The educational part of the project should be continued. At FOR and NSALK several post graduate courses for medical students are arranged annually. Our facility with integrated surgical lecture room is an excellent supplement to the teaching program used at these courses.

FOR is taking part in the development of visualisation and communication, which may be beneficial for diagnosis and treatment as well as for organisation of hospital units. Lecturing of the application of electro-medical equipment has been an increasingly more important task for FOR.

Minimally invasive image-guided treatment
Organisation of Operating Room of the Future

St. Olavs Hospital and the six FOR operating rooms
The staff at FOR

Hans Olav Myhre
Professor emeritus
Scientific adviser

Jan Gunnar Skogås
Biomedical engineer
Managing director

Torbjørn Dahl
Assistant professor
Head of Department, Vascular Surgery

Ronald Mårvik
Assistant Professor
Consultant Surgeon
GE Surgery

Therese Marken
Operating Room Nurse
Project coordinator

Marianne Haugvold
Cand. Scient
Project coordinator

Ketil Thorvik
Cand. Mag
Project leader
AV-Arena Norway

Camilla Berge
Nurse, PhD-kandidat
Project coordinator
**Scientific advisory board**

An important task for FOR is to improve the quality and quantity of clinical research. Therefore the scientific advisory board is going through all research protocols giving advise to those who are doing projects under the direction of FOR. FOR have special directions for projects including the tasks of the scientific advisory board as well as a description how to make research protocols (Professor Per Farup). These documents are forming the basis for the collaboration between FOR and those who are conducting research projects there. In addition we are making separate agreements between FOR and the project leaders, which will take force from 1st of March 2013. In 2012 altogether 5 bachelor degrees, 4 master degrees and 2 PhD degrees were finished in collaboration with FOR. FOR will have several main subjects for medical students. Last meeting in the scientific advisory board was 17th of October 2012. It was decided to recommend Torbjørn Dahl as new leader of the scientific advisory board and this was confirmed by our board of directors.

During the period 2009-2012 the scientific advisory board had the following members:

Professor Hans Olav Myhre (leader)
Consultant Vascular Surgeon Conrad Lange
Professor Gudmund Marhaug
Professor Jon Erik Grønbech
Professor Olav Haraldseth
Professor Toril N. Hernes
Professor Per Farup
Consultant Radiologist Staal Hatlinghus
Professor Olav Sellevold
Assistant Professor Torbjørn Dahl
Assistant Professor Ivar Rossvoll
St. Olavs Hospital HF

St. Olavs Hospital HF, University Hospital of Trondheim, is integrated with NTNU and owned by Central-Norway Regional Health Authority RHF. Most institutions are located in the centre of Trondheim at Øya, Østmarka, Brøset and Lian. St. Olavs Hospital has 3 district centres for psychiatry, 2 in Trondheim and one in Orkdal. Orkdal Hospital, new Røros Hospital and Hysnes Health Center are representing a part of the clinical activity at St. Olavs Hospital.

St. Olavs Hospital is the university hospital of Central-Norway, and local hospital for a population of about 300 000 inhabitants. Treatment of patients, teaching of patients and their relatives as well as research and teaching of health care personnel are the main tasks of the hospital as defined in the specialist health care act. Our core values are integrity, equality, respect and co-determination, forming the background for our clinical activity and our students, colleagues and collaborators. St. Olavs Hospital is integrated with the Norwegian University of Science and Technology, NTNU, and students, teachers and scientists are representing natural parts of the hospitals activity. Within teaching and research we are collaborating closely with several other institutions in central Norway.

In 2012 we had;

- 9681 employees
- 456 beds (somatic)
- 45 operating rooms
- 143 021 total outpatient consultations (somatic)
AV Arena Norway

Operating Room of the Future has the secretariat of AV Arena Norway, which is a resource network within medicine and media technology. This is a member financed network focusing on projects that could obtain medical and organisational benefits within the health care sector.

Background

Operating Room of the Future, St. Olavs Hospital, has since it started in 2005 had a focus on the development of image guided minimally invasive therapy. Digital media technology is important in the development of these techniques. Therefore FOR took an initiative to form a bridge between competence within digital media and health care. This resource network was established in October 2010.

Teaching of employees is important for patient safety and quality. Teaching as well as cooperation with the patient also has high priority. This process includes the improved flow of information and improved logistics. These focus areas have a high priority at St. Olavs Hospitals program for better service during the years 2007-2016. By establishing this resource network we have attracted new collaborators with a strong interest in media technology and ideas, experience and tools from oil and gas industry.

Main goals

The main goal is to establish a leading international arena for innovation within medicine and digital media technology for medical and organisational benefit in the health care sector. This main goal will be realised through projects in national and international settings.

Methods

The resource network is using pilot projects for testing new applications of digital media technology. The network will bring ideas to concrete project. FOR is acting as a hub in this network and is monitoring all projects from our members. FOR will organise good processes for developing and building networks to improve our members’ ability to properly design applications.

20 % of employees in Norway are working within the health care-social sector according to statistics from OECD `Health at a glance’ November 2010. Our future needs within the health care sector will increase because of the increasing part of elderly in the population and an increasing incidence of chronic and lifestyle related diseases. This demand for better collaboration and workflow within the health care sector.
Members
The partners in the network by 31.12.2012 are Nord-Trøndelag Elektrisitetsverk, Hospitality, Incita, Roros E-Verk, Operating Room of the Future (FOR), St. Olavs Hospital, iBruk, Uninett, At Work Systems and Parallel World Labs.

Results
The main result of our network is a portfolio of finished and ongoing projects. The success of the portfolio will be of major importance for growth within the network in a national and international perspective.

Portfolio of projects
All our projects are focusing on better communication within the health care sector. It fits well into the vision of establishing a digital medical learning and information platform to strengthen the quality management system in health care:

1. Digital patient collaboration at home
   This pre-project was designed to serve the use of digital technology for the patient at home (in everyday life) as well as understanding the different applications. The pre-project was hosted by Nord-Trøndelag Elektrisitetsverk (NTE).

2. Pilot project: At Work
   This pilot project is focusing on automatisation of manual work processes. The pilot project was financed by the Norwegian Research Council and has now been finished. We are planning a next step in this project.

3. Pre project: The St. Olavs Hospital experience
   This project was initiated by St. Olavs Hospital and the Medical Faculty at the Norwegian University of Science and Technology (NTNU). We are planning digital medical information and a learning platform in the integrated University Hospital. Operating Room of the Future is project manager. The main project is now ongoing.

4. Project: Digital patient collaboration and lifestyle changes
   The project was initiated by NTNU, St. Olavs Hospital and Kommunenes Sentralforbund (KS). We did an application for a national program, but did not receive funding for the main project.

5. Pre project: Digital monitoring of obese patients
   The project was initiated by Operating Room of the Future and Mid-Norway Centre for Treatment of Obesity. The pre-project was financed and run by the Innovation body of InnoMed. Operating Room of the Future is the project manager. The focus is new digital tools for monitoring and collaboration with this patient group in everyday life. The pre project was finished December 2012.

6. Main project: The "knowledge portal” of the Integrated University Hospital
   This main project is the making of a digital medical learning and information platform in the integrated University Hospital, St. Olavs Hospital. The main project was financed by St. Olavs Hospital, NTNU and Central Norway Regional Health Authority. The latter organisation is also the project manager. The Operating Room of the Future is responsible for the content of and the production part of the main project, which will be finished in 2013.
7. **Digital medical learning solutions**
The project is focusing on new innovative solutions for learning within health care. We have explored such solutions in various sectors including the oil and gas industry and the Norwegian National Defence.

8. **Pre project: Future of telemedicine in oil and gas industry**
The project expanded from collaborative discussions between key persons in oil and gas industry and St. Olavs Hospital, NTNU and SINTEF. We are focusing on the use of new tools to improve diagnostics of patients “offshore” in addition to improved cooperation between health care personnel offshore and medical expertise at St. Olavs Hospital and NTNU. Centre for integrated operations within oil and gas and Conoco Phillips are playing a part in this project. The pre project will be finished in February 2013.

9. **Pilot project: Biosensors**
This project explores the innovation space of monitoring the patient at home as a part of an optimal workflow. The project is in the application process for funding.

10. **Pre project: Decentralised network within dentistry**
This is an ongoing project were the aim is to establish a decentralised network of competence for the Centre of Competence within Dentistry, Central Norway. First we wanted to explore the established workflow and an optimal workflow in collaboration with the odontologic expertise in central Norway. We want to establish an interdisciplinary outpatient clinic as the core for a decentralised network of competence in central Norway. We also want to extend our experience to the national pilot project. The pre project will be finished 31st of January 2013. This project is financed by the Centre of Competence for Dentistry, Central Norway.
11. **Pre project: KVEKK**

This project is also focusing on the use of telemedicine for surveillance of the patient at home. The idea is to transfer medical support closer to the patient’s home. The pre-project is financed by the Regional Research Foundation and will start in January 2013.

Scientific publication:

Offshore platforms are connected with fibre infrastructure and modern solutions for telemedicine. Therefore they are well suited to test new diagnostic modalities for handling of medical data.
**FOR annual meeting 2012**

The annual meeting was arranged October 4-5, 2012, at Røros Hotel. Alotgether 70 participants from St. Olavs Hospital, Central Norway Regional Health Authority, the Medical Faculty, NTNU, SINTEF, industrial collaborators and the oil and gas sector.

Presentations with interesting and important challenges were given by Henrik Sandbu, Ass. Director for research and development, Central Norway Regional Health Authority, Bjørn Gustafsson, Dean for research, the Medical Faculty and NTNU and Toril N. Hernes, Professor and Director of Research, SINTEF.

Sjur Dagestad, Professor in Innovation at NTNU and partner Innoco Ltd and Stig Roar Wigestrand are well recognized authorities within innovation and new thinking. They also organized group work to investigate how to promote innovation within our organisations.

The next annual meeting for 2013 will be organised October 3-4, 2013.

Left: Sjur Dagestad and Stig Roar Wigestrand from Innoco Ltd. Right: Henrik Sandbu from Central Norway Hospital Health Authority, Assistant Director for Research and Development.
**Department of Surgery**

FOR is a research and development arena inside the operating room. With its close collaboration with NTNU as well as industrial companies St. Olavs Hospital has become a showroom regarding development of medical technology within the surgical disciplines.

Clinical research in the operating department is necessary to improve patient treatment and to use the resources more effectively. The FOR - operating rooms have an infrastructure and technological platform which is designed for clinical research. Thus, clinicians, scientists and industry can work together in the same areas, facilitating innovation and developments within medical technology. FOR is extremely important to coordinate the cooperation with our industrial partners.

St. Olavs Hospital is today collaborating with about 20 norwegian entities within health care technology through FOR. In addition we have projects with international companies and close cooperation with international hospitals and universities like Massachusetts General Hospital, Boston, New York Medical Center, Technical University of München, and Yonsei University Hospital, Seoul as well as Vanderbilt University Medical Center, Nashville, TN. FOR has expanded its activity also outside the operating room to look for new solutions for the future.

Ola D. Sæther  
Professor dr. med  
Head of Department of Surgery
Laparoscopic/endoscopic treatment

The operating room for endoscopic surgery has facilities both for laparoscopy and operation via flexible instruments from inside the bowel lumen. A combination of these two methods is also possible. Laparoscopic / endoscopic techniques give advantages for the patient and are fiscally beneficial since the stay in hospital and the recovery time is reduced. However, there may be challenges for surgeons regarding identification of tumours, blood vessels and lymph nodes. Cooperation with SINTEF and Centre of Competence for Ultrasound and Image guided Therapy has made it possible to apply navigation and 3D-ultrasound to address these problems. One of our research fellows has developed an experimental tumour model making it possible by ultrasound navigation to identify an intra-hepatic tumour with great accuracy. CustusX is a navigation tool developed by SINTEF. It is today used in different surgical settings, including laparoscopic treatment of tumours of the adrenal glands and of the posterior abdominal wall. This is part of a multicentre study together with Mesos Medical Centre, Utrecht, The Netherlands.

In cooperation with the Regional Centre for Morbid Obesity (RSSO), FOR has since 2005 been part of a study comparing surgery with lifestyle modification in the treatment of morbid obesity.

Several surgeons from Norway, Denmark, Japan, the Netherlands and Germany have visited FOR in 2012. An excellent synergy between the training laboratory of NSALK and FOR has been established. Here the participants have the possibility to train with simulator and also observe new laparoscopic and endoscopic procedures. In collaboration with NSALK we have arranged the first national course in endoluminal surgery for medical and surgical gastroenterologists.

<table>
<thead>
<tr>
<th>Operative activity, FOR – Operating room 4 Department of Surgery 2012</th>
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<tr>
<td><strong>Gastroenterologic surgery</strong></td>
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<tr>
<td><strong>Endocrine surgery</strong></td>
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<td><strong>Total</strong></td>
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Endovascular treatment

The FOR- operating room in the Centre for Cardiovascular diseases is a hybrid operating room equipped for open surgery as well as angiography/intervention. The operating room is equipped with the angiography unit “Artis Zeego” from Siemens with the possibility of CT like visualisation through Dyna CT.

In 2012 we have performed 44 procedures for abdominal aortic aneurysm, 11 procedures for aneurysm in the thoracic aorta and 29 combined procedures for arterial obstruction of the lower extremities. Nine percutaneous procedures for atherosclerotic arterial obstruction and two sacral nerve stimulations were also performed.

The operating room is also used for minimally invasive treatment of cardiac valve dysfunction (TAVI) were cardiac valves are inserted via the femoral artery the groin or through the apex of the heart. In 2012 altogether 20 such procedures were performed.

The operating room is also used for experimental surgery and testing of electromagnetic navigation. Navigation technology has been explored for exact deployment of implants in blood vessels and during biopsy of tumours in the bronchial tree. Two PhD-candidates have finished their projects in 2012.

In addition to surgery connected to FOR projects this operating room is also used for various elective and acute operations as needed.

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<tr>
<th>Operative activity, FOR - Operating room 1 Department of Surgery 2012</th>
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<tbody>
<tr>
<td>Endovascular repair of abdominal aortic aneurysm</td>
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<tr>
<td>Combined procedures for arterial insufficiency of the lower</td>
</tr>
<tr>
<td>limbs</td>
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<tr>
<td>Endovascular treatment of thoracic aortic aneurysm</td>
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<tr>
<td>Percutaneous procedures for arterial obstruction</td>
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<tr>
<td>Electrode for sacral nerve stimulation (SNS)</td>
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<tr>
<td>TAVI</td>
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<td><strong>Total</strong></td>
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In addition this operating room has been used for various acute operations including trauma, experimental surgery etc.
Department of Ear-Nose-Throat, Eye and Maxillofacial surgery

In 2012 FOR has been involved in the planning of a new operating room. Personnel from our department and FOR went to Berlin and Tuttlingen to get experience regarding new research infrastructure to our department. The annual meeting of FOR at Roros in October was, as usual, inspiring and gave us new contacts. Daniel Bratbak had a presentation from our department introducing “Multiguide”. In collaboration with NTNU Technology Transfer Office we have applied to take out a patent on this instrument. Wenche Moe Thorstensen, Daniel Bratbak, Christoph Ziegler, Ståle Nordgård, Vegard Bugten and Marit Amundsen have made altogether six research protocols submitted to FOR. Two of them are PhD-projects and the last three include testing of new equipment, while one will end up with a master degree. The testing of LigaSure, Covidien was successful during 2012. This instrument has become part of our routine equipment. It can be used during open head and neck surgery like radical neck dissections, laryngectomies, lymph node biopsies and operations of the thyroid gland. The operating time and intraoperative bleeding is decreased significantly. We have a plan to introduce uncomplicated hemithyroidectomies as day surgery during 2012.

Important innovations in our clinic are reflecting our cooperation with FOR like standardisation of nose surgery. Fast-Track rhinology is inspired by FOR who is represented in the steering committee for this project. A local quality registry for rhinologic patients was established in January 2012.

Doctors at our clinic have followed the FOR course in the use of electro-medical equipment, hospital hygienics, etc. We have established an agreement with FOR to have separate courses for our clinic every 3rd year. We will then stop the clinical activity half a day- twice during the year to concentrate on this course. In 2013 we are looking forward to finish the FOR operating room in our unit. Fast-Track rhinology will be continued and will be evaluated at the end of the year. We are looking forward to more projects together with FOR, including testing of new equipment, and improvement in the logistics, hopefully as part of both master degrees and PhDs.

Mette Bratt
Head of Department
Ear-Nose-Throat, Eye and Maxillofacial surgery
During 2012 altogether 160 patients were included in our quality register
Fast-Track was started 2012 - 3 patients are operated pr. week

<table>
<thead>
<tr>
<th>Operation</th>
<th>Count</th>
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<tr>
<td>Treatment of Cluster headache</td>
<td>8</td>
</tr>
<tr>
<td>Use of Ligasure</td>
<td>30</td>
</tr>
<tr>
<td>Balloon dilatation of sinus orifice</td>
<td>8</td>
</tr>
<tr>
<td>Sialoscopies</td>
<td>25</td>
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</tbody>
</table>

Operative activity, FOR - Operating room ENT, Oral surgery and Eye diseases, 2012
Department of Neurosurgery

The Department of neurosurgery has one of the FOR operating rooms, which is facilitating a high scientific activity. The most important research profile of the department is the application of ultrasound within image-guided minimally invasive neurosurgery. This technology in combination with navigation has been applied to several areas including surgery of the pituitary gland, operations for brain tumours, arterio venous malformations and hydrocephalus operations. Several of our projects are exploring the potential 3D-ultrasound and navigation within these fields.

Our research has a background in clinical needs and is through a multidisciplinary approach combining technological and clinical research. Less traumatic and safer treatment modalities are developed.

The research at Department of Neurosurgery is carried out in close cooperation with SINTEF and NTNU, Centre of Competence for Ultrasound and MinimallyInvasive Therapy, which is a very important platform for our research activity.

The collaboration with FOR has been positive and today we have several common projects including the Virtus project, which is developing a new application within spine surgery. Another project is "Picturing the Brain: Perspectives on Neuroimaging" where new methods for visualisation and imaging of the brain are explored. This project will result in two PhD-degrees at NTNU in 2014. In 2012 experimental surgery was performed in cooperation with FOR on the project "Injection of a fluid in the CSF-circuit and brain parenchyma in pigs". During this project we have developed a fluid that gives better ultrasound quality during intraoperative imaging. FOR is assisting with live transmissions performed during the annual international course for neurosurgeons "3D Ultrasound and Neuronavigation”. A successful live transmission in full HD with two-way communication is highly appreciated by the participants.

FOR has on behalf of the clinic arranged compulsory courses in the use of electro medical equipment (EMU). All doctors are trained in the use of electro medical equipment and the documentation is well established. These courses are fulfilling the demands within this area for all doctors at the department. We are looking forward to good collaboration with FOR in 2013.

Geirmund Unsgård
Professor of Neurosurgery
Head of Clinic for neurosurgery
Department of Women and Children’s Diseases

At the Department of Women and Children’s Diseases we have a close collaboration with FOR and our FOR operating room is the first choice for all laparoscopic procedures at our department. The equipment has been transferred from the “old” FOR operating department and includes EndoAlpha and HD camera. In addition we have a high-energy platform Force Triad, and are testing this intraoperatively for haemostasis.

Robotic surgery has now become routine at our department. We are applying this technology both for general gynaecological operations as well as for cancer surgery. Thus, we can obtain a sufficient experience with this particular operating modality. Robotic surgery requires collaboration with Department of urology for optimal use of the capacity of the da Vinci robot. Robotic surgery fits well into the FOR concept; it is high-tech, innovative and has a great potential for the future. We are looking forward to continue the present good cooperation with surgeons, anaesthesiologists and operating room personnel at The Department of Surgery regarding the application of robotics. In 2012 a second da Vinci robot was achieved at Orkdal hospital, indicating that this hospital is a significant part of the University Hospital. One year after the start we have performed over 100 operations. The da Vinci robot is robust and we have not had any technical problems necessitating the conversion to open surgery or cancelling of operative procedures.

FOR has been extremely useful in the training and certification of our personnel in the application in electro medical equipment. This is an important service to the operating clinics. We have also arranged courses in hospital hygienic for all employees at our clinic in collaboration with FOR. This was an excellent course and we were thereby able to fulfil the requirements given by the internal revision.

In conclusion we are extremely pleased with close collaboration with FOR and look forward to contribute with an increasing number of scientific projects.

Runa Heimstad
Head of department
Clinic of Women and Children’s Diseases
<table>
<thead>
<tr>
<th>Section</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternity unit</td>
<td>15</td>
</tr>
<tr>
<td>IVF</td>
<td>36</td>
</tr>
<tr>
<td>Gyn Cancer</td>
<td>44</td>
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<tr>
<td>Gyn General</td>
<td>139</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>234</strong></td>
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197 of the operations were elective.
Clinic for Orthopaedic and Rheumatologic Diseases

After moving into the new hospital the Clinic of Orthopaedic Surgery has a goal to focus on more research at the National Centre of Competence for Orthopaedic Implants, NKSOI. There is need for more competence and better facilities to do research related to orthopaedic implants.

So far the main activity at the FOR operating rooms has been on process optimisation and innovation by establishing Fast-Track surgery for patients needing various orthopaedic implants. We have established a quality register including data from the operation as well as follow-up data. We are also focusing on the possibility of improving operating room logistics. In 2012 Department of orthopaedic surgery received the innovation prize from Central-Norway Regional Health Authority for our project with Fast-Track surgery. September 12-13, 2012, we had a very successful seminar ”Fast Track Surgery” at Clarion Hotel and Conference Centre, Trondheim.

Per Olav Østbyhaug, consultant orthopaedic surgeon had a presentation at the annual meeting of FOR regarding our experience with Fast-Track surgery. After this meeting several of the departments at St. Olavs Hospital became inspired to start similar projects in cooperation with us.

The FOR operating room has an excellent infrastructure and operations are transferred to the lecture room with two-way communication. FOR has the responsibility to arrange courses in the application of electro-medical equipment and hospital hygienic for all orthopaedic surgeons. We are appreciating this important service to the operating clinics and will therefore use one full day for this course to be able to fulfil the requirements given by the internal revision.

Vigleik Jessen
Head of the clinic
Clinic of Orthopaedic and Rheumatologic diseases

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<thead>
<tr>
<th>Operative activity, FOR - Operating room 8</th>
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<tbody>
<tr>
<td>Clinic for Orthopaedic and Rheumatologic diseases 2012</td>
</tr>
<tr>
<td>Total knee replacement                      296</td>
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<tr>
<td>Other                                       14</td>
</tr>
<tr>
<td><strong>Total</strong>                                   <strong>310</strong></td>
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Most of the operations are part of the Fast-Track project.
Developing and testing of medical technology
In addition to clinical activity, the operating rooms at FOR have been used for experimental investigations as well as laboratory studies. In 2012 animal experiments have been performed as a part of two projects. We have applied navigation within pulmonary medicine and laparoscopic surgery. This technique has also been used within laparoscopic surgery as part of a PhD-project. A new treatment modality for ruptured abdominal aortic aneurysm has been tested out experimentally. The FOR operating rooms have been used for development and testing of prototypes and new equipment.

Employees at SINTEF and PhD-candidates have also used FOR operating rooms for calibration, testing and mounting of navigation equipment. Units from our own institution and industrial collaborators have used our platform during 14 weeks for the testing of technological systems, quality control, safety control, upgrading as well as validation.

Da Vinci robotic surgery at St. Olavs Hospital
Two da Vinci robots are available today at St. Olavs Hospital. FOR organised and covered the costs making it possible to use live transmission from the operating room. Such transmissions can be performed within the hospital area and externally. Departments of Gynaecology and Urology have now accumulated a broad experience with the da Vinci robot and several of the surgical disciplines are about to use this technology.
Courses in use of electro-medical equipment (EMU)
On behalf of the operating clinics FOR is conducting a compulsory courses in the use of electro-medical equipment. In 1999 a new regulation regarding “Use and maintenance of electro-medical equipment” was past. This regulation has its background in law on medical equipment from 1995. According to § 13 training and instruction in the application of such equipment is necessary for:

- Personnel who are going to use electro-medical equipment must have training and instruction in the application of such equipment.
- They should know potential side-effects connected to the application of electro-medical instruments and know how to prevent them.
- A training program must be systematic and include documentation.

Systematic training program must include:
- Training when new equipment is introduced.
- Training of new employees.
- Maintenance of the knowledge achieved during this training program.

At present the training program including the documentation is now well established at all operating clinics at St. Olavs Hospital. All surgeons including surgeons in training as well as staff surgeons are getting invitation to courses as part of the continuing medical education.

Development of new teaching systems
We want to develop further the concept with courses in electro-medical equipment. We therefore want to design courses using digital-based learning. This tool can be used by the candidate on their own as a supplement to regular courses. We also want to develop new systems for monitoring and recording of participants at the courses as well as methods for reporting to the head of the clinic. Thus, we are obtaining an automation of several work processes, which is saving time. Simultaneously we are getting better reports regarding participants in the various activities. We have a pilot project together with “At Work” based on these ideas.
Courses in the use of electro-medical equipment (EMU) for surgeons at St. Olavs Hospital:

Course 1 High energy equipment
- Surgical cautery
- Ultrasound cutting

Course 2 Endoscopic equipment including:
- Rigid and flexible endoscopes
- Camera systems, light sources, insufflators and racks
- Navigation tools, microscopy

Course 3 Imaging technology
- Irradiation protection
- C-arm x-ray
- Ultrasound machines

In addition we have arranged courses in hospital hygienic.

Course in hospital hygienic and patient safety.
In 2012 the following EMU-courses were arranged:

- High-energy equipment 11.02.12
- Encoscopy 29.02.12
- C-arm x-ray, irradiation protection 27.03.12
- High-energy equipment 22.05.12
- Hospital hygienics 07.06.12
- Endoscopy 12.09.12
- High-energy equipment 26.09.12
- Hospital hygienics 30.10.12
- One day course for Department of Surgery 01.11.12
- C-arm x-ray, irradiation protection 15.11.12
- EMU – Endoscopy 05.12.12
- Conference with a course for master students in health science – obesity and health 26.04.12

Teaching

Staff

- Medical personnel affiliated to FOR is going through annual certification in compliance with national regulations regarding use and maintenance of electro-medical equipment.
- All surgeons at St. Olavs Hospital are going through courses on an annual basis regarding electro-medical equipment.
- The personnel at FOR is contributing to training of personnel from other departments at St. Olavs Hospital as well as personnel from institutions focusing on clinical procedures, research and application of medical technology.
- FOR have visitors from other hospitals. Organisation and design of operating rooms have been the most important focus areas.
- During a course in simulator training arranged by the National Centre for Advanced Laparoscopic Surgery, FOR has been used as an arena for transmission of operative procedures and for dissemination of information about integration of new equipment applied during these procedures.
- The personnel at FOR has during the last years had courses in leadership, scientific work and professional development.
- Nurses in the oil and gas industry had courses in the application of the pocket-size ultrasound machine.
Students

- Since 2005 FOR has had excellent cooperation with University College of Sør-Trøndelag (HiST). On a regular basis we have presentations for medical students, operating room nurses and anaesthesia nurses as well as radiography students and students within bio-engineering. This has resulted in several bachelor degrees, which have been performed as a cooperation with FOR in our operating rooms. We also have teaching for several of these students within use of electro-medical equipment.
- Master students as well as PhD students at St. Olavs Hospital/ NTNU/ SINTEF have a good opportunity to experience new medical technology and operations from the interactive lecture room at FOR.

Live-transmission organised by FOR 2012

- Transmission from FOR operating room 4 (gastroenterology) to GSU 1 for master students in health science studying obesity and health at nursing college of Namsos and Levanger. April 27th
- The 5th International Training Course “3D Ultrasound and Navigation” SINTEF, Sonowand and Department of Neurosurgery, St. Olavs Hospital. May 30
- Transmission during course in urology October 3rd
- On a regular basis there has been transmission to medical students from the operating room for vascular and gastroenterological surgery for teaching purposes.
- Transmission of operations at FOR in connection with visitors NSALK.
- Visitors at Centre of Competence 3D Ultrasound and Image-guided surgery and National Centre for Advanced Laparoscopic Surgery at the new integrated university clinic (Centre of GI diseases).
- Regular live transmissions of operations at FOR operating rooms to the lecture room at FOR or other lecture rooms. These demonstrations have mainly been for medical students, nursing students and radiography students at Sør-Trøndelag University College and NTNU.
- Employees at St. Olavs Hospital have also been taking part in these transmissions.
**Experimental surgery**

All FOR operating rooms are authorised for experimental surgery including animal research. Such experimental procedures can be ordered at FOR who will organise them. This arrangement is well established among clinicians and scientists. We have a “package” where FOR is organising and planning the animal experiments in collaboration with Department of Comparative Medicine. FOR has trained and authorized personnel assisting during the whole process.

Personnel who is planning or taking part in animal experiments must have courses in animal experiments approved by the Norwegian Food Safety Authority. An important part of this course is to understand laws and regulations connected with the use of animals in medical experiments. The regulation regarding animal experiments assumes that all persons planning or performing such experiments should have passed the courses and be registered in the electronic system (FOTS) of the board for animal research. Both the responsible scientist and his co-workers involved in the practical performance of the experiments, including those who are taking care of the animals, should be included in the application and have documentation that they have passed the course in animal experiments, category C.

During 2012 following experiments were completed:

- Pilot, Departement of Neurosurgery
- Pilot, Department of Surgery in collaboration with Department of Comparative Medicine
- Vascular surgery at Department of Comparative Medicine
- Experiment with use of navigation during biopsy of lung tumour

From FOR Operating room 1. Navigation used in intrabronchial procedure.


**Visitors**

In 2012 there has been great interest in FOR and several national and international groups have visited us. The visitors have been participants at meetings and courses. The visits have been arranged as guided tours, lectures, meetings and courses with live transmission of operations.

The groups of visitors have also consisted of health care professionals, hospital planners, administrators, representatives from the industry, scientists, students etc. In addition FOR has received several groups from St. Olavs Hospital and the Hospital Development Project of Central-Norway as well as SINTEF and NTNU. Since the establishment in 2005 we have had approximately 4500 visitors at FOR.

International cooperation has been an important part of FOR. Since 2006 we have had delegations from altogether 43 nations. FOR has a broad international network and we plan to exchange more PhD-students with international collaborators.

Guiding visitors at Centre for GI surgery.
FOR and Vanderbilt University Medical Center, Nashville, TN, USA
In December 2012 FOR visited Vanderbilt University Medical Center in Nashville, TN, USA. The hospital is organised according to the centre-model like St. Olavs Hospital. Our primary aim with the visit was to study how new treatment modalities could influence the development of new technologic solutions. We wanted to study the use of ICT in the operating rooms to improve work-flow as well as patient logistics. We found the visit extremely useful and look forward to further cooperation.

FOR and Kirkenes Hospital
Representatives for FOR were invited to Kirkenes Hospital where a new hospital is planned. Focus at the meeting was the construction of new operating rooms. Jan Gunnar Skogås had a presentation about FOR, sharing our experiences from the new hospital in Trondheim. The presentation was highly appreciated by the audience.

Visitors at FOR 2006 – 2012
43 nationalities
Medical technology, FOR 2012

In 2012 we have further developed the IP-based communication for telemedicine via FOR, and new IP technology has been applied through the research net – Uninett. This has been used in connection with communication from FOR to various destinations in Asia, Europe, USA in 2012. We have focused on further development of fiber-optic communication from the FOR operating rooms, making live transmission in full high definition possible. We are cooperating with the Department of Medical Technology, HEMIT and Viju regarding a new infrastructure allowing live transmission to several of the meeting rooms and lecture rooms in the new hospital. This infrastructure is also a part of the planning for the new academic centre, which will be ready during the autumn 2013.

In collaboration with Covidien we have implemented a research platform for high-energy medical equipment including cautery and an advanced technology for coagulation of blood vessels during surgery. This has been established in all six FOR operating rooms. The goal is to improve safety during the application of high-energy medical equipment.

Covidien has through cooperation with FOR testes out LigaSure in 2012 at Department of Ear-Nose-Throat, Eye and Maxillofacial surgery and Department of Women and Children’s Diseases. The aim was to explore whether this technique could decrease operating time and improve cost-effectiveness.

Implementation and maintenance of new technology at the FOR operating rooms

- We are developing HD-technology for internal and external live transmissions. We have also developed a camera system for minimally invasive procedures within endoscopic disciplines with a focus on HD and 3D in combination.

- Upgrading of software for Artis zeego angiography laboratory for the FOR operating room, Cardiovascular Centre, which is giving better and faster image processing. We are also developing screen technology.

- In cooperation with Olympus we developed further the new operating room concept with focus on integration and better work-flow at the FOR operating room for GI surgery. It includes video routing, special lightening and glass walls making sanitation simpler. This is ready for implementation of EXERA 3 which was installed in 2012.

- Gynaecology and laparoscopic procedures: This is cooperation between departments for urology and gynaecology. These departments are using the da Vinci robot 3 and 2 days per week respectively. The interest for this technology is increasing and we are already short of capacity.
Research and development in cooperation with SINTEF

Operating Room of the Future is an arena and infrastructure for several ongoing research projects. One of the main activities during 2012 has been connected to National Centre of Competence for Ultrasound and Minimally Invasive Therapy. This is a national service established by the Department of Health and Human Services. The centre is using FOR as an arena for several clinical and technological research projects on medical technology, prototyping and clinical testing of new solutions to improve patient treatment. In 2012, 20 ongoing PhD-projects were running and 3 were finished. 24 scientific papers in peer review journals were published. Through user-controlled projects supported by the Norwegian Research Council, this service has been an important platform for innovation and cooperation with the industry. The competence centre has a broad national and international network and important activity connected to the development and dissemination of knowledge. Through participation in several EU projects (VECTOR, IIIOS Marie Curie training network, 3MICRON, FUSIMO, MISTELA) we have “imported” competence from international groups and have also contributed with competence both nationally and internationally.

The activity at the National Centre for Competence for Ultrasound and Image-guided treatment is a good example how Operating Room of the Future can support research, development and testing of new technology and thereby contribute to strengthen national and international cooperation.

We have ambitions that Operating Room of the Future at St. Olavs Hospital/NTNU together with the Intervention Centre, the National Hospital, through establishment of NorMIT (Norwegian centre for Minimally invasive Image guided Therapy and medical technologies) in 2013 will obtain status as a national infrastructure for research. NorMIT’s position on the Norwegian roadmap for research infrastructure is confirming that the research and research platform with its infrastructure has high international quality and relevance.

Toril A Nagelhus Hernes
Professor Medical Technology,
ISB, NTNU.
Research Director SINTEF,
Coordinator, The National Centre for Ultrasound and Image-guided Treatment,
Member of the scientific advisory board,
FOR
Nils Kvernmo, Director of St. Olavs Hospital

St. Olavs Hospital and the Medical Faculty, NTNU, are integrated and located in the same area. This gives us the possibility to be in the forefront within research and development. A strong professional and scientific profile is mandatory for better recruitment of personnel in the years ahead. It should be attractive to work at the University Hospital of Trondheim.

At the same time high quality in our clinical activity and better utilization of the resources is required. The key factor for success is to have outstanding professionals in an effective organisation. We have all the necessary qualifications to succeed in Trondheim since we have a new university hospital and a good background for effective organisation.

I wish that the Operating Room of the Future should play an active role in our hospital focusing on professional challenges. Therefore multidisciplinary cooperation within the hospital and with institutions outside St. Olavs Hospital is important to obtain these goals and be in the forefront. FOR is also important for promotion of a high academic level, which can be quantified in publishing points and PhD-degrees.

Nils Kvernmo
Director of St. Olavs Hospital
The Dean of the Faculty of Medicine, NTNU, Stig A. Slørdahl

It is a concern that volume of clinical research in Europe might decline. At the same time there is need for evidence-based health care and steadily improvement of surgical procedures. The Operating Room of the Future (FOR) has been a driving force for clinical research and innovation in Trondheim, but the potential is higher than we are able to utilize at the present time.

The neighbourhood between the technology campuses at NTNU and SINTEF, six operating rooms representing various specialities and with research as a priority, close collaboration with the industry and not least co-workers at the Medical Faculty, St. Olavs Hospital, with good ideas and enthusiasm for research, make FOR the best place for surgical research in Norway. However, the success will not come by itself. Research must be given priority in the daily clinical activity. Time and resources are mandatory when new procedures and technology are going to be developed or tested.

Giving priority to research must be a part of the culture as it is at the old university hospitals like the National Hospital. It we succeed in crating the same attitude at St. Olavs Hospital, as we are about to do, then the success of FOR will continue.

I am convinced that the Faculty of Medicine and the hospital will give priority to FOR in the future. Together we will recruit co-workers who are willing to do a career within research. There is no doubt that FOR is important if we are going to succeed with clinical research in Central Norway.

Stig A. Slørdahl
Professor and Dean
The Faculty of Medicine, NTNU
Future plans for FOR

At the annual conference we focused on innovation and the possibilities to promote projects and ideas via NTNU’s Technology Transfer Office (TTO). We think it is important to have representation from various professions at our meeting. Our goal is that FOR should be a research infrastructure of excellent international quality. Our aim is to increase quality and quantity of research relevant for FOR. FOR should be in the international forefront regarding image-guide minimally invasive therapy. FOR has been running since 2005 and continued in 2011 in the new hospital with focus on all operating clinics. This activity is now expanded to the Department of ENT, Orthopaedic department, Department of Neurosurgery and Department of Gynaecology. The core organisation of FOR is unchanged, but the research activity is now decentralised to the various operating centres. Altogether we have six operating rooms with a modern AV-ICT structure, which is continuing the concept of the “interactive lecture/seminar room”. Thus it is possible to make live transmission of interactive communication in full high-definition (HD). The most important motivation for continuing FOR in the new hospital is to form a basis for good clinical research, but also to have a centre of competence for the building and organisation of operating departments. Today a lot of hospitals are on the planning stage in Norway as well as other European countries. Operating rooms are the most expensive part of the hospital and the operating departments are expensive to run. We want to gain experience and to be leading within this field, thereby optimising the investments. We will focus on architecture, use of materials, ergonomics, ICT solutions, logistics and health economy and we hope to be able to build operating rooms at a lower cost and to organise them efficiently. It is important to do this in a systematic way, getting solid knowledge about operating departments.

FOR has a close relationship with many important collaborators, with the industry, clinical departments and with technological research groups. The most important agents involved in FOR are St. Olavs Hospital, the Medical Faculty, NTNU and SINTEF. Various centres of competence like “Centre of Competence for Ultrasound and Image-guided Treatment” and the “National Centre for Advanced Laparoscopic Surgery” as well as University College of Sør-Trøndelag is important collaborators, and it is important to preserve the synergy effect on this cooperation in the years to come.

We want to strengthen the international collaboration. Several international groups want to cooperate with FOR. So far we have focused on Massachusetts General Hospital in Boston, Operating Room of the Future in Tübingen, Germany and a research group at Krakow University Hospital in Poland. We also have cooperation with Vanderbilt University Medical Center, Nashville, TN. Furthermore we cooperate with organisations like EAES and SMIT.
Finally we have established cooperation with Yonsei University Health System, Seoul, Korea. Priority is given to projects in geriatric medicine, the intelligent hospital and transmission of high quality medical information.

Our PhD-candidates are financed through external funding. This has made it possible to obtain a good scientific activity in spite of a small annual budget. FOR has targeted 1-2 PhD-degrees and one master degree per year. In the near future there will be an increasing demand for scientific work, which forms the basis of master degrees, and FOR can be a good platform in this work.

We want to refine and expand the indications for stent-graft treatment of complicated aneurysms, dissections and trauma in the arterial system. One project is based on the application on navigation for exact deployment of the implants. Within laparoscopic surgery we also focus on navigation to make the procedure safer. Navigation technology has also been introduced at the Department of ENT and in pulmonary medicine. Our collaboration with SINTEF regarding navigation technology and ultrasound continues, and we have projects exploring the application of steer able wires in combination with catheters for endovascular treatment. In pulmonary medicine we have applied navigation for endoscopies and endo-bronchial procedures. Robotic surgery is a field of high priority for FOR. Further we are developing new techniques for the treatment of patients with morbid obesity. We are expanding the cooperation with the Department of Radiology focusing on the application of ultrasound in the surveillance of patients treated with stent-grafting for abdominal aortic aneurysm.

In 2012 FOR has developed, established and implemented a teaching system within the use of electro-medical equipment for all doctors in surgical disciplines at St. Olavs Hospital. Focus areas are application of high-energy technology, application of C-arms and x-ray protection. Hospital hygienic is also included in the program. Through the health academy of regional health trust, collaboration has been established in order to expand this arrangement to all hospitals within Central Norway.

Jan Gunnar Skogås      Hans Olav Myhre
Managing Director, FOR            Emeritus Professor
Scientific adviser, FOR

Torbjørn Dahl
Assistant Professor
Scientific adviser, FOR from 2013
Research and development
In the following we give a review of scientific activities within committees, PhD’s, master degrees, bachelor degrees, ongoing projects and publications.

National and international committees
Hans Olav Myhre
- Member of a committee evaluating the position as professor of surgery, University of Odense, Denmark
- Opponent at a doctoral dissertation at the University of Ørebro, Sweden
- Norwegian delegate to the International Union of Angiology
- Member of executive council. European Society for Nanomedicine
- Member of the advisory board. The CLINAM Foundation
- Leader for the network representing FOR within medical technology
- Responsible for vascular surgery in the Centre of Competence for Ultrasound and Image-guided Treatment

Ronald Mårvik
- Leader of the national task force responsible for the report "Work-up and treatment of morbid obesity in secondary health care"
- Member of Technology Committee and NOTES - Committee in European Associations of Endoscopic Surgery
- Member of Program Committee for EAES-annual conference in Brussel
- Member of the board Norwegian Bariatric Association and Norwegian Thoracolaparoscopic Union
- Leader of network Medical Technology, NTNU, Trondheim
- Member of the program committee TSO IKT research activity for robotics (FPR) at NTNU, Trondheim
- Editorial Board, Surgical Endoscopy

Torbjørn Dahl
- Norwegian representative in International Union of Angiology
- Responsible for vascular surgery within Centre of Competence for Ultrasound and Image-guided Treatment

PhD-degrees 2012
- Håkon Olav Leira, PhD, clinical medicine
  "Development of an image-guidance research system for bronchoscopy". Dissertation September 18th, 2012
- Reidar Brekken, PhD, medical technology
  "Ultrasound-based estimation of strain in abdominal aortic aneurysm (AAA)". Dissertation December 18th, 2012

On-going PhD-studies
- Frode Manstad-Hulaas, PhD, medicine/medical technology
  "Navigation Technology in Endovascular Aortic Repair".
  The project has developed a navigation system based on electro-magnetic positioning and 3D imaging for application during endovascular treatment of complex aortic aneurysms. The navigation system is visualising instruments in a 3D scene without the
use of x-rays. The intention is to make it easier to treat patients with complex aortic disease with image-guided minimally invasive therapy. The thesis was delivered for evaluation in 2012.

- Berit Brattheim, PhD, medical technology, health informatics
  "Aortic Aneurysm Network: Coordination support for trans-organizational care processes".
  The project is focusing on how new medical technology is changing the patient flow and course following treatment, which may give challenges for coordination of the hospital stay. The work is focusing on patients with abdominal aortic aneurysm: Selection of patients for EVAR treatment and postoperative follow-up after treatment. The need for ICT-based support is evaluated. This work is carried out at the Department of electronic patient records (NSEP) and is a part of the so-called COSTT project. The thesis was delivered for evaluation in 2012.

- Anna Aasgaard Rethy, PhD, medical technology
  "The role of navigation and intraoperative imaging in laparoscopic surgery".
  This project will be finished in 2013.

- Conrad Lange, PhD, clinical medicine
  "Endovascular therapy of aneurysms".
  The work is in including investigations of endovascular treatment of so-called inflammatory aortic aneurysms and is also evaluating EVAR in elderly patients; above the age of 80. These works are based on the EUROSTAR vascular register. Clinical results and long-term results following endovascular treatment of abdominal and thoracic aneurysms treated at St. Olavs hospital is another part of the study. Three papers have been published and the fourth has been submitted. The project will be finished in 2013.

- Camilla Berge, PhD, Health science
  "Abdominal Aortic Aneurysm in women – Results after surgery".
  The investigation is studying long-term results follow open surgery as well as endovascular therapy. She has also investigated AAA in female patients since the mortality, especially following rupture, is higher in women. Finally, AAA ruptures at a lower diameter in women than in men. One paper has been published.

- Geir Arne Tangen, PhD, medical technology
  "Enhanced Minimally Invasive Therapy".
  The goal is to develop methods for application of navigation technology within endovascular procedures. Today these procedures are dependent upon imaging technology like fluoroscopy for guiding and deployment of endovascular implants. Provided navigation technology can be applied during these procedures, one can achieve more relevant information and reduce the dose of irradiation and contrast material to the patient. This will improve patient safety and reduce the complication rate. Geir Arne started his PhD during the autumn 2010 and the project will be finished 2013/2014.
Master degrees 2012

- Siri Fenstad Ragde, master in molecular medicine
  "Characterisation of surgical staff exposure to surgical smoke at St. Olavs Hospital”
- Cathrine Soleglad, Torstein Høe, Marit Thoresen, Master in media communication and information technology
  “Innovation in the health sector – A qualitative investigation of innovation at St. Olavs Hospital”
- Marit Rødevand, Angel Byrkjeland, NTNU
  ”Visualisation of medical images on smart-phones, laptops, tablet computers.

Bachelor degrees 2012

- Marthe Mari Mathisen and Trond Johansen Staveland, bachelor in bio-engineering
  “Microorganisms in the operating rooms at St. Olavs Hospital with a focus on prepping of patients”
- Tor Eike Jørgensen, Håvard Einum, Stian Lillegård Andersen, bachelor in radiography, HiST
  “Irradiation and observation of irradiation hygienics at Operating Room of the Future”

Ongoing projects

- Wenche Moe Thorstensen, PhD
  ”Symptoms from nose and sinuses in patient with asthma - United airways”. This investigation is focusing of nasal symptoms in patients with bronchial asthma and on the effect of these symptoms when treating the pulmonary function. First part of this investigation has been presented and submitted as an article.

- Daniel Fossum Bratbak, PhD
  “Endoscopic resection of the Sphenopalatine ganglion in chronic cluster headache”. The project is describing a new method for treating cluster headache. The idea is to block the sphenopalatine ganglion in fossa ptterygopalatina using endoscopic transnasal surgery with direct approach to the ganglion. The navigation tool “Multiguide” is patented and developed in collaboration with NTNU TTO and Department of Medical Technology. This work is cooperation between Department of Neurology and Department of Radiology.

- ”Intra-nasal and intra-oral ultrasound guided surgery”
  Testing of ultrasound endo-probes for navigation used during nasal or endo-oral surgery or in the operating field. The tool has been used at the Department of Neurosurgery during intracranial intervention. We are testing this technique for elective and acute operations and endoscopic ultrasound has so far been applied for intervention in parapharyngeal abscesses and metastasis.
  Leader of the project: Professor Ståle Nordgaard

- Sialoscopy as an aid in the diagnosis of salivary gland tumours.
  Sialoscopy is a term used for inspection of the salivary ducts by thin flexible instruments. The project evaluates the use of this method in the diagnosis of sialolithiasis, tumours and other conditions in the salivary glands. It is also the plan to compare sialoscopy with other imaging modalities like MRI. New equipment for sialoscopy including rack to testing has been acquired. Leader of the project: Professor Christoph Ziegler.
"Balloon angioplasty in chronic sinusitis".
Testing of equipment for balloon dilatation of the orifice of the frontal and maxillary sinus for minimally invasive reestablishment of drainage from the sinuses in selected patients. Preliminary testing has been performed and a RCT study is planned. Leader of the project: Assistant Professor Vegard Bugten.

Marit Amundsen, Master Degree
An investigation on the quality of life in patients treated with balloon angioplasty for chronic sinusitis. The investigation also includes factors like pain following the operation and duration of the sick leave compared with traditional open surgery.

The research project "Picturing the Brain: Perspectives on Neuroimaging" is exploring new methods for imaging and visualisation of the brain focusing on the role that these methods may have as images of visual tools within medicine and science. The goal is to improve the understanding how images will improve our knowledge about the brain by serving as a research tool, surgical tool or an important rhetoric instrument. The project is multidisciplinary and includes collaboration between scientists with background in media, science, philosophy, media technology, medical imaging, neuroscience as well as artists. The project consists of three work packages focusing on how the imaging tools will work within the areas of knowledge, surgery and rhetorics. A fourth work package will function as a project laboratory for testing of various ways of integrating science, technology and society through artistic intervention. The project is financed by the Norwegian Research Council and will be carried out during the period September 1st 2010 – July 6th 2014.
Project leader: Assisting Professor Aud Sissel Hoel, Institute for Arts- and Media Science, NTNU. Her team is consisting of Professor Andrew Perkis (NTNU), Assistant Professor Liv Hausken (University of Oslo), senior researcher Annamaria Carusi, Oxford University, PhD-student Jordi Puig (NTNU) and PhD-student Rita E. Nilsen (NTNU). Cooperating partners are Centre for Quantifiable Quality of Service in Communication Systems (NTNU), Operating Rooms of the Future (St. Olavs Hospital), SINTEF, Medical Imaging Lab (NTNU) and TEKS - Trondheim Electronic Art Centre.

Fast-Track surgery for joint replacement. Department of Orthopaedic surgery has worked out details for this project. The principle is based on what is called “Fast-Track surgery” which today must be regarded as evidence based practice. The project is based on the following elements:
- Patient information: The patient should be well informed making the postoperative course predictable when the patient arriving the operating room.
- Optimal anaesthesia and treatment of postoperative pain.
- Optimal treatment of nausea: reduce the use of opioids.
- Fast mobilisation: already at the day of operation.
- Optimal nutrition.
- Adequate surveillance and follow-up.

Department of Orthopaedic surgery has organised research regarding orthopaedic implantation through the National Centre of Competence for Orthopaedic Implants (NKSOI) making all data available for clinical research. Department of Orthopaedic Surgery is also a part of Operating Room of the Future and has an obligation to do research related to operating room 8, which is used for orthopaedic implants. At the moment our research is focusing on process optimalisation and logistics.
• New ultrasound probe.

• Tracing motion and deformation of liver and liver tumors caused by breathing (MRgFUS).

• Testing new functionalities for the navigation platform CustusX.

• Testing accuracy of electro-magnetic navigation in laparoscopic surgery.

• Testing the accuracy of optical and electromagnetic navigation systems applied during deployment of stent-grafts.

• Animal model to explore the use of electromagnetic navigation during deployment of stent-grafts with side-branches to the renal and visceral arteries.

• The project "Endovascular stent-graft implantation during image-guided navigation technology" has been performed by the PhD-candidate Frode Manstad-Hulaas. This work will be continued by engineer Geir Arne Tangen, who is a research fellow at NTNU through the eMIT project. The project will develop further electro-magnetic navigation systems for endovascular procedures. The article "Endovascular image-guided navigation - validation of two volume-volume registration algorithms" has been published in addition to the article "Three-dimensional endovascular navigation with electromagnetic tracking: ex-vivo and in-vivo accuracy".

• The project "The effect of exercise prior to gastric bypass". Tissue samples are retrieved pre- and intra-operatively to estimate whether the gene expression in the tissue is changed in patients as a consequence of pre-operative physical training. The intra-operative sample is taken in connection with gastric bypass procedures, which are performed at FOR. This is collaboration between NTNU and the Regional Center for Morbid Obesity at St. Olavs Hospital (RSSO), University Hospital of Trondheim.

• The application of navigation in laparoscopic surgery is studied in cooperation with Mesos Medical Center, Utrecht, The Netherlands. This is part of a multicenter study.

• High-definition video in laparoscopy. This is a comparative study were the aim is to evaluate the clinical significance of high-definition versus standard definition images. The images will be acquired from the same trocar opening where both types of scopes will be pointing towards the same point. The images will then be compared by an independent observer who primarily does not know what HD is and what is SD.

• Olympus has developed a prototype for a new operating light-source replacing traditional light. This is collaboration between FOR and Olympus.

• Collaboration with the University of Thübingen, Germany, concerning development of an ergonomic grip for laparoscopic instruments.

• Collaboration with the University Hospital, Barcelona, Spain, regarding evaluation of the use of Olympus data technology in the operating room.

• EAES (European Association of Endoscopic Surgery): The Trondheim group has members in one of the NOTES-committees.
• 3D ultrasound in laparoscopy. A solution base on micro-positioning and flexible ultrasound probes to be integrated in the navigation system CustusX is being developed. The ultrasound application has so far been tested under laboratory conditions to evaluate the accuracy of the method. This work will be continued in laboratory experiments, primarily by comparing acquired ultrasound images with corresponding images acquired through DynaCT scans. The project will be included in a PhD-thesis.

• IIIOS (Integrated Interventional Imaging Operating System) is an EU project, Marie Curie ITN project. Two fellows and one post doc position will be available for the Trondheim group. One PhD is going to work with ultrasound-guided laparoscopic surgery using FOR as arena for the investigation.

• NSALK is represented through Ronald Mårvik as member of the Technology Committee, EAES, which is responsible for an annual European symposium. Though this work FOR is used as an arena to demonstrate new concepts and experiences.

• Collaborative effort has been established in Sony Corporation; Kano M, Liverød V and Skogås JG, are collaborating on the basis of a protocol to investigate the application of holograms and 3D-display in the operating rooms.

• ”Micro-biological investigation of mobile equipment at operating departments”. This is collaboration between St. Olavs Hospital, Department of Hospital Hygienics, Sør-Trøndelag University College and FOR. Measurement of the air quality has been carried out in our new operating rooms at St. Olavs Hospital and has been compared to facilities in the old operating department.

• Collaboration has been established with Massachusetts General Hospital (MGH), Boston, in the field of logistics. One of our PhD-candidates has been visiting MGH and we are planning to continue a similar collaboration with Professor Warren Sandberg, MD, Department of Anaesthesiology, Vanderbilt University School of Medicine, Nashville, TN. He is employed as Professor II at Department of Circulation and Medical Imaging, NTNU.

• Safe Access and closure in trans-gastric natural orifice endoscopic surgery (NOTES). The project period is 2009-2014 and the project is run by Suhail A, Mårvik R, Kuhry E.

• Adhesion formation after laparoscopic and open surgery. Project period 2009-2014. Project leader Kuhrij E.

• Analogue simulator with electro-magnetic tracking. Development of electro-magnetic tracking equipment. The project is completed. Mårvik R, Våpenstad C.

• The research project based on the NTNU game ”World of NTNU, WoN” by Q2S is working on a conceptual platform to integrate three research fields, medias in network, QoS mechanisms for dynamic net and quality measurements. The main goal of the platform is to define integrating research activity in all three research fields by developing a main architecture based on serious games. The development phase for WoN is based on a common architecture and is following a cyclic process where each stadium in the development is dependent upon and influenced by the previous one.
The process has been chosen to explore new projects in various fields from architecture to medicine. The intention is to develop further a scenario for advanced surgery. The model is finished and will be implemented in the near future.

- Department of Thoracic Surgery and Cardiology as well as Departments of Anaesthesia and Medical Imaging have together started minimally invasive treatment of patients with aortic stenosis. This treatment, TAVI (Transcutaneous Aortic Valve Implantation) is an alternative to open surgical valve replacement in aortic stenosis or insufficiency of high-risk patients. The operative trauma is less than conventional surgery. The valve can be implanted either via the femoral artery in the groin, or through a mini-thoracotomy and further through the apex of the heart.

Externally financed projects
- IP FP6: VECTOR- Robotic “pill” to diagnose intestinal diseases. The project was finished in 2011 and the last report made in 2012.
- Marie Curie FP7, 2009-2013: IIIOS- Integration of images in the operating room.
- BIP-SimSurgery, 2010-14, Distribution of skills in laparoscopy.
- eMIT lap, 2010-14, Enhanced Minimally Invasive Therapy, Norwegian Research Council.
- 3 new applications have been sent: Musik 2020 (Marie Curie ITN), TRANS-FUSIMO (STREP), VPH-PICASSO (STREP).
EU projects

- VPH-PICASSO. Virtual Physiological Human: Patient Specific Models for Improved Computer Assisted Interventions in the Abdomen
- TRANS-FUSIMO. Clinical Translation of Patient-Specific Planning and Conduction of FUS Treatment in Moving Organs
- SUMMITnet. SUrgical iMage-guided Methodologies for Innovative Therapies. COST Action (http://www.cost.eu) FP7 Project

National and international collaborators

- FOR work closely with HiST (University College of Sør-Trøndelag), Faculty of Medicine NTNU, NSALK (National Centre for Advanced Laparoscopic Surgery), SINTEF – Department of Medical Technology and National Centre of Competence – Ultrasound and image guided therapy and Comparative medicine Core facility.
- We have also good cooperation with our most important industrial collaborators; SONY, Siemens, Olympus and Covidien.

Scientific articles


A stack model and capabilities approach to investigate integrated operations across different industrial sectors – O&G industry versus aviation, military and medicine. Larsen S, NTNU Social Research, Bjørkevoll KS, SINTEF Petroleum Research, Gibson AK, MARINTEK, Gunnerud V, NTNU, Lien DO, Royal Norwegian Airforce Academy, Thorvik L, St.Olav Hospital, Nystad AN, NTNU. Society of Petroleum Engineers, 2012.

Presentations at conferences


- From Minimally Invasive Image-Guided Interventions to Non-Invasive Ultrasound based Interventions. MICCAI, Nice, France, October 1st, 2012.


**Book chapters**


**Popular science**


International Innovation, October 2011, Interview with Toril A N Hernes, Innovation in Diagnostics and Therapy.

Presentations at courses, conferences etc.

- Langø T. Ultrasound fusion with other modalities for surgical planning and therapy guidance. Invited lecture at EAES (European Association for Endoscopic Surgery), Brussels, Belgium, June 20-23, 2012.


- Annual meeting of Norwegian Surgical Association, Oslo, October 2012.

  - 4 lectures from the National Center of Ultrasound and Image-guide Minimally Invasive Therapy, Trondheim

- SMIT (Society for Medical Innovation and Technology), Barcelona, Spain, September 20-22
  - Chair: 5 sessions
  - Lectures: 9 lectures from the National Center, Trondheim (4 from Laparoscopy, including one invited)

- EAES (European Association for Endoscopic Surgery), Brussels, Belgium, June 20-23
  - 3 lectures from National Center, Trondheim including one invited.

- MTF annual meeting ”The project Operating Rooms of the Future” March 19th 2012, Skogås JG.


- Presentation on endoscopy – technological aspects, course in thoracolaparoscopy NSALK, April 25th 2012, Skogås JG.

- Operating Room of the Future – SINTEF, Oslo. May 24th, 2012, Skogås JG.

- Presentation for Oslo Med Tech – June 4th, 2012, Skogås JG.

- Regional Research Conference. Presentation of Operating Room of the Future, June 5-6, 2012, Skogås JG.

- Presentation at Kirkenes Hospital June 20.-21. 2012, Skogås JG.

- Presentation of FOR. Visit by the Norwegian Research Council, June 28, 2012, Skogås JG.
- Presentation of FOR, Tüttlingen, Karl Storz, July 9-10, 2012, Skogås JG.
- Presentation about FOR - Apple. August 31st, 2012, Skogås JG.
- Presentation about endoscopy for University College of Sør-Trøndelag (HiST) September 26th, 2012, Skogås JG.
- Lecture on endoscopy – Course in urology. October 3rd, 2012, Skogås JG.
- Patient and userombud of Sør-Trøndelag, presentation of FOR, October 17th, 2012, Skogås, JG.
- Presentation “A multidisciplinary arena for clinical research and medical technology, FOR”, Hospital days, University of Ørebro, October 24th, 2012, Skogås JG.
- Presentation about FOR to the Medical Faculty, University of Trondheim, NTNU, October 26th, 2012, Skogås JG.
- Presentation about FOR as infrastructure for research and development, Oslo Medtech, November 13th, 2012, Skogås JG.
- Presentation about FOR for medical students at the research division, The Medical Faculty, November 15th, 2012, Skogås JG.
- Lecture about laparoscopy and electro surgery, basic course, NSALK, November 15th 2012, Skogås JG.
- Presentation about FOR, The Air Force Academy, December 4th, 2012, Skogås JG.
- Female scientists within health informatics, Visitors at FOR May 24th, 2012, Haugvold M, Marken T.
- Ørlandet Secondary Junior School, June 8th, 2012, Haugvold M.
- Presentation for FOR for HP and Ministry of Health, Saudi Arabia, August 28th, 2012, Haugvold M.
- Presentation of PhD-project. Annual meeting of FOR, Røros. October 5th, 2012, Berge C.
- Presentation about the activity at FOR from 2005-today. Annual meeting Røros. October 5th, 2012, Myhre HO.

**Participation at seminars and conferences**
- Strategy seminar for the Competence Centre for Ultrasound and Image-guided Therapy, SINTEF, Britannia Hotel, January 5th, 2012.
- Exhibition and lecture at the Norwegian Society for Medical Technology Annual Meeting, Røros, March 19.-21., 2012.

- Regional Research Conference, June 5-6, 2012, Exhibiton TM, MH, CB Presentation Skogås JG.

- Seminar on Fast Track Surgery, Orthopaedic Clinic, Trondheim, September 12.-13., 2012, MH and TM.

- Seminar for Institute for Circulation and Medical Imaging, NTNU, October 19th, 2012.


- FOR meeting, Department of Surgery, October 25.-26., 2012.

- Visit at Vanderbilt University Medical Centre, Nashville, TN. November 26-28, 2012.

Professor Erik Fosse from the Interventional Centre, National Hospital, Oslo, at the Innovation Conference 2012
Media presentations

- FOR at the national news, Norwegian Broadcasting, with the FOR movie
  http://www.nrk.no/video/st_olavs_hospital_i_trondheim_reddet_livet_hennes_etter_trafikkulykke/2ACBACC007A0CEF4/

- News for Hedmark and Oppland County
  http://www.nrk.no/nyheter/distrikt/hedmark_og_oppland/1.7939140

- Schrödinger's Cat – About FOR and TAVI in a series by NTK1 on new technology and treatment modalities at Norwegian hospitals. Minimal invasive deployment of heart valves (TAVI) at the FOR operating room by Knut Hegbom and Aleksander Wahba.

- Movie Operating Room of the Future
  http://www.youtube.com/watch?v=7yi-2nXQWrC
Research collaborators