



Operating
Room of the
Future

ST. OLAVS HOSPITAL
TRONDHEIM UNIVERSITY HOSPITAL



NTNU - Trondheim
Norwegian University of
Science and Technology

Annual report 2014



NTNU - Trondheim
Norwegian University of
Science and Technology



ST. OLAVS HOSPITAL
UNIVERSITETSSYKEHUSET I TRONDHEIM

Table of content

Table of content	1
Summary.....	2
St. Olav's Hospital.....	3
Organisation of the Operating Room of the Future	6
Highlights 2014.....	9
Operative activity in the FOR operating rooms	11
Surgical clinic.....	11
FOR activity at the Department of Women and Children's Diseases.....	14
FOR activity at the Department of Neurosurgery	16
FOR activity at the Department of Ear-Nose-Throat, Eye and Maxillofacial Surgery.....	18
FOR activity at the Clinic for Orthopaedic, Rheumatologic and Skin Diseases	20
Technology in the FOR - operating Room.....	22
Medicine and media technology	23
The National strategy plan for ICT 2013-2020.....	26
Dissemination of knowledge	26
Courses arranged by FOR 2014	27
Research Cooperation	31
FOR in the future	34
Scientific Work.....	36
Ongoing Projects	41
Scientific Articles	44
Presentations at Conferences	46
Live-transmissions FOR 2014	47
Media Presentations	47

Cover illustration: Endoscopic procedure at the FOR operating room in the Gastro Center, St. Olav's Hospital
Photo: Geir Otto Johansen

Summary

The Operating Room of the Future (FOR) is a research infrastructure facilitating research at our hospital. FOR is taking part in several research projects and several of them, but not all, are led by FOR. In the present report we have included some projects where FOR and our staff have represented a prerequisite for the completion of the project. In these cases we have included the project leader /supervisor in the mention.

The Operating Room of the Future is a collaboration between St. Olav's 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 The Department of Surgery, St. Olav's 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 fulfill these goals. Trondheim has a particular responsibility for research within the field of medical technology. From the start in 2005 until the end of 2014 the administration of FOR has been a task for Department of Surgery as well as for Institute of Circulation and Medical Imaging, The Medical Faculty, NTNU. From January first, 2015 FOR became a department lead by the director of research, St. Olav's Hospital and as such also a part of the common research infrastructure of the hospital.

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 center of competence for the construction of operating rooms outside St. Olav's Hospital. An agreement with our industrial partners has made it possible for the Health Care Trust of Central Norway, St. Olav's 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 is 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. FOR has now its basis in six operating rooms at the new St. Olav's 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 a 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.

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 including ENT, orthopaedic surgery, gynaecology and neurosurgery etc. Minimally invasive therapy is less traumatic than traditional open surgery and will become more and more important in the future.

New methods of teaching have been tested, and transmission of images from the operating rooms with two-way communication has been used on several occasions. The educational part of the project will be continued. At FOR and NSALK several postgraduate courses for medical students are arranged annually. Our facilities 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 technology, 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.

St. Olav's Hospital

St. Olav's 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. Olav's Hospital has three district centres for psychiatry, two 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. Olav's Hospital.

St. Olav's Hospital is the university hospital of Central-Norway with a population of 702 869 inhabitants, and local hospital for a population of about 306 197 inhabitants per January first 2014. Through excellent cooperation with the local authorities and the primary health care we aim at optimal patient care. 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. Olav's 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 2014 we had;

- 10201 employees
- 746 beds (somatic - and including Orkdal Hospital and Røros Hospital)
- 43 operating rooms (In addition: 6 OR at Orkdal Hospital and 3 OR at Røros Hospital)
- 420672 somatic outpatient consultations

FOR, NorMIT and the future plans

FOR has been established as a brand for research and development at the integrated University Hospital of Trondheim. FOR is facilitating patient- oriented clinical research and innovation while we are developing the medical technology of tomorrow which then can be offered to the patients today.

National infrastructure for research

The collaboration with the Interventional Center at The National Hospital, Oslo University Hospital through the national infrastructure for research, is now started after the inauguration took place in Trondheim in June 2014. “Norwegian center for minimally invasive Image guided Therapy and medical technologies” will strengthen Trondheim as the national headquarter of research in medical technology in Norway. I also hope that it will influence recruitment of professionals as well as scientists to our research group.



Petter Aadahl
Director of Research
St. Olav`s Hospital
Photo: St. Olav`s Hospital

Innovation

St. Olav`s Hospital will focus on product- and service innovation with the goal of improving the quality of treatment and safety for the patient. FOR will have an important role in our hospitals commitment for innovative solutions within minimally invasive therapy, logistics, work flow and organisation of high-tech diagnostics and treatment.

Competence

The potential within medical technology can be retrieved through cooperation between all those who are involved in the whole patient`s stay in hospital. A higher level of competence is required with focus on competence building to reach our goals on improved treatment with a minimum of complications, shorter stay in hospital, shorter convalescence and improved patient satisfaction. In addition we hope the treatment will be more cost-effective for the health care system as well as for the society as a whole.

The Dean of the Faculty of Medicine, NTNU, Stig A. Slørdahl

Our health care system needs new solutions to meet the challenges of the future. This includes a need for new technology, new ways of cooperation for groups of health care personnel and more knowledge to give the best possible health care.

In all these areas the Operating Rooms of the future can contribute. Since the start of FOR in 2004 we have had ambitious plans for how FOR should be a leading center both for St. Olav's Hospital and for NTNU. We now have six operating rooms for various specialities with priority for research and we are successful in the competition for external funding. This indicates that we were right in the establishment of the FOR center. We are also pleased with the good collaboration with other research including the Intervention Center at the National Hospital, Oslo.

The infrastructure which now has been established at FOR gives us unique opportunities to perform good clinical investigations which could improve the patient treatment. FOR will also contribute to innovation within the health care sector.

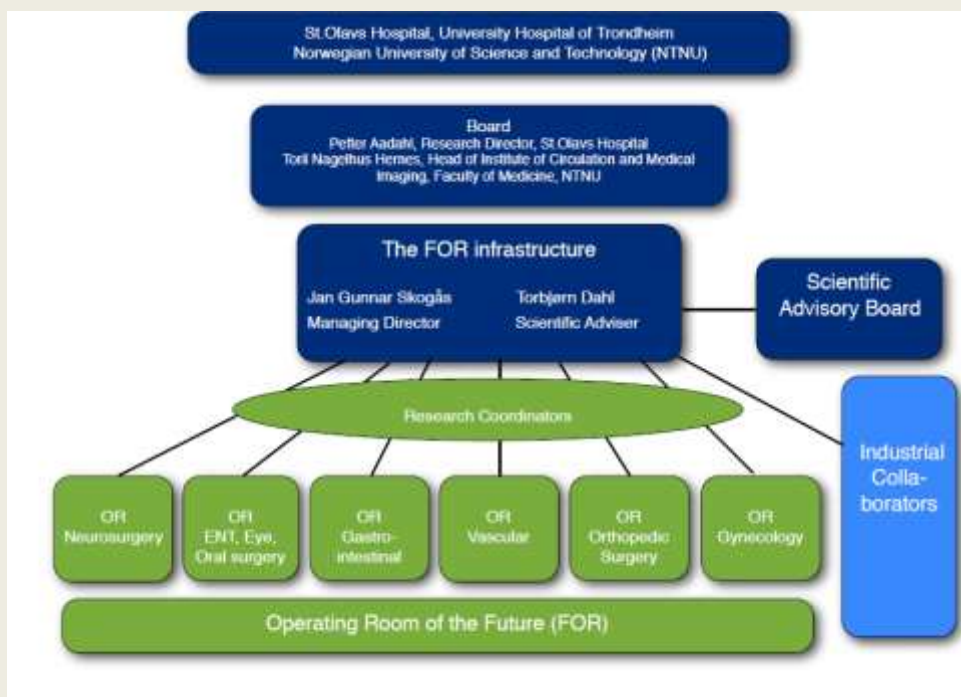
Those of us who are responsible for the medical research at our university have great expectations to the campuses at NTNU and St. Olav's Hospital that they will promote first class international research in collaboration with the research foundation SINTEF. Thus FOR should have a key role in national and international scientific collaboration

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
Dean
The Medical Faculty, NTNU
Photo: Geir Mogen / NTNU

Organisation of the Operating Room of the Future



Overview of the FOR research infrastructure



The personell in FOR



Hans Olav Myhre
Emeritus professor
of surgery



Jan Gunnar Skogås
Biomedical Engineer
Managing director, FOR



Torbjørn Dahl
Assistant professor
Scientific adviser
Chief, Department
of Vascular Surgery



Ronald Mårvik
Assistant professor
Consultant surgeon
Department of
Gastroenterological surgery



Marianne Haugvold
Cand. Scient.
Project coordinator



Therese Marken
Surgical nurse
Project coordinator



Liv-Inger Stenstad
Radiographer/ Master student
Project coordinator



Ketil Thorvik
Cand. Mag.
Project leader



Geir Andre Pedersen
Radiographer / Master student
Project coordinator

Photo: St. Olavs Hospital

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 advice to those who are doing projects under the direction of FOR. FOR has a special guideline 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. In 2014 altogether 12 Bachelor degrees, 3 Master degrees and 2 PhD degrees were finished in collaboration with FOR. FOR will have several main subjects for medical students.

The scientific advisory board has the following members in the period 2009- 2014:

Assistant professor Torbjørn Dahl (leader)

Professor Hans Olav Myhre

Professor Jon Erik Grønbech

Professor Olav Haraldseth

Professor Toril N. Hernes

Professor Per Farup

Professor Olav Sellevold

Assistant Professor Ivar Rossvoll

Professor Ståle Nordgård



Torbjørn Dahl
Photo: St. Olav's Hospital



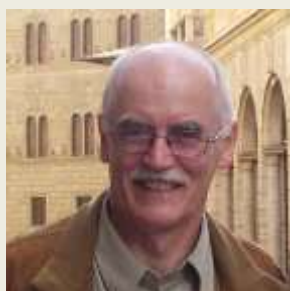
Hans Olav Myhre
Photo: St. Olav's Hospital



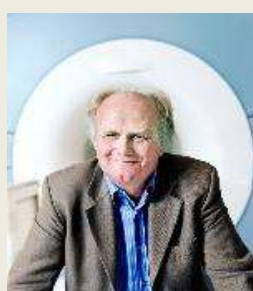
Toril N. Hernes
Photo: NTNU



Per G. Farup
Photo: Private



Olav Sellevold
Photo: NTNU



Olav Haraldseth
Photo: NTNU



Ståle Nordgård
Photo: St. Olav's Hospital



Jon Erik Grønbech
Photo: Private



Ivar Rossvoll
Photo: FOR

Highlights 2014

NorMIT



Photo: Kjersti L. Nilsen, NTNU

Front row from right:
Jan Gunnar Skogås,
Operating Room of the
Future
Toril A. Nagelhus Hernes,
NTNU
Siv Mørkved,
St. Olavs Hospital

Rear form left:
Sigbjørn Smeland,
Oslo University Hospital
Per Kristian Hoel,
Oslo University Hospital
Petter Aadahl,
St. Olavs Hospital
Stig Slørdahl,
NTNU

NorMIT ("Norwegian centre for Minimally invasive Image guided Therapy and medical technologies") is a cooperation between Operating Rooms of the Future, St. Olav's hospital and the Intervention Centre at Oslo University Hospital. The official opening of this cooperation took place June 10.2014 at St. Olav's Hospital.

This establishment will improve the clinical and technological research activity and lead to better innovation and competence. It will also improve patient safety. Although the main focus is minimally invasive therapy, also topics like logistics, work flow, communication, organisation and transmission of high quality medical images will be addressed. This initiative lead to a research grant from the Norwegian Research Council distributed over 5 years for the two institutions. Research director Petter Aadahl is the leader of this national project. The present project, which is supported by Liaison Committee between the Central Norway Regional Health Authority (RHA) and the Norwegian University of Science and Technology (NTNU), is part of the wider project supported by the Norwegian Research Council.

The operating rooms included in NorMIT are actually modern research laboratories for developing, testing and applying new technology, new treatment modalities and new pharmacological agents. The cooperation and different profiles of the centres will form them into one national infrastructure for image guided treatment and

technology. The goal is to improve the treatment by decreasing the risk of complications and to reduce the length of stay as well as the convalescence. In the long run this will be cost effective for the health care system and for the society at a whole. One important goal has been to reduce complications following the use of medical equipment. Therefore FOR is organising a course in the use of electromedical instruments (EMU) and this program is now used by all operating units at St. Olav's Hospital.

The research units in Trondheim and Oslo represent two of the strongest groups in Norway within their fields and they play an important role in the development of methods and technology also internationally. The Intervention Centre at Oslo University Hospital avd. The operating Rooms of the Future are planning to make NorMIT one common infrastructure for research and innovation with two nodes; one in Trondheim and one in Oslo. The project includes a significant package for upgrading and modernising of the equipment used for research. This infrastructure will strengthen research significantly in several areas in Norway: medical technology, CT, nanotechnology, translation research and health innovation. NorMIT has several potential users and will promote national and international cooperation between academia, the industry and clinical work.

Newsletter from FOR

In October 2014, the first newsletter from FOR was available. It will be distributed every other month focusing on the FOR clinics including the activity at the FOR operating rooms. In each newsletter we will focus on one particular clinic. We think this is a useful way to inform

about the activities at FOR and hope you will enjoy it. To visit the newsletters please use this link: <http://www.stolav.no/no/Om-oss/Avdelinger/Fremtidens-operasjonsrom/Nyhetsbrev/130314/>



Two newsletters were distributed in 2014 - one issue in October and one in December



Two PhD theses with connection to FOR were defended in 2014

Conrad Lange

“Endovascular therapy of aneurysmal disease”.

The work is including investigations of endovascular treatment (EVAR) 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. Olav’s hospital is another part of the study. Four papers have been published. The thesis was defended October 10th 2014. Supervisors: Erney Mattsson, Hans O. Myhre

Wenche Moe Thorstensen

“Symptoms from nose and sinuses in patient with asthma - united airways”.

This investigation is focusing on nasal symptoms in patients with bronchial asthma and on the effect of these symptoms when improving the pulmonary function during treatment. 100 patients with bronchial asthma and 100 non-asthmatic control subjects were included in the investigation. We observed that patients with asthma had a smaller nasal volume and smaller nasal cross sectional area than control subjects. The asthma patients had significant more symptoms of nasal stenosis, lower maximal nasal air flow and lower nose-sinus related quality of life compared with controls. Patients having non-allergic asthma had the same degree of symptoms as those with allergic asthma. Defended October 17th 2014 Supervisors: Sverre Steinsvåg, Vegard Bugten, Malcolm Sue Chue.



Photo: Private



Photo: Kari Lilleeng

Operative activity in the FOR operating rooms

Surgical clinic

There is great interest in using the FOR operating room at the AHL (Acute and cardiopulmonary centre), Surgical Clinic, not only for research purposes, but also for clinical use for several disciplines realizing the significance of a fully equipped operating room with imaging including fluoroscopy. The activity of the surgical clinic included topics like sacral nerve stimulation for problems with the bowel function as well as advanced stent-graft solutions for extensive aortic aneurysm including the orifices of the visceral arteries.

I have noticed experimental work with implantation of completely new vascular grafts and advanced imaging techniques and instruments for navigation. Navigation technology can be applied for diagnostics of lung tumours, for the deployment of vascular stent-grafts and for surgery of liver metastasis.

Interesting activity is also going on at the FOR operating room for laparoscopic surgery. I have great expectations to the NorMIT project which opens up for closer cooperation with the Interventional Centre at The National Hospital, Oslo, especially regarding development of new methods for the treatment of gastrointestinal cancer.

In addition to research groups at St. Olav's Hospital, NTNU and SINTEF, there is also great interest in doing FOR projects at Sør-Trøndelag University College (HiST), at the department of radiography and the department of health and social work. Several bachelor students have finished their projects at FOR. Especially within clinical surgery, more projects for these students are warranted.



Birger H. Endreseth
Head of Surgical Clinic
Photo: St. Olav's Hospital

Operative activity FOR - operating room AHL- 1F Department of Surgery 2014	
TAVI	34
New stentgraft for AAA	59
Various vascular operations	44
Various other operations	15
Thoraco-abdominal stent-grafts w/ side branches	4
Combined procedures (open operation +PTA/stent)	32
PTA/stent	3
Various endovascular procedures (coiling etc)	14
Experimental surgery	5
Removal of infected pacemaker	26
Total	236



Stent-graft operation at FOR operating Room, AHL-1F
Photo: Liv-Inger Stenstad, FOR

TAVI numbers for 2014

Altogether 34 patients were treated, 16 women and 18 men. 31 had aortic stenosis while 3 were treated for degeneration of biologic aortic valve implant. 27 of the procedures were transfemoral and 7 transapical. 25 had implantation of balloon-expandable valve and 9 with self-expanding valve implant.



AHL-1F FOR Operating room: TAVI- operation
Photo: Liv-Inger Stenstad, FOR

Operative activity, FOR - operating room 4 Department of surgery 2014	
Laparoscopic appendectomy	4
" Pancreatectomy/resection	9
" Sigmoid resection	6
" Gastric bypass	5
" Cholecystectomy	12
" Splenectomy	6
" Paraoesophageal hernia	10
" Adrenalectomy	8
" Hemicolectomy	15
" Liver resection	14
" Myotomy	4
" Fundoplication	7
Total colectomy	5
" Rectal amputation/resection	10
" Ventral hernia	5
" Gastric resection	7

There has been a high activity in this operating room. "Upper GI" had more than 100 laparoscopic and almost 100 endoscopic procedures. "Lower GI" had around 50 laparoscopic and 50 endoscopic procedures. In addition, the operating room was used for open surgery at Department of Gastroenterological Surgery, Department of Urology and Endocrine surgery.



The da Vinci-robot, Department of Surgery
Photo: FOR

FOR activity at the 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. 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 the 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. We are now doing robotic surgery 2-3 days per week; two days at St. Olav's Hospital and 1-2 days at Orkdal Hospital.

Research at our clinic has concentrated on ovarian cancer (tumor reductive surgery) and on operative technique applied during hysterectomy. All robot-assisted operations are recorded prospectively in a register. During the 3-year period ending October 2013 altogether 390

such operations has been performed. 50 % of them were carried out for malignant or premalignant conditions (e.g. carcinoma of the endometrium or cervix) and 50 % for benign conditions (hysterectomy for uterine haemorrhage, ovarian cysts, endometriosis, and genital descence).

Numbers for robotic surgery at our department for 2014: Total number of patients operated: 183. At St. Olav's Hospital: 124, Orkdal Hospital: 59.

We have obtained a shorter stay in hospital and less postoperative complications. With increasing experience, the operating time has been reduced and very few operations need conversion to open surgery. We are now conducting a research project exploring the importance of sentinel lymph nodes in cancer of the cervix and endometrium using a fluorescence camera connected to the Da Vinci robot.

FOR has been extremely useful for the training and certification of our personnel in the application in electro-medical equipment. This is an important service to the operating clinics. 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 continue it in the years to come.



Runa Heimstad
Head of Clinic of Women and children's diseases
Foto: St. Olavs Hospital

Operative activity FOR-operating room 7 Department of Women and Children's diseases 2014	
Maternity unit	15 patients
IVF	32 patients
Gyn Cancer	32 patients
Gyn General	113 patients
Total	192 patients
166 of the operations were elective.	



Testing of head-mounted display during laparoscopic surgery at the FOR operating room, Department of Women and Children's diseases.
Photo: Therese Marken, FOR

FOR activity at the Department of Neurosurgery

The Department of Neurosurgery has one of the FOR operating rooms, which is facilitating a high scientific activity. The research at Department of Neurosurgery is carried out in close cooperation with "Centre of Competence for Ultrasound and Minimally Invasive Therapy", a very important platform for our research activity. Our research has its background in clinical needs and is through a multidisciplinary approach, combining technological and clinical research. Less traumatic and safer treatment modalities are developed.

The most important research profile of the department is the application of 2D and navigated 3D ultrasound within image-guided minimally invasive neurosurgery. This technology 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. A new and exciting project in collaboration with FOR is the "Visualisation project"- where new imaging technology for clinical images is tested during minimally invasive surgery in a prototype operating room.

Another project carried out as collaboration with the Clinic of Neurosurgery and FOR is 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 2015.

Together with the IO center- Center for Integrated Operations in the petroleum industry, NTNU, SINTEF and FOR, a case study was performed during the spring 2014 exploring how collaboration in a team might improve the way we work in an operating room, thereby leading to better safety and effectivity. Observation and interviews of the operating team was also performed during the spring 2014.

A project "Navigation for surgery of the spine and neck"- a cooperation with the National Center of Competence for Diseases of the Neck and Spine, was completed in 2014.

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.

The research activity going on at the FOR operating room is integrated in the routine clinical work.

We are looking forward to good collaboration with FOR in 2015.



Geirmund Unsgård
Professor of Neurosurgery
Head of Clinic for Neurosurgery
Photo: St. Olav's Hospital

Operative activity at FOR operating room 3 Department of Neurosurgery 2014	
Craniotomies/intracranial operations, vascular lesions and head trauma	100
Shunt operations	90
Operations on the spinal canal, spinal cord and nerve roots	70
Other operations: <ul style="list-style-type: none"> • Spinal cord • Nerve root • Pain or dysfunction 	40
Total	300



FOR operating room, Department of Neurosurgery
Photo: St. Olav's Hospital

FOR activity at the Department of Ear-Nose-Throat, Eye and Maxillofacial Surgery

The FOR operating room for ENT/Maxillofacial surgery is now well established. There have been several delegations from other departments of St. Olav's Hospital and from other hospitals to study our FOR operating room with its ergonomic cockpit solution and pleasant lighting. New optical navigation equipment partially financed by NorMIT has been installed and is used for exciting research projects.

A local quality register for rhinology was established in 2012.

The activity has been stable on a high level. It has become popular to operate in the FOR operating room because there is great visualisation on large screens, and this is important for the operating surgeons.

About 500 patients have been operated upon, and with excellent logistics they have been followed from the out-patient clinic via the operating department to the follow-up nurse. So far our experience has resulted in analyses which have formed the basis for presentations on seminars and one Master degree about the quality of life in patients operated for chronic rhino sinusitis.

Our staff is looking forward to implement new routines regarding testing of medical technology in cooperation with the industry and FOR.

And we are looking forward to continue the good cooperation with FOR with stimulation to exciting research projects, including testing of new medical equipment.



Mette Bratt
Head of Department
Ear, Nose and Throat Diseases,
Maxillofacial- and Eye Diseases
Photo: St. Olav's Hospital

Operative activity at the FOR operating room 1 Department of ENT, Maxillofacial and Eye diseases in 2014	
Functional endoscopic sinus surgery (FESS)	101
Septal plasty	22
Multiguide injections	26
Concha plasty	24
Sialoscopy	6
Arthroscopy	11
Total	190



FOR operating room, ENT and Maxillofacial Surgery
Photo: Geir Mogen / NTNU

FOR activity at the Clinic for Orthopaedic, Rheumatologic and Skin Diseases

It is the intention of our clinic to increase the use of the FOR-infrastructure. So far, the FOR operating room has to a large extent been used for implantation of joint prostheses within the fast-track project. This way of organising joint prosthesis surgery has spread to other hospitals, and our department is arranging courses on this topic for health care personnel from all over the country. There is a need for upgrading of the technology at the FOR operating room to make it a good arena for innovation within orthopaedic surgery.

There is a great need to develop new treatment modalities and medical technology in orthopaedic surgery. Therefore we are planning more projects within

research and development. During the last year four research projects, involving the FOR infrastructure, have been announced. In a similar way, FOR has a good system including a deal structure, for the testing of medical technology and supplies in a controlled way. It is hereby recommended!

FOR has the responsibility to arrange courses in the application of electro-medical equipment and hospital hygiene for all orthopaedic surgeons. We are appreciating this important service.



Vigleik Jessen
Head of Clinic
Photo: St. Olav's Hospital

Operative activity FOR operating room 8 Clinic of Orthopaedic Surgery 2014	
Primary hip prostheses	89
Revision of hip prostheses	31
Knee prostheses	149
Other operations	47
Total	316
Mainly total prostheses of the knee are included in the fast-track project.	



From the "fast-track" project at the Department of Orthopedic Surgery
Photo: Department of Orthopedic Surgery



Photo: Department of Orthopedic Surgery

Technology in the FOR - operating Room

Medical technology, FOR 2014

At the FOR operating rooms, The Cardiovascular Center, Department of Gastroenterologic surgery, ENT and Neurosurgery, we have upgraded a significant part of the technology. This includes the software for ArtisZeego angiography laboratory for the FOR operating room, Cardiovascular Centre, which is giving better and faster image processing and the possibility for new applications. Integration of ultrasound imaging the visualisation display and improvement of the user-interphase has been made possible.

At the Center for GI Surgery we have found solutions for 3D visualisation of laparoscopic procedures. Upgrading of the software of the EndoAlpha – system and EXERA give us access to the latest version of endoscopes.

At the FOR operating rooms at The Department of Neurosurgery and The Department of Gynaecology we have upgraded the display technology giving full access to HD and later 4K. These changes will lead to better display solutions for high resolution images with depth of field, good ergonomic and correct colour reproduction.

At St Olav's Hospital we have today two Da Vinci robots available. Live transmissions from the operating department to the lecture room GM-37 is available. These transmissions can be done internally and externally. Departments of Urology and Gynaecology have both excellent experience with the Da Vinci robot and several other surgical specialities are interested in implementing this technology. Therefore technology-time and operating room capacity is becoming a challenge for us. FOR is working together with the clinics to find a more permanent solution to these problems. Service and upgrading of both robots have been made in 2014.

One of the robots is a part of the NorMIT infrastructure.

In 2014 we have further developed the fiber and IP-based communication for telemedicine via FOR, and new IP technology has been applied through the research net – Uninett. This has been used in communication from FOR to various destinations in Asia, Europe and USA in 2014. We have focused on further development of fiber-optic communication from the FOR operating rooms, making live transmission in full high definition possible. When 4K becomes available we have already made prototypes for imaging and visualisation with the possibility of live transmission. We are cooperating with the Department of Medical Technology, MTA, HEMIT and Viju regarding optimisation of the ICT infrastructure. Today it is possible to make live transmissions from all six FOR operating rooms to the Knowledge Center.

In addition to clinical research, the operating rooms at FOR have been used for experimental investigations as well as laboratory studies. Navigation has been tested out in experimental neurosurgery, ENT, laparoscopy and in connection with vascular procedures. We have also applied navigation within pulmonary medicine. Development and testing of prototypes and new equipment has been carried out in collaboration with various research groups and international industry. 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 18 weeks for the testing of technological systems, quality control, safety control, upgrading and validation



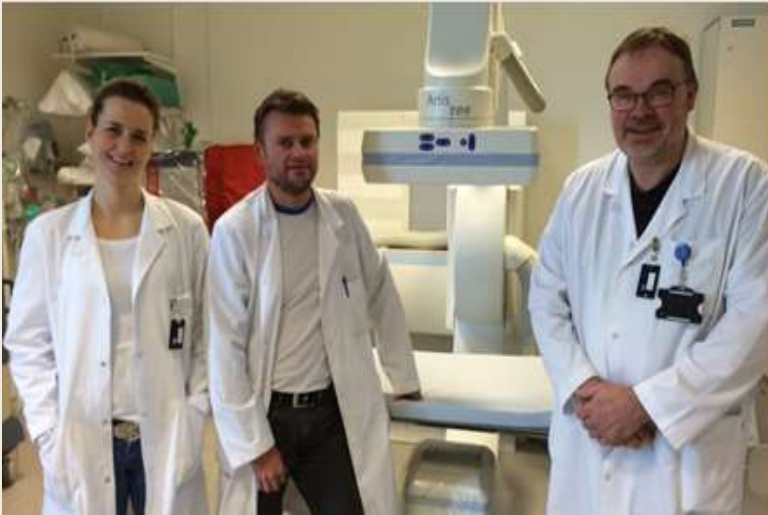
From the left: Jon Arild Gundersen, Martin Svenning, Bjørn Olav Myhre og Ole Petter Rønsåsbjørg.

Photo: Liv- Inger Stenstad, FOR

FOR is receiving excellent assistance from the Department of Medical Technical Equipment.

They are taking part in the organization of the live transmissions and are looking after the equipment at the operating rooms to keep it in order to function properly. In case service is needed, it is carried out within a short time.

This personnel is also assisting at the courses in electro-medical equipment with special responsibility for the demonstration of C-arm technology.



From the left:
Medical physicist Kristin Ramberg, contact person for irradiation protection for diagnostics Tommy Berglund, physicist Sven-Erik Johnsson.
Photo: Liv- Inger Stenstad, FOR

FORs collaborators at the Department of Medical Imaging.

They are assisting at the EMU courses (in the use of electro-medical equipment). They are also giving lectures on irradiation protection in the operating rooms and on the use of C-arm technology. This is extremely important both for surgeons and for other categories of operating room personnel. Furthermore this department is cooperating with FOR on various research projects.

Medicine and media technology

AV Arena Norway

AV Arena Norway is a resource network within medicine and media technology. Operating Rooms of the Future, St. Olav's Hospital has since it started in 2005, had focus on the development of image guided surgery and image guided treatment in general. Digital media technology is important for the further development of this discipline. During the autumn 2010 FOR took the initiative to form a bridge between competence within digital media and health care. The network is financed by members and the focus area is to initiate projects to release medical and organizational benefits within the health care sector.

The network will bring ideas into projects. FOR is acting as a hub in this network and is monitoring all projects from our members. FOR will organize good processes for developing and building networks to improve our members' ability to properly design applications. 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 within health care.

Telemedicine of the future - collaboration with the oil and gas industry

June first 2014, the project “The Future of Telemedicine in O&G” was completed. The project was based on a pre-project finished a year ago. Partners in this project are: Conoco Phillips, Petrobras. IBM, St. Olav’s Hospital represented with FOR and The Emergency Department, Medical Imaging Laboratory (MI lab), NTNU, Albert Einstein Hospital, and Center for Integrated Operations in the petroleum sector at NTNU/IFE/SINTEF.

The project is studying the work-flow within telemedicine today and is exploring the future potential for telemedicine. Thus we are developing and demonstrating prototypes for new telemedical solutions. And we are investigating safety aspects as well as aspects of planning and implementation of new telemedical practice offshore. The project is developed together with

representatives from Norwegian and Brazilian oil industry and will most likely influence telemedical solutions in the health care sector as well. One result of the project was introduction and demonstration of a virtual examination room. See illustration page 25.

It has been decided to continue the project in a phase 3. Here we are planning an upscaling of both development and demonstration of a prototype in 2015-2016

Operating Rooms of the Future is the project leader and 31. Of March 2014 the research report with preliminary results was presented and published at the “SPE Intelligent energy” conference in Utrecht, The Netherlands.



The Ekofisk platform. The nearest platform (with the helipad) is also the accommodation platform and includes an examination room.
Photo: ConocoPhillips

Decision support and “seamless” sharing of medical information within and between the various

The Operating Room of the Future received a grant from the Health Authorities of Central Norway to start a project on how to share medical information and on collaboration for decision support within and between the levels of treatment in specialist- as well as in primary health care and pre hospital service. The project is founded on results of a project “Telemedicine of the future in oil and gas industry “which again is anchored in Center of Integrated Operations in the Petroleum Sector, NTNU and organised by FOR. The project will demonstrate new applications of ICT technology and new work processes for decision support between the various levels of treatment.

The primary health-care report a satisfactory development of new medical technology which can be used for better diagnostic work and for treatment of patients.

A good example is the pocket sized ultrasound machine Vscan. However there is need to improve the next step in the work process with simple solutions and systems for sharing medical information, and how cooperation and decision support can be achieved with a minimal response time while the quality of priorities and decisions are at the same time improved.

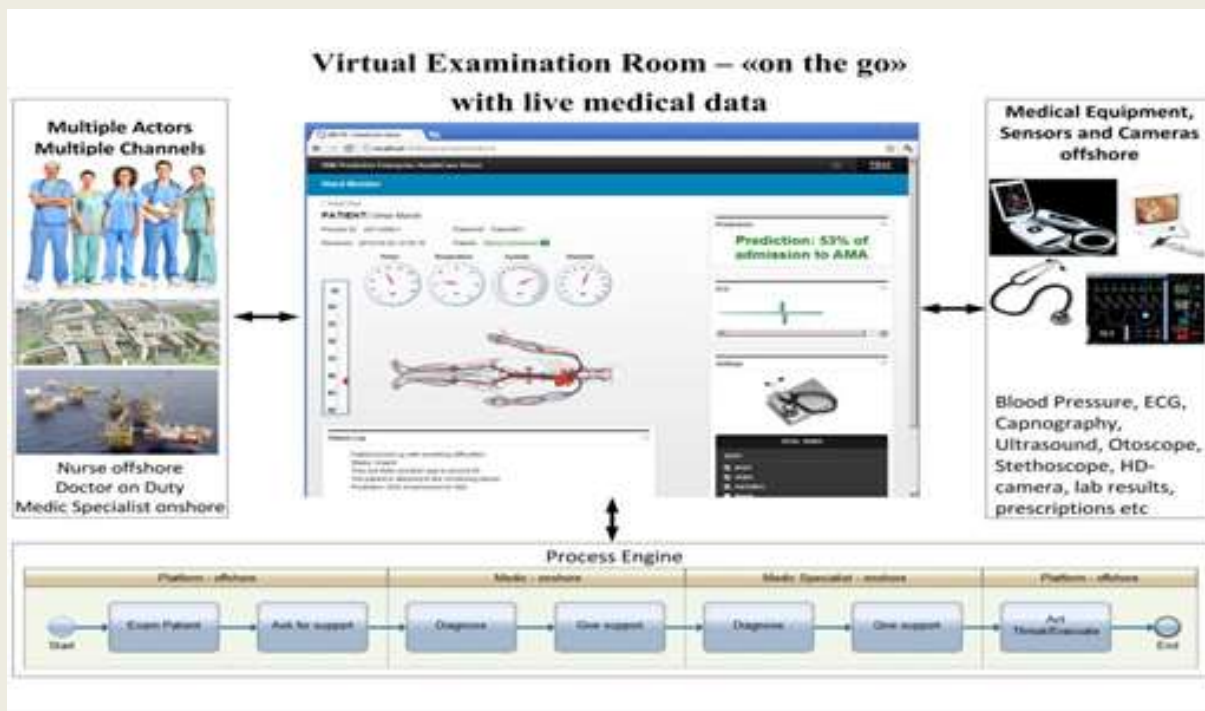
Today the primary health care has no “seamless” systems for sharing medical information in the decision support in and between levels of care. The routine today is the use of phone, telefax, e-mail, video and letters and the structure is rather fragmented.

The director of interaction at St. Olav`s Hospital has expressed the need for the specialist health care to provide “packages“ which could trigger decision support to the primary health care including prehospital service. Transmission of information while the patient is transferred between the different levels of care is representing such a challenge for obtaining better patient treatment. Such decision support is important to maintain good quality in the treatment and is supporting the implementation of a “seamless» course for the patient. This will also improve documentation regarding who did what and when in the decision chain. Finally it will be an important tool for documentation of quality in the treatment.

Demonstrations have shown promising results. The ideas have matured to an extent that they can now be moved and transformed further by the needs of our regular health care system. St. Olav`s Hospital is in a good position lead the development of forming future “packages” for decision support in our health care system and to become a reference center for the important commitment in ICT- development adopted by the Health Authorities of Central Norway.

The project has focus on defining the needs and to understand the work process on a detailed level. On this basis the aim is to form ICT solutions which will lead to new routines .The project will start during the autumn 2014 and will be continued throughout 2016.

Illustration: FOR



The National strategy plan for ICT 2013-2020

The Operating Room of the future is mentioned in the national plan for ICT 2013- 2022.

The Norwegian government has a strategy for research and development within ICT where they focus on important areas where they want to spend resources in the years to come.

ICT in combination with medical technology is becoming more and more widespread. To improve growth and formation of values we need strong ICT groups in Norway and we are dependent upon research and development within this area. Although much is going on internationally, we need our own national expertise within the field.

The government has pointed at three focus- areas of ICT research and development in the years to come:

- ICT of high international quality
- Business development
- Social challenges

Link to: Nasjonal strategi-IKT-forskning og-utvikling.

<http://www.regjeringen.no/nb/dep/fad/dok/rapporter/planer/planer/2013/strategi-ikt-forskning.html?id=734430>

Dissemination of knowledge

The Annual Røros FOR seminar 2014



Photo: Archive

The annual FOR seminar was arranged at the beautiful mining city of Røros.

Approximately 70 participants from St. Olav`s Hospital, NTNU, SINTEF and industrial partners attended the meeting. Exciting presentations were given, including one by a representative from the Norwegian air Force. The program was including various topics .And the meeting is of great importance for FOR and our collaborators .To meet at another arena than during daily routine work promotes new ideas and strengthen the infrastructure.

Courses arranged by FOR 2014

Arranged EMU-courses in 2014:

January 2rd and 3rd - The Department of Neurosurgery

High energy equipment, endoscopy, imaging and radiation protection.

September 17th and 25th - The Department of Orthopedic Surgery

High energy equipment, endoscopy, imaging and radiation protection.

September 24th and October 1st - Department of Womens and Childrens Health

High energy equipment and endoscopy.



EMU course at the Department of Orthopedic Surgery

Photo: Liv- Inger Stenstad, FOR

Courses in use of electro-medical equipment (EMU)

On behalf of the operating clinics FOR is conducting compulsory courses in the use of electro-medical equipment. In 1999 a new regulation regarding "Use and maintenance of electro-medical equipment" was passed. 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 because:

- 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.
- The 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.

Course in hospital hygiene

A course in hospital hygiene can now be followed at the electronic network "Kilden" of the hospital. It consists of 4 modules. After completion, documentation will be given by FOR that the course has been completed.

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 also going through courses on an annual basis regarding the use and maintenance of electro-medical equipment. The personnel at FOR is including so-called super-users having special focus on modern, advanced medical technology. They need to go through refresher courses on a regular basis.

The personnel at FOR is contributing to training of personnel from other departments at St. Olav's Hospital as well as personnel from institutions focusing on clinical procedures, research and application of medical technology. As an example, nurses working in the oil and gas industry had demonstration of the application of the pocket-sized ultrasound machine Vscan.

FOR has visitors from other hospitals in Norway and has thereby been giving information about new technology and methods. Organisation and design of operating rooms have been among 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 year been participating in courses in leadership, scientific work and professional development.

Students

Since 2005 FOR has had excellent cooperation with University College of Sør-Trøndelag (HiST). On a regular basis we had presentations for students at the Department of Health and Social Work, for 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. FOR is also

taking care of teaching the use of electro-medical equipment for several of these students.

Master students as well as PhD students at St. Olav's Hospital/ NTNU/ SINTEF have a good opportunity to experience new medical technology and operations from the interactive lecture room at FOR where they also learn about opportunities in research.

Other courses at FOR

January 6th - Strategy meeting - Center of Competence for ultrasound and image guided treatment - Collaboration with FOR, JGS

February 7th - Course for Bachelor students. Hygiene, clothing, how to behave in the operating room. Arne Hansen. MH/LIS

November 10th - Presentation for the radiography students at Sør-Trøndelag University College about the possibilities to take their Bachelor degree through FOR. MH, GAP

Visitors at FOR 2014

April 9th - Visit by members of the Nansen Neuroscience Network and LMI. Presentation by HOM and visit at FOR including ENT operating room. MH

May 26th - Visit by 10 persons from Hudiksvall hospital, Sweden. Presentation about FOR. Visit to ENT operating room. MH

September 8th - Visit from Brainlab. Presentation by JGS and visit to FOR, ENT, AHL-1 and NSALK. JGS, LIS, GAP

September 29th - Visit from the American Embassy. Visit arranged at the ENT operating room by MH.

November 11th - Visit by chiropractor Ola Bromseth. Observation of an orthopaedic operation at AHL-1F. Observed animal experiment at the animal lab. Inspected equipment at the Department of Nuclear Imaging, PET and Irradiation Therapy. Presentation about FOR by LIS.

December 19th - Visit from Aleris Medical Center, 16 persons. Demonstration of FOR operating room ENT.

Illustration of visitors at FOR
2014



Photo: FOR- visit from the American Embassy



Photo: FOR-Visit from Brainlab



Photo: FOR – Visit from the IO conference



Informal chat with Minister of Oil and Energy Tord Lien at the IO conference 2014.
From the left: Jan Gunnar Skogås, Arild Nystad and Tord Lien.
Photo: Kai Torgeir Drageland, NTNU



Photo: Kai Torgeir Drageland, NTNU

Experimental surgery

All FOR operating rooms are authorised for experimental surgery including animal research. Such experimental procedures can be ordered at FOR who will then 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 (AKM). FOR has trained and authorized personnel assisting during the whole process.

Personnel who is planning or taking part in animal experiments must go through 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 registration and have documentation that they have passed the course in animal experiments, category C.

During 2014 following experiments were completed:

- Application of “temporary stents” in the vascular system. The hypothesis is that this will give fewer complications than regular permanent stents. Erney Mattsson and Frode Manstad-Hulaas have performed 8 experiments in a sheep model.
- Geir Arne Tangen and Frode Manstad-Hulaas have done 5 experiments in a pig model. They use a tracking system as supplement in the navigation within blood vessels, especially branches from the aorta.
- Tore Amundsen and Erney Mattsson are using temporary stents in the bronchial system. Experiences from 4 experiments in a pig model are so far promising.
- Erney Mattsson and Frode Manstad-Hulaas have tested the temporary stent (Erneystent) in the aortic arch in 3 pig experiments.

13.01.2014	Erney Mattson	Erneygraft	sheep	AHL-1F
16.01.2014	Erney Mattson	Erneygraft	sheep	AHL-1F
17.01.2014	Erney Mattson	Erneygraft	sheep	AHL-1F
24.01.2014	Erney Mattson	Erneygraft	sheep	AHL-1F
03.02.2014	Erney Mattson	Erneygraft	sheep	AHL-1F
10.02.2014	Erney Mattson	Erneygraft	sheep	AHL-1F
03.03.2014	Erney Mattson	Erneygraft	sheep	AHL-1F
31.03.2014	Erney Mattson	Erneygraft	sheep	AHL-1F
27.03.2014	Geir Arne Tangen	Navigasjon	pig	AHL-1F
28.04.2014	Geir Arne Tangen	Navigasjon	pig	AHL-1F
05.05.2014	Geir Arne Tangen	Navigasjon	pig	AHL-1F
12.05.2014	Geir Arne Tangen	Navigasjon	pig	AHL-1F
05.06.2014	Geir Arne Tangen	Navigasjon	pig	AHL-1F
06.11.2014	Erney Mattson	Erneystent / aorta	pig	AHL-1F
17.11.2014	Erney Mattson	Erneystent / aorta	pig	AHL-1F
12.12.2014	Erney Mattson	Erneystent / aorta	pig	AHL-1F
10.11.2014	Tore Amundsen	Erneystent / lung	pig	AHL-1F
24.11.2014	Tore Amundsen	Erneystent / lung	pig	AHL-1F
08.12.2014	Tore Amundsen	Erneystent / lung	pig	AHL-1F
12.12.2014	Tore Amundsen	Erneystent / lung	pig	AHL-1F



From AHL-1F: Stent in the aortic arch
Photo: Liv- Inger Stenstad, FOR



From AHL-1F: Stent in the bronchial system
Photo: Liv- Inger Stenstad, FOR

Research Cooperation

National and international collaborating partners

SINTEF is FORs most important national research partner.

Most of this collaboration is concentrated around “National Center of Competence for Ultrasound and Minimally Invasive Treatment”.

Together with The Intervention Center at The National Hospital, FOR received a research grant based on establishment of the national research infrastructure “NorMIT”- Norwegian Center for Minimally invasive Image guided Therapy and medical technologies. The focus for 2014 was Investment in medical technology and tools for the infrastructure, which will continue in 2015. We are working on a common website explaining how the NorMIT infrastructure can be used for various research groups.

FOR has an excellent cooperation with The University College of Sør-Trøndelag, HiST. More than 50 student from this institution have finish their bachelor-or master degree at FOR.

FOR has also good cooperation with industrial partners like Sony, Siemens, Olympus Karl Storz, Brainlab and Covidien. Routines for such collaboration have been established with the assistance of legal expertise within the field.

FOR has an excellent cooperation with Vanderbilt University Medical Center, TN, USA. This hospital is organised in a similar way as St. Olav’s Hospital. We are planning research projects on how new treatment modalities could influence technological solutions. We are also looking for cooperation on the use of ICT in the operating rooms to optimize organisation and patient flow. In 2014 we have further started cooperation with Albert Einstein Hospital in Sao Paulo, Brazil regarding telemedicine and decentralisation of specialist health care.

FOR is also cooperating with Massachusetts General Hospital, Boston, Operating Room of the Future, Tübingen, Germany and research groups at Krakow University Hospital, Poland. A cooperation has further been established with Yonsei University Health Center, Korea. Focus areas are here the health of the aging population, the intelligent hospital and transmission of high quality medical images. FOR has collaboration with organisations like EAES (European Association for Endoscopic Surgery) and SMIT (Society for Minimally Invasive Therapy)

Research and development in cooperation with SINTEF

National Center of Competence for Ultrasound

Operating Room of the Future is an arena and infrastructure for several ongoing research projects. Some of the main activities during 2014 have 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 2014, 12 ongoing PhD-projects were running and 2 were finished. Often, an engineer and a clinician are working on a PhD investigating a problem from their individual viewpoint. 31 scientific papers in peer reviewed journals were published in 2014 and several of these studies used FOR as their infrastructure.

Through user-controlled projects supported by the Norwegian Research Council and EU, The Center of Competence for Ultrasound and Minimally Invasive Therapy 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, RASimAs, TRANS - FUSIMO) we have "imported" competence from international groups and have also contributed with competence both nationally and internationally.



Thomas Langø,
Head of Research, Department of Medical Technology
Photo: SINTEF Media

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. Research at this center of competence includes image guided minimally invasive surgery within vascular surgery, neurosurgery and laparoscopic surgery, pulmonary medicine and Ear Nose and Throat diseases. In addition to the use of ultrasound, navigation has become an important research topic. The navigation system Custus X has been developed by SINTEF. The purpose is to improve accuracy of the diagnostic work. This platform will now be published nationally and internationally as an Open Source Platform through the NorMIT cooperation.



Illustrations showing the use of the
Navigation platform CustusX.
Below: Laparoscopic surgery. Above: Bronchoscopy at FOR
Photo: SINTEF Media

Operating Room of the Future and Institute of Circulation and Medical Imaging, DMF, NTNU

Finally the national NorMIT research infrastructure has been established

Institute of Circulation and Medical Imaging has a special responsibility to promote the cooperation between NTNU and St. Olav's hospital through Operating Rooms of the Future. Support and excellent infrastructure for research and innovation is mandatory for clinicians to use research for the improvement of their own expertise.

The establishment of NorMIT as a national infrastructure in 2014 represented a milestone for FOR. The possibilities are now excellent to do patient-oriented clinical research based on national and international cooperation. A good infrastructure is important to obtain good quality within

research and teaching, as it is within patient treatment. An active scientist must easily be kept up to date with the latest results within his field and thus achieve important knowledge through own research, reading of scientific articles and by being active in debates taking place in research networks and during conferences. For a scientist import and export of new knowledge is a continuous process. And it is important that Norwegian patients are getting the benefit of this knowledge. Therefore, the Operating Rooms of the Future is perhaps more important for the patients than for the health care personnel.



Toril A. Nagelhus Hernes,
Professor of medical technology
Leader of Institute of Circulation and Medical Imaging, DMF, NTNU
Photo: NTNU

FOR in the future

FOR has been running since 2005 and continued in 2010 in the new hospital with focus on all operating clinics using image guided minimally invasive treatment. 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 transmissions and interactive communication in full high-definition (HD) while 4K will soon be available. 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 organization of operating departments. Image guided minimally invasive treatment is one of the most important fields of innovation within the specialist health care system. Such procedures are important to give a less traumatic and more efficient treatment of the patients. It may lead to shorter convalescence, reduced need for intensive care, less complications and often better results of the treatment. Several surgical procedures can now be performed as day surgery and the patient will need shorter time to get back to everyday activities and work. The elderly part of the population is increasing and open surgery in elderly patients may include certain challenges. Thus the risk of complications is higher than in younger patients and the convalescence is generally longer. Whenever the situation allows it, minimally invasive therapy may be the preferred treatment modality in elderly patients.

Today a lot of hospitals are on the planning stage in Norway as well as in 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 optimizing 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 organize them efficiently. It is important to do this in a systematic way, getting solid knowledge about operating departments. There is need to do testing of new equipment and new techniques in a systematic way. FOR will continue to support this through the formation of contracts, the accomplishment and the evaluation of the projects.

We are also planning a new FOR operating room at the Department of Pulmonary Medicine where research and development of navigation and image guided procedures is important. We want to refine and develop further the technique and to expand the indications for stent-grafting for aneurysmal disease, dissections and trauma of the vascular system. In one project we are using navigation for exact deployment of the implants.

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.

In 2014 FOR has developed, established and implemented a teaching system within the use of electro-medical equipment for all doctors in surgical disciplines at St. Olav's Hospital. Focus areas are the application of high-energy technology, application of C-arms and x-ray protection. Hospital hygiene is also included in the program. Our plan is to develop courses using digital learning. One advantage is that the students then can use this material any time. In collaboration with "at work" we have developed digital based interactive reports. This is a prototype of a completely new type of course registration and approval. The system can be integrated with other systems. Through the health academy of Regional Health Trust, collaboration has been established in order to expand this arrangement to other hospitals within Central Norway

FOR has close collaboration with several other institutions like international industrial companies, clinical departments, and technological groups. Our closest collaborators are The Medical Faculty, NTNU and SINTEF, Department of Medical Technology. Other important collaborators are “Center of Competence for Ultrasound and Image Guided Therapy”, “National Center for Advanced Laparoscopic Surgery”, University College of Sør-Trøndelag-HIST”, NTNU Technology Transfer and Center for Interdisciplinary Research in Space (CIRIS).

Our collaboration with SINTEF regarding navigation technology and ultrasound continues, and we have projects exploring the application of steerable wires in combination with catheters for endovascular treatment. In pulmonary medicine we have applied navigation for endoscopy 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.

The Operating Room of the Future is a preferred co-worker, especially regarding imaging and visualization technology for minimally invasive therapy. Our aim is to strengthen the international collaboration, and several international centers wish to cooperate with FOR. So far we have concentrated on Massachusetts General Hospital, Boston, Operating Room of the Future, Tübingen and research groups at Krakow University Hospital, Poland. We are also cooperating with Vanderbilt University Medical Center, Nashville TN and Yonsei University Health System, Seoul, Korea. Finally, FOR has cooperation with organizations like EAES and SMIT.

Our goal is that FOR should be a research infrastructure of excellent international quality. Quantity as well as quality of research relevant for FOR should be improved. And FOR should be at the international forefront in image guided minimally invasive treatment. Today FOR is involved in research projects and quality improvement programs in such treatment within most surgical disciplines.

The infrastructure-project NorMIT (Norwegian Center for Minimally Invasive Image guided Therapy and Medical Technologies) is a research platform that promote new contacts nationally and internationally. This platform has been developed together with The Intervention Center at The National Hospital with economic support from The Norwegian Research Council. The aim is to improve patient treatment and to strengthen research and innovation putting Norway on the map from an international point of view. We are pleased to get this opportunity together with The intervention Center and our other collaborators. In 2014 we have mainly focused on the establishment of the structure.

*Jan Gunnar Skogås
Managing Director, FOR*



Scientific Work

PhD theses completed in 2014

Conrad Lange

"Endovascular therapy of aneurysmal disease"

The work is including investigations of endovascular treatment(EVAR) 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 including long-term results following endovascular treatment of abdominal and thoracic aneurysms treated at St. Olav`s Hospital is another part of the study. Four papers have been published. The thesis was defended October 10th 2014.

Supervisors: Erney Mattsson, Hans O. Myhre

Wenche Moe Thorstensen

"Symptoms from nose and sinuses in patient with asthma - united airways"

This investigation is focusing on nasal symptoms in patients with bronchial asthma and on the effect of these symptoms when improving the pulmonary function during treatment. 100 patients with bronchial asthma and 100 non-asthmatic control subjects were included in the investigation. We observed that patients with asthma had a smaller nasal volume and smaller nasal cross sectional area than control subjects. The asthma patients had significant more symptoms of nasal stenosis, lower maximal nasal air flow and lower nose-sinus related quality of life compared with controls. Patients having non-allergic asthma had the same degree of symptoms as those with allergic asthma.

Defended October 17th 2014.

Supervisors: Sverre Steinsvåg, Vegard Bugten, Malcolm Sue Chue.

Ongoing PhD studies

Daniel Fossum Bratbak

"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 pterygopalatina using endoscopic transnasal surgery with direct approach to the ganglion. The navigation tool "Multiguide" is patented and developed in collaboration with TTO and Department of Medical Technology. This work is a cooperation between Department of ENT, Department of Neurology and Department of Radiology.

The first part of the study is including 40 patients. It includes biopsies and injection by the Multiguide system transnasally and transorally. The procedures are performed in local or general anaesthesia at the FOR operating room, ENT. A pilot study including 10 patients with "therapy resistant" cluster headache is completed. EU application for an international study including 8 centers has been completed. NOK 1 mill. has been granted for disposable equipment for the project. Please see www.multiguide.no for further information regarding this project.

Supervisors: Erling Tronvik, Ståle Nordgård.

Mads Moxness

"Modelling of upper airways in patients with sleep apnea"

The Norwegian research council has allocated a research grant of NOK 9 mill. to The Medical Faculty, Faculty of Engineering, Science and Technology and SINTEF in order to develop a 3 D model with data simulation of upper airways in patients with sleep apnea. The investigation will take place before and after surgery for this condition. The model is based on CT scan, MRI and measurement of the airways. In one part of the project, 20 patients will be operated at the FOR operating room, ENT. The clinical results will be compared with postoperative measurements and results from the model-based calculations. The aim is to explore factors influencing the results of nasal surgery in OSAS and to be able to predict the results of surgical treatment in each individual patient.

This is a 3 year project for Mads Moxness.

Supervisor at Department of ENT: Ståle Nordgård

The project will be finished in 2017 and will lead to 2 PhD degrees and one Master degree regarding evaluation of the data-simulation.

See www.osas.no for further information.

Cecilie Våpenstad

“Tools and methods for skills training in minimally invasive surgery-using simulators, ultrasound and navigation”. Technological PhD candidate. Evaluating how simulation and the use of simulators can improve surgical skill and surgical team work. The aim is also to develop tools for using navigation and ultrasound. Supervisors: Toril A. Hernes, Ronald Mårvik, Petter Aadahl.

Geir Arne Tangen

“Enhanced Minimally Invasive Therapy”. Technological PhD candidate. The goal is to develop methods for the 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. In 2014 the focus has been the integration of steerable catheters with navigation technology. He has also worked on a method to obtain better conformity between CT images and the blood vessel anatomy during catheter-based intervention. Supervisors: Toril A. Nagelhus Hernes, Petter Aadahl.

Anna Rethy

“Navigated 3D ultrasound in the treatment of liver tumours.” Clinical PhD candidate. She is studying the use of laparoscopic ultrasound during surgery for primary tumours and metastases of the liver. One is also investigating changes in anatomical position of solid organs while insufflating gas into the peritoneum during laparoscopy and how navigation technology can be used in this situation. Finally she is studying multimodal models of the liver to simulate and test multimodal imaging and training with laparoscopy and navigation instruments. Supervisors: Ronald Mårvik, Thomas Langø.

Camilla Berge

“Abdominal Aortic Aneurysm. Factors influencing early and late mortality”
The investigation is studying long-term results following 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, and AAA rupture at a lower diameter in women than in men. Co morbidity like cerebrovascular disease, diabetes, chronic obstructive pulmonary disease, diabetes and renal insufficiency influenced long term survival negatively. Female patients had a higher incidence of auto-immune diseases than men. There were no differences in the occurrence of co morbidity and

postoperative complications which could explain the higher mortality following surgery in female patients. Inflammatory response in patients with abdominal aortic aneurysm –and its influence on mortality, has been studied. In general, in elective cases, those with a high white blood count preoperatively had a higher mortality than those with normal WBC. Supervisors: Torbjørn Dahl, Anne E. Hagen.

Rita E. Nilsen

“Mapping Brain Plasticity”
Rita Elmkvist Nilsens PhD project is exploring how new image technologies have a formative role in cognitive neuroscience. This includes how image technologies may give knowledge about the brain and as an intervening therapeutic tool for training of the brain and for functional regeneration. The project is using new approaches within cognitive neuroscience regarding the brain as an adaptive and dynamic organ with plastic potential which will be supplemented with perspectives from humanities linked to the mediated nature and bodily anchoring of the human cognition. Supervisors: Aud Sissel Hoel, Liv Hausken, Annamaria Carusi.

Jordi Puig

“Visualisation for neuroscience”
This is a project studying aspects of visualisation in neuroscience. The main focus is on neuronavigation where visualisation techniques, interaction and expanded reality are converging. The aim of the investigation is to analyse visualisation techniques within neuroscience, to develop extended reality- and social web-based visualisations and to evaluate the quality of these interactive visualisation methods via evaluation of experienced esthetics and functionality. At the moment Puig is focusing on social tools for neuroscientists. The tool includes the possibility to store and find results which other scientists have found regarding the function of specific areas in the brain. Supervisors: Andrew Perkins and Aud Sissel Hoel.

Páll Jens Reynisson

Multimodal image fusion in minimally invasive interventions.

Technological PhD candidate, NTNU, 2011-15.

Lars Eirik Bø

Image-guided spine surgery.

Technological PhD candidate.

Vijayan Sinara

Work title: Planning and intraoperative ultrasound imaging in laparoscopic liver therapy – Technological aspects to enable navigated laparoscopy.

Technological PhD candidate, NTNU, IIIOS project, ITN EU.

Hanne Sorger

Development of navigated ultrasound in bronchoscopy. Clinical PhD candidate.

Erik Smistad

Medical Image Segmentation. Technological PhD candidate.

Mohammad Mehdi

Medical Image Visualization. Technological PhD candidate.

Post doc. – ongoing**Heidi Gilstad****“Health communication in a digital everyday situation”**

In spite the fact that adequate information is a patients right in today’s health care system, the number of complaints about insufficient information is steadily increasing. Therefore information and communication need to be improved. The aim of the investigation is to accumulate knowledge about communication practice from the patient is admitted to hospital and until the treatment is completed. The experience from patients and health care workers will be investigated. Data from field investigations, interviews, written patients records etc. in a major Norwegian hospital will form the basis for the investigation.

Håkon Olav Leira

Håkon Olav Leira has a 50 % postdoc position for 6 years at ISB, DMF, and NTNU. He is also a consultant at the department of pulmonary medicine. His main research topic is on bronchial carcinoma, especially navigation combined with bronchoscopy. This is a part of USIGT, FOR and NorMIT. He is also active in the planning of the new FOR operating room at the department of pulmonary medicine.



Heidi Gilstad
Photo: NTNU



Håkon Olav Leira
Photo: Liv-Inger Stenstad, FOR

Completed Master Projects

Marit Furre Amundsen

“Quality of life after surgery for chronic rhinosinusitis”. Chronic rhinosinusitis and acute recurrent sinusitis (CRS) are among our most common diseases of the airways. One common cause of CRS is obstruction of the sinal ostia which may interfere with drainage of the sinuses. Whenever conservative treatment is insufficient, endoscopic surgery of the sinuses (FESS) is a possibility. The goal is then to remove the obstruction and to improve the drainage. There are indications that the quality of life is improved after surgical treatment of CRS. However there may not always be a good correlation between the patients’ health related quality of life and findings on CT scan or endoscopy.

In 2012 St. Olavs Hospital started a quality register for patients undergoing endoscopic sinus surgery. The register will be used in the present investigation.

The aim was to explore whether generic and disease-specific quality of life is changing during 6 months after endoscopic sinus surgery in patients with CRS. The Master project was defended October 30th 2014.



Mari Furre Amundsen
Photo: Kari Lilleeng

Ida Lerheim Fagerli og Cecilie Liseth

“Safety in the operating room”

This project was carried out by the students Cecilie Liseth and Ida Lerheim Fagerli in collaboration with The Operating Rooms of the Future (FOR) and NTNU. The main supervisor at NTNU is Karin Laumann and the co-supervisor was Gunhild Sætren. The project led to a master degree in work and organizational psychology. The aim was to study the culture regarding safety at Norwegian operating departments. And we wanted to evaluate this culture comparing with new knowledge and theory within this field.

An important goal was to investigate how various factors may influence safety in the operating rooms and how theories regarding safety might improve this. We wanted

to study the attitude towards personal failures and how such failures influenced routines and procedures in operating rooms. We also wanted to study how the hospital is organizing the operating rooms to maintain safety and we wanted to compare the routines with relevant organizations. This could give information that may lead to changes of the actual organization and thereby improve safety and reduce the risk for the patients.

The data-collection of this investigation is consisting of nine interviews of employees at the operating department and observation of two operations. The Master project was defended September 12th 2014 and both candidates obtained the mark A.

Ida Lerheim Fagerli

The findings of Ida Lerheim Fagerli indicates that failures in the operating room lead to focusing on the individual, and that there is a potential for improvement of the team work and the patient safety. The system of reporting deviations should probably be used to a greater extent. Several measures have been suggested to increase the number of such reports and to improve the quality of them. The findings from this study are in agreement with similar investigations from other countries.



Ida Lerheim Fagerli
Photo: Privat

Cecilie Liseth

In Cecilie Liseths Master thesis it became clear that the informants regarded patient safety as the core of the safety work. Various factors influencing achievements and the work with unwanted events were of importance in this respect. A focus on individual responsibility and failing facilitation were characteristic for the safety work in the organization. In this system the reporting of deviations is of major importance. And this system is regarded as an important resource in case it is used whenever unwanted events are observed. Better understanding and facilitation of the use is required.

The findings are in agreement with observations from other countries and indicate that it is possible to improve patient safety by improving knowledge and facilitate the safety work in the organization.

FOR came in contact with the supervisors for these two theses. They were exploring how to find a platform for the project. After approval by the scientific advisory board of FOR, FOR has assisted in contacting departments to take part in the project and FOR has been the link between the students and the hospital.



Cecilie Liseth
Photo: Private

Bachelor degrees, 2014 (HiST, University College of Sør-Trøndelag)

Biomedical laboratory scientist, HiST

“Microbiological testing of medical equipment used in patient treatment at St Olav`s Hospital”

Candidates: Karoline Kittelsrud Aaram, Karoline Brodal Bjørgum and Camilla Håkonsen

Department of Radiography, HiST

“Measurement of radiation and observation of radiation hygiene at The Department of Neurology”

Candidates: Silje Pedersen and Inger Marie Reitstøen

Department of Radiography, HiST

“Measurement of radiation dose to the lens in personnel working with TAVI”

Candidates: Linn Anett Govassli and Ina Gardsegg

Department of Health and Social Work, HiST

“Check lists for safe surgery”

Candidate: Silje Hernes

Department of Health and Social Work, HiST

“Check lists for safe surgery in Operating Rooms of the Future and factors influencing adherence to check lists”

Candidates: Sondre Sørmo

Department of Health and Social Work, HiST

“Safe surgery by a customized check list according to WHO”

Candidate: Kristine Skjold

Department of Health and Social Work, HiST

“Check lists for safe surgery-how can it be improved?”

Candidate: Camilla Jacobsen

Department of Health and Social Work, HiST

“Improved survival by adherence to check lists for safe surgery”

Candidate: Olav Andre Gjøvik

Ongoing Projects

An important part of the mandate of FOR is to create R&D projects and commitments in the interphase between scientists, health care personnel and industry. It is a goal to achieve new knowledge and new solutions which will be for the benefit of the patients and the health care system. We are here in the interphase between research and innovation- between the creation of new knowledge and its use in daily routine.

Interaction with the clinical departments is important to assure that new solutions, methods and processes are implemented in the routine work. We are representing an infrastructure for the testing of new medical technology and new treatment modalities in order to secure the bridge between existing routine and new developments. The Operating Room of the Future has an extensive cooperation with industry, nationally as well as internationally through several research and development projects. This cooperation is important for the promotion of satisfactory application of the research and development projects performed by FOR.

By establishing NorMIT, the Norwegian Research Council realized that FOR have methods and systems to work effectively together with industrial companies and clinical centers to generate new knowledge and to promote innovation. The Norwegian Research council as well as The Frame Program of the European Union have recently stressed the importance of the usefulness of research results is an important criterion when allocating research grants .We regard the support of NorMIT as a recognition of our focus on new applications and innovation. This is important in our future strategic orientation to programs for research and development.

In 2014 FOR had collaboration with several industrial companies like Sony, Covidien, Intuitive, Siemens, Nice Design, Incita, Parallel World Labs, Kantega, Stryker, IBM, Petrobas, Dorc, ConocoPhilips, Olympus, Medtronic, Nord Trøndelag E-verk and Karl Storz. We also have excellent cooperation with NTNU Technology Transfer regarding ideas and patents developed by FOR or our close collaborators. Several innovation projects have been established as a result of this cooperation.

Quality Register for ENT sinus surgery and “Fast-track”

St. Olav`s Hospital established in January 2012 a quality register for patients undergoing endoscopic sinus surgery where quality of life is recorded preoperatively and 6 months postoperatively.

All endoscopic and open surgical procedures within this field are recorded consecutively regarding type of procedure and results. So far 600 patients have been included. The register is forming the basis of several research projects. As a result of this work, a national register for nose-and sinus surgery has been established in Trondheim.

“Fast track” refers to a standardized course for patients having undergone certain types of nose-sinus surgery including instruction of the patients, planning of the patient`s postoperative visits at the hospital and organization of work to obtain an optimal and cost-effective treatment .This is included in the quality register.

“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 a rack for the testing has been acquired.

Leader of the project: Professor Christoph Ziegler.

Balloon sinoplasty in chronic sinusitis

We are testing 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 where the drainage has been blocked by chronic rhino-sinusitis. Preliminary testing has been performed and a study on the quality of life after balloon dilatation is running.

Leader of the project: Assistant Professor Vegard Bugten.

Arthroscopy of the mandibular joint

So-called craniomandibular dysfunction might affect 5-10 % of the population. In several cases of primary joint-related pathology, athrocentesis or arthroscopy can be used for diagnosis or therapy. The present project is exploring the effect of arthroscopy in general anaesthesia on function (chewing) and on subjective discomfort (pain) for the patient.

Project leader: Professor Christoph Ziegler.

Project at the department of Eye diseases.

This project is focusing on the situation where it is necessary to operate on the retina and for cataract simultaneously. Such operations are carried out as elective procedures as well as emergencies. Today we need one type of equipment for each operation which means that we have to change equipment intraoperatively. This situation is also occupying space in the operating room. We will now test out combi-equipment allowing us to perform both operations (cataract and retina) without having to change equipment. The differences between the two types of instruments to be tested are mainly on the pump system. We hope that this also might increase the capacity for combined procedures at our department and that the operating room logistics will improve. The project was finished in May 2014.

Case study, ORF-IO. Clinic of Neurosurgery, Røros Hospital and FOR.

This project is a comparative study where we are learning from other fields. With the background from similar studies with onshore rig teams we made an investigation of technology-supported interpretation and collaboration in a surgical team at St. Olav's Hospital. By identifying core characteristics and conditions for these teams, we could focus on important factors that must be taken into consideration when establishing geographically distributed arenas for collaboration as in the petroleum sector and in the health care sector.

We observed that an important success factor in the operating room was to create a meaningful image of the future. This means that all those working in or in relation to the operating rooms had the same interpretation of the information given to them. This gives a good background for the understanding of what is going on the next seconds, minutes, hours and days.

Another important finding is that the separation of work processes between interpretation, decision and execution, which usually forms the basis for the creation of work processes in geographically and professionally distributed settings, may be demanding. Our study of surgical teams is supplementing observations from the petroleum industry and is forming a basis for the understanding of interpretation, decision making and execution as non-discrete activities without sharp borders between them.

The case study will be described in a paper in the journal CSCW-Computer Supported Cooperative Work in a special issue on Collaboration and Augmented Reality.

Knitted stent

Stenting of the blood vessel system is today a common method to restore blood flow after treatment of pathological processes. Most stents used today will remain within the vessel forever, in spite of the fact that the stent is necessary only a few days after balloon angioplasty performed to dilate the vessel. When the acute reaction after the dilatation is over, the stent is usually no longer required. From this period the stent is rather functioning as a foreign body creating mechanical irritation and scar tissue which might lead to re-occlusion of the vessel. This could then lead to recurrent symptoms for the patient.

We have now tested a knitted stent which can be unravelled by pulling the thread forming the stent. The purpose of these experiments in a sheep-model was to compare the risk of recurrent stenosis when comparing with traditional stents which are commonly used today. Preliminary results indicate that the knitted stent do not induce secondary stenoses in the treated vessel. Please see demonstration at "Schrødingers katt":

<http://tv.nrk.no/serie/schrodingers-katt/dmpv73001114/13-03-2014#t=4m58s>

Knitted stents in the bronchial system

There are benign as well as malignant obstructions in the airways (e.g. congenital stenosis, fibrous membranes, post-infectious granulomas, extra and intra bronchial carcinomas). Stenting can in some cases be life-saving and may relieve symptoms significantly when the patients are suffering from shortness of breath. In the latter group a permanent stent may be disadvantageous because they may induce complications when the initial phase is passed. The obvious solution is a removable stent which is left in the bronchial tree as long as needed-and then removed.



Photo: Erney Mattson

Minimally invasive treatment of chest diseases-testing of new bronchial stent.

Background: Lung cancer and interventional bronchoscopy (laser and stenting)

Diagnosis and treatment of bronchial carcinoma – has been given high priority by the health authorities.

Project cooperation: St. Olav`s Hospital (Department of pulmonary medicine, department of vascular diseases, MedTekDepartment and FOR) and NTNU, SINTEF.

Project leaders: Professor Tore Amundsen/Professor Erney Mattsson

Minimally invasive treatment for life-threatening bronchial obstruction caused by tumor-STENT treatment.

Obstruction of the bronchial system by malignancy (Malignant airway obstruction=MAO) is a feared complication in lung cancer. MAO can often be treated by stenting with or without laser treatment, irradiation or chemotherapy. During recent years, the department of pulmonary diseases has established the competence for such treatment. The new stent is an important contribution to this activity. Further development of this method is therefore important.

The self-expanding stents (SEMS) used today cannot be removed from the bronchial system.

This is a problem since these stents can in the long run induce complications caused by inflammation, stagnation of bronchial secretion, cough, dyspnoe and pneumonia. Permanent stents can also form fistulas or be dislocated to a more narrow part of the bronchus.

The new self-expanding stent is mechanically knitted and can be removed any time. The stent can be unravelled by pulling the thread which originally is forming it. In this way it is possible to perform the necessary treatment (chemotherapy, irradiation or laser in patients with intrabronchial obstructing tumors) and the stent can be removed later when it is no longer required. In addition the stent can be "tailored" regarding length, diameter, thickness of the material (strength) etc.



Foto: Erney Mattsson

The STENT is a completely new development, invented and tested by professor Erney Mattsson before he started working at St Olav`s Hospital/DMF/NTNU. But so far it has only been tested to a limited extent. He is now doing investigations of stenting in various blood vessels in an animal (pig) model. This was demonstrated in Norwegian TV in the program "Schrödinger`s katt" march 13th 2014. We are now performing animal testing (pig) with the new stent(proof of principle studies):It will be deployed in various segments of the central airways: trachea and the main stem bronchus, followed by stent removal . The procedure is carried out under bronchoscopic guiding using flexible bronchoscope and with the animal in general anaesthesia. Several experiments were performed consecutively during the period November/December 2014.

Further aim:

1. To accumulate experience and competence within stent treatment of obstructing bronchial carcinoma (SEMS will need modifications).
2. To carry out phantom – based investigations, animal studies and pilot studies in patients prior to the start of larger RCT studies.
3. Publication of our experience in peer reviewed international journals.

Scientific Articles

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Presentations at Conferences

- 20.03.14 - NSH and architect forum for hospital building (200 participants). Presentation of FOR. New medical technology and new treatment modalities. JGS
- 03.04.14 – Presentation Utrecht. KT
- 09.04.14 - Network meeting. Presentation about FOR and guiding, LMI, NTNU, NNN – HOM and MH
- 02.05.14 – Kosmorama Trondheim International Film Festival. Medical technologies, advanced image technologies and image guided surgery. JGS
- 13.05.14 - Mr. Jan Gunnar Skogås of St. Olavs Hospital Norway gives speech at Atsugi Tec, Sony Tokyo - Operating Rooms of the Future
- http://www.psg.sony.co.jp/home/BSquare/english/event_show/FY14/20140718_01/20140718_01.html
- 10.06.14 – Inauguration of the research platform NorMIT. The Operating Room of the future from start to NorMIT. JGS
- 11.06.14 - IO-center for Integrated Operations, NTNU, board meeting IO. Operating Room of the future and telemedicine. JGS
- 25.06.14 – National ICT steering committee. Presentation of FOR . discussion about integration MTU and IKT. LIS and JGS
- 15.09.14 – Health authorities of Central Norway . Strategy group of the administrating director. Development of medical technology and ICT, integration and planning. JGS
- 26.09.14 – Drammen Hospital HF, Health authorities of East-Norway. Introduction to future operating rooms and medical technology. JGS
- 2-3.10.14 – Workshop in Telemedicine by FOR. International oil industry in cooperation with medical leaders. FOR og Røros. JGS, MH, LIS and GAP
- 7-8.10.14 – Two- day meeting with the department of development Brainlab. Medical tecnology and navigation. JGS, GAP and LIS
- 14-16.10.14 - Conference in infection limitation, Hamar 14th-16th October, arranged by NSH.
- 05.11.14 – HEMIT: Innovation and operating Rooms of the Future. JGS
- 10.11.14 – Presentation for the students at The department of Radiography ,Trondheim University College . GAP and MH
- 11.11.14 – Hospital Seminar, Stavanger. University Hospital of Stavanger. Medical technology and how new treatment modalities are influencing design of the operating rooms. JGS



FOR, IBM, Arild Nystad and Minister of Oil and Energy, Tord Lien at the IO conference.
Photo: Kai Torgeir Dragland, NTNU

Live-transmissions FOR 2014

- 04.04 – Day of Master degrees
Video transmission from Gastro FOR operating room, Gastric sleeve.
- 22.10 – Video transmission: Total hip replacement – High school KVT, 45 pupils.
- 30.10 – Transmission from FOR operating room 4 to lecture room GU1 – Basic course in hernia operation NSALK, 30 participants.

Participation at Conferences

- Medical Images across Art and Science, 3.- 4.09.14
- VPH 2014 – Virtual Physiological Human Conference. 09. - 12.09.14
- IO14 – 10th International Conference on Integrated Operations 30.09 – 01.10.14
- Seminar Institute of Circulation and Medical Imaging, NTNU 15.10.14
- Innovation conference 20.11.14, Stjørdal.
- Radiological Society of North America (RSNA) 30.11 - 5.12.14

Media Presentations

- 13.03 – Schrødingers Cat, Norwegian TV – Presentation of FOR Operating Room, Cardiovascular AHL-1F.
<http://tv.nrk.no/serie/schrodingers-katt/dmpv73001114/13-03-2014#t=4m58s>
- 21.03 – A-Magasinet nr. 12, 2 pages about Multiguide, Department of ENT.
- "The last days of the scalpel".
Text: Per Magnus Riseng
Photo: Lena Knutli
- 10.04 – <http://www.lmi.no/aktuelt-fra-lmi/2014/04/-straalende-samarbeid-mellom-helsetjeneste-og-industri>
- 02.05 - <http://www.stolav.no/no/Om-oss/Avdelinger/Fremtidens-operasjonsrom/Nyheter/FOR-pa-Kosmorama-Trondheim-Internasjonale-Filmfestival/128333/>
- 23.09 - E 24 - <http://e24.no/digital/fremtidens-arbeidsliv/flere-av-dagens-operasjoner-vil-snart-utfoeres-i-folks-hjem/23260521>
- Helse-Medisin-Teknikk HMT nr. 2. april 2014. Fremtidens Operasjonsrom – en forskningsinfrastruktur (Operating Room of the Future - a research infrastructure)



