

Research at Akershus University Hospital 2015



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Introduction

The research is an important part of the core activities at Akershus University Hospital. We know that active research environments contribute to the development of the disciplines and strengthen the quality of the treatment we provide to patients. Therefore, we want research to be closely integrated with the clinical part of the business. An important goal is for research at Akershus University Hospital to benefit many people. Our research groups contribute to this by increasing knowledge about diseases that affect large patient groups.

It is great that research activity is increasing year by year. The number of employees with research expertise is increasing, and we are actively helping to train more good researchers through the supervision of PhD candidates. This also strengthens us as an educational institution. The close contact we have with the academic communities at the University of Oslo and Oslo University Hospital makes us part of a strong medical professional network that we both contribute positively to and benefit from. It is particularly gratifying that the research communities succeed in obtaining external funding for large and important research projects. The positive effect of this is reflected in the ever-increasing number of scientific publications.

Another important initiative is research-based innovation. This is what will equip us to face the future. Some of our research communities work actively to develop tools that can help solve key challenges in diagnostics and treatment. We will support this by creating a good innovation culture at the hospital in the years to come.

Lørenskog, 18 September 2016,


Øystein Mæland
Administrerende direktør


Tone Ikdahl
Viseadministrerende direktør

1. Summary

Research and innovation are important focus areas at Akershus University Hospital. The initiative has resulted in an increasing number of scientific articles and public defences in recent years, and the annual report shows that the positive development continues.

In 2015, a total of 285 scientific articles were published based on research at Akershus University Hospital. This represents an increase of almost 20% compared to the previous year. The number of articles with international collaboration is also increasing. The three articles that were awarded the hospital's prize for outstanding research in 2015 testify to the high quality and professional breadth of production. The number of doctoral degrees is also rising; from five defences in 2008 to 17 in 2015.

In 2015, 169.3 full-time equivalents were used among 447 people for research activity at Akershus University Hospital. Mapping according to the Health Research Classification System (HRCS) shows that the use of research resources has a good academic spread, with emphasis in the areas of mental health, cancer, neurology and the category "general health relevance", where health services research constitutes a significant part. There is approximately equal distribution between research on causalities, detection and diagnosis on the one hand, and research on prevention, treatment and management of disease states on the other.

Much of the research is externally funded. Solid planning and good applications from the research groups have led to an increased allocation of research funding. In 2015, Akershus University Hospital was allocated a total of NOK 89 million for research, compared with NOK 53 million in 2014. Important sources of funding are the South-Eastern Norway Regional Health Authority, the Research Council of Norway, the Norwegian Cancer Society and the Extra Foundation. Internal strategic research funds are used to support further investment in research areas that are important to the hospital.

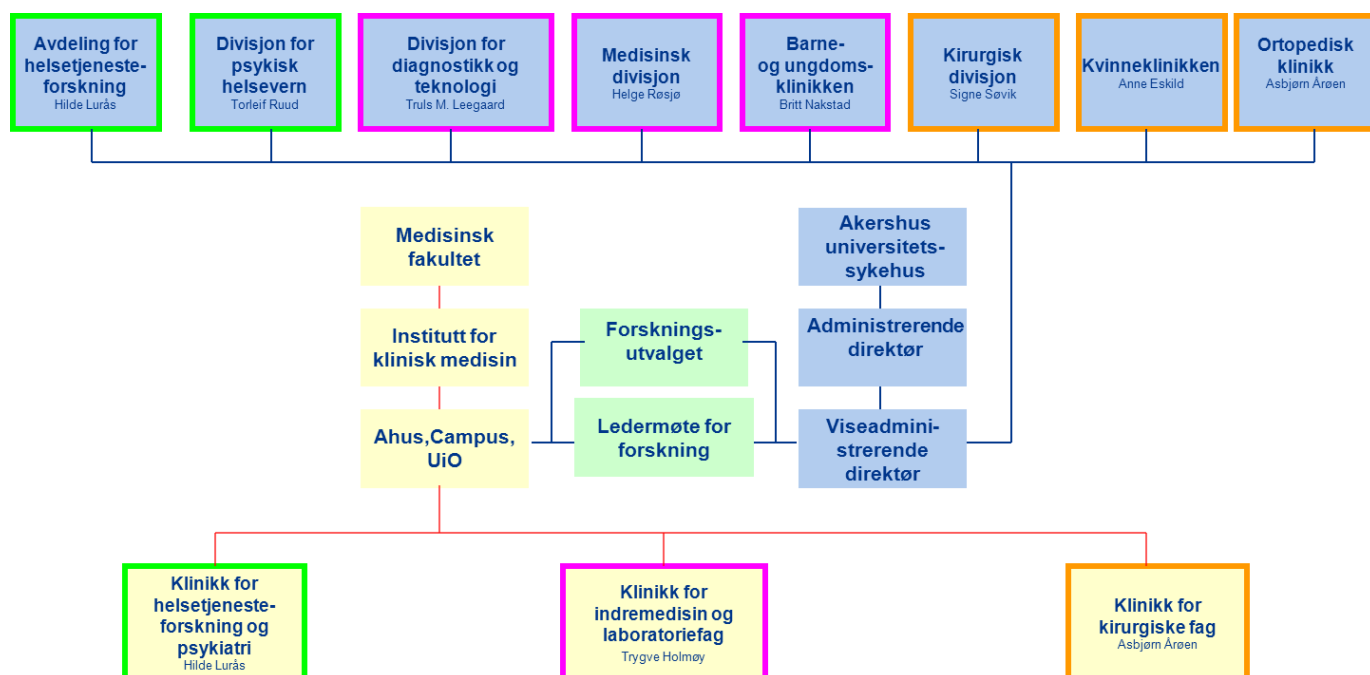
2. Organisation of research at Akershus University Hospital

The research activity at Ahus is organized together with UiO with joint research management that reports to both hospitals (blue boxes) and universities (yellow boxes). On the hospital side, responsibility for research is related to divisions and clinics, while research on the university side is organized into three clinics; health services research and psychiatry, internal medicine and laboratory sciences, and surgical sciences. All research active participants are affiliated with a research group (see Appendix 1).

The Division Director/Clinic Director has delegated responsibility for research in his unit to a research manager. The leaders of the three UiO clinics have shared positions, and have research leadership responsibility for academic positions in several divisions, illustrated in the figure by the outline colour of the various boxes.

The management meeting for research (bottom green box) discusses topics related to management and organisation of research. The Research Committee (top green box) is a strategic advisory body for the Executive Director of Research Affairs. The committee is based on the Collaboration Agreement between UiO and Ahus.

Figure 1: Organisation of research at Ahus and UiO, campus Ahus.



3. Use of resources

In 2015, total resource use for research and development (R&D) amounted to 169.3 full-time equivalents. Of this, research full-time equivalents constitute 162.3. The full-time equivalents are distributed among 447 people as a result of most research professionals having combined positions in the clinic. In addition to the Ahus full-time equivalents, 47.2 full-time equivalents are affiliated with UiO. This includes six 100% professorships, 20% professorships/associate professorships and various types of research support. Ahus has two combined positions with Oslo and Akershus University College (HiOA), one in the Division of Mental Health Care and one in the Department of Health Services Research.

Table 1 shows the distribution of research full-time equivalents by division/clinic. For example, if we look at the column on the left of the table (Division of Diagnostics and Technology, DDT), that division has a total of 11 Ahus full-time equivalents divided into 30 people, nine of the full-time equivalents are internally funded, while two are financed externally. Similar information for the other divisions can be found in the columns to the right. Table 2 shows the corresponding overview of UiO associated full-time equivalents.

The research support at the hospital is partly funded from UiO and partly from Ahus (right column in both tables). Research support includes libraries, data capture, statistics, biobank, administrative and technical services. This amounts to a total of 10.5 full-time equivalents distributed among 16 people in the Ahus line, and 10.5 full-time equivalents distributed among 11 people in the UiO line.

Table 1: Divisional distribution of full-time equivalents (persons) for research and development (R&D) Ahus. 2015.

Ahus	DDT	PSYK	KIR	Orto	MED	KK	BUK	Forskning og innovasjon	Forskningsstøtte
Internt finansiert	9,0	27,2	5,1	6,6	30,5	2,3	5,6	5,0	10,5
<i>Antall ansatte</i>	27,0	69,0	36,0	35,0	116,0	6,0	21,0	10,0	16,0
Eksternt finansiert	2,0	2,3	0,2	0,8	34,3	3,8	7,2	16,9	
<i>Antall ansatte</i>	3,0	3,0	1,0	4,0	53,0	9,0	12,0	26,0	
Ahus totalt årsverk	11,0	29,5	5,3	7,4	64,8	6,1	12,8	21,9	10,5

Table 2: Divisional distribution of full-time equivalent academic positions. Campus Ahus, UiO. 2015.

UiO - Campus Ahus	DDT	PSYK	KIR	Orto	MED	KK	BUK	Forskning og innovasjon	Forskningsstøtte
Internt finansierte årsverk	1,2	0,4	7,1	2,9	12,5	1,4	1,2	0,4	10,5
Eksternt finansierte årsverk	0,2	0,0	0,6	0,0	7,5	0,0	0,2	1,2	0,0
UiO totalt årsverk	1,4	0,4	7,7	2,9	20,0	1,4	1,4	1,6	10,5

Table 3 shows the development in the number of full-time equivalents over the last three years. In total, the number of Ahus full-time equivalents has increased by 37, the increase has mainly taken place in the Medical Division and in the Department of Paediatric and Adolescent Medicine. The total number of UiO full-time equivalents (FTE) has increased by 10 in the same period.

Table 3: Development of divisional distribution of full-time equivalents for research and development (R&D) Ahus and Campus Ahus for the period 2013 - 2015.

	DDT	PSYK	KIR	Orto*	MED	KK	BUK	HØKH	Research Support	TOTAL
Ahus FTE										
2013	12,8	22,2	8,5		46,0	7,0	3,3	23,0	8,5	131,3
2014	13,0	30,6	4,4	4,9	55,6	6,9	9,0	19,7	9,6	153,7
2015	11,0	29,5	5,3	7,4	64,8	6,1	12,8	21,9	10,5	169,3
UiO FTE										
2013	2,4	0,9	8,5		13,0	1,4	2,1	1,6	7,0	36,9
2014	1,4	0,4	6,2	3,2	16,7	1,9	1,4	2,8	9,8	43,8
2015	1,4	0,4	7,7	2,9	20,0	1,4	1,4	1,6	10,5	47,3

*In 2013, the Department of Orthopaedics was organized under the Division of Surgery.

DDT: Division of Diagnostics and Technology

PSYK: Division of Mental Health

KIR: Division of Surgery

ORT: Orthopaedic Clinic

MED: Division of Medicine

KK: Division of Gynaecology and Obstetrics

BUK: Division of Paediatric and Adolescent Medicine

HØKH: Health Services Research Group including Head and neck research group

4. Publications and doctoral degrees

Scientific publication channels for health trusts are divided into two quality levels¹

Level 1: Approved scientific publication channels (1 point)

Level 2: Especially reputable scientific journals (3 points)

In 2015, 285 articles with Ahus address were registered in CRISTin (Current Research Information System in Norway)² in 2015. Of these, 18 % have been published in a level 2 journal, the rest in a level 1 journal (Table 4). Table 5 shows the distribution of scientific articles between divisions/clinics.

Table 4: Number of scientific publications by level and total at Ahus.

Level 1		Level 2	
Number	%	Number	%
234	82	51	18

Table 5: Scientific publications by division at Ahus

	Total	Level 1	Publ. points *	Level 2	Publ. points *
Division of Paediatric and Adolescent Medicine	28	24	10,49	4	4,45
Division of Diagnostics and Technology	30	27	10,37	3	0,85
Division of Mental Health	43	36	13,84	7	5,09
Unit for Medicine and Health Sciences	1	1	0,13		
Health Services Research Unit*	64	49	17,87	15	20,86
Division of Surgery	30	28	11,91	2	2,08
Division of Gynaecology and Obstetrics	16	6	3,77	10	16,21
Division of Medicine	124	102	37,42	22	21,06
Orthopaedic Clinic	7	6	2,76	1	1,95

*: Including Head and Neck

In 2015, 17 employees defended their dissertations, table 6 shows the distribution of the number of completed doctoral degrees per division. Section 12 contains a brief summary of the various theses.

Table 6: Number of public defences per division

	Number
Division of Medicine	8
Health Services Research Unit	3
Division of Gynaecology and Obstetrics	1
Division of Mental Health	1
Division of Paediatric and Adolescent Medicine	2
Orthopaedic Clinic	2

¹ <https://dbh.nsd.uib.no/publiseringskanaler/Forside>

² <http://www.cristin.no>

5. Development in the number of publications and doctoral degrees

Tables 7 and 2 and 3 show the development in the number of scientific publications and the number of completed doctoral degrees in the period from 2008 to 2015. The number of published articles has remained relatively stable in recent years, but for 2015 we see a positive increase to 285 articles from 238 articles in 2014. The number of completed doctoral degrees has fluctuated somewhat, but there is an underlying growth from 2008 to 2015.

Table 7: Publications and doctoral degrees 2008-2015.

	2008	2009	2010	2011	2012	2013	2014	2015
Publications	108	107	130	210	238	228	238	285
Doctoral degrees	5	7	10,5	8	20	10	15	17

Figure 2: Development in number of publications

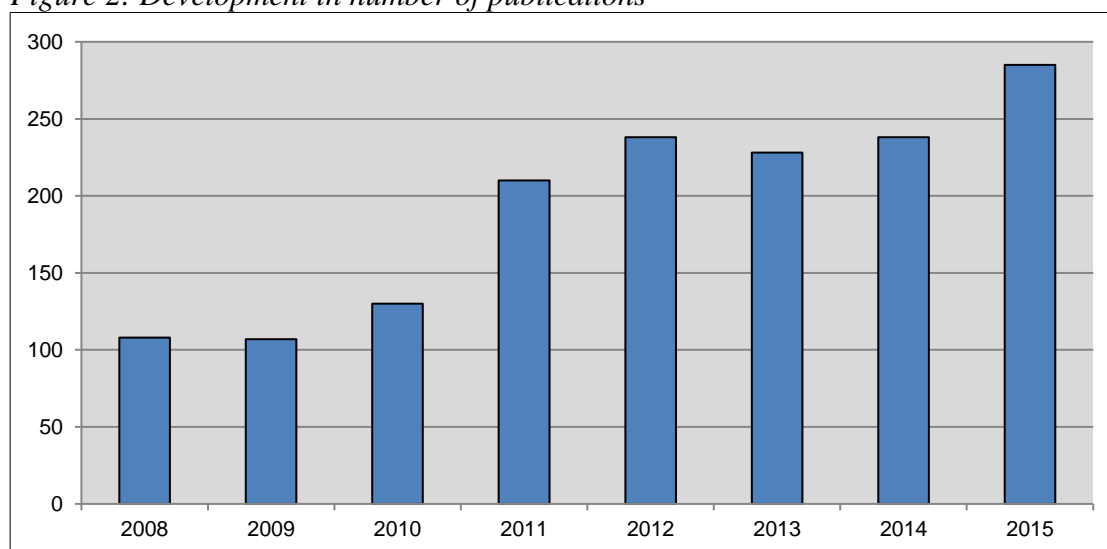


Figure 3: Development in the number of doctoral degrees

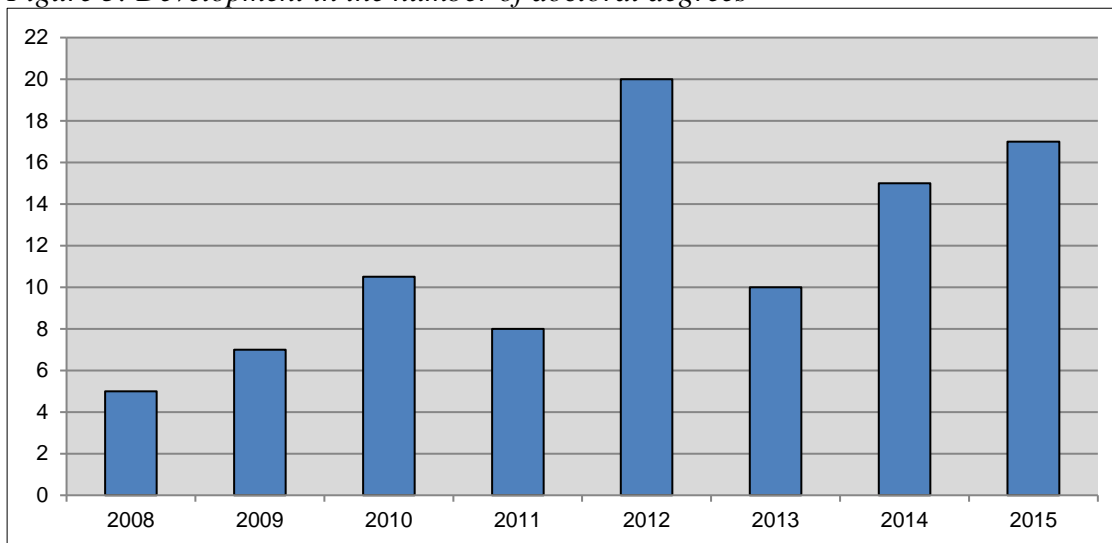
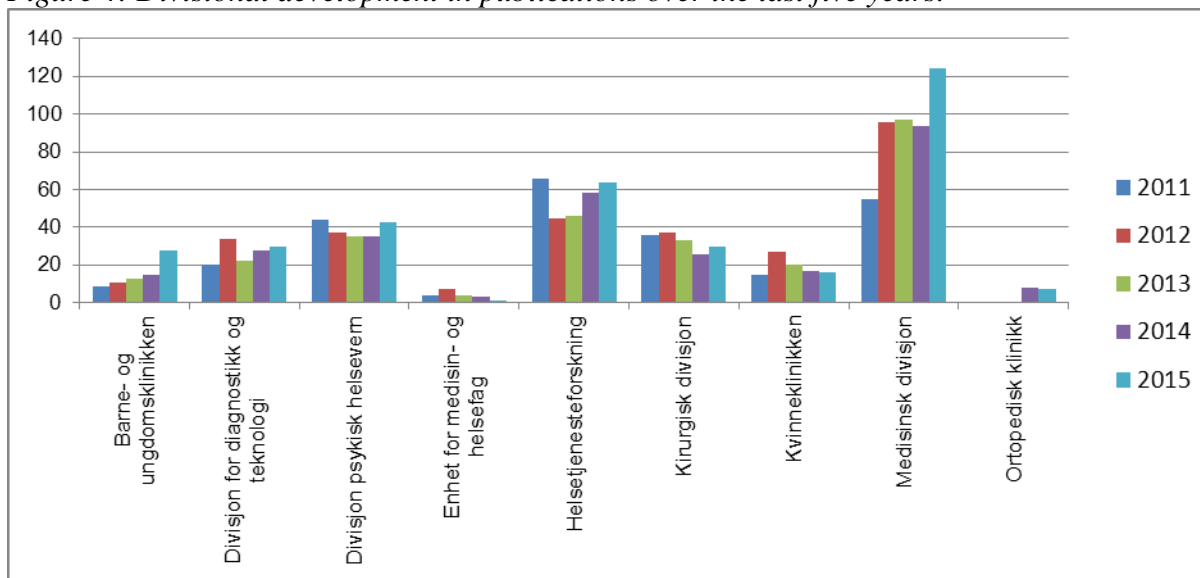


Figure 4: Divisional development in publications over the last five years.



6. Publishing researchers

The tables below show the number of researchers who have published at least one scientific article with Ahus address in 2015. Table 8 shows publishing researchers by gender and age, and Table 9 shows the corresponding overview by division. Data were obtained from CRISStin.

Table 8: Publishing researchers by gender and age

Men		Women		Total	
Number	Avg. age	Number	Avg. age	Number	Avg. age
115	48,4	130	43,3	245	45,7

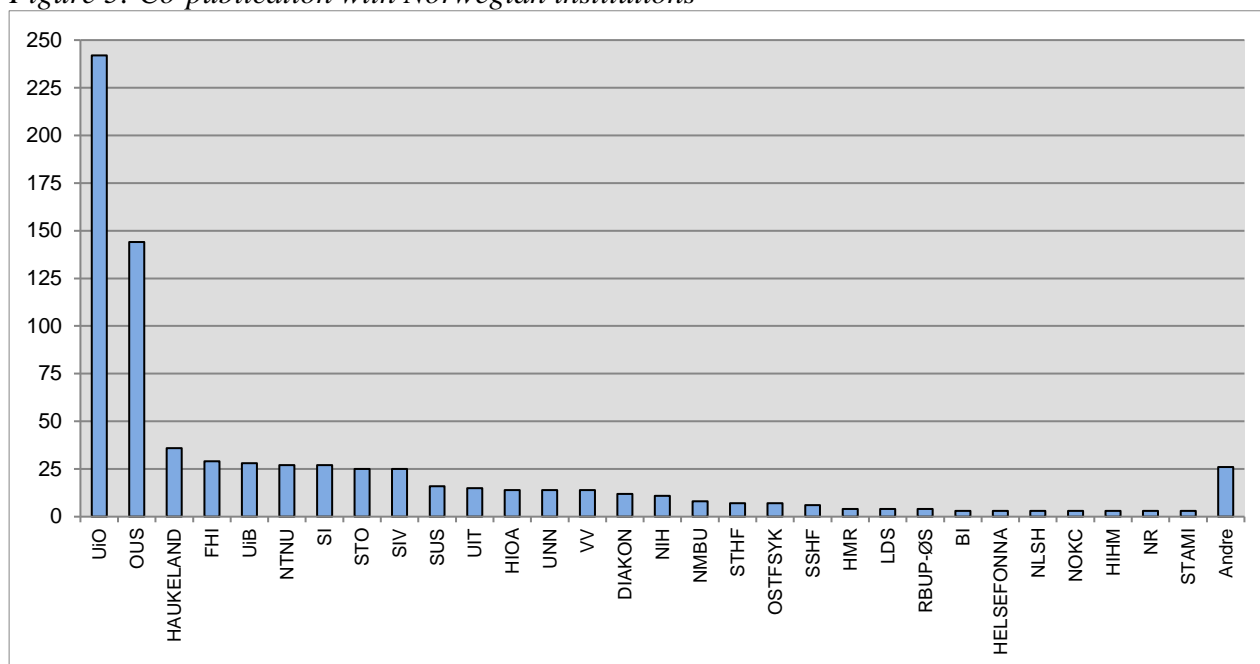
Table 9: Publishing researchers by sex and age by division

	Men		Women	
	Number	Avg. age	Number	Avg. age
Division of Paediatric and Adolescent Medicine	9	45	10	40
Division of Diagnostics and Technology	16	51	25	47
Division of Mental Health	8	51	11	45
Unit for Medicine and Health Sciences	0		1	52
Health Services Research Unit	10	43	16	44
Division of Surgery	19	51	5	40
Division of Gynaecology and Obstetrics	2	58	16	42
Division of Medicine	43	48	44	42
Orthopaedic Clinic	8	47		

7. National cooperation

Figure 5 shows an overview of Norwegian institutions that researchers at Ahus publish with. Co-publication with UiO and Oslo University Hospital (OUS) is most common.

Figure 5: Co-publication with Norwegian institutions



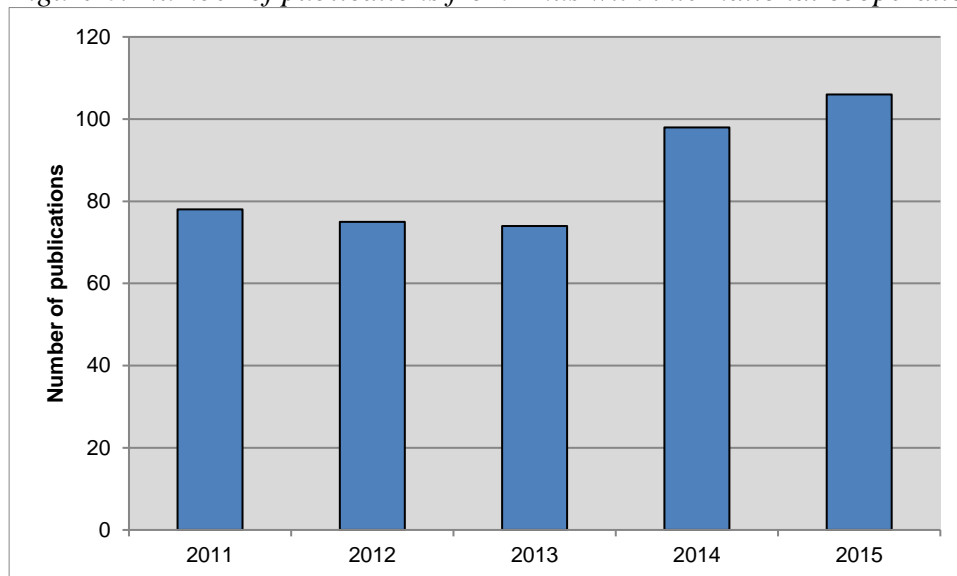
Description of the abbreviations in the figure above:

<ul style="list-style-type: none"> • UiO – University of Oslo • OUS – Oslo University Hospital • HAUKELAND - Haukeland University Hospital • NIPH – Norwegian Institute of Public Health • UiB – University of Bergen • NTNU – Norwegian University of Science and Technology • SI – Innlandet Hospital Trust • STO – St Olav Hospital • SIV – Vestfold Hospital Trust • SUS – Stavanger University Hospital • UiT – University of Tromsø • NIH – Norwegian School of Sport Sciences • HiOA – Oslo and Akershus University College • UNN – University Hospital of North Norway • VV – Vestre Viken • DEACON – Diakonhjemmet 	<ul style="list-style-type: none"> • NIH – Norwegian School of Sport Sciences • NMBU - Norwegian University of Life Sciences • STHF – Telemark Hospital Trust • OSTFSYK – Østfold Hospital Trust • SSHF - Sørlandet Hospital HF • HMR – Møre og Romsdal Hospital Trust • LDS - Lovisenberg Deaconess Hospital • RBUP_EEA - RBUP East and South • BI – BI Norwegian Business School • Health Fonna • NLSH – Nordland Hospital Trust • NOKC – Norwegian Knowledge Centre for the Health Services • HIHM - Hedmark University College • NR – Norwegian Computing Center • STAMI – National Institute of Occupational Health
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8. International cooperation

In 2015, 106 articles or 37% of the published articles were co-publication with international partners. As figure 6 shows, the number of articles that include international cooperation has increased in recent years.

Figure 6: Number of publications from Ahus with international cooperation



9. Distribution of resource use by health category and research purposes

The Health Research Classification System (HRCS) is a system for mapping how research resources are distributed by health/disease category (e.g. cardiac, neurology or mental health) and research purposes/type of research (e.g. causal research, evaluation research or treatment research).

This type of survey has not been conducted in Norwegian health trusts so far, but the objective of the HealthCare21 strategy is to facilitate this. In connection with this year's resource survey, an HRCS pilot was carried out at Ahus. The results for the health trust overall show that research in mental health constitutes more than 20% of the activity and is by far the largest disease category, followed by cancer and neurology. Research of general relevance also accounts for nearly 15% of the activity, encompassing health service research (Figure 7). Furthermore, we see that 26% of the research is related to causative research/epidemiology, while the development of diagnostic, prognostic, and predictive markers and technologies accounts for 20% (Figure 8).

Figure 7: Health category overview for Ahus

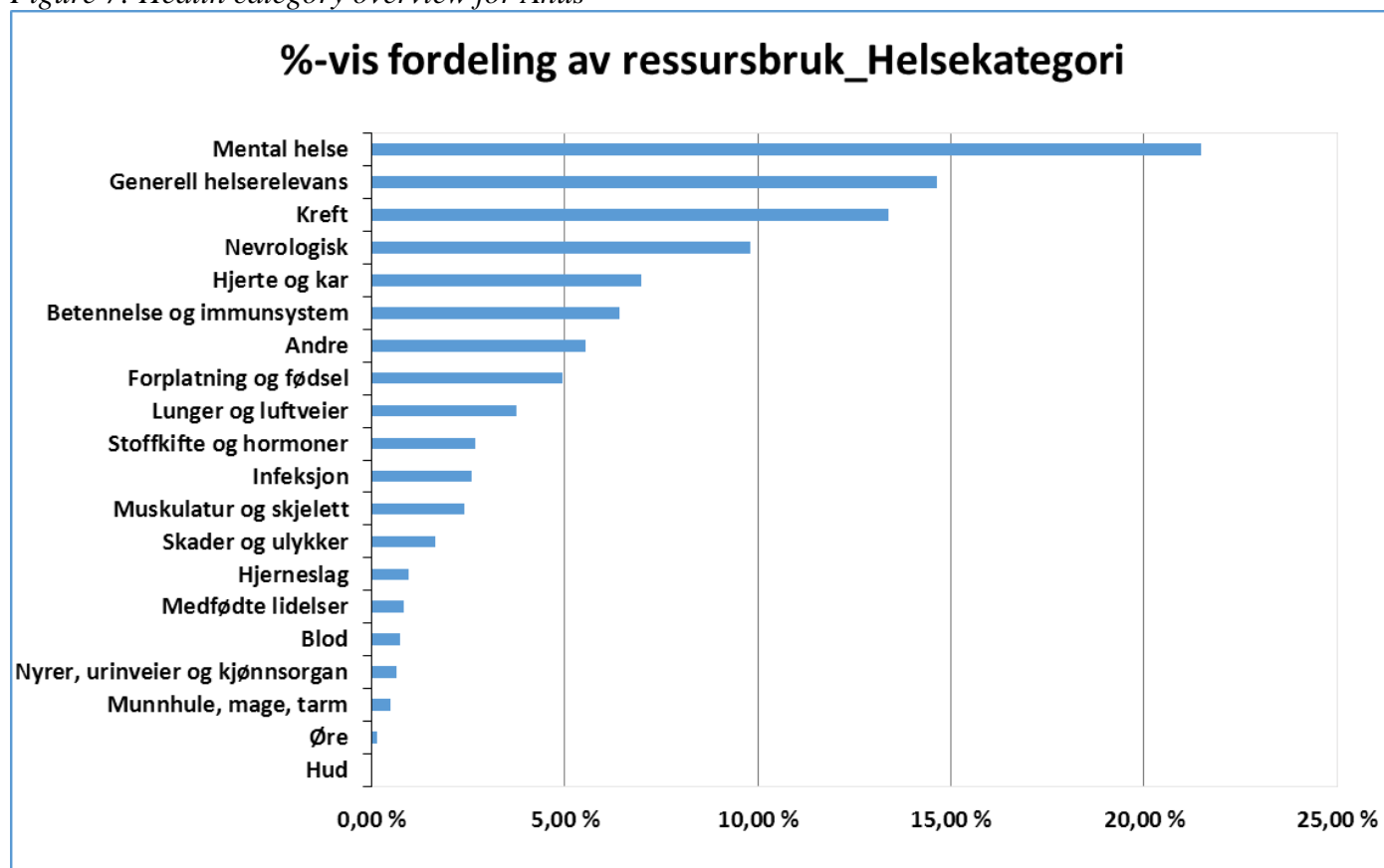
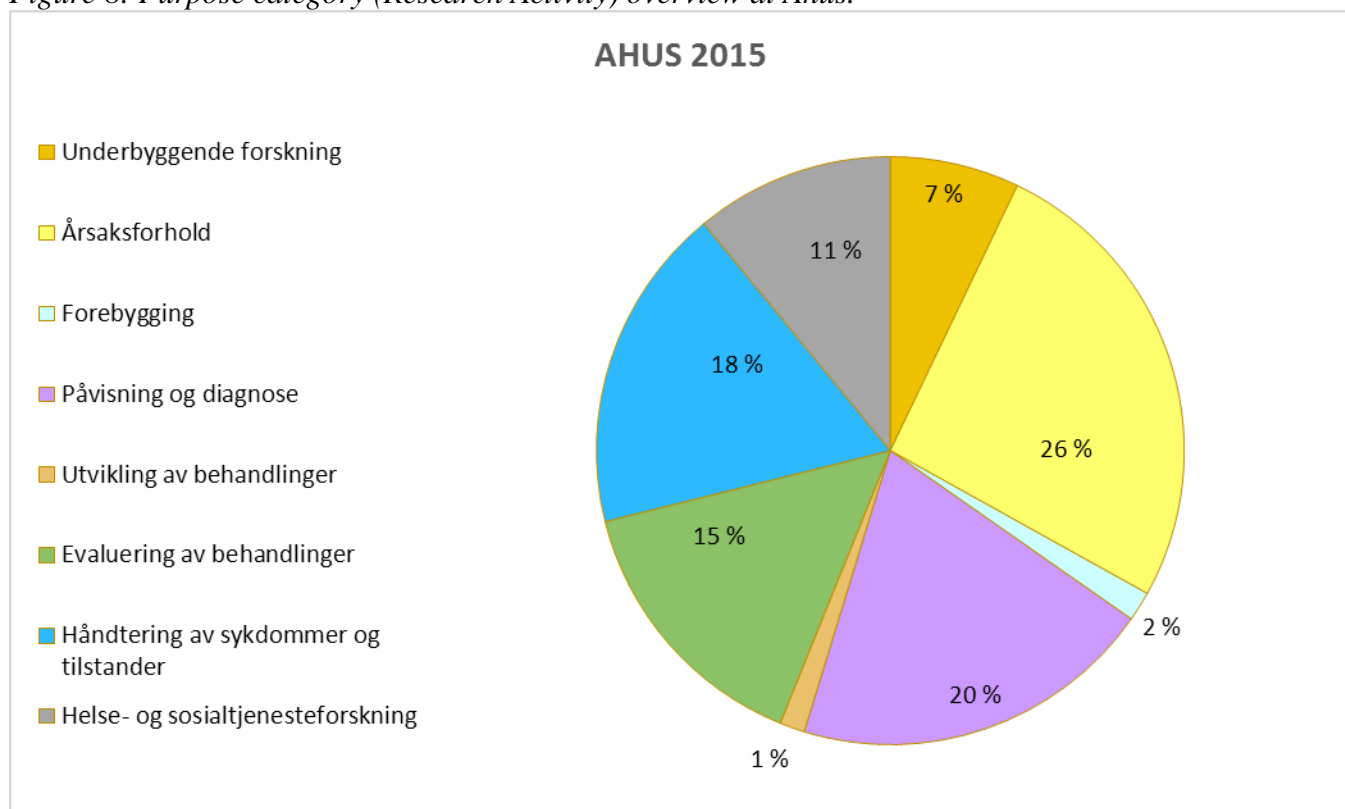


Figure 8: Purpose category (Research Activity) overview at Ahus.



10. Granting of External Research Funds Ahus and Campus Ahus

Table 10 provides an overview of research projects that in 2015 were granted external research funds for PhD scholarships, post-doc scholarships, or larger operational grants. Most grants are multi-year; the annual allocation is shown in the right column of the table. Table 11 presents a summary of smaller grants, which are typically one-time allocations.

Table 10: Projects granted external research funds for PhD scholarships, post-doc scholarships, and larger operational grants.

Project Title	Project Leader	Division/Clinic	Funded by:	Allocation 2015
Causes and consequences: Mechanisms by which DNA damage and repair contribute to aging and neurodegenerative disease	Hilde Loge Nilsen	Division of Medicine	South-Eastern Norway Regional Health Authority	1 784 667
Circulating Biomarkers of Efficacy and Tolerability Combined-Modality Cancer Therapy	Anne Hansen Ree	Division of Medicine	South-Eastern Norway Regional Health Authority	970 000
Novel imaging biomarkers of rectal cancer aggressiveness	Kathrine Røe	Division of Medicine	South-Eastern Norway Regional Health Authority	970 000
Time course dissection of the immune component of Breast Cancer during treatment with targeted - and chemotherapy	Vessela Kristensen	Division of Medicine	South-Eastern Norway Regional Health Authority	1 160 000
Epigenetic biomarkers in circulating DNA (ctDNA) for early diagnostics and treatment monitoring in breast cancer.	Vessela Kristensen	Division of Medicine	South-Eastern Norway Regional Health Authority	485 000
New insights into chest compressions in newborn cardiopulmonary resuscitation	Britt Nakstad	Division of Medicine	South-Eastern Norway Regional Health Authority	357 000
The Norwegian Cartilage Project: A Multidisciplinary Approach to Improve the Treatment of Injured Articular Cartilage	Asbjørn Årøen	Orthopaedic Clinic	South-Eastern Norway Regional Health Authority	19 000 000
A cluster randomized study on implementation of guidelines and evidence based treatments of psychoses	Torleif Ruud	Division of Mental Health	South-Eastern Norway Regional Health Authority	18 000 000
Hypoxic Tumor Targets in Advanced Radiotherapy and Prevention of Metastasis in Rectal Cancer	Anne Hansen Ree	Division of Medicine	The Norwegian Cancer Society	947 936
Functional implications of the RNA and DNA processing activity of SMUG1 in telomere maintenance, stem cells and cancer	Hilde Nilsen	Division of Medicine	The Norwegian Cancer Society	881 000
Modelling treatment and rehabilitation of stroke patients - Using simulations to evaluate the present and plan for the future	Fredrik A Dahl	HØKH	The Research Council of Norway	1 493 333
Microbiota in acute heart failure	Gunnar Einvik	Division of Medicine	Extrastiftelsen through LHL	680 000

Project Title	Project Leader	Division/Clinic	Funded by:	Allocation 2015
Improved participation in MS treatment choices	Pål Gulbrandsen/ Trygve Holmøy	HØKH/Division of Medicine	Extrastiftelsen through the MS- Society	680 000
Coercion and voluntariness in psychiatry	Jorun Rugkåsa	HØKH	Extrastiftelsen through The Mental Health Council	680 000
C3: Centre for Connected Care - Accelerating the adoption and spread of patient-centric innovations	Fredrik A Dahl	HØKH	The Research Council of Norway through OUS	428 000

Table 11: Projects granted minor allocations from external funding sources.

Project Title	Project Leader	Division/Clinic	Funded by:	Allocation 2015
SN as a novel prognostic cardiovascular biomarker	Helge Røsjø	Division of Medicine	The National Association for Public Health	100 000
Bayer's gynaecological honorary award 2014	Anne Eskild	Division of Gynaecology and Obstetrics	Bayer Health Care Pharmaceuticals	20 000
Bayer's gynaecological honorary award 2014	Gunnar Einvik	Division of Medicine	Astra Zeneca through Norwegian Association of Pulmonology	50 000
Bayer's gynaecological honorary award 2014	Gunnar Einvik	Division of Medicine	National Competence Center for Sleep Disorders	10 000
Nor-Switch	Jørgen Jahnsen	Division of Medicine	Project through Diakonhjemmet	777 000
AbbVie-Stipend	Trond Espen Detlie	Division of Medicine	AbbVie	50 000
Fast track patient pathway for hip fracture patients	Christian Pollmann	Orthopaedic Clinic	Norwegian Osteoporosis Association	30 000
Evaluation of novel prognostic and predictive markers in early Breast cancer patients	Jürgen Geisler	Division of Medicine	Bodil and Magne's Legacy	625 000
Fast track patient pathway for hip fracture patients	Kim Rand- Hendriksen	HØKH	EuroQol Research Foundation	126 000
Fast track hip fracture - Heraeus (paid via DNLF)	Christan Pollmann	Orthopaedic Clinic	The Norwegian Medical Association	50 000
Physical therapy interventions for pelvic girdle pain (PGP) after pregnancy	Gunvor Hilde	Division of Gynaecology and Obstetrics	Norwegian Fund for Post-graduate Education of Physiotherapists	175 000
Predictive value of cardiac markers in children with heart murmurs	Vegard Bruun Wyller	Division of Paediatric and Adolescent Medicine	The Norwegian Association for Children with Congenital Heart Disease	150 000

Project Title	Project Leader	Division/Clinic	Funded by:	Allocation 2015
3D CT for impacted femoral neck fractures	Sigurd Erik Hoelsbrekken / Max Temmesfeld	Orthopaedic Clinic	Ortomedic (Charnley-stipend 2015)	100 000
In-hospital Resuscitation Education-Delivery	Anne Marthe Boldingh	Division of Paediatric and Adolescent Medicine	Laerdal Foundation	148 122
Lung biopsies	Haseem Ashraf	Division of Diagnostics and Technology	Haakon and Sigrun Ødegards Fund	40 000
Holes Legacy	Anna Paula Bousquet	Division of Medicine	Ivar, Ragna and Morten Holes legacy	20 000
Childhood Influenza in Norway: Burden of disease and Vaccine Effectiveness	Truls Leegaard og Britt Nakstad	Division of Paediatric and Adolescent Medicine / Division of Diagnostics and Technology	Norwegian Institute of Public Health	711 000
Medical Association's award for preventive medicine	Malin Eberhard-Gran	HØKH	The Norwegian Medical Association	30 000
NorCrin Ahus	Helge Røsjø	Division of Medicine	The Research Council of Norway through St. Olav's hospital	
Extended AF Screening in ACE 1950	Helge Røsjø	Division of Medicine	Vestre Viken Hospital Trust	300 000
Rotavirus vaccination of premature infants, and the rotavirus surveillance study	Britt Nakstad / og Microbiology	Division of Paediatric and Adolescent Medicine / Division of Diagnostics and Technology	Norwegian Institute of Public Health	280 000

11. Allocation of Internal Research Funds

Once a year, internal strategic research funds are announced, which employees at Ahus and Campus Ahus can apply for. Applications are quality-assessed by external experts.

In 2015, a total of 29 million kroner was applied for across 74 applications. The total amount awarded was six million kroner spread across 30 projects. The award amount per project ranged from 150,000 to 250,000 kroner. Applicants are encouraged to use the feedback from the experts to improve their applications when seeking research funding from South-Eastern Norway Regional Health Authority and other external sources.

Table 12: Projects awarded internal research funds 2015

Project Title	Project Leader	Division/Clinic
The Reliability of the International Cartilage Repair Society (ICRS) Classification system for Grading Cartilage Lesions of the Knee Arthroscopically	Asbjørn Årøen	Orthopaedic Clinic
Advanced ColoRectal Cancer - Individualization of Therapies	Anne Hansen Ree	Division of Medicine
The Oxytarget study	Kathrine Røe	Division of Medicine
Imaging tumor hypoxia in rectal cancer: comparing functional MRI and PET	Kathrine Røe	Division of Medicine
Concomitant injuries and etiology for PCL injuries	Asbjørn Årøen	Orthopaedic Clinic
Specific antibodies and serum proteins in patients with Staphylococcus aureus bloodstream infection - new prognostic biomarkers?	Hege Vangstein Aamodt	Division of Diagnostics and Technology
What is the risk of intestinal dysfunction after small bowel denervation during modern surgery for right-sided colon cancer?	Dejan Ignjatovic	Division of Surgery
Gene expression of Multiple Sclerosis associated genes in MS patient and control CD8 immune cells	Bettina Kulle Andreassen	Division of Medicine
MicroRNA in Exosomes - Circulating Biomarker of Rectal Cancer Aggressiveness	Anne Hansen Ree	Division of Medicine
Occurrence and impact of pelvic floor muscle injuries during delivery: studies using three and four dimensional ultrasound.	Marie Ellstrøm Engh	Division of Gynaecology and Obstetrics
Atrial fibrillation and stroke risk	Pål Smith	Division of Medicine
INSPIRE - Infant Special Program for In-hospital Resuscitation Education in the Delivery Room - INSPIRE-D	Britt Nakstad	Division of Paediatric and Adolescent Medicine
The Ultrasound Study: Classification of Achilles Tendon Injuries and Prospective Evaluation of Treatment Outcomes.	Sigurd Erik Hoelsbrekken	Orthopaedic Clinic
Volar locked plating versus bridging external fixation	Jan Erik Madsen	Orthopaedic Clinic
Educational attainment, lifestyle factors and gene-environmental interactions in dementia (EL-GENIDEM)	Astrid Liv Mina Bergem	Division of Mental Health
The Effect of Chiropractic Treatment on Migraine and Cervicogenic Headaches.	Michael Bjørn Russell	Unit for Research and Patient Safety
The role of hepcidin isoforms in various inflammatory diseases	Tor-Arne Hagve	Division of Diagnostics and Technology
Long term follow-up of the Brief Intervention for Medication-Overuse Headache in primary care - BIMOH study	Espen Saxhaug Kristoffersen	Unit for Research and Patient Safety
Prevention of Cardiac Dysfunction during Adjuvant breast cancer therapy - PRADA-study	Torbjørn Omland	Division of Medicine
A novel principle for attenuating heart failure progression	Helge Røsjø	Division of Medicine

Project Title	Project Leader	Division/Clinic
Exploring novel pathophysiology in heart failure	Helge Røsjø	Division of Medicine
Neoadjuvant Treatment of Patients with Locally Advanced Breast Cancer Using Letrozole and Exemestane: A Cross-Over Study.	Jürgen Geisler	Division of Medicine
CT Hip Arthrography (CTHA): a new method to assess abductor deficiency in patients with hip pain following Total Hip Arthroplasty	Claude Pierre-Jerome	Division of Diagnostics and Technology
Drivers and Barriers of Cancer in inflammatory bowel disease	Hilde Nilsen	Division of Medicine
What is the value of colonoscopy evaluation after acute uncomplicated diverticulitis	Tom Øresland	Division of Surgery
Development of right-sided heart failure in patients with chronic obstructive pulmonary disease (COPD).	Kjetil Steine	Division of Medicine
DNA methylation markers identified by next generation sequencing, array technology and mass spectrometry-based approaches in tumors and plasma from breast cancer patients	Ida Bukholm	Division of Surgery
Integrated Molecular Profiles of Invasive Tumors; Prognostic and Predictive Power of Differential Vascular and Interleukin Signalling in Cancer	Vessela Kristensen	Division of Medicine
Airway microbiota and exacerbation frequency in chronic obstructive pulmonary disease	Gunnar Einvik	Division of Medicine
Sequencing of human papillomavirus type 16 for personalized cancer diagnostics	Irene Kraus Christiansen	Division of Diagnostics and Technology

12. Outstanding Research Award

Each year, awards are presented for outstanding research to three articles with first authors from Ahus. An important purpose of this is to showcase the high-quality research produced and published by the hospital's staff. The Research Committee, based on publication points/impact factor of published works in the past year, recommends the winners for the award. The winners receive flowers, a diploma, and 10,000 NOK which can be used for conference participation or similar purposes. The 2015 winners were Jovana Klajic (Division of Medicine), Eirik Auning (Division of Mental Health), and Jorun Rugkåsa (Department of Health Services Research, HØKH).



From left: Deputy CEO Tone Ikdahl, Jovana Klajic, Eirik Auning, and Jorun Rugkåsa.

Rugkåsa J, Molodynski A, Yeeles K, Vazquez-Montes M, Visser C, Burns T. (2014) Community Treatment Orders: clinical and social outcomes, and a sub-group analysis from the OCTET RCT. *Acta Psychiatrica Scandinavica*, doi:[10.1111/acps.12373](https://doi.org/10.1111/acps.12373)

In order to address the revolving door effect in patients with severe and persistent mental disorders who experience frequent relapses and readmissions, Community Treatment Orders (CTOs) are utilized. Previous research has shown that despite being implemented in over 70 states and countries as part of mental health legislation, CTOs do not have an impact on readmissions. Three randomized controlled trials (RCTs), along with several systematic literature reviews and meta-analyses, have failed to demonstrate any effect on readmissions. However, there is limited RCT evidence regarding outcomes other than readmissions, and it is also unclear whether there are specific patient subgroups that may benefit from this form of treatment.

This article reports on clinical and social outcomes, as well as subgroup analyses, from the largest RCT conducted in this field to date. 336 patients were randomly assigned to either be discharged from the hospital under a CTO or to voluntary status through a brief leave, and there were no differences between the groups at baseline. Outcome measures included symptoms, social functioning, alcohol/drug problems, insight into illness, employment participation, satisfaction with services, therapeutic alliance, and perceived coercion. Subgroup analyses examined the effects on readmission, time to and length of readmissions, symptoms, and social functioning. Subgroups (defined at baseline) were based on diagnosis, age, gender, ethnicity, education, living arrangements, symptoms, and social functioning.

After 12 months, there were no differences between the intervention group and the control group on any of the measures, except for a slight effect on how effectively patients perceived treatment pressure. There were no differences among the subgroups, except that symptoms showed a weak interaction with age and education, but no discernible patterns were found. The study supports existing evidence that CTOs do not have a positive effect.

Jovana Klajic, Florence Busato, Hege Edvardsen, Nizar Touleimat, Thomas Fleischer, Ida Bukholm, Anne-Lise Børresen-Dale, Per Eystein Lønning, Jörg Tost, Vessela N. Kristensen. DNA Methylation status of key cell cycle regulators such as *CDKNA2/p16* and *CCNA1* correlates with treatment response to doxorubicin and 5-fluorouracil in locally advanced breast tumors. *Clinical Cancer Research*, doi:[10.1158/1078-0432.CCR-14-0297](https://doi.org/10.1158/1078-0432.CCR-14-0297).

In this study, we investigated changes in DNA methylation profiles in locally advanced breast cancer patients treated with doxorubicin and 5'-fluorouracil-mitomycin C before and after neoadjuvant therapy, and validated these profiles in a larger cohort. We identified and validated that methylation patterns of key cell cycle regulators such as *CDKN2A* and *CCNA1* could be potential predictive markers for anthracycline/mitomycin sensitivity. We observed a correlation between genes that were differentially methylated before and after treatment and genes involved in cell cycle regulation and immune cell response. We found an association between TP53 mutation status and DNA methylation levels in repetitive elements such as *ALU1* and *LINE1*, and propose that the methylation levels of these genes, along with TP53 status, can be used to predict response prior to chemotherapy treatment. We also demonstrated a correlation between *CDKN2A* and molecular subtypes, suggesting that the Luminal B subgroup could be used to define a group that would benefit from chemotherapy treatment.

Auning E, Selnes P, Grambaite R, Saltyte Benth J, Haram A, Løvli AO, Bjørnerud A, Hessen E, Hol PK, Løndalen AM, Fladby T, Aarsland D. Neurobiological correlates of depressive symptoms in people with subjective and mild cognitive impairment. *Acta Psychiatrica Scandinavica*, doi:[10.1111/acps.12352](https://doi.org/10.1111/acps.12352)

Subjective cognitive impairment (SCI) and mild cognitive impairment (MCI) can be precursors to dementia. Depression (major depression) is common in SCI, MCI, and dementia, and it is possible that depression increases the overall risk of dementia. However, potential shared mechanisms between dementia and depression are still unknown.

We wanted to investigate whether there is a relationship between depressive symptoms in SCI and MCI patients at a memory clinic and biomarkers for Alzheimer's disease. The latter includes cerebrospinal fluid markers, measurement of brain atrophy in the cortical regions including the hippocampus using magnetic resonance imaging (MRI), as well as white matter changes and brain glucose metabolism measured using a specialized variant of MRI (diffusion tensor imaging) and Positron Emission Tomography (PET). Depression was assessed using the Geriatric Depression Scale (GDS-15).

Patients who qualified for a diagnosis of depression according to ICD-10 (major depression) were not included, only patients without depression and those with milder depressive symptoms (minor depression). A total of 60 patients (22 SCI and 38 MCI) were studied, of which 24 patients had depressive symptoms.

Overall, we found no relationship between depression and typical Alzheimer's changes, but some patients with precursors to dementia (biomarker-positive) may come for evaluation at the memory clinic early due to depressive symptoms. Mild depressive symptoms are common in SCI and MCI patients and may explain the cognitive impairment.

13. This year's dissertations

In 2015, 17 employees at Ahus successfully defended their dissertations. Table 3 displays the distribution of doctoral degrees per division. Below is a brief summary of the different dissertations.



Silje Kjeka Namtvedt

Cand.med. Silje Kjeka Namtvedt from the Division of Medicine defended her dissertation on February 27th in the field of Internal Medicine. The title of her dissertation is "**Obstructive sleep apnea and indices of cardiovascular function and injury in Norwegian community-dwelling adults: The Akershus Sleep Apnea Project**".

The supervisors were Professor Torbjørn Omland, Dr. med. PhD Helge Røsjø, and Professor Virend Somers.

Obstructive sleep apnea negatively affects the cardiovascular system. In her population study, physician and researcher Silje Kjeka Namtvedt, along with her colleagues at Akershus University Hospital and Oslo University Hospital, found that obstructive sleep apnea is associated with reduced vascular function, increased risk of cardiac arrhythmias, and mild cardiac injury. Obstructive sleep apnea is a sleep disorder where the airway collapses, leading to temporary pauses in breathing. This pattern repeats multiple times during the night and often results in daytime fatigue for the patient. Approximately 1 in 5 adults suffer from obstructive sleep apnea, and the condition is often accompanied by high blood pressure and obesity.

The study revealed that individuals in the general population with obstructive sleep apnea are more likely to have a mild form of cardiac arrhythmias compared to those without the disease. Vascular function was found to be poorer in women with obstructive sleep apnea, although the same findings were not observed in men. In a smaller sample, it was also discovered that reduced vascular function in individuals with obstructive sleep apnea was independent of obesity. The study suggests that obstructive sleep apnea is linked to mild cardiac injury, but this damage is likely due to a higher accumulation of other cardiovascular disease risk factors in this patient group.

Overall, Silje Kjeka Namtvedt's study indicates that obstructive sleep apnea can have detrimental effects on the cardiovascular system. These findings emphasize the importance of recognizing and diagnosing this frequently undetected condition. Individuals with moderate to severe obstructive sleep apnea should be advised to undergo cardiovascular function tests. The Akershus Sleep Apnea Project involved over 500 men and women between the ages of 30-65 who were assessed for obstructive sleep apnea from 2006-2008. Various medical assessments were conducted within different fields of medicine. The results presented in Namtvedt's dissertation are based on examinations of participants' heart rate, heart function, and vascular function.



Jan Harald Myhreng Røtterud

Cand.med. Jan Harald Myhreng Røtterud from the Orthopedic Clinic defended his dissertation on March 6th in the field of Orthopedic Surgery. The title of his dissertation is "**Focal cartilage lesions in anterior cruciate ligament-injured knees - Incidence, risk, prognosis and treatment**".

The main supervisor has been Professor Asbjørn Årøen.

Joint cartilage and anterior cruciate ligament (ACL) injury in the knee: Orthopedic surgeon and researcher Jan Harald Røtterud has shown in his dissertation "Focal cartilage lesions in anterior cruciate ligament-injured knees - Incidence, risk, prognosis and treatment" that current treatment for patients with ACL injury combined with cartilage damage in the knee yields poor results. ACL injury combined with cartilage damage often leads to impaired knee function, most commonly affecting younger individuals who are active in sports or work. Optimized treatment would improve the quality of life for patients and reduce costs for society.

Røtterud and colleagues utilized data from the national ACL registries in Norway and Sweden and analyzed information from up to 16,000 patients with anterior cruciate ligament injury. This is one of the largest patient populations studied in this field.

In his work, Røtterud and colleagues demonstrated that patients with ACL injury and cartilage damage reported worse knee function two years after ACL surgery compared to patients without accompanying cartilage damage. Surgical treatment for cartilage damage was not performed in about half of the patients, while the remaining patients were mainly treated with surgical debridement or suturing (microfracture). Debridement showed no benefit, and suturing resulted in worse outcomes compared to no treatment. The results indicate that caution should be exercised when suturing these cartilage lesions. Furthermore, Røtterud and colleagues found that men in general, and male handball players in particular, are more susceptible to these combined injuries.



Anna Randby

Cand.med. Anna Randby from the Division of Medicine defended her dissertation on March 13th in the field of Cardiology. The title of her dissertation is "**Markers of Cardiovascular Risk in Subjects with Obstructive Sleep Apnea Recruited from the General Population**".

The supervisors have been Professor Torbjørn Omland and Professor Virend K Somers.

Untreated sleep disorder with nocturnal breathing pauses damages the heart and blood vessels: Doctor and researcher Anna Randby has found signs of early damage to the heart and blood vessels in individuals with sleep disorder known as obstructive sleep apnea (repeated brief pauses in breathing during the night). From 2005 to 2008, a total of 535 randomly invited individuals were examined through sleep tests, medical examinations, blood tests, tests of vascular function, and heart rate monitoring. It is already known that those who experience breathing pauses at night have an increased risk of developing high blood pressure, having a stroke, and premature death, but there is still much uncertainty about how this occurs. Additionally, most previous studies on these associations were conducted on men, overweight individuals, older people,

and individuals recruited from sleep clinics, with the majority of research being from the United States.

In her dissertation "Markers of Cardiovascular Risk in Subjects with Obstructive Sleep Apnea Recruited from the General Population," Anna Randby and her colleagues have shown that signs of damage to the heart and blood vessels can also be found in a gender-balanced Scandinavian sample of relatively young, slim, and healthy individuals with undiagnosed sleep disorder with breathing pauses. Signs of early heart damage were detected by measuring small amounts of troponin in the blood, a substance released into the bloodstream when heart muscle cells die, and by measuring heart rhythm disturbances that can occur in a damaged or stressed heart. Signs of early damage to the blood vessels were measured using a completely new method that, through a pressure meter around the finger, can detect when the blood vessel walls begin to stiffen and become less able to expand rapidly when there is a need for increased blood flow.

It has been estimated that around 8% of the adult population in Norway suffer from moderate to severe nocturnal breathing pauses. The fact that heart and blood vessel damage can be detected early in the condition, even in individuals who are not aware that they have the disease, highlights the seriousness of this issue both for the individual and for society.



Elisabeth Astrup

Dr. Elisabeth Astrup from the Division of Medicine defended her dissertation on March 20th in the field of Internal Medicine. The title of her dissertation is "**Inflammation in rickettsial infections. Role of Wnt-signaling and innate immunity in Mediterranean spotted fever and scrub typhus**".

The main supervisor has been Professor Pål Aukrust.

Similar to Ebola fever and several other infectious diseases, Mediterranean spotted fever (MSF) and scrub typhus are not well-known in Norway but have a significant impact in other parts of the world, including Asia, Europe, and Africa. There is little research focused on these diseases, which often affect the poor, and there is a great need for vaccines and better treatment options. We have worked on uncovering the mechanisms by which these bacteria cause disease. A pathogenic microbe triggers a cascade of harmful events that can affect all organs in the body. Detailed knowledge of these complex mechanisms is necessary to target specific points for the development of new treatments and vaccines. We need to target factors that are necessary for the disease to progress while avoiding harm to other parts of the body.

In scrub typhus, we found that certain signalling molecules appear to play a particularly important role in the development of the disease. We have also studied signaling pathways that are primarily known for their importance in organ development, particularly during fetal life, and for maintaining a constant balance in the immune system. Our findings suggest that these systems may also play a role in the development of MSF, for example, by helping the bacteria "hide" from the immune system, allowing them to develop undisturbed until they can cause disease. Our findings may be important for the development of vaccines and new treatment approaches for MSF and scrub typhus, diseases that affect people living in poverty with limited access to healthcare services.



Aron Adelved

Cand.med. Aron Adelved from the Division of Orthopaedics defended his dissertation on April 15th in the field of Orthopaedic Surgery. The title of the thesis is "**Long-term Functional and Radiological Outcome after Displaced Sacral Fractures**".

The supervisors have been Professor Olav Røise and Dr. Anna Tötterman. Doctor and researcher Aron Adelved has discovered that patients with misaligned sacral fractures have significant long-term consequences, many years after their injuries. The sacrum forms the posterior part of the pelvic ring.

Sacral fractures with misalignment are uncommon and serious injuries that typically occur in high-energy accidents, such as traffic accidents or falls from great heights. The nerves that supply the pelvic organs and lower extremities originate from the spinal cord and exit through the sacrum, making them vulnerable to injury in cases of misaligned fractures, resulting in functional impairment or loss in the legs or pelvic organs. Significant functional disability and pain shortly after such injuries have been described in several previous studies. However, long-term outcomes and changes in functional disabilities over time have been poorly explored.

In his dissertation, "Long-term Functional and Radiological Outcome after Displaced Sacral Fractures," Aron Adelved and his colleagues investigated 28 patients who underwent surgery for misaligned sacral fractures in a 10-year follow-up. Another group of 13 patients with a rare type of sacral fracture, called Traumatic Lumbosacral Dissociation, was also examined in a 7-year follow-up. The study shows that patients experience symptoms such as nerve dysfunction in the legs, pain, impaired bladder function, reduced sexual function, low self-reported health, and a high proportion of work disability. No associations were found between pain and the remaining misalignment in the pelvic ring and sacrum, or other clinical or radiological findings.

Comparisons of the 10-year results with the 1-year results revealed a worsening of bladder function in a significant proportion of patients, but no significant changes in other functional impairments were observed.



Christopher S. Inchley

Cand.med. Christopher Steph Inchley from the Division of Paediatric and Adolescent Medicine defended his dissertation on May 27th in the field of Paediatrics. The title of the thesis is "**Immune regulation and RNA interference in the etiology of Respiratory syncytial virus disease**".

The supervisors have been Professor Britt Nakstad and Dr. Hans Olav Fjærli.

Respiratory syncytial virus (RSV) causes bronchiolitis and pneumonia in infants. However, most children who are infected with RSV only experience mild cold symptoms and cough. The aim of this project was i) to identify factors that may predispose infants to more severe RSV disease, and ii) to identify microRNAs that are active in the immune response to RSV. Umbilical cord blood from 2108 healthy newborns was available for gene expression analysis. We examined infants who later tested positive for RSV and compared their gene expression to infants who did not have a positive RSV test. IL7R, CCR7, TLR4, and Dicer were downregulated in RSV-positive infants several months before they were infected. These genes control gene expression and immune activation and communication within the immune system. Dicer produces microRNAs, which regulate gene

expression. We analysed microRNA levels in the nasal mucosa of children with active RSV infection and children without clinical infection. Twelve microRNAs were upregulated or downregulated in RSV infection, and many of these regulate the innate immune system. Three microRNAs showed different expression levels depending on the severity of the disease. Two of these are associated with macrophage function. Our results suggest that downregulation of immune genes in infants before RSV infection may delay the immune response to infection. This can lead to higher viral load in the respiratory tract, spreading of the virus to the lower airways, and increased inflammatory response when the immune system finally kicks in. We have identified a novel set of microRNAs that are important for the immune response to RSV.



Kjersti Grøtta Vetvik

Cand.med. Kjersti Grøtta Vetvik from the Division of Medicine defended her dissertation on June 12th in the field of Neurology. The title of the thesis is **"Menstrual migraine in the general population – prevalence, clinical characteristics and classification"**.

The supervisors have been Professor Michael Bjørn Russel, Professor E. Anne MacGregor, and Professor Christofer Lundqvist.

Menstrual migraine in women in the general population: During the reproductive age, migraines occur 2-3 times more frequently in women compared to men, and it is believed that female hormones play an important role in this gender difference. Previous research has shown that the occurrence of migraines in women is highest in the days around the first day of menstruation. Some women experience migraines regularly during menstruation, and this condition is called menstrual migraine. Neurologist and researcher Kjersti Grøtta Vetvik has studied the prevalence and clinical characteristics of menstrual migraine in women in the general population. In her dissertation "Menstrual migraine in the general population – prevalence, clinical characteristics and classification", Vetvik and colleagues examined 5000 randomly selected women in their thirties from Akershus County. Approximately one-third of all women had experienced migraines, and among these, around 20% experienced migraines regularly in connection with menstruation. Migraine attacks associated with menstruation differed from non-menstrual migraine attacks in that they lasted longer (on average 11 hours), were twice as often accompanied by severe nausea, and were treated with multiple doses and types of medication. Women with menstrual migraine who used contraceptives that suppressed menstruation reported more frequent improvement in their migraines compared to those who still had menstrual bleeding. The results show that migraines are very common in women in their thirties and that menstruation likely represents the most important or only trigger for approximately one-fifth of these women. Migraine attacks that occur during menstruation are more prolonged and associated with more pronounced and troublesome symptoms than other migraine attacks. Contraceptive methods that suppress menstrual bleeding may have a beneficial effect on this patient group



Helle Høyer

M.Sc. Helle Høyer from the Division of Medicine defended her dissertation on September 11th in the field of Medical Genetics. The title of the thesis is "**Molecular diagnostics of Charcot-Marie-Tooth disease in Norway**".

The supervisors have been Professor Michael B. Russell, Camilla F. Skjelbred, and Geir J. Braathen.

Researcher Helle Høyer has utilized new DNA technology in her doctoral research to diagnose patients with inherited peripheral nerve disorders. Around 3000 people in Norway are affected by Charcot-Marie-Tooth disease, an inherited peripheral nerve disorder. The disease leads to muscle wasting, paralysis, and loss of sensory abilities, with varying severity. Identifying the genetic cause is crucial for patients to determine prognosis and risk of recurrence. In the future, this will be essential for benefiting from targeted treatments. However, obtaining a genetic diagnosis has been challenging, as the hereditary factors triggering the disease vary from person to person. In two previous Norwegian studies, only 14% and 25% of this patient group received a genetic diagnosis after analysing the most common factors. In her dissertation "Molecular diagnostics of Charcot-Marie-Tooth disease in Norway", Helle Høyer and her colleagues used newer DNA technology to investigate this patient group. The results of the study showed that, after employing the new DNA technology, 49% of the patients in the study received a genetic diagnosis. Particularly, the method of next-generation sequencing, which detects small variations in our genetic material, was advantageous. This method was more effective than the previously used method and yielded almost three times the previous results. Next-generation sequencing is now recommended for routine diagnostics of patients with inherited peripheral nerve disorders.



Jette Stær-Jensen

Dr. Jette Elisabeth Stær-Jensen from the Division of Gynaecology and Obstetrics defended her dissertation on September 18th in the field of Gynaecology and Obstetrics. The title of the thesis is "**Pelvic floor changes during pregnancy and after delivery assessed by ultrasound**".

The supervisors have been Professor Marie Ellström Engh and Professor Kari Bø.

Vaginal delivery is the biggest risk factor for the later development of pelvic floor dysfunction, such as urinary incontinence, fecal incontinence, and pelvic organ prolapse, which are common among women. The underlying mechanisms for the development of pelvic floor dysfunction, and particularly the impact of pregnancy on the pelvic floor, have been poorly studied. New ultrasound technology enables direct visualization and examination of the pelvic floor. In her dissertation "Pelvic floor changes during pregnancy and after delivery assessed by ultrasound", Jette Stær-Jensen and her colleagues have studied changes in the levator ani muscle. This muscle is the main component of the pelvic floor as it supports the pelvic organs and contributes to continence for urine and feces. They examined 300 primiparous women with ultrasound scans from pregnancy week 21 to one year after delivery. They found that changes in the levator ani muscle occur not only after delivery but also during pregnancy. The opening in the levator muscle (levator hiatus), which allows the passage of the urethra, vagina, and rectum, and thus childbirth, increased

by 21% from mid-pregnancy to late pregnancy. 14% of women who had vaginal deliveries had a tear injury where the muscle had lost its attachment to the symphysis pubis. After delivery, the muscle showed good recovery. For women who delivered by caesarean section, at 6 weeks postpartum, the levator hiatus had already decreased in size and had a similar size to that seen at pregnancy week 21. Women who had vaginal deliveries had a longer recovery time for the muscle, with healing of tear injuries and reduction of the levator hiatus until 6 months after delivery, without fully returning to the size seen in mid-pregnancy. This is one of the first longitudinal studies following women from pregnancy to one year after delivery. The study contributes to increased knowledge about changes in the pelvic floor during pregnancy and after delivery and may help develop new methods to reduce the impact of childbirth on the pelvic floor.



Eirik H. Ofstad

Cand.med. Eirik Haugaas Ofstad from the Health Services Research Group defended his dissertation on September 18th in the field of Medicine. The title of the thesis is "**Medical decisions in 372 hospital encounters**".

The supervisors have been Professor Pål Gulbrandsen and Professor Jan C. Frich.

Doctor and researcher Eirik Haugaas Ofstad has developed a new method to identify medical decisions as they unfold in the dialogue between doctor and patient. Previous research in the field has generally focused on user involvement and shared decision-making in individual decisions and has generally reported a low level of patient involvement. In a study of 380 video-recorded doctor-patient consultations at Akershus University Hospital (Ahus), Ofstad and his colleagues found that, on average, 13 medical decisions are communicated per consultation. The method developed by Ofstad and the research group at Ahus is a taxonomy consisting of ten categories that distinguish between types of decisions and three categories that describe a temporal dimension. The taxonomy is called The Decision Identification and Classification Taxonomy for Use in Medicine (DICTUM). When applying the taxonomy, they found that medical decisions are not only communicated in a high number but also span a longer timeframe than the duration of the consultation and that they are often made with the involvement of multiple individuals (mostly healthcare professionals) in the decision-making process. This finding may help explain why hospital patients are seldom included in decision-making processes. Ofstad and his colleagues conclude that the way specialist care in hospitals is organized makes it challenging for patients to participate. One measure to counteract such a barrier would be for doctors to become more mindful of when and by whom decisions are made and who should be involved. The content analysis of the material has provided a precise and detailed description of clinically relevant decisions across clinical specialties, types of consultations, doctors, and doctor-patient encounters. The taxonomy may be useful in future studies aiming to assess the quality of medical decisions in terms of patient involvement, patient safety, professionalism, and adherence to evidence-based practice.



Helene Kjøllesdal Eide

Clinical nutritionist Helene Kjøllesdal Eide from the Health Services Research Group defended her dissertation on October 23rd in the field of Nutrition. The title of the thesis is "**Nutritional risk and care in elderly hospitalized patients. A mixed methods research approach**".

The supervisors have been Professor Kari Almendingen, Associate Professor Kristin Halvorsen, and Professor Jurate Šaltytė Benth.

In her doctoral work, clinical nutritionist Helene Kjøllesdal Eide has demonstrated that key elements of good nutritional care practices seem to be lacking for elderly hospitalized patients. Their research also reveals that one in two elderly patients were at nutritional risk. The elderly are particularly vulnerable to malnutrition, especially those in hospitals and nursing homes. Malnutrition can lead to a range of serious consequences for patients. Therefore, there is a desire to prevent and treat the condition. Malnutrition in the elderly is a highly relevant societal issue considering the increasing proportion of older adults in the population.

In her doctoral work "Nutritional risk and care in elderly hospitalized patients. A mixed methods research approach", Eide and her colleagues conducted a large cross-sectional study, assisted by nursing students in hospital practice, and two focus group sub-studies with healthcare professionals in the hospital and associated nursing homes. Eide and her colleagues found that a staggering 45% of the examined patients in the hospital were at nutritional risk. Recommended nutritional care practices, in accordance with national and international guidelines, were not implemented in clinical hospital practice. Elderly patients were rarely assessed for nutritional risk, and malnutrition and nutritional risk were clearly undertreated. Documentation of nutritional status and treatment was unsatisfactory. Information about the patient's nutritional status and needs was rarely well communicated between the hospital and nursing homes.

Overall, the findings suggest that many elderly hospitalized patients do not receive the nutritional care they need, and a basic need such as nutrition seems to be ignored and not sufficiently prioritized. The dissertation emphasizes a clear need and highlights a great potential for quality improvement in nutritional care practices to ensure that malnutrition is adequately prevented and treated among elderly hospitalized patients.



Eirik Auning

Cand. med. Eirik Auning from the Division of Mental Health defended his dissertation in the field of Neurology/Biological Psychiatry on October 27th. The title of the thesis is "**Presenting symptoms, biomarkers and underlying brain changes in pre-dementia Lewy body and Alzheimer's disease**".

The supervisors have been Professor Dag Årslund and Professor Tormod Fladby.

The most common brain organic diseases include Alzheimer's disease, Parkinson's disease, dementia with Lewy bodies (DLB), and cerebrovascular disease. The primary focus of the project is Lewy body diseases (DLB and Parkinson's disease) and the development of cognitive impairment. A major goal of the project is early diagnosis, primarily before patients develop dementia. We found that visual hallucinations and memory loss are common

initial symptoms in DLB. We also demonstrated that changes in white matter can be observed through magnetic resonance imaging (MRI) in Parkinson's patients before they develop dementia, and that depression can be an early sign and a risk factor for later development of dementia. These findings can help us detect brain organic diseases early in the course of the illness and before patients become demented.

The project included patients with subjective cognitive impairment (subjective complaints without objective impairments on cognitive tests) and mild cognitive impairment (objective impairments on cognitive tests but not dementia, known as "mild cognitive impairment, MCI") from a memory clinic. Patients with an increased risk of future dementia, primarily Alzheimer's disease, were selected from this group. Patients with newly diagnosed Parkinson's disease and patients with early-stage DLB and Alzheimer's disease were also studied. We combined neuropsychological tests, imaging techniques (MRI, PET, Dopamine transporter scan), blood tests, and genetic/proteomic analyses in cerebrospinal fluid/blood to diagnose predisposed patients who develop cognitive impairment as early as possible.

The project follows the aforementioned patients until they become demented, with regular examinations to detect brain organic changes and cognitive impairment. The patients are compared to normal controls. Precursors to different types of dementia (e.g., DLB and Alzheimer's disease) are compared to find suitable diagnostic/prognostic biomarkers that can predict which patients will develop dementia in the future.



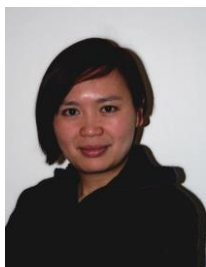
Helga Helseth Hektoen

M.Sc. Helga Helseth Hektoen from the Division of Medicine defended her dissertation in the field of Cancer Research on October 29th. The title of the thesis is "**Translational studies of microenvironmental factors in rectal cancer with emphasis on tumor hypoxia**".

The supervisors have been Professor Anne Hansen Ree, Professor Kjersti Flatmark, and Dr. Med. PhD Katrine Røe Redalen.

Cancer cells living in conditions of low oxygen (hypoxia) are extremely resistant to traditional radiation and chemotherapy. In addition, these cells have an increased ability to spread to other organs. Hypoxia is often present in cancer tumors and is a fundamental challenge in the treatment of cancer patients. To improve treatment outcomes, there is a need for more targeted therapy against these resistant cancer cells. In her dissertation, Helga H. Hektoen has examined an alternative way to treat the hypoxic part of the tumor. The strategy has been to inhibit a hypoxia-specific protein (CAIX), which is rarely found in normal and well-oxygenated tissue. By using cancer cells from rectal cancer patients, Helga H. Hektoen has studied how CAIX inhibition affects the cells. Among other things, she observed that inhibition of CAIX led to cell death when the cells had limited access to oxygen, while well-oxygenated cells survived the treatment. These findings are interesting in terms of selectively treating the hypoxic cell population of the tumor, but further research is needed to be able to use them in the treatment of cancer patients. In order to identify patients who may benefit from treatment specifically targeted at hypoxic cells or who require intensified treatment for other reasons, there is a need for good biological cancer markers. Proteins circulating in the bloodstream can easily be identified through a blood test and are well-suited as such markers. In her work, Helga H. Hektoen and colleagues have studied blood

samples from patients with locally advanced rectal cancer and have examined the levels of the hypoxia-specific protein CAIX in the blood. In addition, two other proteins (MMP9 and Lipocalin-2) have been identified as potential biological markers for patients with locally advanced rectal cancer.



Jun Yin

M.Sc. Jun Yin from the Health Services Research Group defended their dissertation in the field of Health Economics on November 23rd. The title of the thesis is "**Activity-based financing, primary care capacity, and hospital use among the elderly in Norway**".

The supervisors have been Professor Terje P. Hagen, Researcher Fredrik A. Dahl, and Associate Professor Hilde Lurås.

The rapid increase in the number of older adults in Norway poses several challenges due to the increased need for primary and secondary healthcare services, which in turn result in higher healthcare costs. Norwegian authorities use two policy instruments to control healthcare costs, namely activity-based financing (ABF), and access to long-term care services. The aim of the thesis is to investigate how these two policy instruments affect hospital resource utilization related to the use of healthcare and long-term care services among older adults.

In the first part of the study, the researchers examine whether ABF affects length of hospital stay. The changes in ABF rates over the years form the basis for this analysis. The results show that increased ABF rates lead to shorter length of hospital stay, but the effect for the analysed patient groups is marginal. Article 2 analyses whether ABF rates affect hospital readmission rates. The results show that the ABF component had no effect on readmission rates, and patient-specific factors were the most important explanatory variables for predicting acute readmission rates.

In article 3, the researchers analyse the relationship between access to long-term care services in the municipality and hospital resource utilization. The question they aim to address is whether hospital resource utilization will be reduced when access to municipal long-term care services increases. The results show that greater access to long-term care services is associated with shorter length of hospital stay, more admissions, and higher DRG points in hospitals.



Kjersti Træland Hanssen

Cand. psychol Kjersti Træland Hanssen from the Division of Medicine defended their dissertation in the field of Neurology on November 24th. The title of the thesis is "**Multiple Sclerosis Rehabilitation with a Cognitive Focus - Awareness and Adjustment**".

The supervisors have been Professor Erik Hessen and Professor Nils Inge Landrø.

Improved quality of life for individuals with multiple sclerosis: Cognitive rehabilitation can enhance the quality of life and psychological well-being of individuals with multiple sclerosis (MS). This is one of the findings of Kjersti Træland Hanssen's doctoral dissertation. She has studied the effects of cognitive rehabilitation aimed at providing

individuals with MS insight into cognitive functioning and assistance in coping with cognitive challenges. Over half of individuals with MS experience cognitive symptoms, such as difficulties with concentration, memory, planning, or thinking speed. The consequences for everyday life and quality of life can be significant. To provide help, more knowledge about cognitive MS rehabilitation is needed. The study was conducted at the Hakadal MS Center. 120 participants with cognitive challenges were randomly assigned to a control group that participated in the regular four-week rehabilitation program, and an intervention group that received cognitive rehabilitation in addition. The cognitive rehabilitation consisted of group meetings and individual sessions that provided guidance in setting goals for managing cognitive everyday challenges. In the three months following the rehabilitation stay, the intervention group received bi-weekly follow-up telephone calls focusing on goal achievement. Goal Attainment Scaling (GAS) was utilized for goal setting and measuring goal achievement. Significant improvement in goal achievement was observed from the first assessment two weeks after returning home, and this improvement was maintained throughout the telephone follow-up period. The effect was still present seven months after the start of rehabilitation. Goal achievement was not predicted by executive functions, neurological impairment, depression, or cognitive ability. This suggests that the GAS method is suitable for cognitive MS rehabilitation and can be used regardless of central, disease-related variables. The findings suggest that it is beneficial to provide assistance in translating the insights gained through rehabilitation into concrete goals. Telephone follow-up after the rehabilitation stay can help maintain focus on the goals and establish good habits. Compared to the resources required for a rehabilitation stay, the resources needed for post-rehabilitation telephone follow-up are modest. Cognitive challenges and coping strategies should be addressed as a natural part of any psychotherapy and rehabilitation for individuals with MS.



Anke Meta Neukamm

Cand. med. Anke Meta Christina Neukamm from the Division of Medicine defended her dissertation in the field of Pulmonology on November 30th. The title of the thesis is "**Cardiovascular Comorbidity in Chronic Obstructive Pulmonary Disease: Biomarkers, Vascular Function, and Effects of Statin Treatment**". The supervisor has been Professor Torbjørn Omland.

Undiagnosed cardiac damage and the effect of statin treatment in COPD patients: Approximately 20,000 Norwegians are diagnosed with chronic obstructive pulmonary disease (COPD) every year. Multiple studies have shown that unrecognized heart disease is common in patients with COPD.

Cardiac disease in COPD has a negative impact on the overall disease burden and survival of patients. Statins, a class of medications used to lower cholesterol, have beneficial effects on heart patients, independent of their cholesterol-lowering effects. In her doctoral work, Dr. Anke Neukamm and her colleagues at Akershus University Hospital (Ahus) used a new and sensitive type of blood test to investigate the extent of cardiac damage in patients with exacerbation of COPD and in stable COPD patients. Furthermore, in stable COPD patients, she examined whether statin treatment affects vascular function, lung function, and the degree of systemic inflammation.

Upon hospitalization for COPD exacerbation, three out of four patients had elevated levels of the cardiac protein troponin T, which is typically used to detect acute heart attacks. Even patients with relatively modest increases in troponin T levels had significantly higher mortality after

discharge compared to those with normal levels. The same protein was also elevated in stable COPD patients without previously known heart disease, compared to individuals in the general population. The medication study was randomized, double-blind, and placebo-controlled, involving COPD patients in a stable disease phase with a generally low risk profile for cardiovascular disease. Statin treatment had no effect on lung function but had a potential anti-inflammatory effect in the entire patient group and improved vascular function in patients with signs of low-grade inflammation in the body.

Whether COPD patients can benefit from troponin T diagnostic testing and whether statin treatment can reduce the incidence of heart disease in COPD patients will be assessed in future clinical studies.



Ingrid Dannevig

Cand. med. Ingrid Dannevig from the Division of Paediatric and Adolescent Medicine, defended a dissertation on December 15th in the field of Neonatology. The title of the thesis is "**Newborn Resuscitation: An Experimental Study of Inflammatory and Hemodynamic Responses in Newborn Pigs**". Supervisors were Professor Britt Nakstad and Professor Ola Didrik Saugstad.

Up to 10% of all newborns require resuscitation after birth, with most only needing basic respiratory support while a few require chest compressions and medication. Effective resuscitation is crucial for their long-term outcomes. The most important measure during resuscitation is providing effective respiratory support to the newborn. Resuscitation guidelines recommend providing respiratory support for 30 seconds before starting chest compressions, with a recommended ratio of 3 compressions to 1 breath (3:1). Dr. Ingrid Dannevig and her team conducted a study using a model of newborn pigs to explore alternative resuscitation methods, measuring markers of injury in the central nervous system and lungs. Based on the levels of these markers, they found that it may be advantageous for the brain and lungs to provide respiratory support for a slightly longer duration than previously believed before initiating chest compressions. They also demonstrated that the ratio of breaths to chest compressions can be varied within certain limits while still achieving equally good results. Additionally, the group showed that resuscitation using room air after cardiac arrest is equally effective as using supplemental oxygen. The findings from this research could have implications for the development of improved guidelines for resuscitating newborn infants.

14. Research Support

Research Clinics

Every Tuesday from 13:30 to 15:00, research clinics are held at the hospital. The clinics are located on the 5th floor in the New North building and are open to all employees at Ahus and UiO, Campus Ahus. The clinics operate on a drop-in basis, meaning that individuals receive assistance as they come.

Statistical Research Clinic

The Statistical Research Clinic offers guidance in analysis and the use of statistical methods. We encourage those seeking help to be open to allowing others to be present during the discussion of their own project. This way, we foster connections between research-oriented clinicians and expand available learning time by involving multiple individuals simultaneously. In 2015, we had a total of 59 visits to the clinic

Health Sciences Research Clinic

The Health Sciences Research Clinic offers low-threshold advice on health-related research questions. In 2015, we held a total of 42 health sciences research clinics.

Health Economics Research Clinic

The Health Economics Research Clinic provides a low-threshold service for employees at Ahus and UiO who have an interest in health economic issues in a clinical setting, such as cost-benefit analysis, cost-effectiveness analysis, decision models, quality of life measurements, etc.

Idea Clinic

The Idea Clinic is open to anyone with ideas, whether they are completely new or improvements to existing processes, services, or products. The Idea Clinic's task is to receive and coordinate the work of idea collection and evaluation in collaboration with idea submitters, hospital employees, and potential external partners. The Idea Clinic does not have its own funds for distribution or project managers to loan, but it can provide advice on financing, grant writing, project establishment, etc.

Data Collection

The Data Collection group supports research projects at Ahus by collecting data through electronic and paper-based questionnaires, extraction and linkage of data from electronic patient records, or a combination of these. The group has also developed solutions for secure data storage and performs deidentification/anonymization of datasets. The group manages the researcher solution at Ahus and has a close collaboration with the privacy function at Ahus. In 2015, the Data Collection group had 68 deliveries spread across 33 projects. This includes data extraction from electronic patient records, on Access databases, Snap Survey, etc. Additionally, the Data Collection group has been involved in external and internal projects.

Clinical Research Support

The Data Collection group supports research projects at Ahus by collecting data through electronic and paper-based questionnaires, extraction and linkage of data from electronic patient records, or a combination of these. The group has also developed solutions for secure data storage and performs deidentification/anonymization of datasets. The group manages the researcher solution at Ahus and has a close collaboration with the privacy function at Ahus. In 2015, the Data Collection group had 68 deliveries spread across 33 projects. This includes data extraction from electronic patient records, on Access databases, Snap Survey, etc. Additionally, the Data Collection group has been involved in external and internal projects.

Clinical Research Support In the government's strategic document, Health and Care 21, guidelines have been set for university hospitals to build infrastructure and support functions for the implementation of clinical studies in order to offer patients new and experimental treatments.

Ahus has a goal of increasing the number of clinical studies. Based on this, strategic and practical efforts were made in 2015 to strengthen the infrastructure and support functions for clinical research. In 2015, a coordinator for clinical treatment studies was hired to assist investigators in both contract studies (studies initiated by industry) and investigator-initiated studies (studies initiated by hospital staff).

Ahus participates in the national research infrastructure network NorCRIN, where we lead Work Package 4 "Collaboration with Industry". The network received funding from the Research Council of Norway for the period 2015-2019. This entails further investment in clinical studies in the years to come.

Deliveries in 2015:

- A total of 32 new clinical treatment studies reported in 2015 (< 70% increase from 2014)
- Publication of 12 studies on helsenorge.no
- Development of procedures and guidelines for clinical studies
- Implementation of a "one-stop" contact person for patients wanting to participate in studies and for the industry wanting to conduct studies at Ahus
- Mapping of relevant investigators at the hospital interested in conducting clinical treatment studies across various therapy areas
- Closer collaboration between internal departments/divisions at the hospital
- Enhanced collaboration with the technology transfer agency Inven2, the trade association for the pharmaceutical industry (LMI), and the pharmaceutical industry
- Mapping of support personnel/resource persons that are part of the hospital's research infrastructure
- Development of an internal course portfolio including regular courses in Good Clinical Practice (GCP)

Privacy and Biobank

The main responsibility is internal control of research and quality projects to ensure that they are conducted in accordance with the law, as well as providing research advice related to privacy and biobanks. This includes teaching and lectures, as well as guidance on procedures and regulations,

assessment of consents and project design, advice on sampling/processing and storage of biological material.

Deliveries in 2015:

- Processed 216 new projects.
- Established and conducted a course on "privacy and research" as part of the portfolio for Research and Innovation.
- Implemented and completed the eBiobank project at Ahus, from the project phase to the operational phase.
- Revision of research projects: Complete revision including review of all formal case documents, study documents, study preparations, and biobank materials.
- Ahus is represented in the management group for the Cancer Research Biobank at Oslo University Hospital.

Research Administration

The research administration takes care of personnel administration (approximately 270 employees on the payroll per month and 40 new hires in 2015), financial management (a total of 345 projects, including 31 new ones in 2015), reporting, and general operations for all research activities at the hospital. The department is administratively responsible for meetings in the joint research committee, research leadership meetings, research theme meetings, and internal strategic research funding announcements and allocations (75 applications in 2015).

Medical Library

The medical library organizes and facilitates access to quality-assured sources of knowledge for hospital staff. The knowledge sources are offered in print or electronic form, and employees have direct access to the electronic resources within Ahus' network. New in 2015 is the possibility of access for employees even when they are not at Ahus, through the login service OpenAthens/MyAthens. The library has a staffed counter on Mondays from 9 am to 12 pm and Tuesday to Friday from 9 am to 3 pm, but employees have access 24/7 with their ID card and code. Employees need to register in order to borrow and order articles and books. The library offers courses and guidance in literature searches and EndNote, and we also undertake larger search assignments for procedures, systematic reviews, etc.

Innovation

According to reports from Inven2, the status for 2015 is as follows:

- 11 new inventions (DOFIs) through Inven2
- 1 patent application
- 2 commercialization agreements (1 new company establishment and 1 interinstitutional agreement)
- 6 ongoing innovation projects through Inven2.

Ahus piloted the use of Induct as a tool for idea management and process support for prioritized improvement areas and innovation projects in the Division of Paediatric and Adolescent Medicine and the Idea Clinic from February to September. 49 employees participated in the evaluation and processing of 18 improvement ideas and four innovation projects. Various templates and forms were

developed for use in different phases of the innovation process (first version of Ahus innovation methodology). Inven2 provided advice and expertise in this work. The final report and experiences from the pilot were submitted to hospital management and shared with the national innovation network for university hospitals. The final report has been sent to the Ministry of Health and Care Services, Health South-East Norway, and other hospitals that have expressed their interest.

15. Expert and Research Day for the Population.

On Tuesday, April 14, Ahus organized the "Expert and Research Day" for the seventh time. The purpose is to provide residents and employees with insight into the expertise and research activities at Ahus, emphasizing that Ahus is a hospital with high professional ambitions and skilled professionals. The lectures are brief, allowing ample opportunity for questions afterward. Speakers provide short summaries of their presentations, which are distributed along with contact information so that those interested can reach out for more information.

More than 200 people attended the Auditorium on this Tuesday evening, listening to presentations on topics such as ALS (Amyotrophic Lateral Sclerosis), Parkinson's disease, stroke, diverticula in the colon, and worn-out knees. The audience demonstrated significant engagement, leading to a fruitful dialogue between the audience and individual presenters.



VELKOMMEN

Akershus universitetssykehus HF inviterer lokalbefolkningen til spennende foredrag om forskning på vanlige sykdommer som berører de fleste familier.

Tirsdag 14. april 2015
kl. 18.00 - 20.30

Auditoriet Akershus
universitetssykehus HF



PROGRAM

18:00 - 18:05
Velkommen til Akershus universitetssykehus HF
Tone Ikdaal, Visedirektør

18:10 - 18:25
Amyotrofisk lateral sklerose (ALS):
Sjelden sykdom med store utfordringer
Trygve Holmøy, Overlege/Professor
Neurologisk avdeling

18:30 - 18:45
Hjelpemidler når pustemuskulaturen svikter?
Toni Pedersen, Overlege og
Ann-Christin Pettersen, Intensivsykepleier
Avdeling for lungesykdommer

18:50 - 19:05
Tid fra hjerneslag til sykehusinnleggelse
Kashif Waqar Faiz, Avdelingsjef/PhD
Akuttmedisin

19:10 - 19:25
Det utslitte kneet
- når er tiden inne for kneprotese?
Frode Hellum, Overl

19:30 - 19:45
Individualisert behandling av tarmkreft
Kathrine Røe, Postdoktor/PhD
Kreftavdelingen

19:50 - 20:05
Parkinsonbehandling
- med fokus på komplikasjonene
Christofer Lundqvist, Overlege/Professor
Neurologisk avdeling og Ård

20:10 - 20:25
Når mor husker dårlig
Satu Johanna Delerud, Spesialsykepleier/Klinisk spesialist
Alderspsykiatrisk avdeling

www.ahus.no

UiO : Universitetet i Oslo

16. Appendix 1: Research Groups

The following research groups were active as of December 2015. Research group leader indicated in parentheses.

Division of Surgery, Campus Ahus: Asbjørn Årøen

- Division of Surgery. Research Manager Signe Sjøvik
 - ENT research group (Magnus von Unge)
 - Urology research group (Stig Müller)
 - Gastrointestinal research group including maternal/endocrine, anaesthesia, vascular / thorax (Ola Røkke)
 - Vascular/Thoracic Research Group (Jarlis Wesche)
- Orthopaedic Clinic/Research group. Research Manager Asbjørn Årøen.
 - Orthopaedic research group (Asbjørn Årøen)
- Division of Gynaecology and Obstetrics. Research Manager Anne Eskild.
 - Department of Obstetrics and Gynecology (Anne Eskild)

Division of Health Services Research and psychiatry, Campus Ahus: Hilde Lurås

- Division of Mental Health/R&D Research and development. Research Manager Torleif Ruud
 - Children & adolescents mental health (Pravin Israel)
 - Quality & implementation (Kristin S. Heiervang)
 - Experiences of service-users and carers (Bente Weimand)
- Division of Research and Innovation: Research Manager Hilde Lurås.
 - Research Group for Health Services Research (Hilde Lurås)
 - Research Group for Clinical Communication (Pål Gulbrandsen)
 - Head and neck research group (Michael Russel)

Division of Medicine and Laboratory Sciences, Campus Ahus: Trygve Holmøy

- Division of Medicine – Research Department. Research Manager Helge Røsjø
 - Oncogenomics (Vessela Kristensen)
 - Cardiothoracic Research Group (Torbjørn Omland)
 - Clinical Neuroscience Group (Tormod Fladby)
 - Gastroenterology Research Group (Jørgen Jahnsen)
 - Center for Hematological Research at Ahus (Anders Dahm)
 - DNA-Repair (Hilde Nilsen)
- Division of Paediatric and Adolescent Medicine. Research Manager Britt Nakstad
 - The AHUS Newborn Resuscitation Research Group (Britt Nakstad)
 - The AHUS Child and Adolescents Respiratory Tract Infection Research Group (Britt Nakstad)

- Research Group for Neonatal Nutrition, Growth and Development (Britt Nakstad)
- PAEDIA (Vegard Bruun Wyller)
- Division of Diagnostics and Technology. Research Manager Truls Leegaard
 - Infectious Diseases and Microbiology (Truls Leegaard)
 - Medical biochemistry. Interdisciplinary laboratory medicine and technology (Tor-Arne Hagve) (Tor-Arne Hagve)
 - IMTRA research group (Seyed Ali Mousavi)

17. Appendix 2: Health categories and Research activity codes

Helsekategorier i HRSC («health categories»)

1. Blod (*blood*)
2. Kreft (*cancer*)
3. Hjerte og kar (*cardiovascular*)
4. Medfødte lidelser (*congenital disorders*)
5. Øre (*ear*)
6. Øye (*eye*)
7. Infeksjon (*infection*)
8. Betennelse og immunsystem (*inflammatory and immune system*)
9. Skader og ulykker (*injuries and accidents*)
10. Mental helse (*mental health*)
11. Stoffskifte og hormoner (*metabolic and endocrine*)
12. Muskulatur og skjelett (*musculoskeletal*)
13. Nevrologisk (*neurological*)
14. Munnhule, mage, tarm (*oral and gastrointestinal*)
15. Nyrer, urinveier og kjønnsorgan (*renal and urogenital*)
16. Forplantning og fødsel (*reproductive health and childbirth*)
17. Lunger og luftveier (*respiratory*)
18. Hud (*skin*)
19. Hjerneslag (*stroke*)
20. Generell helserelevans (*generic health relevance*)
21. Andre (*other*)

Formålskategorier i HRSC («research activity codes»)

De åtte hovedkategoriene er videre delt opp i totalt 48 underkategorier. Mer informasjon om klassifikasjonssystemet finnes på nettsidene www.hrcsonline.net.

1. **Underbyggende forskning** (*underpinning research*)
Forskning som kan underbygge videre helseforskning rettet konkret mot sykdomsforståelse, forebygging, diagnose, behandling og helsetjenester.
2. **Årsaksforhold** (*aetiology*)
Forskning for forståelse av årsak, risiko og utvikling av sykdom og dårlig helse.
3. **Forebygging** (*prevention of disease and conditions, and promotion of well-being*)
Forskning rettet mot primærforebygging av sykdom og fremme av god helse.
4. **Påvisning og diagnose** (*detection, screening and diagnosis*)
Utvikling av diagnostiske, prognostiske og prediktive markører og teknologier.
5. **Utvikling av behandlinger** (*development of treatments and therapeutic interventions*)
Utvikling av behandling og terapeutiske intervensjoner i prekliniske settinger.
6. **Evaluering av behandlinger** (*evaluation of treatments and therapeutic interventions*)
Testing og evaluering av behandling og terapeutiske intervensjoner i kliniske settinger.
7. **Håndtering av sykdommer og tilstander** (*management of diseases and conditions*)
Forskning på pasientbehov og håndtering av sykdommer og tilstander.
8. **Helse- og sosialtjenesteforskning** (*health and social care services research*)
Forskning på helse- og sosialtjenester, helsepolicy og forskningsmetodologi.