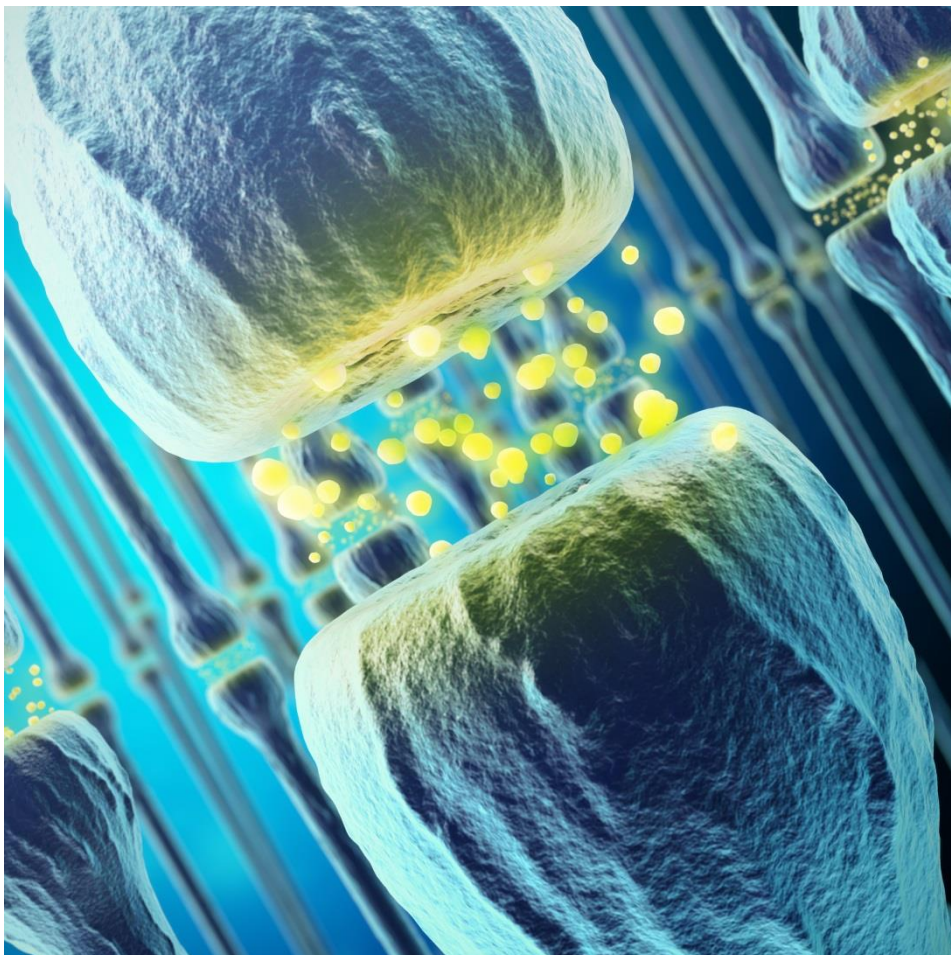




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# Annual Report

## Research Activity 2018



**Division of Clinical Neuroscience**  
**University of Oslo and Oslo University Hospital**





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## Oslo University Hospital and the University of Oslo

Oslo University Hospital (OUH) is Norway's largest hospital with over 20 000 employees and a budget of 20 billion NOK. The Hospital has a local function for parts of Oslo's population. It has a regional function for the inhabitants in the South-Eastern Norway Regional Health Authority, and it also has a large number of national functions. The Hospital is responsible for the majority of medical research and education of health personnel in Norway.

The University of Oslo (UiO) is Norway's largest research and educational institution with 28 000 students and 7 000 employees. Professional breadth and internationally recognized research environments make UiO an important contributor to society. The Faculty of Medicine was established in 1814 and works for progressive education, research and dissemination for the patients' and society's best interests.

### From Division Director Eva Bjørstad

Being the largest hospital in Norway, Oslo University Hospital provides highly specialized health care services to the citizens of Oslo and the Southeast health region. In addition, the Hospital has a nationwide responsibility for a number of national and multi-regional assignments. The Division of Clinical Neuroscience encompasses the disciplines of neurology, neurosurgery, physical medicine and rehabilitation, neuro habilitation and complex epilepsy. The proximity to patients and their medical issues are the cornerstones for the research conducted at our Hospital, and the research is aimed at improving patient care. High ethical standards ensure the confidentiality and our goal is to continuously improve diagnostics, treatment and management for all our patients.

### Research activity at the Division of Clinical Neuroscience

The Division's research activity is organized into 16 different research groups covering a broad range of basic, clinical and epidemiological research with an overall aim to improve patient care with emphasis on diagnostic, therapeutic and preventive measures. Most group leaders have a combined position at Oslo University Hospital and the University of Oslo. In total the Division has 18 Professors, 4 Associate Professors, several postdoctoral fellowships and PhD students, administrative staff and technical staff. The Division has an advisory research board that in 2018 consisted of: Professor and Head of Research John-Anker Zwart, Division Director Eva Bjørstad, Senior Consultant Morten Lossius, Professor and Senior Consultant Eirik Helseth, Senior Consultant Mona Skjelland, Senior Consultant Nada Andelic, Quality and healthcare adviser Hege Hammer and Administrative Manager Agnete Hager. In 2018 there were in total 217 registered peer reviewed publications and 10 PhD dissertations.

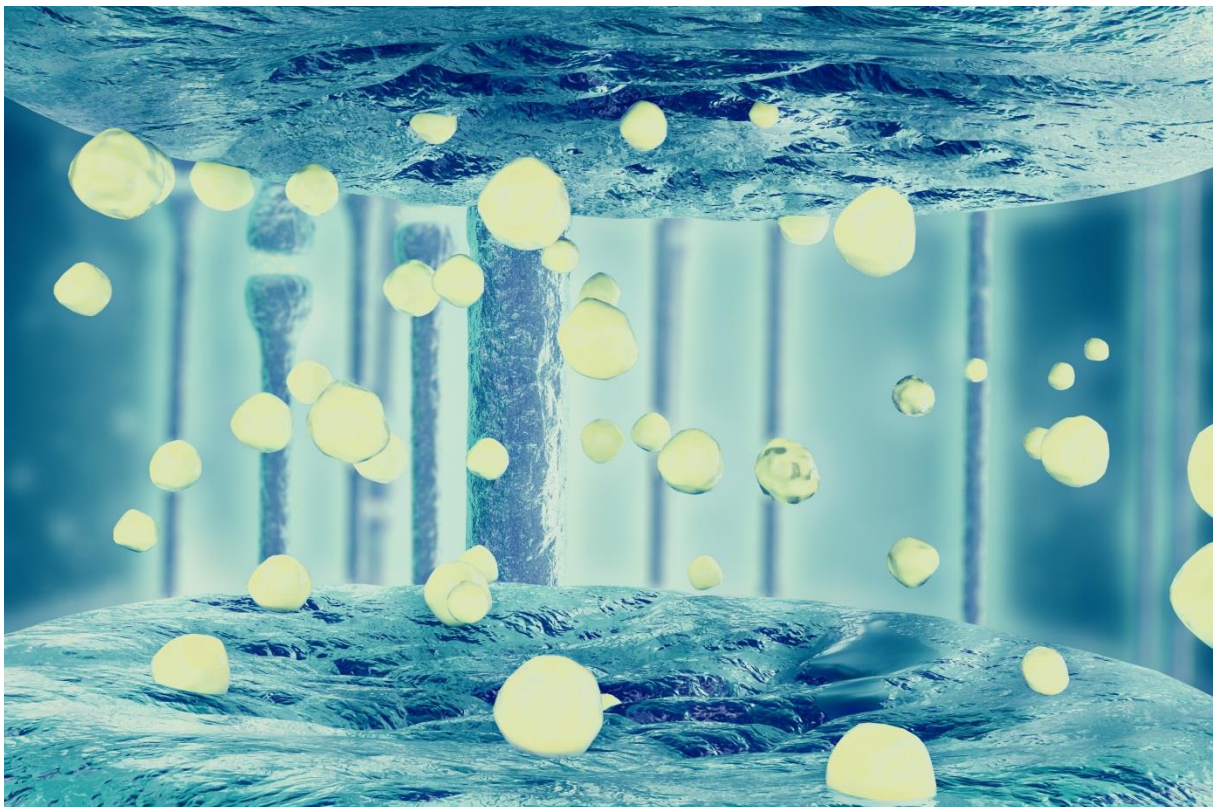
*Eva Bjørstad*



## Division of Clinical Neuroscience (NVR) Organizational Chart



\*UiO employees



## Rehabilitation after trauma



### Group Leader

Nada Andelic, MD/PhD, Researcher, Dept. of Nursing Science, UiO  
(nada.andelic@medisin.uio.no) / OUH (nadand@ous-hf.no)

### Group members

- Cecilie Røe, Professor, MD/PhD, UiO
- Erik Bautz-Holter, Professor emeritus, UiO
- Helene Lundgaard Sjøberg, PhD, Senior researcher, OUH
- Unni Sveen, Professor, PhD, OUH
- Tonje Haug Nordenmark, PhD, Postdoc, OUH
- Marit V. Forslund, PhD, postdoc, OUH
- Tanja Karic, PhD, OUH
- Torgeir Hellstrøm, PhD, OUH
- Ingerid Kleffegaard, PhD fellow, OUH
- Mari S. Rasmussen, PhD fellow, UiO
- Emilie I. Howe, Cand Psych, PhD fellow, UiO
- Silje Fure, PhD fellow, UiO
- Elin Western, PhD fellow, UiO
- Ida Maria Borgen Henriksen, PhD fellow, UiO
- Cathrine Buaas Tverdal, PhD fellow, UiO

### Associated group members

- Line Preede, PhD fellow, UIO

### Research profile and aims

The research group generates knowledge about the mechanisms and consequences of trauma, patient care, trends and challenges in treatment and rehabilitation including the patients' healthcare needs. The main research focus is traumatic injuries including traumatic brain injury (TBIs), and aneurysmal subarachnoid hemorrhage (aSAH). The research conducted by this group is multidisciplinary and collaborative, where collaboration between genetics, intensive medicine, neurosurgery, neuroradiology, neuropsychology and rehabilitation has been established over the last 10 years. By combining the perspectives and methods of basal, clinical and health care service research, we may provide unique knowledge on the consequences of injuries, how to organize effective patient care and improve the functional outcomes after injuries.

The main aims are:

1. To better understand the mechanisms, course and consequences of TBI and multiple traumas by using translational research strategy.
2. To develop and build evidence based efficient protocols for the rehabilitation implementation.
3. To strengthen existing and initiate new national and international research collaborations.



## Main ongoing projects

- *Center-TBI (Collaborative European NeuroTrauma Effectiveness Research in TBI)*. Principal investigator at the Oslo University Hospital Study Site of Center-TBI Nada Andelic
- *The course of functional recovery after moderate-to-severe TBI (5, 10 and 20 years after injury)*. In collaboration with Sunnaas Rehabilitation hospital. Principal investigator Nada Andelic, Researchers: Cecilie Røe, Torgeir Hellstrøm, Emilie I. Howe, Marit V. Forslund
- *The family as a resource for improved patient and family functioning after traumatic brain injury*. A randomized controlled trial of a family centered intervention. Principal investigator Helene L. Sjøberg, PhD fellow Mari S. Rasmussen
- *The effect evaluation of combined cognitive and vocational interventions after mild-to-moderate traumatic brain injury: a randomized controlled trial and qualitative process evaluation*. Principal Investigator: Nada Andelic, PhD fellows: Emile I. Howe and Silje Fure. Postdoc Torgeir Hellstrøm
- *Traumatic brain injury; needs and treatment options in the chronic phase. A randomized controlled community-based intervention*. Principal investigator: Cecilie Røe, PhD fellow Ida M. Borgen Henriksen, postdocs: Marit V. Forslund, Solveig L. Hauger, Ingerid Kleffelgaard
- *OSU6162 in the treatment of fatigue and other neuropsychological sequelae after aneurysmal subarachnoidal hemorrhage - a double-blind, randomised, placebo-controlled study*. Principal investigators Angelika Sorteberg and Tonje Haug Nordenmark. PhD fellow Elin Western
- *Rehabilitation needs after trauma*. In collaboration with the National Trauma Register and University Hospital of North Norway and CHARM. Principal investigator Nada Andelic, PhD fellows to be hired

## Other projects

- *Development of persistent fatigue after moderate-to-severe TBI*. In collaboration with Sunnaas Rehabilitation Hospital. Principal investigator Marianne Løvstad, PhD fellow Daniel Løke
- *Global functioning and quality of life 5 and 10 years after aneurysmal subarachnoid hemorrhage*. Principal investigator Tonje Haug Nordenmark, researcher Tanja Karic
- *Transitions in rehabilitation: Biographical reconstruction, experiential knowledge and professional expertise*. In collaboration with OsloMet. Investigators from OUH Helene L. Sjøberg and Unni Sveen
- *Effect of adapted physical activity and goal-setting on physical and mental health*. In collaboration with Beitostølen Health Sport Center. Principal investigators Cecilie Røe and Erik-Bautz Holter, fellow Line Preede
- *Pediatric traumatic brain injury: A prospective study investigating incidence, outcomes and unmet treatments needs 2 years post-injury*. In collaboration with Children Dept. Principal investigators Trond Diseth and Mia Myhre. PhD fellow Hilde M. Dahl
- *Acute treatment of traumatic brain injury at Oslo University Hospital. Profile of patient population, hospital resource use and hospital discharge*. In collaboration with Dept. of Neurosurgery. Principal investigator Eirik Helseth, PhD fellow Cathrine Buas Tverdal



## Most important national and international collaborators

### National

- Oslo Traumatic Brain Injury Outcome and Rehabilitation Research Network (OBIOR-research network)
- Hospitals in the South-East Region, including Sunnaas Rehabilitation Hospital
- The Norwegian University Hospitals
- OsloMet
- Work Research Institute (AFI)
- Norwegian Labor and Welfare Administration, Oslo
- NAV, Dept. of vocational rehabilitation
- Universities of Oslo, Bergen, Trondheim and Tromsø
- Helsam/Charm

### International

- Karolinska, Uppsala, Umeå and Salgrenska University Hospitals, Sweden
- Copenhagen University Hospital and Hammel Rehabilitation and Research Centre, Denmark
- Virginia Commonwealth University, Richmond, US
- BioCruces Health Research Institute, Spain
- University of California, San Diego, CA, USA
- University of Gottingen, Germany
- Hannover Medical School, Germany
- CENTER-TBI collaborators across the European hospitals/universities ((particularly Finland, UK, France, Slovakia and Germany)

### Funding

- European Union's Seventh Framework Programme for Research and Development
- Norwegian Research Council
- Heath Authority South-East Region
- Norwegian Extra Foundation for Health and Rehabilitation
- University of Oslo
- Oslo University Hospital

## Scientific production of the research group in 2018

### Dissertations

#### PhD thesis

Torgeir Hellstrøm:

*“Functional impairment, cognition, and MRI changes following mild traumatic brain injury”*

Faculty of Medicine, UiO

Ingerid Kleffelgaard:

*“Vestibular rehabilitation for dizziness and balance problems after mild-to-moderate traumatic brain injury”*

Faculty of Medicine, UiO

#### Master thesis

Cathrine Buaas Tverdal:

*“Care transition after traumatic brain injury. Discharge process from trauma hospital; patient experience and satisfaction with care transition”*

Faculty of Medicine, UiO







Øyvor Haugsbakk Talåsen:

«Det handler om å gi folk en sjanse». En kvalitativ studie om hvordan personer med traumatisk hodeskade opplever arbeidslivet ti år etter skaden

Collaboration between OUH and Oslo Met

**Peer reviewed original research articles: 15**

**Other publications: 10**

**Selected publications:**

Kleffelgaard I, Soberg HL, Tamber AL, Bruusgaard KA, Pripp AH, Sandhaug M, Langhammer B (2018)  
“The effects of vestibular rehabilitation on dizziness and balance problems in patients after traumatic brain injury: a randomized controlled trial”

Clin Rehabil, 33 (1), 74-84

DOI 10.1177/0269215518791274, PubMed 30056743.

Tverdal CB, Howe EI, Røe C, Helseth E, Lu J, Tenovuo O, Andelic N (2018)

“Traumatic brain injury: Patient experience and satisfaction with discharge from trauma hospital”

J Rehabil Med, 50 (6), 505-513. DOI 10.2340/16501977-2332, PubMed 29620136.

Howe EI, Andelic N, Perrin PB, Røe C, Sigurdardottir S, Arango-Lasprilla JC, Lu J, Løvstad M, Forslund MV (2018)

“Employment Probability Trajectories Up To 10 Years After Moderate-To-Severe Traumatic Brain Injury”

Front Neurol, 9, 1051. DOI 10.3389/fneur.2018.01051, PubMed 30568630,



## Painful musculoskeletal disorders



### Group Leader

Cecilie Røe, Professor, Head of Dept of Physical Medicine and Rehabilitation,  
UiO (cecilie.roe@medisin.uio.no)/ OUH (cecilie.roe@ous-hf.no)

### Group Members

- Erik Bautz-Holter, Professor emeritus, UiO
- Siri Bjorland, PhD student, UiO
- Jens Ivar Brox, Professor, UiO
- Kaia Beck Engebretsen, PT, PhD, OUH
- Marte Heide, PhD student, UIO
- Aasne Hoksrud, PhD, OUH
- Marianne Bakke Johnsen, PhD, OUH
- Niels-Gunnar Juel, MD, Dr. Philos, OUH
- Synnøve Kvalheim, PhD, OUH
- Elisabeth Kvalvaag, PhD, OUH
- Kjersti Myhre, PhD, OUH
- Marianne Mørk, PhD student, OUH
- Line Preede, PhD student, UiO
- Elina Schistad, PhD, postdoctoral student Pain Medicine, OUH
- Helene Skaara, MSc, OUH
- Sigrid Skatteboe, PhD, OUH
- Mirad Taso, PhD student, OUH
- Thy Vanem, PhD student, OUH

### Research profile and aims

The research unit generates knowledge regarding diagnostics, treatment and rehabilitation of painful musculoskeletal conditions. The main focus is on neck, back and shoulder conditions. The research is multidisciplinary, and collaboration with basal, clinical and health care service milieus established. Based on the framework of the International Classification of Functioning, Disability and Health (ICF) and the biopsychosocial model, interaction between the genetic and other basal disease mechanisms with psychosocial, personal and environmental factors are studied regarding the course of pain, functioning and participation. Furthermore, developing and evaluating treatment models in prospective and randomized studies, aiming to improve functioning and return to work are focus areas.

The main aims are:

- To understand the mechanisms, course and consequences of painful musculoskeletal conditions.
- To develop and evaluate treatment models for painful musculoskeletal conditions.



## Ongoing projects

- A randomized controlled study of surgical versus non-surgical treatment for cervical radiculopathy. Principal investigator Jens Ivar Brox, PhD fellow Mirad Taso
- The effectiveness of radial extracorporeal shockwave therapy, standardized exercise program or usual care for patients with plantar fasciopathy. Study protocol for a double-blind, randomized, sham-controlled trial. Principal investigator Aasne Fenne Hoksrud, PhD fellow Marianne Mørk and Marte Heide
- The long-term course of low back pain and radiculopathy. Principal investigators Cecilie Røe and Johannes Gjerstad, National Institute of Occupational health. PhD fellow Siri Bjorland
- Reliability of Modic changes. Principal investigator Elina Schistad
- Improving functioning and participation among persons with physical disabilities. Principal investigator Cecilie Røe. PhD student Line Preede
- Clinical course and prognostic factors for shoulder pain patients in primary and specialized care. Principal investigator Kaia Engebretsen
- Antibiotic treatment in patients with chronic low back pain and Modic Changes: randomized trial. Conducted by FORMI. Principal investigator in the research group Jens Ivar Brox and Elina Schistad
- Development of a minimum reporting set for rehabilitation services, Principal investigator Cecilie Røe
- FINITE - Finnish-Norwegian Tennis Elbow Study. Principal investigator, Aasne Fenne Hoksrud, Collaborators Jens Ivar Brox, Stein Tyrdal, Helene Skaara, Cecilie Røe

## Most important national and international collaborators

### National

- Dept. of Orthopaedics, OUH
- Forsknings og formidlingsenheten for muskelskjelett helse, FORMI
- Dept. of Physical medicine and Rehabilitation, St Olavs Hospital
- Dept. of Physical medicine and Rehabilitation, University Hospital of North Norway
- Dept. of Physical medicine and Rehabilitation, Haukeland University Hospital

### International

- Tuomas Lähdeoja, Helsinki University Central Hospital
- Juan Lu, Paul Perrin, Virginia Commonwealth University, US
- Christoph Gutenbrunner, Hannover Medical School, Department of Rehabilitation Medicine, Hannover, Germany





## Scientific production of the research group in 2018

Peer reviewed original research articles: 10

### Doctoral dissertation:

Sigrid Skatteboe: *“Outcome expectations in patients with persistent neck, back and shoulder complaints”*  
16 March 2018

Elisabeth Kvalvaag: *“Subacromial Pain Syndrome. Treatment, diagnostic imaging and predictors of outcome”*  
23 April 2018

Niels Gunnar Juel: *“Shoulder and hand diagnoses, stiffness and associated disability of the upper extremities in patients with type 1 diabetes for more than 45 years. The Dialog study”*  
21 June 2018

### Selected publications:

Juel NG, Brox JI, Hellund JC, Merckoll E, Holte KB, Berg TJ (2018)  
*“Radiological glenohumeral osteoarthritis in long-term type 1 diabetes. Prevalence and reliability of three classification systems. The Dialog shoulder study”*  
Skeletal Radiol, 47 (9), 1245-1251

Schistad EI, Bjorland S, Røe C, Gjerstad J, Vetti N, Myhre K, Espeland A (2018)  
*“Five-year development of lumbar disc degeneration-a prospective study”*  
Skeletal Radiol (in press)

Enger M, Skjaker SA, Melhuus K, Nordsletten L, Pripp AH, Moosmayer S, Brox JI (2018)  
*“Shoulder injuries from birth to old age: A 1-year prospective study of 3031 shoulder injuries in an urban population”*  
Injury, 49 (7), 1324-1329

### Funding

- The Research Council of Norway
- South-Eastern Norway Regional Health Authority
- Sofies Minde Ortopedi
- Oslo University Hospital (interaction means)



## Complex epilepsy



### Group Leader

Morten I. Lossius, Consultant neurologist, National Centre for Epilepsy, OUH ([mortenl@ous-hf.no](mailto:mortenl@ous-hf.no)) and Professor, UiO ([morten.lossius@medisin.uio.no](mailto:morten.lossius@medisin.uio.no))

### Group Members

- Marit Bjørnvold, MD/PhD, SSE
- Cecilie Johannessen Landmark, MSc/PhD, SSE and OsloMET
- Kristin Alfstad, MD/PhD, SSE
- Karl Otto Nakken, MD/PhD, SSE
- Magnhild Kverneland, MSc, SSE and UiO
- Kari Modalsli Aaberg, MD/PhD, SSE and UiO
- Hilde Karterud, Cand.san/PhD, SSE and UiO
- Antonia Villagran, MD, SSE and UiO
- Torleiv Svendsen, MD, SSE and UiO
- Oliver Henning, MD, SSE
- Sigrid Pedersen, MSc, SSE
- Erik sætre, MD, PhD, SSE
- Annette Holth Skogan Clin.Neuro.Psych/PhD, SSE
- Ellen Molteberg, MD, SSE and UiO

### Associated group members

- Anette Huuse Farmen, MD, Innlandet Hospital and UiO
- Marte Syvertsen, MD, Vestre Viken and UiO
- Kaja Kristine Selmer, MD/PhD, OUS and UiO

## Research profile and aims

Clinical research in patients with difficult-to-treat epilepsy, with particular focus on:

- Characterization of different epilepsy syndromes (genotype/phenotype)
- Clinical pharmacology of antiepileptic drugs
- Different diagnostic and treatment options; EEG, pharmacotherapy, surgery, VNS, diets
- Psychosocial, psychiatric and neurocognitive aspects
- Psychogenic non-epileptic seizures

## Ongoing projects

### PhD candidates in the UiO PhD program:

- Kari Modalsli Aaberg: *Epilepsy in young children*. Supervisor: Camilla Stoltenberg. Co-supervisors: Pål Suren, Per Magnus, Richard Chin, and Morten I. Lossius [Dissertation June 04, 2018](#)
- Magnhild Kverneland: *Effect of modified Atkin's diet in adult patients with pharmacoresistant focal epilepsy. A randomized controlled study*. Supervisor: Karl Otto Nakken. Co-supervisor: Erik Taubøll
- Antonia Villagran. *Psychiatric comorbidity in patients with psychogenic non-epileptic seizures (PNES)*. Supervisor: Morten I. Lossius. Co-supervisor: Roderick Duncan
- Torleiv Svendsen: *Tolerability and efficacy of new antiepileptic drugs*. Supervisor: Cecilie Johannessen Landmark. Co-supervisors: Ole Morten Rønning and Morten I. Lossius
- Sigrid Pedersen: *Epilepsy in Children: The Impact of the Gut Microbiota and Epigenetics in Successful Treatment of Epilepsy*. Supervisor: Kaja Kristine Selmer. Co-supervisors: Knut Rudi, Per Ole Iversen, and Benedicte Alexandra Lie
- **Ellen Molteberg**: *Long term effects of modified Atkins diet in therapy-resistant epilepsy*. Supervisor: Erik Taubøll. Co-supervisor: Per Medbøe Thorsby and Karl O. Nakken

### Dr. philos. candidate:

- Oliver Henning: *"Sexuality, depression and side effects in refractory epilepsy patients"*. Supervisor: Morten I. Lossius

### Post doc:

- Silje Alvestad: *"Scandinavian multi-registry study of antiepileptic drug teratogenicity: the SCAN-A study"*

### PhD-candidates not yet in the UiO PhD program:

- Eli B. Kyte: *"Impact of epilepsy surgery on cognition, psychiatry and quality of life at the commencement of aging"*  
Supervisor: Kristin Å. Alfstad
- Kathrine C. Haavardsholm: *"Long term effect of ketogenic diet in children with epilepsy"*  
Supervisor: Anette Ramm Pettersen
- Konstantin H. Kostov: *"Clinical outcomes and determinants of effectiveness of vagus nerve stimulation in a large national refractory epilepsy population"*  
Supervisor: Jukka Peltola. Co-supervisor: Morten I. Lossius and Pål Gunnar Larsson

### PhD-candidates in the UiO PhD program, associated to the group:

- Anette Huuse Farnen: *"Effect of epilepsy and antiepileptic drugs in pregnancy: cognition, neurodevelopmental symptoms and obstetric outcome in offspring – a prospective cohort study"*  
Supervisor: Morten I. Lossius. Co-supervisor: Merethe Øien

### International projects:

- “*EURAP study. An International Antiepileptic Drugs and Pregnancy Registry*” (International concerted Action on the Teratogenesis of Anti-epileptic Drugs) (<http://www.eurapinternational.org/>); **Silje Alvestad** and **Kari Mette Lillestølen**, national coordinators
- “*E-PILEPSY*” is a pan European project, with the primary aim of improving awareness and accessibility of surgery for epilepsy across different countries. Epilepsy surgery is an established treatment in the management of individuals with drug resistant focal epilepsy (<http://www.e-epilepsy.eu/>); **Morten I. Lossius**, associated partner
- “*EpiCARE*” *European Reference Network (ERN) on rare and complex epilepsies associated member.* Head of Scientific Advisory Board **Morten I. Lossius**
- “*NESREC*” *Nordic Epilepsy Surgery Research Consortium. SSE*
- “*Nordic prospective observational study of outcomes after rare epilepsy surgery procedures*”; **Fridny Heimsdottir**
- “*TRACE*” ((Transcutan VNS (t-VNS) for drug resistant epilepsy)); **Oliver Henning** and **Konstantin Kostov**
- “*Pharmacokinetic variability, efficacy and tolerability of a new antiepileptic drug, brivaracetam*” Scandinavian project between the National Centre for Epilepsy in Norway and Denmark (Filadelfia, Dianalund); **Torleiv Svendsen**, medical leader, **Cecilie Johannessen Landmark**, project leader
- “*Children with refractory epilepsy and use of the newest antiepileptic drugs*”. Scandinavian project between the National Center for Epilepsy in Norway and Denmark (Filadelfia, Dianalund); Margrete Larsen Burns, Marina Nikoronova, responsible in Denmark, **Cecilie Johannessen Landmark**, project leader
- “*EDDI EMG triggered seizure alarm*”; **Oliver Henning** in cooperation with Danish Epilepsy Center Dianalund
- “*Scandinavian multi-registry study of antiepileptic drug teratogenicity: the SCAN-A study*”; **Silje Alvestad**, post-doc, in cooperation with UiB/Haukeland
- CMD Expert Group. **Cecilie Johannessen Landmark**
- EpiPed. ILAE Task Force. **Cecilie Johannessen Landmark**
- EpiEd. ILAE Task Force. **Cecilie Johannessen Landmark**
- Pediatric Treatment. ILAE Task Force. **Cecilie Johannessen Landmark**
- **Tosca**. Novartis. Prot.No CRAD001MIC03: “*TuberOus SCLerosis Registry to IncreAse Disease Awareness*” International multicenter study. **Marit Bjørnvold**, Principle Investigator, and **Caroline Lund**
- **EXIST 3**. Novartis (everolimus). Prot.No. CRAD001M2304: “*A three-arm, randomized, double-blind, placebo-controlled study of 2 trough-ranges of everolimus as adjunctive therapy in patients with tuberous schlerosis complex (TSC) who have refractory partial-onset seizures*” International multicenter study; **Marit Bjørnvold**, principle investigator, and **Caroline Lund**





## Most important national and international collaborators

### National

- Prof. Eylert Brodtkorb, St. Olavs Hospital and NTNU, Trondheim
- Prof. Erik Taubøll, OUH and UiO
  
- Prof. Jeanette Koht, Drammen hospital and UiO
- Marte Syvertsen, MD, Drammen hospital and UiO
- Ass. prof. Marte Bjørk, Haukeland University Hospital and UiB

### International

- Prof. Torbjörn Tomson, Karolinska Institutet, Stockholm, Sweden
- Prof. Philippe Ryvlin, Lausanne University Hospital, Switzerland
- Prof. Marina Nikoronova, Dianalund, Denmark
  
- Prof. Christoph Helmstaedter, Bonn University Hospital, Germany
- Prof. Kristina Malmgren, Sahlgrenska University Hospital, Sweden
- Prof. Sándor Beniczky, Århus University, Denmark
- Prof. Guido Rubboli, Copenhagen University, Denmark
- Ass. Prof. Rikke Steensbjerre Møller, University of Southern Denmark, Denmark
- Prof. Jukka Peltola, Tampere University Hospital, Finland

## Scientific production of the research group in 2018

Peer reviewed original research articles: 20

Other publications: 5

### Dissertations : 1

Kari Modalsli Aaberg: *"Epilepsy in young children"*. June 04, 2018

### Selected publications:

Aaberg KM, Bakken IJ, Lossius MI, Lund Sjøraas C, Tallur KK, Stoltenberg C, Chin R, Surén P (2018) *"Short-term Seizure Outcomes in Childhood Epilepsy"*

**Pediatrics, 141 (6), (June 2018:e20174016)**

Kverneland M, Molteberg E, Iversen PO, Veierød MB, Taubøll E, Selmer KK, Nakken KO (2018)

*"Effect of modified Atkins diet in adults with drug-resistant focal epilepsy: A randomized clinical trial"*

**Epilepsia, 59 (8), 1567-1576**

Farmen AH, Grundt JH, Nakling JO, Mowinckel P, Nakken KO, Lossius MI (2018)

*"Increased rate of acute caesarean sections in women with epilepsy: results from the Oppland Perinatal Database in Norway"*

**Eur J Neurol, 26 (4), 617-623**

### Funding

- South-Eastern Norway Regional Health Authority
- Norwegian ExtraFoundation for Health and Rehabilitation
- Innlandet Hospital Trust





## Neurovascular–Hydrocephalus Research Group



### Group Leader

Per Kristian Eide, Professor, Dept of Neurosurgery, UiO (p.k.eide@medisin.uio.no)/  
Head of Section, Dept of Neurosurgery, OUH (peide@ous-hf.no)

### Group Members

- Brastad Evensen, Karen, PhD fellow, OUH
- Dahlberg, Daniel, PhD fellow, OUH
- Eide, Per Kristian, professor, OUH
- Fric, Radek, PhD fellow, OUH
- Hassan-Olive, Md Mahdi, PhD fellow, OUH
- Lashkarivand, Aslan, PhD fellow, OUH
- Langvatn, Erlend, Consultant, OUH
- Slettebø, Haldor, Senior Consultant, OUH
- Sortberg, Angelika, dr.med., OUH
- Sorteberg, Wilhelm, dr.med., OUH
- Stanisic, Milo, dr.med., OUH
- Ringsby, Jon-Olav, Consultant, OUH
- Wiedemann, Markus, PhD, Consultant, OUH

### Research profile and aims

The research group focuses on clinical and translational neurosurgical research within the fields of neurovascular disease and cerebrospinal fluid disorders.

1. Cerebrovascular disorders. Cerebral hemodynamics. Focus on intracranial aneurysms and subarachnoid hemorrhage, including neurointensive monitoring and outcome.
2. Brain Monitoring. Several projects study intracranial pathophysiology with a strong focus on intracranial pressure and arterial blood pressure dynamics, and cerebral autoregulation.
3. Hydrocephalus. Studies focus on the pathophysiology of hydrocephalus and alterations in pressure dynamics in hydrocephalus and other brain water disorders. Translational research has been initiated to study molecular-genetic mechanisms of hydrocephalus and diseases involving disorders in brain water homeostasis. Clinical studies focus on outcome of treatment of hydrocephalus. Studies on imaging of CSF circulation.

## Ongoing projects

- Pathophysiology by cerebral abscesses
- Pathophysiology of hydrocephalus and abnormal brain pressure
- Pathophysiology of subarachnoid hemorrhage and subdural hematomas
- Outcome of treatment of subarachnoid hemorrhage, vascular compression syndromes, stroke and hydrocephalus
- Bleeding Risks of cerebral aneurysms
- Rehabilitation after subarachnoid hemorrhage
- Diagnostic Imaging by disturbances in the cerebrospinal fluid circulation
- Non-invasive monitoring of intracranial pressure
- Glymphatic circulation in humans

## Most important national and international collaborators

### National

- Simula, UiO
- Physical medical dept, OUH
- Dept of Radiology, OUH
- Interventional Centre, OUH
- Dept of Informatics, UiO
- Dept of Mathematics, UiO
- Dept of Neurology, OUH
- Trauma Clinic , OUH
- Sunnaas Rehabilitation Hospital
- Institute of Basic Medical Sciences, UiO

### International

- University of Gothenburg, Sweden (Prof. Hansson)
- University of Kupio, Finland
- University of Copenhagen

## Funding

- South-Eastern Norway Regional Health Authority
- European Union

## Scientific production of the research group in 2018

Peer reviewed original research articles: 20

Invited lectures at international congresses: >15



### Doctoral dissertations: 3

**Dahlberg, Daniel** *“When bacteria hit the brain: toxic and depolarization levels of neuroactive amino acids, ammonia and potassium in brain abscesses”*

Institute of Clinical Medicine, Faculty of Medicine, University of Oslo, ISBN 978-82-8377-160-2  
Dissertation January 19<sup>th</sup> 2018

**Paulsen, Anne Henriette** *“Adult outcome in pediatric hydrocephalus”*

Institute of Clinical Medicine, Faculty of Medicine, University of Oslo, ISBN 978-82-8377-195-4  
Dissertation March 16<sup>th</sup> 2018

**Ringstad, Geir** *“Imaging cerebrospinal fluid dynamics in idiopathic normal pressure hydrocephalus”*

Institute of Clinical Medicine, Faculty of Medicine, University of Oslo, ISBN 978-82-8377-269-2  
Dissertation September 14<sup>th</sup> 2018

### Selected publications:

Haug Nordenmark T, Karic T, Sorteberg W, Sorteberg A (2018)

*“Predictors of cognitive function in the acute phase after aneurysmal subarachnoid hemorrhage”*

Acta Neurochir (Wien), 161 (1), 177-184

DOI 10.1007/s00701-018-3760-0, PubMed 30535853, WoS 000455568300029 (Details)

Lindstrøm EK, Ringstad G, Mardal KA, Eide PK (2018)

*“Cerebrospinal fluid volumetric net flow rate and direction in idiopathic normal pressure hydrocephalus”*

Neuroimage Clin, 20, 731-741

DOI 10.1016/j.nicl.2018.09.006, PubMed 30238917, WoS 000450799000079 Cristin 1607786 (Details)

Ringstad G, Valnes LM, Dale AM, Pripp AH, Vatnehol SS, Emblem KE, Mardal KA, Eide PK (2018)

*“Brain-wide glymphatic enhancement and clearance in humans assessed with MRI”*

JCI Insight, 3 (13), e121537

DOI 10.1172/jci.insight.121537, PubMed 29997300, WoS 000438547200009 Cristin 1591663 (Details)



## Oslo Neurosurgical Outcome Study Group (ONOSG)



Professor Eirik Helseth, MD/PhD, Consultant neurosurgeon, Dept. of Neurosurgery, Oslo University Hospital (eirik.helseth@ous-hf.no) and Professor of Neurosurgery, Faculty of Medicine, University of Oslo (eirik.helseth@medisin.uio.no)



Torstein Meling, MD/PhD, Consultant neurosurgeon, Dept. of Neurosurgery, Oslo University Hospital (tmeling@ous-hf.no), Professor of Neurosurgery, Faculty of Medicine, University of Oslo and Assistant Professor, Institute of Psychology, University of Oslo (t.r.meling@medisin.uio.no)

### Group Members

- Petter Brandal, MD/PhD, OUH
- Bjarne Lied, MD/PhD, Oslofjordklinikken
- Tom Børge Johannesen, MD/PhD, OUH
- David Scheie, MD/PhD, Rigshospitalet, Copenhagen, Denmark
- Mads Aarhus, MD/PhD, OUH
- Einar Vik-Mo, MD/PhD, OUH
- Charlotte Halvorsen, MD, PhD fellow, OUH
- Hege Linnerud, MD/PhD, OUH
- Markus Wiedmann, MD/PhD, OUH
- Jon-Terje Ramm-Pettersen, MD/PhD, OUH
- Pål Rønning, MD/PhD, OUH
- Benjamin Lassen, MD, PhD fellow, OUH
- Marton König, MD, PhD fellow, Faculty of medicine, UiO
- Tor Brommeland, MD/PhD fellow, OUH
- Ali Rizvi, MD, PhD fellow, OUH
- Christina Teisner Høstmælingen, MD, PhD fellow, OUH
- Cathrine Buaas Tverdal, registrar and PhD fellow, OUH
- Dag Ferner Netteland, PhD fellow
- Ola Fougner Skaansar, medical student, UiO
- Ingar Næss, medical student, UiO
- Guro Jahr, PhD fellow
- Michele Da Broi, MD/PhD fellow

### Research profile and aims

Main focus on surgical complications and outcome after surgery for:

- Intracranial tumors
- Intraspinal tumors
- Outpatient spinal surgery
- Neurotrauma



## Ongoing projects

- Intraspinial tumors – Surgical management
- Cervical trauma – Epidemiology and Surgical management
- Traumatic Brain Injury – Epidemiology and management
- Intracranial tumors – Epidemiology, imaging and management
- CenterTBI – European study
- Transocular ultrasound for ICP measurement – with SINTEF/Nisonic
- GLOBAL NEUROTRAUMA OUTCOMES STUDY (GNOS)
- Low-grade gliomas: Scandinavian Study of Surgical Selection, Techniques and Results (S4TAR)
- Safety of outpatient spine surgery

## PhD projects

- Skull base tumors - Marton König
- CNS lymphomas – Guro Jahr
- Intracranial meningiomas – Michele Da Broi
- Intraspinial tumors – Charlotte Halvorsen
- Odontoid fractures – Ali Rizvi
- Subaxial cervical fractures - Christina Teiner Høstmælingen
- Transocular ultrasound for ICP measurement - Dag Ferner Netteland
- Traumatic brain injury – Cathrine Buas Tverdal

## “Forskerlinje” projects

- Traumatic brain injury – Ola Fougner Skaansar
- Bicycle accidents – Ingar Næss

## Funding

South-Eastern Norway Regional Health Authority

## Scientific production of the research group in 2018

Peer reviewed original research articles: 21

Invited lectures at international congresses: 40





### Selected publications:

König M, Osnes T, Jebsen P, Meling TR (2018)

*“Craniofacial resection of malignant tumors of the anterior skull base: a case series and a systematic review”*

Acta Neurochir (Wien), 160 (12), 2339-2348

DOI 10.1007/s00701-018-3716-4, PubMed 30402666, WoS 000450984500010 Cristin 1629947 (Details)

Formo M, Halvorsen CM, Dahlberg D, Brommeland T, Fredø H, Hald J, Scheie D, Langmoen IA, Lied B, Helseth E (2018)

*“Minimally Invasive Microsurgical Resection of Primary, Intradural Spinal Tumors is Feasible and Safe: A Consecutive Series of 83 Patients”*

Neurosurgery, 82 (3), 365-371

DOI 10.1093/neuros/nyx253, PubMed 29992282, WoS 000439685800038 Cristin 1567286 (Details)

Meling TR, Da Broi M, Scheie D, Helseth E (2018)

*“Meningiomas: skull base versus non-skull base”*

Neurosurg Rev, 42 (1), 163-173

DOI 10.1007/s10143-018-0976-7, PubMed 29627874 Cristin 1593332 (Details)



## Vilhelm Magnus Laboratory for Neurosurgical Research



### Group Leader

Iver A. Langmoen, MD/PhD, Professor, Dept of Neurosurgery, UiO  
(i.a.langmoen@medisin.uio.no) /Dept of Neurosurgery, OUH (UXLAIV@ous-hf.no)

### Group Members:

- Cecilie J Sandberg, MSc, PhD, Lab manager/HR/Daily activities, OUH
- Einar O. Vik-Mo, MD, PhD, Deputy group leader, OUH
- Awais Mughal, MD, PhD
- Kirsten Strømme Kireulf-Vieira, MD, PhD
- Artem Fayzullin, MD, PhD-student, UiO
- Erlend Skaga, MD, PhD-student, UiO
- Marit Brynjufsen, MSc, PhD-student, UiO
- Zanina Grieg, MSc, OUH
- Birthe Mikkelsen, BSc, OUH (leave of absence)
- Emily Palmero, BSc, OUH
- Elise Solli, MSc-student, NTNU

### Research profile and aims

The Vilhelm Magnus Laboratory (VML) is a section within the Department of Neurosurgery focusing on translational research: exploration of the biology underlying neurosurgical conditions with an ambition of making contributions to novel treatments. Research efforts during the last 15 years have concentrated on stem cells from the adult human brain and brain cancer. The studies on brain cancer are focused on glioblastoma (GBM) which is both the most frequent and most deadly brain cancer (median survival in unselected series  $\approx$ 10 months).

#### Aims:

- To characterize cell types and cellular mechanisms in GBMs with special attention on GBM stem cells (GSCs)
- To develop therapeutic strategies against GCSs
- To characterize human brain stem cells and develop cell types for treatment of neurodegenerative disorders

## Ongoing projects

### **Background**

Fifteen years ago we showed for the first time that stem cells from the adult human brain can differentiate into functional neurons, and that it is possible to generate a small nervous system with numerous neurons that fire action potentials and communicate via synapses, from a single stem cell harvested from the adult human brain (Moe et al Brain, 2005;128:2189-99, Westerlund et al Exp Cell Res. 2003; 289:378-83, Moe et al Neurosurgery 2005;56:1182-8).

Simultaneously we started to grow cells from GBMs. A population of cells from these tumors turned out to have stem cell-like properties. We showed that a GBM only can be transferred from one animal to another by transplantation of cells from the GSC subpopulation, in keeping with other results indicating that it is this subpopulation that is responsible for recurrence, growth and drug resistance. We have therefore characterized GSCs quite extensively (Varghese et al Neurosurgery. 2008;63:1022-33; Vik-Mo et al, Neuro Oncol, 2010 Dec;12:1220-30, Vik-Mo et al, Exp Cell Res, 2011 Apr 15;317:1049-59, Joel et al, Dev Dyn, 2013;242:1078-93, Sandberg et al, Exp Cell Res, 2013 15;319:2230-43, Fayzullin et al Exp Cell Res. 2016 10;349:199-213, Mughal et al, Neoplasia. 2018;20:643-6569).

### **Development of a stem cell-based vaccine in patients with brain cancer:**

We developed the first clinical protocol that targeted stem cells in a solid tumor by transducing dendritic cells from patients with mRNA from their own GBM stem cells. This significantly improved clinical outcome (Vik-Mo et al, Cancer Immunol Immunother. 2013;62:1499-509). One out of four of the patients are still alive.

The responders have a median survival of 7 years and are still recurrence free. A randomized trial of the vaccine was certified by all required authorities and started in the spring of 2018. Our intention in the current study is also to clarify why some patients respond and others do not; by in-depth studies of individual tumors and treatment responses.

### **Individualized systems medicine strategy to target GSCs in patients with recurrent glioblastoma:**

In collaboration with our partners at the Finnish Institute for Molecular Medicine, we are combining the novel technical possibilities of high-throughput screening and deep sequencing with our established know-how on patient specific tumor stem cell cultures. Exploring a panel of 525 drugs established in clinical use, as well as drugs in early-phase development, at five different concentrations, we have screened stem cells from individual tumors for drug sensitivity. The approach has been coined Individualized Systems Medicine. This study has shown that GBMs from individual patients are very heterogeneous with respect to drug sensitivity. A manuscript has been submitted for publication.

A clinical trial where we treat patients based on the result from this screening has been planned and applications to relevant authorities are being sent.

### **Coordinated undermining of survival paths with nine repurposed drugs (CUSP9) and temozolomide in patient-derived GBM samples:**

A major barrier to effective treatment in glioblastoma is the simultaneous activity of multiple survival and growth-promoting mechanisms. A conceptually new treatment approach has emerged focusing on coordinated blockade of the native survival paths of GBMs. The coordinated blockade is





undertaken by nine clinically well-known and repurposed drugs concomitant with the cytotoxic and standard of care, temozolomide, in a drug cocktail termed CUSP9. We have evaluated the in vitro efficacy of CUSP9 in patient-derived GBM samples using clinical relative drug concentrations across several different experimental cell assays. The coordinated approach has demonstrated a broad efficacy among several patient samples and experimental cell assays, and as the drugs have well-known safety profiles the results are intriguing for translation to patient treatment. A manuscript has been submitted for publication.

#### **Characterization of invasive GCSs at the single cell level:**

Glioblastomas are characterized by diffusely infiltrative growth. To investigate the invasive properties of glioblastoma cells we film cells while they invade into rodent brain slices or 3D-biomatrixes using time-lapse microscopy. We have identified subpopulations of cells with different invasive potentials. These cells display specific movement patterns and morphology. This is part of a PhD project where the last paper has been submitted and the thesis is expected to be submitted in 2018.

#### **Molecular targeting of cancer stem cells in glioblastoma:**

By performing a systematic comparison of gene expression in adult human neural stem cells and GSCs, we have identified differentially expressed genes that may have the potential as new and specific targets for treatment of glioblastoma. Our results from exploring several of these genes and pathways in-depth, suggest a functional role for the Wnt signaling pathway, PBK and NAT12/NAA30 in GBM. As a strategy to more efficiently and directly identify targets that are likely to trigger a therapeutic response, we are currently focusing on genetic high throughput loss-of function screening as tools to identify both individual and shared target hits in patient derived GSC cell cultures.

### **Most important national and international collaborators**

#### National

- Gunnar Kvalheim/Dag Josefsen, OUH
- Steinar Aamdal/Paal Brunsvig, OUH
- Gustav Gaudernack, Targovax
- Kyrre Emblem, OUH
- Ola Myklebust, OUH
- Petter Brandal, OUH
- Elsa Lundanes, UiO
- Steven Wilson, UiO

#### International

- Krister Wennerberg, Markus Perola, Finnish Institute for Molecular Medicine, Finland
- Aki Laakso, Emilia Gaa-Paavola, Töölö Hospital, Helsinki, Finland
- Rainer Glass, LMU, München, Germany
- Krishna Bhat and Frederick Lang, MD Anderson Cancer Center, Houston, USA
- Winston Hide, Harvard University, MA, USA



## Funding

- Norwegian Cancer Society
- The Norwegian Research Council
- South-Eastern Regional Health authorities
- OUH, Dept. of Neurosurgery

## Scientific production of the research group in 2018

Peer reviewed original research articles: 6

### Selected publications:

Mughal AA, Zhang L, Fayzullin A, Server A, Li Y, Wu Y, Glass R, Meling T, Langmoen IA, Leergaard TB, Vik-Mo EO

*“Patters of Invasive Growth in Malignant Gliomas – The Hippocampus Emerges as an Invasion-Spared Brain Region”*

Neoplasia. 2018 Jul;20(7):643-656.

Fayzullin A, Sandberg CJ, Spreadbury M, Saberniak BM, Grieg Z, Skaga E, Langmoen IA, Vik-Mo EO.

*“Phenotypic and Expressional Heterogeneity in the Invasive Glioma Cells”*

Transl Oncol. 2019 Jan;12(1):122-133.

Skottvoll FS, Berg HE, Bjørseth K, Lund K, Roos N, Bekhradnia S, Thiede B, Sandberg C, Vik-Mo EO, Roberg-Larsen H, Nyström B, Lundanes E, Wilson SR.

*“Ultracentrifugation versus kit exosome isolation: nanoLC-MS and other tools reveal similar performance biomarkers, but also contaminations”*

Future Sci OA. 2018 Nov 9;5(1):FSO359



## Functional Neurosurgery Group



### Group Leader

Pål G. Larsson, MD/Dr. philos, Head of Clinical Neurophysiology, Dept. of Neurosurgery, OUH (pall@ous-hf.no)

### Group Members

- Arild Egge, MD/PhD, OUH
- Frode Kolstad, MD, PhD, OUH
- Milo Stanisic, MD, Dr.med., OUH
- Jugoslav Ivanovic, MD/PhD fellow
- Mark Züchner, MD/PhD, OUH
- Ane Konglund, MD/PhD, OUH
- Marianne Nævra, Mphil., OUH
- Ketil Berg Olsen, MD, OUH
- Lars Etholm, MD/PhD, OUH
- Anne Henriette Paulsen, MD/PhD

### Research profile and aims

Main research aim is assessment of brain, medulla and peripheral nerve function and surgical treatment:

- Epilepsy surgery
- Deep brain stimulation
- Other electrical nerve tissue stimulation
- Assessment of grain function through EEG
- Stereotactic intracranial recording (SEEG)
- Function localization
- Clinical assessment through deep machine learning

### Ongoing projects

- Cognitive function assessment through SEEG
- Consciousness assessment with transcranial magnetic stimulation (TMS) (EU HBP)
- Dynamics of large-scale cortical networks during general anesthesia
- Changes in brain connectivity during the Wada test
- Epilepsy surgery outcome
- Changes in connectivity in preterm children
- Adjuvant treatment with Cyclocapron in surgical treatment of CSDH
- ProTLE – follow up study of newly diagnosed temporal lobe epilepsies
- Long QT-time and seizures
- Continues spike wave during sleep (CSWS)
- Source localization in epilepsy (E-epilepsy, EU-consortium)
- Antiepileptic drug use in Norway



- Quality assessment of intraoperative neuro-monitoring in spine surgery (IONM)
- NORSTIM – prospective study of DBS in STN in Parkinson disease
- DBS in tremor
- Microbiota in Nuclius Subthalamicus and CSF in patients with Parkinson disease
- Predictors of VNS stimulation
- EEG as predictor of Brivaracetam effect
- Interictal EEG features as biomarkers in presurgical epilepsy work up
- Refractory status epilepticus
- Genetic mapping in Moya Moya

### Most important national and international collaborators

#### National

- Institute of Psychology, UiO
- Institute of Basic Medical Sciences, UiO
- Department of Neurology, OUH
- Department of Anesthesiology, OUH
- Children's Department, UUS, OUH
- National Center for Epilepsy, OUH
- Department of Radiology, OUH
- Research laboratory, DNR, OUH
- Internal Medicine, OUH
- OsloMet
- Department of Engineering Cybernetics, NTNU

#### International

- Helene Wills institute, UC Berkeley, US
- Department of Neurology, Marburg , Germany
- Clinical Neurophysiology, Århus, Denmark
- Dianalund Epilepsy Center, Denmark

### Scientific production of the research group in 2018

**Peer reviewed original research articles:** 14

**Invited lectures at international congresses:** 12 of whom 3 in international meetings

**Doctoral dissertations:** 2 (with collaborating partners)

**Arton Baftiu** *“Antiepileptic drug utilization and clinical implications”*

Department of Life Science and Health, Faculty of Life Sciences, OsloMet,  
ISBN 978-82-8364-088-5

**Paulsen, Anne Henriette** *“Adult outcome in pediatric hydrocephalus”*

Department of Neurosurgery, Faculty of Medicine, University of Oslo, ISBN 978-82-8377-195-4





### Selected publications:

Juel BE, Romundstad L, Kolstad F, Storm JF, Larsson PG (2018)

*"Distinguishing Anesthetized from Awake State in Patients: A New Approach Using One Second Segments of Raw EEG"*

Front Hum Neurosci, 12, 40

DOI 10.3389/fnhum.2018.00040, PubMed 29515381, WoS 000425544400001 Cristin 1566930 (Details)

Züchner M, Kondratskaya E, Sylte CB, Glover JC, Boulland JL.

*"Rapid recovery and altered neurochemical dependence of locomotor central pattern generation following lumbar neonatal spinal cord injury"*

J Physiol. 2018 Jan 15;596(2):281-303

Johnson EL, Adams JN, Solbakk AK, Endestad T, Larsson PG, Ivanovic J, Meling TR, Lin JJ, Knight RT (2018)

*"Dynamic frontotemporal systems process space and time in working memory"*

PLoS Biol, 16 (3), e2004274

DOI 10.1371/journal.pbio.2004274, PubMed 29601574, WoS 000458621400003 Cristin 1592498 (Details)

### Funding

- None directly to the group
- More national and international fundings through collaborators



## Movement Disorders



### Group Leader

Mathias Toft, MD/PhD, Professor and Senior consultant, Dept. of Neurology, UiO (mathias.toft@medisin.uio.no)/OUH (mtoft@ous-hf.no)

### Group Members

- Victoria Berge, MD
- Silje Bjerknes, MD
- Kari Anne Bjørnarå, MD PhD (Vestre Viken)
- Vidar Gundersen, Prof MD PhD
- Sandra Pilar Henriksen, MSc
- Chiara Cappelletti, MSc
- Zafar Iqbal, PhD
- Nadja Anette Myrvik Kvernmo, MD
- Lasse Pihlstrøm, MD, PhD
- Inger Marie Skogseid, MD PhD
- Margrete Langmyhr, MSc
- Maren Stolp Andersen, MD
- Espen Dietrichs, Prof MD PhD
- Kristin Ørstavik, MD PhD
- Trine Haug Popperud, MD PhD
- Magnhild Rasmussen, MD PhD
- Ellen Annexstad, MD
- Marianne Nordstrøm, Registered dietitian, PhD
- Anna Benterud, MD (Ahus)
- Hanne Ludt Fossmo, MSc
- Gro Solbakken, MSc (Vestre Viken)

### Research profile and aims

Our research aims at mapping the clinical expression, natural progression and treatment of movement disorders and neuromuscular disorders, as well as their causes (genetic disposition, environmental factors, and pathophysiological mechanisms).

Clinical research is performed at both sites of Department of Neurology, i.e. at Rikshospitalet (The National Hospital) and at Ullevål University Hospital. Laboratory research is performed in the Neuroscience Research Unit in our new facilities at Domus Medica IV, close to Rikshospitalet. Our Department is the secondary referral center for all neurology in Oslo (mainly at Ullevål), and the tertiary referral center for neurology in the South-East Health Region of Norway (which includes one half of the Norwegian population). In addition, we have different national functions, including deep brain stimulation (DBS) for movement disorders and other conditions (shared with St. Olavs hospital). The group is also part of the National Advisory Unit on Rare Disorders.





## Ongoing projects

Our research group studies movement disorders and neuromuscular disorders. We have projects with focus on Parkinson's disease, dystonia, tremors and neuromuscular disorders, especially myotonic dystrophy and Duchenne muscular dystrophy. These topics include clinical research as well as laboratory research/translational research.

## Most important national and international collaborators

### National

- Division of Clinical Neuroscience, UiO (Internal collaboration, joint academic and laboratory)
- The other university hospitals in Norway
- Vestre Viken Hospital Trust
- Prof. Ole Andreassen, UiO, DemGene – Genetics of Dementia
- Dept. of Cardiology, OUH
- Prof. Jan Frich, Dept. of Health Management and Health Economics, UiO
- Prof. SO Kolseth, Dept. of Nutrition, Inst. of Basic Medical Sciences, UiO
- Sunnaas Hospital

### International

- IPDGC (international Parkinson Disease Genetics Consortium)
- COURAGE-PD consortium
- Dr. Owen Ross, Mayo Clinic, USA
- GEO-DP consortium
- Dr Wilma van der Berg, VuMC University Hospital, Amsterdam, Netherlands
- Prof. Per Odin, Lund University, Sweden
- Prof. Henry Houlden, University College London, UK

## Funding

Among others:

- The Research Council of Norway
- South-Eastern Norway Regional Health Authority
- Norwegian ExtraFoundation for Health and Rehabilitation
- Michael J. Fox Foundation (US)
- The Norwegian Health Association
- Stiftelsen Sophies Minde





## Scientific production of the research group in 2018

Peer reviewed original research articles: 31

### Selected publications:

Pihlstrøm L, Blauwendraat C, Cappelletti C, Berge-Seidl V, Langmyhr M, Henriksen SP, van de Berg WDJ, Gibbs JR, Cookson MR, International Parkinson Disease Genomics Consortium, North American Brain Expression Consortium, Singleton AB, Nalls MA, Toft M (2018)

*"A comprehensive analysis of SNCA-related genetic risk in sporadic parkinson disease"*

Ann Neurol, 84 (1), 117-129

DOI 10.1002/ana.25274, PubMed 30146727, WoS 000443302300011 Cristin 1614151 (Details)

Bjerknes S, Toft M, Konglund AE, Pham U, Waage TR, Pedersen L, Skjelland M, Haraldsen I, Andersson S, Dietrichs E, Skogseid IM (2018)

*"Multiple Microelectrode Recordings in STN-DBS Surgery for Parkinson's Disease: A Randomized Study"*

Mov Disord Clin Pract, 5 (3), 296-305

DOI 10.1002/mdc3.12621, PubMed 30009214, WoS 000435280300009 Cristin 1600490 (Details)

Fossmo HL, Holtebekk E, Giltvedt K, Dybesland AR, Sanaker PS, Ørstavik K (2018)

*"Physical exercise in adults with hereditary neuromuscular disease"*

Tidsskr Nor Laegeforen, 138 (11) DOI 10.4045/tidsskr.17.1024, PubMed 29947206, WoS 000436491800025 (Details)





## Cerebrovascular diseases



### Group Leader

Mona Skjelland, Associate professor and Consultant, Dept. of Neurology, UiO (m.e.skjelland@medisin.uio.no) and OUH (moskje@ous-hf.no)

### Group Members

- Anne Hege Aamodt, MD, PhD, postdoc
- Lars Alteheld, MD
- Helge Fagerheim Bugge MD, PhD fellow
- Brian Enriques, MD
- Erik Eriksen, MD
- Mona Guterud, paramedics, PhD fellow
- Guri Hagberg MD, PhD fellow
- Sophia Charlotta Hamre, PhD fellow
- Maren Ranhoff Hov, MD, PhD, postdoc
- Gudrun Anette Høie, MD, PhD fellow
- Jørgen Ibsen, MD, PhD fellow
- Hege Ihle-Hansen, MD, PhD
- Svein Håkon Ingebretsen, MD
- Henriette Johansen, MD
- Mirza Jusufovic, MD, PhD
- Kristian Kraglund, MD, PhD
- Karianne Larsen, MD, PhD fellow
- Christian Lund, MD, PhD
- Terje Nome, MD
- Barbara Ratajczak-Tretel MD, PhD fellow
- David Russell, Professor emeritus
- Else-Charlotte Sandset, MD, PhD, postdoc
- Karolina Skagen, MD, PhD, postdoc
- Kristine Stø, MD, PhD fellow
- Mahtab Zamani, MD, PhD fellow
- Anna Tancinova, MD, PhD fellow
- Georgus Vlachos, MD, PhD fellow

### Associate Group members

- Eivind Berge, Professor, UNN
- Mona Beyer, MD, Associate Professor
- Kjersti Johnsrud, MD, PhD fellow, OUH

## Research profile and aims

The main goal is to conduct high-quality cerebrovascular research leading to new knowledge and hopefully better treatment of stroke patients. The main research areas are:

- **Acute stroke, inflammation and the gut-brain axis.** The main aim of this group is to study the role of inflammation in acute stroke, and the impact of gut microbiota on cerebrovascular disease. Subgroup leader is Karolina Skagen.
- **Pre-hospital and acute stroke.** The focus of this group is to improve and implement prehospital diagnostics and treatment of acute stroke patients. Subgroup leader is Else Charlotte Sandset.
- **Acute stroke treatment and atrial fibrillation.** The scientific research interest is acute stroke treatment, diagnostic workup in acute ischemic stroke and the relation between stroke and atrial fibrillation. Subgroup leader is Anne-Hege Aamodt.
- **Stroke and cognition.** This group aims to quantify and measure levels of cognitive impairment after stroke and to identify biological and clinical markers associated with prognosis for cognitive disorders following incident stroke. Subgroup leader is Hege Ihle-Hansen.

## Ongoing projects

- The Gut and Oral bacteria, Atherosclerosis and Ischemic Stroke Study
- Atherosclerosis, Inflammation and Ischemic Stroke Study
- Acute cerebral thrombi: mapping the immuno-thrombotic content -developing clinical tools for identifying the embolic source
- Advanced ultrasound methods in the assessment of carotid plaque instability
- Inflammation, atherosclerosis and ischemic stroke in chronic rheumatological disease
- FETCH: Fetal microchimerism (FMC) and future maternal cardiovascular health
- Hidden impairment after stroke
- OSCAR; The Oslo Acute Revascularization Stroke Study
- NOR-FIB 1; A nordic multi-center prospective observational study of the occurrence of AF in patients with cryptogenic stroke / TIA
- NOR-CRAOS; The Norwegian Central Retinal Artery Occlusion and Thrombolysis Study
- TEN-CRAOS; A randomized controlled trial with tenecteplase in central retinal artery occlusion
- Para-NASPP; Diagnostics and triage of acute stroke by the National Institute of Stroke Scale (NIHSS) by paramedics, the Para-NASPP (Paramedic – Norwegian Acute Stroke Prehospital Project)
- Treat-NASPP; Prehospital advanced diagnostics and treatment of acute stroke
- The rural CT-study. A case-control study with pre-hospital treatment with intravenous thrombolysis in acute stroke at “Sjukestugu Ål”
- NorCOAST; The Norwegian Cognitive impairment after Stroke study. A descriptive cohort study recruiting patients from five Norwegian hospitals
- ACE 1950; The ACE 1950 Study is a prospective, population-based, cohort study of the cardio- and cerebrovascular health of all men and women born in 1950 in Akershus County, Norway



## Most important national and international collaborators

### National

- Research Institute of Internal Medicine, RH, OUH, Prof Bente Halvorsen
- Norwegian Air Ambulance Foundation (NLA)
- Dep of Thoracic Surgery, OUH
- Dep of Ophthalmology, OUH, Prof Morten C Moe
- Dep of Infectious Diseases, OUH
- Dep of Transplantation Medicine, OUH, Senior researcher Johannes Espolin Hov
- **Division of Obstetrics and Gynaecology, OUH, Prof I Annetine Staff**
- Akershus University Hospital , Dep of vascular and Thoracic Surgery
- Østfold Hospital, Dep of cardiology and Dep of Neurology
- National Hospital of Epilepsy (SSE)
- Dep of Clinical and Molecular Medicine, NTNU, Prof Terje Espevik
- Institute of Basic Medical Science, biostatistics, OUH
- The Arctic University of Norway, UiT, Prof Ellisiv B Mathiesen

### International

- University of Calgary, Canada, Prof Mayank Goyal
- The George Insitute for Global Health, China and Australia Prof Craig S. Anderson and Prof Philip M. Bath
- Nottingham University, UK
- University Hospital Bern, Switzerland, Prof Urs Fischer
- Greater Manchester Comprehensive Stroke Center, UK, Prof Craig Smith
- University of Maastricht, the Netherlands, Prof Erik Biessen

### Funding

- South-Eastern Norway Regional Health Authority
- OUH
- NLA
- Research grants, Blix





## Scientific production of the research group in 2018

Peer reviewed original research articles: 13

### Invited lectures at International congresses:

- EC Sandset. ESO Karolinska Stroke Update, Stockholm. Blood pressure management during the chain of treatment in patients with acute ischaemic stroke
- AH Aamodt. ESOC, Gothenburg. Retinal artery occlusion: Diagnosis and management
- K Skagen. Virginia-Nordic Precision Neuroscience II, Oslo. Targeted anti-inflammatory treatment for ischemic stroke

### Selected publications:

Larsen K, Bache KG, Franer E, Tveit LH, **Hov MR, Lund CG**, Solyga V, Lossius HM (2018)

*"Pre-hospital thrombolysis of ischemic stroke in the emergency service system-A case report from the Treat-NASPP trial"*

Acta Anaesthesiol Scand, 63 (3), 410-413

DOI 10.1111/aas.13285, PubMed 30426474, WoS 000458335800018 Cristin 1642989

Thingstad P, Askim T, Beyer MK, Bråthen G, Ellekjær H, **Ihle-Hansen H**, Knapsko.

*"The Norwegian Cognitive impairment after stroke study (Nor-COAST): study protocol of a multicentre, prospective cohort study"*

g AB, Lydersen S, Munthe-Kaas R, Næss H, Pendlebury ST, Seljeseth YM, Saltvedt I. BMC Neurol. 2018 Nov 26;18(1):193. doi: 10.1186/s12883-018-1198-x. PMID: 30477436

Skarpengland T, **Skjelland M**, Kong XY, **Skagen K**, Holm S, Otterdal K, Dahl CP, Krohg-Sørensen K, Sagen EL, Bjerkeli V, **Aamodt AH**, Abbas A, Gregersen I, Aukrust P, Halvorsen B, Dahl TB (2018).

*"Increased Levels of Lectin-Like Oxidized Low-Density Lipoprotein Receptor-1 in Ischemic Stroke and Transient Ischemic Attack"*

J Am Heart Assoc, 7 (2). DOI 10.1161/JAHA.117.006479, PubMed 29330254, WoS 000426642400011 Cristin 1517973



## Epilepsy Research Group – Department of Neurology



### Group Leader

Erik Taubøll, Professor, Dept. of Neurology, UiO  
(erik.tauboll@medisin.uio.no) / OUH (erik.tauboll@ous-hf.no)

### Group Members

- Erik Taubøll, Consultant, Professor
- Kjell Heuser, Consultant/Postdoc. Project leader; TLE/translation
- Sigrid Svalheim, Section Head. Project Leader; side effects of AED
- Dag Aurlien, Consultant, Stavanger. Project Leader; epilepsy and cardiology
- Agnes Balint Bjørke, MD, PhD fellow; TLE
- Toni Berger, MD, PhD fellow ; Marie Curie programme, EU
- Alba Gonzalez; MD, Ph.D. fellow; Epilepsy and cardiology
- Monika Mokol, PhD fellow; side effects of AED
- Helle Hermann, PhD fellow; deep brain stimulation for epilepsy
- Line Sveberg, Consultant; Women and epilepsy/autoimmune epilepsy
- Ketil Berg Olsen, Consultant; Status epilepticus
- Line Bedos Ulvin, MD; Status epilepticus
- Hild F. Sjødal, MD; posttraumatic epilepsy project

### Associated Group Members

- Cecilie Nome, Elective research student; TLE/translation
- Erlend Nagelhus, Professor, UiO
- Rune Enger, Elective research student; basic medical research
- Bjørnar Hassel, Department of Neurohabilitation, UiO/OUH
- Leif Gjerstad, MD/PhD Professor, OUH/UiO, Prof. emeritus
- Pål Gunnar Larsson, Department of Neurosurgery, OUH

### Research profile and aims

The Epilepsy Research Group in Department of Neurology (ERGO) has been active for about 25 years. Our research is currently focused on four main areas:

1) Epilepsy-Translational Research. This focuses on research on temporal lobe epilepsy (TLE) through genetic, basic, and clinical studies. The leader is Kjell Heuser. The main project concerns studying the role of the brain's glial cells in the development and exacerbation of epilepsy (epileptogenesis). The initial studies are basic research using epilepsy models. In addition, larger patient trials are used in which the clinical, radiological (MRI), and neuropsychological development of TLE is monitored over time. Recently, we have also started epigenetic studies investigating changes in DNA methylation and gene expression during epileptogenesis.

2) "Gender issues", endocrinology and long-term effects of AEDs. The leader is Sigrid Svalheim. "Gender issues" have been an important area of research for the group over many years, with many PhD theses. The current major focus is studying the long-term side-effects of AEDs on hormones, immunology, haematology and bone health.

3) Epilepsy and cardiology / SUDEP (sudden unexpected death in epilepsy patients). The leader is Dag Aurlen who is presently based at Stavanger University Hospital. The project is a collaborative venture between Oslo University Hospital (OUS) and Stavanger University Hospital. Both clinical and basic animal research is going on.

4) Status epilepticus (SE). OUS has a large population of patients who has experienced SE and epidemiological studies have recently been performed regarding underlying causes, treatment, outcome etc. We will now especially focus especially on possible predictors for outcome and study in more detail treatment of the super refractory cases.

In addition to these four main areas of research, the group also has interests in deep brain stimulation (DBS) in epilepsy, ketogenic diets for adults, and status epilepticus.

### Ongoing projects

1) Can the brain's glial cells be a point of attack for novel AED treatments? This is a major project in which, among other approaches, a mouse model is being used to investigate how epilepsy arises and evolves over time. The main question is how glia cells behave during the development and worsening of epilepsy, and whether these changes can be affected by various drugs such as AEDs, anti-inflammatory drugs, drugs that affect intracellular cell signalling etc.

In extension to this study, we are now also investigating possible epigenetic changes taking place during epileptogenesis. This is done in collaboration with Dr. Kaja K. Selmer and her group in Department of Genetics, OUS. Studying possible mechanisms involved in epileptogenesis may open new treatment strategies to prevent epilepsy, i.e. after stroke and brain injuries.

2) Is epilepsy a progressive disease? This is a long-term study that focuses on changes in the clinical, radiological and neuropsychological picture in patients with temporal lobe epilepsy (Pro-TLE). Comprehensive investigations are conducted on patients with newly diagnosed temporal lobe epilepsy at various time points over a 10-year period. We are also performing a retrospective study (Retro-TLE) investigating MR changes over time before operation in patients with surgically verified hippocampal sclerosis.

3) Long-term effects of AEDs. Patients starting treatment with the AEDs levetiracetam and lamotrigine will be followed prospectively for 2-years in terms of immunological, hormonal, and haematological adverse reactions, and possible changes in bone health. The data will be collected through interviews, questionnaires, blood tests, and bone density measurements. This project is supported with a 50 % PhD student from Østfold Hospital.

As part of this project, also studies on the effect of AEDs on gene expression related to immune genes are under way in collaboration with NMBU (Norwegian University of Life Sciences) and a study on the effect of AEDs on markers for inflammation in humans with epilepsy is performed together with collaborators in OUS.



4) Epilepsy and cardiology. It has become increasingly clear that several epilepsies are channelopathies, as are many cardiac arrhythmias, and are associated with many of the same channels and ions. The relationship between epilepsy and cardiac arrhythmias like the long QT syndrome (LQTS) is studied. This is also of central importance for understanding sudden unexpected death in epilepsy (SUDEP). We are also studying the impact of several years of active epilepsy on cardiac function.

An experimental study in mice experiencing status epilepticus to investigate possible deleterious effects on the heart using mouse MR, ecco-cor and ECG is also ongoing. This is done in collaboration with Prof. Ivar Sjøstad and his group in Institute for Experimental Medical Research, OUS – Ullevål.

5) National registration of refractory status epilepticus. We are collating national experiences on how patients with this condition are treated in Norway and how this can be improved. As there are only a few such patients at each centre, joint exchange of experiences is essential. Collection of data commenced in 2015. A national reference group for SE has been established.

6) Deep brain stimulation (DBS) in epilepsy. In this study patients with hard-to-treat epilepsy are treated with DBS using a blinded study design. The clinical work is now completed and the first results published.

7) Traumatic brain injury and posttraumatic epilepsy. A project is now starting up (2019) to study the possible predictive value of different parameters, especially related to inflammation, measured immediately after traumatic brain injuries on the frequency of posttraumatic epilepsy.

## Most important national and international collaborators

### National

- Dept. of Cardiology, OUH
- Kaja Selmer's research group, Div. of Clinical Neuroscience, OUH
- National Centre for Epilepsy
- Stavanger University Hospital
- Østfold Hospital
- Institute of Basic Medical Science, Glia cells research group (GLIALAB), UiO
- Prof. Erik Ropstad, NMBU (Norwegian University of Life Sciences)

### International

- Institute of Cellular Neurosciences, Medical Faculty, University of Bonn, Germany (Prof. C. Steinhäuser)
- University of Innsbruck, Austria (Prof. G. Luef)
- Pavel Klein, the CURE programme for post-traumatic epilepsy research, Washington, USA
- To be started 2019: Annamaria Vezzani, Department of Neuroscience, IRCCS – Mario Negri Institute for Pharmacological Research, Milan, Italy



## Scientific production of the research group in 2018

**Peer-reviewed original research articles: 8**

**Other publications: 5 abstracts**

**Invited lectures at international congresses: 2**

Toni Berger and Kjell Heuser, lecture at EU Glia PhD meeting, Malta 28.04 – 02.05.18

Toni Berger and Kjell Heuser, lecture at EU Glia PhD meeting, Paris 10.12 – 14.12.18

**Selected publications:**

Heuser K, Nome CG, Pettersen KH, Åbjørsbråten KS, Jensen V, Tang W, Sprengel R, Taubøll E, Nagelhus EA, Enger R.

*“Ca<sup>2+</sup> Signals in Astrocytes Facilitate Spread of Epileptiform Activity”*

Cereb Cortex. 2018 Nov 1;28(11):4036-4048. doi: 10.1093/cercor/bhy196

Bjørke AB, Nome CG, Falk RS, Gjerstad L, Taubøll E, Heuser K.

*“Evaluation of long-term antiepileptic drug use in patients with temporal lobe epilepsy: Assessment of risk factors for drug resistance and polypharmacy”*

Seizure. 2018 Oct;61:63-70. doi: 10.1016/j.seizure.2018.07.011

González A, Aurlien D, Larsson PG, Olsen KB, Dahl IT, Edvardsen T, Haugaa KH, Taubøll E.

*“Seizure-like episodes and EEG abnormalities in patients with long QT syndrome”*

Seizure. 2018 Oct;61:214-220. doi: 10.1016/j.seizure.2018.08.020

### Funding

- Health and rehab, 1 PhD
- The South-Eastern Norway Regional Health Authority, 1 PhD
- EU grant, 722053, Marie S Curie programme, 1 PhD





## Multiple Sclerosis (MS)



### Group Leader

Elisabeth Gulowsen Celius, Professor and consultant of Neurology (MD/PhD),  
Department of Neurology, OUH and Institute of Clinical Medicine, UiO  
(e.g.celius@medisin.uio.no/ uxelgu@ous-hf.no).

### Group members

- Elisabeth Gulowsen Celius, MD/PhD, Professor, OUH/UiO
- Hanne Flinstad Harbo, MD/PhD/MHA, Professor, OUH/UiO
- Tone Berge, MSc/PhD, researcher OUH, Ass. prof., OsloMet
- Steffan D. Bos-Haugen, MSc/PhD, researcher, UiO
- Daniel Rinker, PhD, OUS (from December 2017)
- Pål Berg-Hansen, MD/PhD, engagement ass. professor UiO and consultant OUH
- Gro Owren Nygaard, MD/PhD, OUH
- Sigrid Aune de Rodez Benavent, MD/PhD fellow, Department of Ophthalmology, OUH/UIO
- Ingvild Sørnum Leikfoss, MSci/PhD, UiO
- Anna M. Eriksson, MSci/PhD fellow, UiO
- Ina S. Brorson, MSci/PhD fellow, OUH
- Einar August Høgestøl, MD/PhD fellow, UiO/OUH
- Cecilia Smith Simonsen, MD/PhD fellow, Drammen Hospital/OUH
- Heidi Øyen Flemmen, MD/PhD fellow, Skien Hospital/OUH
- Synne brune, MD/PhD fellow, UiO/OUH
- Line Broch, MD, PhD fellow (application in preparation), Drammen hospital/OUH (from 1.1.19)
- Chiara Cappelletti, MSci/PhD fellow (application in preparation), OsloMet (from 1.1.19)
- Zakia Raja, BSc, Master student, OsloMet
- Mikal Fitsum, BSc, Master student, OsloMet

### Associated Group Members

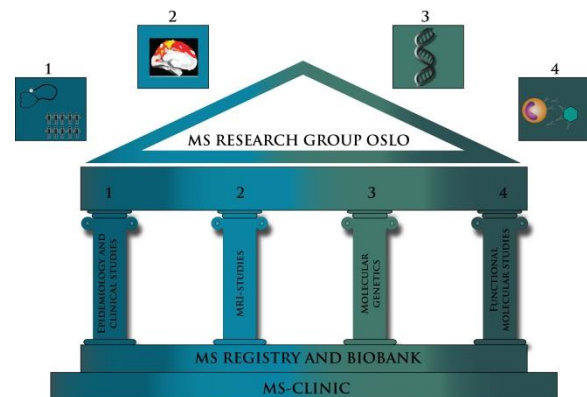
- Marte Wendel Gustavsen, MD/PhD, STHF, Skien Hospital
- Stine Marit Moen, MD/PhD, Head of research and development, MS-Center, Hakadal
- Piotr Sowa, MD/PhD, Division of Radiology and Nuclear Medicine, OUH
- Mona K Beyer, MD/PhD, Professor, Division of Radiology and Nuclear Medicine UiO/OUH
- Christina Sundal, MD/PhD, Neuroclinic Norway

We have this year had six medical students connected to our group, writing student theses:

- Ellen Trap Aspeggen, UiO (Harbo/Høgestøl)
- Ingerid Maria Voorham Tuttoren, UiO (Harbo/Høgestøl)
- Magnus Ørseng Kværner, UiO (Harbo/Høgestøl)
- Inger Bjurstrøm (Berg-Hansen)
- Victoria Løvstad (Berg-Hansen)
- Sakina Baqeri (Celius)

## Research profile and aims

Multiple Sclerosis (MS) research group at the Department of Neurology, OUH and UiO, aims to identify characteristics and susceptibility factors of MS, and to contribute to a better understanding of the disease and development of better treatments. We perform genetic, immunological, clinical, epidemiological, environmental, MRI and translational studies of MS in collaboration with national and international research partners and networks.



## Ongoing projects

- Sigrid Aune de Rodez Benavent, PhD fellow: A longitudinal cohort study of ophthalmologic biomarkers correlated with neurodegeneration in early MS. (OUH Department of Ophthalmology) Supervisor: Elisabeth G. Celius, Co-supervisors: Emilia Kerty, Bruno Laeng and Liv Droslum.
- Tone Berge, researcher, Ingvild Sørum Leikfoss (Senior Engineer): Vitamin D responsive regulation of susceptibility genes for autoimmune diseases. In collaboration with Professor Lisa Barcellos at the University of California.
- Steffan Daniel Bos, researcher: Identification of molecular mechanisms and biomarkers of Multiple Sclerosis (MS-biomarkers) – RNA sequencing of CD4+ and CD8+ T cells as potential biomarkers of MS phenotypes.
- Anna M. Eriksson, PhD fellow: Identification of molecular mechanisms and biomarkers of Multiple Sclerosis (MS-biomarkers) – molecular characterization of DEXI and other MS susceptibility genes. Supervisor: Tone Berge, Co-supervisors: Hanne F. Harbo and Steffan D. Bos.
- Ina S. Brorson, PhD fellow: Defining and characterizing molecular pathways in multiple sclerosis. Supervisor: Steffan D. Bos, Co-supervisors: Hanne F Harbo and Tone Berge.
- Einar August Høgestøl, PhD fellow: MRI- and other biomarkers in multiple sclerosis. Supervisor: Hanne F Harbo, Co supervisor: Lars T Westlye and Gro O Nygaard.
- Daniel Rinker, Post Doc from December 2017: Integrating genetic and MRI data in multiple sclerosis.
- Cecilia Smith Simonsen, PhD fellow : Predictors for disease susceptibility and disease progression in Multiple sclerosis, Supervisor: Elisabeth Gulowsen Celius, Co supervisors: Stine Marit Moen and Kari Anne Bjørnerå.
- Heidi Øyen Flemmen, PhD fellow : Socioeconomic factors as predictors for disease susceptibility and disease progression in Multiple sclerosis, Supervisor: Elisabeth Gulowsen Celius, Co supervisor: Pål Berg-Hansen.
- Line Broch, PhD fellow: Fatigue in Multiple Sclerosis. Supervisor: Elisabeth Gulowsen Celius, Co-supervisor: Heidi Ormstad (start 1.1.19).
- Synne Brune: PhD fellow: MRI changes and clinical MS phenotypes. Supervisor: Hanne F Harbo, Co supervisors: Mona K Beyer and Pål Berg-Hansen.



- Chiara Cappilletti, PhD fellow: Novel molecular mechanisms for severe brain disorders – a study using complex data analyses. Supervisor: Tone Berge, Co supervisor: Mathias Toft (start 1.1.19).
- Zakia Raja (Master project): Vitamin D regulation of MS-associated genes in CD4+ T cells. Supervisors: Tone Berge and Ingvild Sørnum Leikfoss
- Mikal Fitsum (Master project): Genetic factors as risk factors in MS. How do they affect vitamin D response in CD8+ T cells. Supervisors: Tone Berge and Ingvild Sørnum Leikfoss
- Tone Berge, collaboration with Professor Frode Berven at the University of Bergen; Mass spectrometry analyses of immune cells in multiple sclerosis (Funded through a grant from Biogen Idec to Berge).
- Ingvild Sørnum Leikfoss, Anna M. Eriksson, Tone Berge: CLEC16A and other candidate genes.
- Ingvild Sørnum Leikfoss, Synne Brune, Tone Berge: Neurofilament analysis in MS research and clinical practice.
- Hanne F Harbo, Steffan D. Bos, Elisabeth G Celius. MS chip study, collaboration with IMSCG (Harbo Oslo PI).
- Hanne F Harbo, Steffan D. Bos, Elisabeth G Celius. Exome chip study, collaboration with IMSCG. (Harbo Oslo PI).
- Hanne F Harbo, Steffan D. Bos, Pål Berg-Hansen, Mona Beyer: BorrSci study, lead from Kristiansand (South-Eastern Norway Multi- Regional Health Authority grant).
- Hanne F Harbo, Steffan D. Bos, Pål Berg-Hansen, Tone Berge, Ingvild S Leikfoss, Elisabeth G Celius Mona Beyer, Synne Brune: MultipleMS - partner in EU Horizon 2020-project (Harbo Oslo PI).
- Hanne F Harbo, Einar A Høgestøl, Sigrid de Rodez Benavent, Steffan Bos, Tone Berge, Synne Brune, Elisabeth G Celius, Mona Beyer: Sys4MS- Biotek 2021/NFR Project. (Harbo Oslo PI).
- Einar A Høgestøl, Steffan D. Bos, Hanne F Harbo: MYO Project. With Prof Pierre Gourraud, Nantes. NFR-Aurora travel grant (Harbo Oslo PI).
- Einar A Høgestøl, Hanne Harbo, Dan Rinker, Elisabeth Celius, Piotr Sowa, Mona K Beyer: NORMENT collaboration on various MRI projects.
- Elisabeth G. Celius, Mona Beyer, Piotr Sowa, Tobias Granberg : Neuroprotective effects of alemtuzumab in patients with MS in a clinical setting.
- Elisabeth G. Celius, Pål Berg-Hansen, Stine Marit Moen/MS-Centre Hakadal and SINTEF : AutoActive :Tools and Methods for Autonomous Analysis of Human Activities from Wearable Device Sensor Data (SINTEF PI).
- Elisabeth G. Celius, Stine Marit Moen/MS-Centre Hakadal and SINTEF: Digital oppfølging og støtte for personer med multipel sklerose (MS-DOS).
- Elisabeth Gulowsen Celius: Lemtrada PASS, international observational study. EGC national invetsigator.
- Elisabeth G. Celius, Stine Marit Moen/MS-Centre Hakadal, Tone Berge and OsloMet: Use of functional near-infrared spectroscopy analyses for studies of neuroplasticity in MS patients – a pilot study.





MS research group OUS-UiO photo 2018 at Domus Medica 4, UiO:

From left: Synne Brune (PhD student, MD), Gro Owren Nygaard (MD, PhD), Sigrid A. de Rodez Benavent (consultant of ophthalmology, PhD student, MD), Stine Marit Moen (consultant of neurology, MD, PhD, Head of research and development MS-Centre Hakadal), Einar August Høgestøl (PhD student, MD), Tone Berge (Ass.Professor at OsloMet – Oslo Metropolitan University and researcher at OUS, MSc, PhD), Heidi Øyen Flemmen (consultant of neurology, PhD student, MD), Pål Berg-Hansen (Ass.professor, PhD and consultant of neurology, MD,) Hanne F. Harbo (professor, consultant of neurology, MD, MHA, PhD), Cecilia Smith Simonsen (PhD student, MD), Daniel Rinker (Post Doc, PhD), Elisabeth Gulowsen Celius (consultant of neurology, Professor and project leader, MD, PhD), Anna Marie Eriksson (PhD student, Msc), Ina Skaara Brorson (PhD student, MSc), Ingvild Sørum Leikfoss (Senior engineer, PhD, Msc), Steffan Daniel Bos (post doc, PhD, MSc), Maite Larrañaga Fernandez (Erasmus Bachelor Student).

## Funding

- South-Eastern Norway Regional Health Authority
- The Research Council of Norway
- University of Oslo
- European Commission: EU Horizon 2020
- European Commission/The Reserach Council of Norway: Sys4MS - Biotek 2021
- Norwegian Extra Foundation for Health and Rehabilitation
- South-Eastern Norway Multi- Regional Health Authority grant
- Unrestricted research grants from Novartis, Biogen, Genzyme,
- Odd Fellow Foundation, Forsberg and Aulie, and Ingrid and Fritz Nilsen, UNIFOR
- The Peder Saether Fundation

## Most important national and international collaborators

### National

- Mona Beyer, Rigmor Lundby, Atle Bjørnerud and Tuva Hope, Div. of Radiology and Nuclear Med., OUH
- Stine Marit Moen, MS-Center Hakadal
- Benedicte A. Lie, Dept. of Medical Genetics, OUH /UiO
- Kristine Walhovd and Anders Fjell, Dept. of Psychology, UiO
- Anne Spurkland, Institute of Basic Medical Sciences, UiO
- Bettina Kulle Andreassen, Cancer Registry, Norway
- Emilia Kerty, Dept. of Neurology, OUH/UiO
- Liv Drolsum, Dept. of Ophthalmology, OUH/UiO
- Ole A. Andreassen, Lars T. Westlye, Tobias Kaufman and Dag Alnæs, NORMENT, OUH/UiO
- Odd Stokke Gabrielsen, Section for Biochemistry and Molecular Biology, UiO
- Greger Abrahamsen and Vibeke Sundvold, Div. of Anatomy, Molecular Immunology (MOLIMMUN), UiO
- Trygve Holmøy, Dept. of Neurology, Akershus University Hospital
- Torbjørn Rognes, Section for Biomedical Informatics, Dept. of Informatics, UiO
- Nils Inge Landrø and Bruno Laeng, Dept. of Psychology, UiO
- Ole Landsverk, Dept of Pathology, KLM, OUH
- Kristian Bernhard Nilsen and L. Etholm, Dept. of Neurophysiology, OUH
- Kjell-Morten Myhr and Jan Aarseth, Haukeland University Hospital
- Frode Berven, Dept. of Biomedicine, Uiniversity of Bergen
- Åslaug Lorentzen, Dep. of Neurology, Sørlandet Sykehus

### International

- Lisa Barcellos, University of California, Berkeley, US
- Stephen Sawcer, University of Cambridge, UK
- Jorge Oksenberg, University of California, San Francisco, US
- Sergio E. Baranzini, University of California, San Francisco, US
- Pablo Villoslada, Hospital Clinic of Barcelona, Spain
- Steve Francis, University of California, San Francisco, US
- Anders Dahle, University of California San Diego, US
- Soheil Damangir and Gabriela Spulber, Karolinska Institute, Stockholm, Sweden
- Jan Damoiseaux, Dept. of Neurology, Canisius Wilhelmina Hospital, Nijmegen, the Netherlands
- Joost Smolders, Dept. of Neurology, Canisius Wilhelmina Hospital, Nijmegen, the Netherlands
- B. Wilhelm, Steinbeis Transfer-Centre for Biomedical Optics and Function Testing, Tübingen, Germany
- Nordic MS genetics consortium (Hillert, Olsson, Kockum, Oturai, Sørensen, Saareala)
- International MS Genetics Consortium (Adrian Ivinson, Stephen Sawcer, Stephen Hauser, An Goris)
- Helen Tremlett, Dept of Neurology, Vancouver, Canada
- Pierre Antoine Gourraud, Hôpital St-Jacques - CHU de Nantes, France
- Jennifer Graves, University of California, San Diego, US
- Tobias Granberg, Karolinska Institute, Stockholm, Sweden
- Heidi Ormstad, Universitetet Sør-Øst
- Kaj Blennow, Sahlgrenska University Hospital, Gothenburg, Sweden



## Scientific production of the research group in 2018

### Master thesis dissertations:

- Stud. med. Ellen Trap Aspeggen, UiO: Klinisk betydning av gadoliniumavleiring i hjernen hos pasienter med multippel sklerose (Harbo/Høgestøl)
- Stud. med. Ingerid Maria Voorham Tuttoren, UiO: Use of wearable biosensor in clinical examination of patients with multiple sclerosis (Harbo/Høgestøl)
- Stud.med. Victoria Løvstad og Stud.med. Inger Hagen Bjurstrøm: Erfaringer ved bruk av Lemtrada® hos MS-pasienter v/nevrologisk avdeling, OUS, Ullevål (Berg-Hansen)

### Selected publications:

- *“Increased DNA methylation of SLFN12 in CD4+ and CD8+ T cells from multiple sclerosis patients”*  
Rhead B, Brorson IS, Berge T, Adams C, Quach H, Moen SM, Berg-Hansen P, Celius EG, Sangurdekar DP, Bronson PG, Lea RA, Burnard S, Maltby VE, Scott RJ, Lechner-Scott J, Harbo HF, Bos SD, Barcellos LF.  
PLoS One. 2018
- *“Low-Frequency and Rare-Coding Variation Contributes to Multiple Sclerosis Risk”*  
International Multiple Sclerosis Genetics Consortium. chris.cotsapas@yale.edu  
Cell. 2018
- *“Restriction spectrum imaging of white matter and its relation to neurological disability in multiple sclerosis”*  
Sowa P, Harbo HF, White NS, Celius EG, Bartsch H, Berg-Hansen P, Moen SM, Bjørnerud A, Westlye LT, Andreassen OA, Dale AM, Beyer MK.  
Mult Scler. 2018

### Other publications (abstracts excluded):

#### Blogger Ekspertsykehuset OUS:

- Harbo HF. Livet ditt styres fra hjernen. Nov 2018
- Høgestøl EA. Ved å finne hjernealder kan vi gi deg bedre behandling av multippel sklerose. Nov 2018
- Celius EG. Multippel sklerose i dag er ikke hva det var før. Des 2018

#### Blogger DagensMedisin:

- Høgestøl EA. Fra forskerspire til muntlig presentasjon på verdens største MS congress. Nov 2018
- Høgestøl EA. MS – ikke ensbetydende med rullestol. Des 2018

### Invited lectures at international congresses:

- Berg-Hansen P: Epidemiology and changes over time. Teva Nordic meeting, Stockholm, Sweden 27.1.18
- Celius EG: Clinical impact of sex hormone treatment in MS. Teva Nordic meeting, Stockholm, Sweden 28.1.18
- Celius EG: The dark side of MS: cognition and cognitive rehabilitation. 3<sup>rd</sup> Neurology Symposium of Military Hospitals, Spetses, Greece, 13.4.18
- Celius EG: WomeninMS. How can family planning be managed in a real life setting. EAN Lisbon, Portugal 17.6.18
- Celius EG: Patient experience, NorNe Early mavenclad Experience, Berlin, Germany, 10.10.18
- Harbo HF. Multiple approaches towards personalized medicine in the MultipleMS EU-project. MAGNIMS meeting , Siena, Italy 8.11.2018
- Harbo HF. IMSGC updates- and chair of meeting in Berlin, Germany, Oct 9 2018

- Harbo HF. Work package 8 updates and chair of stakeholder meetin. MultipleMS meetings at ECTRIMS congress in Berlin, Germany, Oct 9 an 11 2018
- Harbo HF. A proposal for a Norwegian Center for Clinical Treatment and Research. Virginia-Nordic Precision Neuroscience, Oslo, Norway, 20. September 2018
- Harbo HF. Communication, Dissemination and Exploitation in the EU MultipleMS project. MultipleMS meeting, London, UK, May 15<sup>th</sup> 2018

### Hosting of meetings – invited guests:

- Diagnostics and Biomarker, half-day seminar arranged by Tone Berge and research group DIAMED at OsloMet, invited speaker Professor Frode Berven, UiB;; 28/11/18.
- Neuroscience Research Unit seminar- Cerebrospinal fluid proteomics for biomarker discovery in multiple sclerosis - coordinated by Tone Berge, invited speaker Professor Frode Berven, UiB; 29/11/18.
- Neuroscience Research Unit seminar with external evaluator, coordinated by Tone Berge, invited speaker and external evaluator –Professor Lars Westlye, UiO/OUS - Imaging Research in neurodegenerative disorders; 18/10/18
- University course on inflammatory demyelinating disorders in the CNS for candidates in neurology, 22-23/10/18, OUH (Berg-Hansen, Nygaard, Harbo, Celius).
- We hosted two open meetings for MS-patients and others during 2018. The first was a Kick-off meeting on the fourth follow-up of the Oslo Longitudinal MS Study held on the 30<sup>th</sup> of August. The second meeting was during the Brain Awareness Week on the 21<sup>st</sup> of November. Both meetings gathering large crowds and good debate.

### Social media:

- The research group has its own designated Facebook page named “ Multipel Sklerose Forskningsgruppen Oslo”, currently with 426 followers. Here we keep our followers updated on our current ongoing research projects, as well as international MS research and dissemination activities concerning our research group
- We also have our own homepage at both the Oslo University Hospital and the University of Oslo, which we update on a regular basis
- During the Brain Awareness Month at the Oslo University Hospital in November 2018 many of our members also posted blog posts concerning different topics, reaching out to thousands of readers
- In association with the Multiple MS project, we also manage both the Facebook page and Twitter account to promote the project in social media



Example of Facebook post



## NEMU – Neurological and musculoskeletal pain and genetics



### Group Leader

John-Anker Zwart, Professor, Dept. of Neurology, Head of Research, Division of Clinical Neuroscience, UiO (j.a.zwart@medisin.uio.no) / OUH (uxzwjo@ous-hf.no)

### Group Members

- Ellen Jørum, Professor, UiO/OUH
- Kjersti Storheim, PhD/Associate Professor, OUH/OsloMet
- Astrid Lunestad, Research coordinator
- Ingrid Fjeldheim Bånerud, Msc/Administrative, OUH
- Olaf Fjeld, MD/PhD fellow
- Håvard Furunes, MD/PhD fellow
- Margreth Grotle, Professor, OUH/HioA
- Maren Hjelle Guddal, Msc/PhD fellow
- Alf Inge Hellevik, MD/PhD fellow, OUH/NTNU
- Ingrid Heuch, MD/Senior researcher, OUH
- Synne Øien Stensland, MD/ Postdoctoral fellow, OUH
- Marianne Bakke Johnsen, PhD/Postdoctoral fellow, UiO
- Kristin Ørstavik, MD, PhD/ Senior consultant, OUS
- Inge Petter Kleggetveit, MD/Postdoctoral fellow, OUH
- Ida Løchting, Msc/PhD fellow
- Kristian Bernhard Nilsen, MD/Associate Professor, OUH
- Linda M. Pedersen, PhD/Postdoctoral fellow, OUH
- Vibeke Siewers, Research coordinator, OUS
- Monica Wigemyr, Msc/Research coordinator, OUH
- Bendik Winsvold, MD/Postdoctoral fellow, OUH
- Lars Christian Haugli Bråten, MD/PhD fellow
- Maria Dehli Vigeland, Msc/PhD fellow
- Sigrid Børte, MD/PhD fellow
- Eira Ebbs, Msc/Research coordinator, OUH
- Amy Martinsen, Msc/Research coordinator, OUH
- Marie Udnesseter Lie, Msc/PhD fellow
- Espen Saxhaug Kristoffersen, MD/PhD, associate professor
- Tone Berge, Scientist
- Marie Skovli Pettersen, Master student
- Daniel Gregor Schulze, PhD fellow
- Dagrund Sagafos, PhD fellow
- Lars Kristian Lunden, PhD fellow
- Mads Peder Rolfsen, PhD fellow
- Kaja Kristine Selmer, Scientist
- Elisabeth Gjefsen, PhD fellow
- Ioannis Kitsos, PhD fellow
- Marianne Mørk, PhD fellow
- Gøril Brevik Melbye, PhD fellow



## Research profile and aims

The main focus of the research group is to generate research based knowledge on genetics, mechanisms, prevention and treatment of pain in the musculoskeletal- and nervous system.

## Ongoing projects

- The Acute Low-Back Pain Study. Clinical, neurophysiological and genetic risk factors
- Genetic risk variants in migraine and cardiovascular disease. The Gene HUNT study
- Risk factors for anterior cruciate ligament injuries in Norwegian adolescents and young adults: (the ACL/HUNT studies)
- BackToBasic; TNF alfa blocker treatment of chronic low-back pain with Modic changes, a randomized double blind multicenter placebo controlled trial
- Genetic and environmental causes of migraine, a large-scale family-based analysis
- Early risk factors for migraine. The young-HUNT study
- Familiar hemiplegic migraine in Norway
- The AIM-study (Antibiotics In Modic changes); antibiotic treatment of chronic low-back pain with Modic changes, a randomised double blind multicenter placebo controlled trial
- Epigenetic and molecular biomarkers in chronic low back pain and Modic changes. A case-control study
- The HUNT OsteoArthritis study (the HOA-study)
- Lumbar disc prosthesis versus multidisciplinary rehabilitation in chronic back pain and localized degenerative disc. Long term follow-up of a randomized multicentre trial
- The NORwegian Degenerative spinal STENosis-trial (the NORDSTEN-study)
- Physical activity and sport participation during adolescence and musculoskeletal complaints in adulthood. A population based cohort study
- Spinal surgery in Norway. Trends, costs and regional differences
- The Norwegian Cervical Arthroplasty Trial. The NORCAT study. A prospective, single blinded, randomized, controlled multicenter study
- Risk factors for development of chronic pain after hospitalization for acute low back pain and/or sciatica (RUKSAR)
- Clinical and genetic aspects of neuropathic pain (ClINGNeuP)
- Conditioned pain modulation with respect to different test pain stimuli (CPM2TS)
- Childbirths, hormonal factors and low back pain - a prospective epidemiological survey
- Back Pain in Elderly (BACE). A prospective cohort study of older people visiting primary care with a new episode of back pain
- Genetic risk factors for development of Pain – The Tromsø Study
- All-In-HUNT, genetic assessment of neurological and psychiatric disorders
- Targeting low back pain and comorbidity in primary care – a plan for a prospective study aimed to increase treatment effects in back pain (pilot project, NFR)
- Clinical and neurophysiological aspects of peripheral neuropathies
- Genetics of juvenile myoclonic epilepsy – a part of the BIOJUME consortium (BIOJUME)
- Gut microbiota in adult patients with epilepsy (EpiGUT – a pilot project)
- Epilepsy in Children: The Potential Impact of the Ketogenic Diet on Gut Microbiota and Epigenetics (EpiMICRO)
- Genetic mosaicism in overgrowth syndromes

- Neck surgery in Norway
- Exploring function and disability in patients with Cervical dystonia; an observational study
- Environmental and genetic causes of migraine in children and adolescents
- Migraines, obesity and body fat distribution
- Biomarkers in headaches

## Most important national and international collaborators

### National

- University Hospital of North Norway (UNN)
- The Arctic University of Norway (UiT)
- Drammen Hospital
- St.Olavs Hospital, Trondheim University Hospital
- The Hospital Østfold Kalnes
- Haukeland University Hospital
- University of Bergen (UiB)
- Stavanger University Hospital
- The National Institute of Occupational Health (STAMI)
- Norwegian University of Science and Technology (NTNU)
- OsloMet
- National Centre for Epilepsy (SSE)
- Norwegian Institute of Public Health (FHI)
- Diakonhjemmet Hospital

### International

- Leiden University Medical Centre (LUMC), the Netherlands
- Broad Institute of MIT and Harvard, Boston, US
- Institute for Molecular Medicine (FIMM), Finland
- University of Oxford, UK
- Keele University, UK
- The Karolinska Institute, Sweden
- McGill University, Canada
- University of Munich, Germany
- University of Sydney, Australia
- University College London, UK
- Aarhus University Hospital, Denmark
- University Hospital RWTH Aachen, Germany
- The George Institute of Global Health, Australia
- Dianalund and University of Copenhagen, Denmark
- University of Erlangen-Nuremberg, Germany
- Queensland University of Technology, Australia
- Danish Headache Center, Denmark
- King's College, London, UK
- Vall d'Hebron University Hospital and Quirón Hospital, Spain
- Heidelberg University, Germany
- University of Michigan, US
- The low-back pain consortium
- The headache genetics consortium
- Erasmus MC, Rotterdam, the Netherlands

## Scientific production of the research group in 2018

**Peer reviewed original research articles: 15**

**Master thesis:**

Marie Skovli Pettersen: *“Reliabilitet av Balance Evaluation Systems Test (BESTest) for personer med arvelig perifer nevropati”*



### Selected publications:

Furunes H, Hellum C, Espeland A, Brox JI, Småstuen MC, Berg L, Storheim K (2018)  
*“Adjacent Disc Degeneration After Lumbar Total Disc Replacement or Nonoperative Treatment: A Randomized Study with 8-year Follow-up”*  
Spine (Phila Pa 1976), 43 (24), 1695-1703  
DOI 10.1097/BRS.0000000000002712, PubMed 29794581, WoS 000452187300009 Crislin 1596288 (Details)

Johnsen MB, Winsvold BS, Børte S, Vie GÅ, Pedersen LM, Storheim K, Skorpen F, Hagen K, Bjørngaard JH, Åsvold BO, Zwart JA (2018)  
*“The causal role of smoking on the risk of headache. A Mendelian randomization analysis in the HUNT study”*  
Eur J Neurol, 25 (9), 1148-e102  
DOI 10.1111/ene.13675, PubMed 29747220, WoS 000441240200014 Crislin 1584758 (Details)

Namer B, Schmidt D, Eberhardt E, Maroni M, Dorfmeister E, Kleggetveit IP, Kaluza L, Meents J, Gerlach A, Lin Z, Winterpacht A, Dragicevic E, Kohl Z, Schüttler J, Kurth I, Warncke T, Jorum E, Winner B, Lampert A (2018)  
*“Pain relief in a neuropathy patient by lacosamide: Proof of principle of clinical translation from patient-specific iPS cell-derived nociceptors”*  
EBioMedicine, 39, 401-408  
DOI 10.1016/j.ebiom.2018.11.042, PubMed 30503201, WoS 000456677400048 (Details)

### Funding

- South-Eastern Norway Regional Health Authority
- The Research Council of Norway
- The Norwegian Fund for Post-Graduate Training in Physiotherapy
- UiO
- OUH



## Brain plasticity and neuropsychiatry



### Group Leader

Torbjørn Elvsåshagen; M.D., PhD, postdoctoral research fellow; Department of Neurology, OUH (telvsaha@ous-hf.no) and Norwegian Centre for Mental Disorders Research (NORMENT), UiO (torbjorn.elvsashagen@medisin.uio.no)

### Group Members

- Erlend Bøen; M.D., Ph.D.; Diakonhjemmet Hospital
- Britta Bürker; M.D., Ph.D. research fellow; OUH/UiO
- Guro Dunvoll; M.Sc., Ph.D. research fellow; OUH/UiO/Oslo and Akershus University College of Applied Sciences
- Torfinn Hynnekleiv; M.D.; OUH and Innlandet Hospital Trust
- Katalin Juhasz; M.D.; Akershus University Hospital
- Eva A. Malt; M.D., Ph.D., Assoc. professor; Inst. of Clinical Medicine, UiO
- Ulrik F. Malt; M.D., Ph.D., Professor emeritus; Inst. of Clinical Medicine, UiO
- Kåre Osnes; M.D., Ph.D.; Diakonhjemmet Hospital
- Torunn Søyseth; M.Sc., OUH
- Mathias Valstad; M.Sc., Ph.D. research fellow; OUH/UiO
- Nathalia Zak; M.D., Ph.D. research fellow; OUH/UiO

### Associated Group Members

- Stein Andersson; Ph.D., Professor; Dept. of Psychology, UiO
- Atle Bjørnerud; Ph.D., Professor; OUH
- Birgitte Boye; M.D., Ph.D., Professor; Inst. of Basic Medical Sciences, UiO
- Torgeir Moberget; Ph.D., postdoctoral research fellow; OUH

### Research profile and aims

Our group conducts research in the fields of adult brain plasticity and neuropsychiatry. Plasticity – the capacity for change – is increasingly recognized as an intrinsic property of the adult brain and may play important roles in the etiologies and treatments of neurological and psychiatric illnesses. Neuropsychiatry recognizes that the brain and mind are one, that mental illnesses are disorders of the brain, and that psychiatric symptoms are commonly found in neurological disorders. One important goal of neuropsychiatric research is to bridge the gap between neurology and psychiatry.

Among the main aims of our current research are:

1. To examine whether structural and functional brain plasticity are core characteristics of the human sleep-wake cycle
2. To increase our understanding of how novel schizophrenia- and bipolar disorder-associated genetic variants affect synaptic function and plasticity
3. To examine the role of brainstem regions in neuropsychiatric and neurological disorders



## Ongoing projects

- Sleep-wake-dependent brain plasticity in health and depression
- Genes, synaptic function, and stem cells in bipolar disorder, schizophrenia, and autism spectrum disorder: from pathophysiology towards personalized medicine
- Brainstem volumes: genetic architecture and roles in neuropsychiatric and neurological disorders
- Brain plasticity and psychobiology in bipolar II disorder and borderline personality disorder
- G-protein genotypes and associations with anxiety and depression in the HUNT Study
- Studies of genotype-phenotype interactions in the 3q29 microdeletion syndrome
- Neuropsychiatry and coping in heart and lung transplantation
- Non-invasive human LTP-like plasticity – examining robustness, functional significance and clinical utility of a novel biomarker
- Mapping and modulating brain networks in severe mental illness: towards new targets for therapeutic non-invasive brain stimulation

## Most important national and international collaborators

### National

- Prof. Ole A. Andreassen, NORMENT, UiO/OUH
- Prof. Erik Jönsson, NORMENT, UiO
- Prof. Srdjan Djurovic, NORMENT, UiO
- Ass. prof. Lars T. Westlye and Dr. Tobias Kaufmann, NORMENT, UiO
- Prof. Bjørn Bjorvatn, Norwegian Competence Center for Sleep Disorders, Bergen
- Dr. Stine Knudsen, C. of Exp. For Neurodevelopmental Disorders and Hypersomnias, OUH
- Prof. Espen Dietrichs, Dept. of Neurology, OUH/UiO
- Prof. Guttorm Haugen, Dept. of Obstetrics and Gynecology, OUH/UiO
- Prof. Ragnhild Emblem, Dept. of Pediatric Surgery, OUH/UiO
- Prof. Sigmund Karterud, Dept. for Personality Psychiatry, OUH/UiO
- Prof. Lars Gullestad, Dept. of Cardiovascular Medicine, OUH/UiO
- Prof. Arne E. Vaaler, NTNU, BRAIN: Bipolar research and innovation network
- Prof. Hilde Nilsen, Dept. of Molecular Biology (EpiGen), UiO
- Prof. Jan Ivar Røssberg, OUS/UiO
- Prof. Gaute Einevoll, NMBU/UiO

### International

- Ass. prof Ana Andreazza, Dept. of Psychiatry, University of Toronto, Canada
- Prof. and Chair Trevor Young, Dept. of Psychiatry, University of Toronto, Canada
- Prof. Eus van Someren, Netherlands Institute for Neuroscience, Amsterdam, the Netherlands
- Ass. prof. Mirjana Maletic-Savatic, Baylor College of Medicine, Houston, USA
- ENIGMA group (Enhancing NeuroImaging Genetics through Meta-Analysis)
- EURONET-SOMA: European Research Network on somatoform disorders; group leader: Prof. Bernd Löwe, Uni Hamburg-Eppendorf, Abt. Für Psychotherapie und Psychosomatische Medizin, Germany



## Funding

- South-Eastern Norway Regional Health Authority
- Norwegian Competence Center for Sleep Disorders
- Oslo University Hospital
- Throne-Holst foundation
- Ebbe Frøland foundation

## Scientific production of the research group in 2018

Peer reviewed original research articles: 25

### Research grants:

Centre for rare disorders, Oslo University Hospital. *"The 3q29 project"*, 500KNOK, PI: Malt E.

### Selected publications:

Elvsåshagen T, Mutsaerts HJ, Zak N, et al.

*"Cerebral blood flow changes after a day of wake, sleep, and sleep deprivation"*

Neuroimage. 2019 Feb 1;186:497-509. Epub 2018 Nov 22.

Ruderfer DM, .... Elvsåshagen T, .... Malt UF, et al.

*"Genomic Dissection of Bipolar Disorder and Schizophrenia, Including 28 Subphenotypes"*

Cell. 2018 Jun 14;173(7):1705-1715.e16.

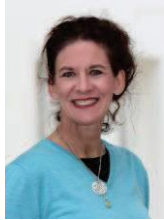
Nunes A, .... Bøen E, .... Elvsåshagen T, .... Malt UF, et al.

*"Using structural MRI to identify bipolar disorders - 13 site machine learning study in 3020 individuals from the ENIGMA Bipolar Disorders Working Group"*

Mol Psychiatry. 2018 Aug 31. doi: 10.1038/s41380-018-0228-9.



## Cognitive Health in Brain Disorders (CHBD)



### Group Leader

Ira Ronit Hebold Haraldsen, MD/PhD, OUH (i.haraldse@ous-hf.no)

### Group Members

- Vebjørn Anderson, BSc, Technician, OUH
- Aksel Erichsen, MD, PhD-candidate, OUH
- Christoffer Hatlestad, cand.psychol., PhD-candidate, OUH
- Kjersti Gulbrandsen, MNSc, Clinical Nurse Specialist, OUH
- Reidar Jessen, cand.psychol., PhD-candidate, OUH
- Syed Nuruddin, VetMD, OUH
- Patrick Riss, PhD, Chemist, OUH/UiO
- Uta Sailer, PhD, Senior Researcher, OUH/UiO
- Helle Stangeland, MSc, Clinical Research Coordinator, OUH
- Stefan Sütterlin, PhD, Psychologist, OUH/HiØF
- Linn Cesilie Tovås, Research Assistant, OUH
- Slawomir Wojniusz, PhD, Physiotherapist, OUH/Oslo MET

### Research profile and aims

We want to understand how and why physical trauma and somatic disorders affect cognitive functions and brain health. Our aim is to contribute to improved prevention, diagnosis and treatment of neuropsychiatric and neuroendocrinological diseases through high-quality research.

We are interested in how physical trauma and somatic disorders affect the central nervous system.

The CHBD group conducts research in the following areas:

- Healthy aging and neurodegenerative disease
- Non-reproductive, cognitive functions of gonadotropin releasing hormone (GnRH) and its receptor (GnRHR)
- Sex differences in brain function

We are currently trying to learn more about how diverse somatic disorders affect cognitive health, especially during puberty and aging. Because of our team's hands-on experience with basic science methods, as well as our clinical experience, we are able to take part in several translational research projects. Our methods range from microscopy and immunohistochemistry, to molecular imaging by



positron emission tomography and radiochemistry, to MR imaging and electrophysiological neuropsychological testing.

We are an international group of researchers that come from a variety of different educational backgrounds, including medicine, psychology, physiotherapy, nursing and biological science. Our multidisciplinary approach to brain-behavior relations allows us to conduct research across various systems and cognitive levels; from molecules to cells to cognitive systems to behaviors.

## Ongoing projects

- Development of a Novel F18-PET tracer for early diagnosis of Alzheimer Dementia
- Novel risk factor assay for Alzheimer's disease-Multi-parametric quantification of HPG/HPT-axis dysfunction
- Does the gut hormone ghrelin act as a general reward enhancer?
- Effectiveness of somatocognitive therapy for the treatment of provoked localized vestibulodynia (the Pro-LoVe study)
- Gender dysphoria in adolescents – a qualitative study
- Gender dysphoria: Worldwide exacerbation, prevalence, and the impact of GnRH treatment on brain development; an investigation in a human and animal model (CONOS)

## Most important national and international collaborators

### National

- Atle Bjørnerud, OUH
- Tor Endestad, UiO
- Tormod Flatby, Ahus
- Trond Jenssen, OUH
- Jo Klaveness, UiO
- Pål Gunnar Larsen, OUH
- Per Magnus, FHI
- M. R. Amiry Moghaddam, UiO
- Syed Nurrudin, NMS
- Eirik Næs Ulseth, Pubgene
- Mona-Elisabeth Revheim, OUH
- Erik Ropstad, Norwegian School of Veterinary Science
- Thor Audun Saga, NMS
- Anne-Kristin Solbakk, OUH
- Jan Solberg, Inven2
- Erik Taubøll, OUH
- Reidun Torp, UiO

### International

- Walter Bockting, New York, USA
- Neil Evans, Glasgow, Scotland
- Fernando Maestu, Madrid, Spain
- Laura Hughes, Cambridge, UK
- Ernesto Pereda, Madrid, Spain
- Hanna Renvall, Helsinki, Finland
- Jane Robinson, Glasgow, Scotland
- James Rowe, Cambridge, UK







## Scientific production of the research group in 2018

Peer reviewed original research articles: 19

### Selected publications:

Fjellaksel R, Oteiza A, Martin-Armas M, Riss PJ, Hjelstuen OK, Kuttner S, Hansen JH, Sundset R (2018)  
*"First in vivo evaluation of a potential SPECT brain radiotracer for the gonadotropin releasing hormone Receptor"*

BMC Res Notes, 11 (1), 811

DOI 10.1186/s13104-018-3924-2, PubMed 30442192

Meessen J, Sütterlin S, Gauggel S, Forkmann T (2018)

*"Learning by heart-the relationship between resting vagal tone and metacognitive judgments: a pilot Study"*

Cogn Process, 19 (4), 557-561

DOI 10.1007/s10339-018-0865-6, PubMed 29796847

Stangeland H, Orgeta V, Bell V (2018)

*"Poststroke psychosis: a systematic review"*

J Neurol Neurosurg Psychiatry, 89 (8), 879-885

DOI 10.1136/jnnp-2017-317327, PubMed 29332009

### Funding

- The Research Council of Norway
- South-Eastern Norway Regional Health Authority



## Intellectual disability and neurohabilitation



### Group Leader

Bjørnar Hassel, Professor, Dept. of Neurohabilitation, OUH  
(bjornar.hassel@ous-hf.no) and UiO (bjornar.hassel@medisin.uio.no)

### Group Members

- Nils Olav Aanonsen, MD, OUH
- Sigrun Hope, MD, PhD, OUH
- Anne Katrin T. Holmøy, MD, OUH
- Kathrine Haggag, MD, OUS
- Jutta Rummel, MD, OUS
- Alma Sikiric, MD, OUS
- Helene Portilla, MD, OUS
- Daniel Dahlberg, MD, OUS
- Amalie Poole, Stud. med.
- Marleen van Walsem, PhD, OUS

### Research profile and aims

The aim of the neurohabilitation research group is 1) to conduct research that will lead to improvement of the quality of life of persons with developmental disabilities, 2) to investigate mechanisms behind brain dysfunction and damage that leads to developmental disability.

In collaboration with the municipality of Oslo, SINTEF, and The University College of Oslo and Akershus we investigate the use of sensors for autonomic responses as a means of communication for developmentally disabled persons who are unable to express their needs.

To investigate mechanisms that underlie some forms of developmental disability we use clinical and preclinical approaches to elucidate mechanisms of toxicity of certain metabolites and microbes.

### Ongoing projects

- Wearable sensors for autonomic responses as a means of communication for persons with developmental disability who lack the ability to express themselves
- Mechanisms of seizure generation and cell death during brain abscess formation, a preventable cause of developmental disability
- Mechanisms of cell death and seizure generation during formation of cystic brain tumors
- The effects on brain cells of propionic acid, a metabolite that causes cerebral dysfunction in an inborn error of metabolism
- The metabolism of fructose and its metabolite glyceraldehyde, two causes of neurodegeneration through formation of advanced glycation end products





## Most important national and international collaborators

### National

- Cecilie Morland, HIOA/Inst. of Pharmacy, UiO
- Frode Strisland, SINTEF – Smart sensor systems, Oslo
- Oslo Municipality and the burroughs of Nordstrand, Østensjø and Vestre Aker
- Erik Taubøll, Dept. of Neurology, UiO
- Torgeir Bruun Wyller, Leiv Otto Watne and Nenad Bogdanovic, Dept. of Geriatrics, OUH
- Espen Mariussen and Øyvind Voie, Norwegian Defence Research Establishment, Kjeller
- Frode Rise, Inst. of Chemistry, UiO

### International

- Farshid Amirabdollahian, University of Hertfordshire, UK
- Sergio Guillen, Mysphera, TSB Real time location systems, Valencia, Spain
- Jordi Rovirasimon, Parc Sanitari Sant Joan de Deu, Barcelona, Spain
- Raymond Dingleline, Emory University, Atlanta, GA, USA

## Scientific production of the research group in 2018

Peer reviewed original research articles: 11

### Selected publications:

Hassel B, Mariussen E, Idland AV, Dahl GT, Ræder J, Frihagen F, Berg JP, Chaudhry FA, Wyller TB, Watne LO (2018)

*“CSF sodium at toxic levels precedes delirium in hip fracture patients”*

Neurotoxicology, 69, 11-16

DOI [10.1016/j.neuro.2018.08.010](https://doi.org/10.1016/j.neuro.2018.08.010), PubMed [30149051](https://pubmed.ncbi.nlm.nih.gov/30149051/), WoS [000451106200002](https://www.scopus.com/search/form.do?prf=pub&id=000451106200002) Cristin [1626113](https://www.cristin.no/record/1626113) (Details)

Reimers A, Helde G, Becser Andersen N, Aurlien D, Surlien Navjord E, Haggag K, Christensen J, Lillestølen KM, Nakken KO, Brodtkorb E (2018)

*“Zonisamide serum concentrations during pregnancy”*

Epilepsy Res, 144, 25-29

DOI [10.1016/j.eplepsyres.2018.05.002](https://doi.org/10.1016/j.eplepsyres.2018.05.002), PubMed [29751353](https://pubmed.ncbi.nlm.nih.gov/29751353/), WoS [000435622900005](https://www.scopus.com/search/form.do?prf=pub&id=000435622900005) Cristin [1594211](https://www.cristin.no/record/1594211) (Details)

Morland C, Frøland AS, Pettersen MN, Storm-Mathisen J, Gundersen V, Rise F, Hassel B (2018)

*“Propionate enters GABAergic neurons, inhibits GABA transaminase, causes GABA accumulation and lethargy in a model of propionic academia”*

Biochem J, 475 (4), 749-758

DOI [10.1042/BCJ20170814](https://doi.org/10.1042/BCJ20170814), PubMed [29339464](https://pubmed.ncbi.nlm.nih.gov/29339464/), WoS [000428086400004](https://www.scopus.com/search/form.do?prf=pub&id=000428086400004) Cristin [1555674](https://www.cristin.no/record/1555674) (Details)



## Specialized medical rehabilitation – Sunnaas Rehabilitation Hospital



### Group Leader

Johan K. Stanghelle, MD/PhD, Director of Research (johan.stanghelle@sunnaas.no)/  
Professor, Dept. of Physical Medicine and Rehabilitation, UiO

### Group Members

- Johan K. Stanghelle, MD/PhD, Professor, Sunnaas Rehabilitation Hospital/UiO
- Frank Becker, MD/PhD, ass Professor, Sunnaas Rehabilitation Hospital/UiO
- Grethe Månnum, MD/PhD, ass Professor, Sunnaas Rehabilitation Hospital/UiO
- Emil Kostovski, MD/PhD, postdoc fellow, Sunnaas Rehabilitation Hospital/UiO
- Svend Rand-Hendriksen, MD/PhD, postdoc fellow, Sunnaas Rehabilitation Hospital/UiO
- Dag Brekke, MD/PhD, Sunnaas Rehabilitation Hospital
- Tor Haugstad, MD/PhD, Sunnaas Rehabilitation Hospital
- Anne-Kristine Schanke, PSYCH/PhD, Professor, Sunnaas Rehabilitation Hospital/UiO
- Marianne Løvstad, PSYCH/PhD, ass Professor, Sunnaas Rehabilitation Hospital/UiO
- Solrun Sigurdardottir, PSYCH/PhD, postdoc fellow, Sunnaas Rehabilitation Hospital
- Jan Egil Nordvik, PSYCH/PhD, Sunnaas Rehabilitation Hospital
- Per Ola Rike, PSYCH/PhD, Sunnaas Rehabilitation Hospital
- Sveinung Tornås, PSYCH/PhD, Sunnaas Rehabilitation Hospital
- Solveig Hauger, PSYCH/PhD, Sunnaas Rehabilitation Hospital
- Arve I. Opheim, PT/PhD, Sunnaas Rehabilitation Hospital
- Vivien Jørgensen, PT/PhD, Sunnaas Rehabilitation Hospital
- Ellen Høyser, PT/PhD, Sunnaas Rehabilitation Hospital
- Anne Lannem, PT/PhD, ass Professor, Sunnaas Rehabilitation Hospital/Norwegian school of Sport Sciences
- Kirsti Skavberg Roaldsen, PT/PhD, ass Professor, Sunnaas Rehabilitation Hospital/OsloMet/Karolinska Institute
- Birgitta Langhammer, PT/PhD, Professor, Sunnaas Rehabilitation Hospital/OsloMet
- Ellen Berg Svendby, Cand Scient/PhD, Sunnaas Rehabilitation Hospital/OsloMet
- Grace I. Romsland, RN/PhD, Professor, Sunnaas Rehabilitation Hospital/OsloMet
- Melanie Kirmess, ST/PhD, ass Professor, Sunnaas Rehabilitation Hospital/UiO
- Vegard Strøm, Cand Scient/PhD, Sunnaas Rehabilitation Hospital
- Gry Velvin, SW/PhD, Sunnaas Rehabilitation Hospital

### Associated group members:

- Fin Biering-Sørensen, MD/PhD, Professor, Copenhagen University
- Katharina Sunnerhagen, MD/PhD, Professor, Gothenburg University
- Lena Hartelius, ST/PhD, Professor, Gothenburg University
- Kerstin Fugl-Meyer, SW/PhD, Professor, Karolinska Institute
- Agneta Ståhle, PT/PhD, Professor, Karolinska Institute
- Helle Ploug Hansen, RN/PhD, Professor, University of Southern Denmark, Odense
- Jennie Ponsford, PSYCH/PhD, Professor, Monash University, Melbourne



### Associated group members (continued):

PhD Fellows/MD: Thy Thy Vanem, Ingebjørg Irgens, Erlend Solberg Dørum, Hege Prag Øra, Claudia Nyberg, Vesna Miloshevska Jakimovska, Mladen Savikj, Svein Otto Fredwall, Kristine Marie M. Vege, Jelena Simic

PhD Fellows/PSYCH: Kjersti Mæhlum Walle, Daniel Løke, Geneviève Richard, Knut Kolskår

PhD Fellows/RN: Anne-Stine Røberg, Anne Geard

PhD Fellows/PT: Emelie Butler Forslund, Matthijs Wouda, Linda Rennie, Anu Piira

PhD Fellows/SW: Jannike K. Vikan

PhD Fellows/ST: Maribeth C. Rivelsrud

PhD Fellows/OT: Anne-Marthe Sanders

#### Administration:

Annette M. Juelsen

### Research profile and aims

Clinical and some basic research within specialized rehabilitation, organized into four research groups: Brain injuries, Spinal cord injuries, Patients with movement problems and Patients with seldom diagnosis. The research is aiming to give optimal rehabilitation programs.

### Ongoing projects

- Follow-up of the most serious injured patients after the July 22<sup>nd</sup> attack
- Multinational studies on specialized rehabilitation for stroke patients and spinal cord injuries
- Several studies on neuropsychological consequences after brain injury
- Several studies on movement disorders and gait analysis
- Basic physiological mechanisms after spinal cord injuries
- Basic mechanisms after brain injuries (fMRI, electrophysiological functions etc)
- Several studies on patients with seldom diagnosis

### Most important national and international collaborators

#### National

- Oslo University Hospital
- Institute of Psychology, UiO
- OsloMet
- Norwegian Sport High School
- Haukeland University Hospital
- St. Olav Hospital
- University Hospital of North Norway
- Beitostølen Health Sport Center
- Hospitals in Health Region South-East

#### International

- Karolinska Institute, Stockholm, Sweden
- Gothenburg University, Sweden
- Copenhagen University, Denmark
- University of Southern Denmark, Odense; Denmark
- Monash University, Melbourne, Australia
- China Rehabilitation and Research Center, China
- Rusk Institute of Rehabilitation , NY, USA
- Policlinic no2, Petrozavodsk, Karelia, Russia
- Sheba Medical Center, Tel Aviv, Israel





- Betlehem Arab Society for Rehabilitation, Palestine
- El Wafa Hospital, Gaza, Palestine
- Sahlgrenska University Hospital, Högsbo, Sweden
- Bayi 81 Rehabilitation Center, Sichuan, China
- Schweizer Paraplegiker-Forschung AG, Switzerland

## Scientific production of the research group in 2018

Peer reviewed original research articles: 50

Other Publications: 20

### Doctoral thesis: 4

Anne Stine Bergquist Røberg	Momentum of coordination reform
Rongrong Wang	Life satisfaction in persons with stroke in China
Matthijs Ferdinand Wouda	High intensity aerobic exercise in ambulatory persons with..
Kjersti Mæhlum Walle	Attentional resources in unilateral spatial neglect

### Selected publications:

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*"Telerehabilitation for aphasia - protocol of a pragmatic, exploratory, pilot randomized controlled trial"*  
Trials, 19 (1), 208  
DOI 10.1186/s13063-018-2588-5, PubMed 29606148, WoS 000428896100002 (Details)

Rike PO, Eriksen LA, Schanke AK (2018)  
*"Associations between self and informant ratings of executive functioning and driver behaviour following acquired brain injury"*  
J Rehabil Med, 50 (7), 589-597  
DOI 10.2340/16501977-2359, PubMed 30003269, WoS 000438084000003 (Details)

Langhammer B, Sunnerhagen KS, Sällström S, Becker F, Stanghelle JK (2018)  
*"Return to work after specialized rehabilitation-An explorative longitudinal study in a cohort of severely disabled persons with stroke in seven countries: The Sunnaas International Network stroke study"*  
Brain Behav, 8 (8), e01055  
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- Bonsaksen T, Dolva AS, Hagby C, [Sveen U](#), Horghagen S, Thyness EM, Arntzen C (2018)  
Involvement in Research and Development Projects Among Community-working Occupational Therapists in Norway  
Occup Ther Health Care, 33 (1), 22-36  
DOI [10.1080/07380577.2018.1526434](https://doi.org/10.1080/07380577.2018.1526434), PubMed [30596456](https://pubmed.ncbi.nlm.nih.gov/30596456/), WoS [000467939600002](https://www.scopus.com/search/form.do?prf=pub&id=000467939600002) Cristin [1610433](https://www.cristin.no/1610433) ([Details](#))
- van Essen TA, den Boogert HF, Cnossen MC, de Ruiten GCW, Haitsma I, Polinder S, Steyerberg EW, Menon D, Maas AIR, Lingsma HF, Peul WC, CENTER-TBI Investigators and Participants (2018)  
Variation in neurosurgical management of traumatic brain injury: a survey in 68 centers participating in the CENTER-TBI study  
Acta Neurochir (Wien), 161 (3), 435-449  
DOI [10.1007/s00701-018-3761-z](https://doi.org/10.1007/s00701-018-3761-z), PubMed [30569224](https://pubmed.ncbi.nlm.nih.gov/30569224/), WoS [000460607500002](https://www.scopus.com/search/form.do?prf=pub&id=000460607500002) Cristin [1665415](https://www.cristin.no/1665415) ([Details](#))
- Prasad K, Siemieniuk R, Hao Q, Guyatt G, O'Donnell M, Lytvyn L, Heen AF, Agoritsas T, Vandvik PO, Gorthi SP, Fisch L, [Jusufovic M](#), Muller J, Booth B, Horton E, Fraiz A, Siemieniuk J, Fobuzi AC, Katragunta N, Rochweg B (2018)  
Dual antiplatelet therapy with aspirin and clopidogrel for acute high risk transient ischaemic attack and minor ischaemic stroke: a clinical practice guideline  
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Spine (Phila Pa 1976), 43 (24), 1695-1703  
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