The Swedish Ear, Nose and Throat (ENT) specialty developed out of the surgical specialty for more than one hundred years ago. Stockholm with Karolinska Institutet became the first ENT center of Sweden, originally governed by the ENT-giant professor Gunnar Holmgren. In 1940s the Karolinska University Hospital was founded at the Solna site and later the Huddinge site was incorporated.

Today the Division of ENT diseases at Karolinska Institutet is a successful and leading national and international academic center for ENT. In this book we have gathered information concerning the Karolinska ENT history, some ongoing scientific projects and also presenting the current research groups among other things.

We, who have gathered and edited this information, are Britt Nordlander, Agneta Wittlock and Sten Helskog (see picture below).
Staffan Larsson
The head photographer and editor of photography of this scientific report. He has an AS degree in
photography and holds a national certificate in digital image workflow delivery systems. Staffan Larsson
has forty-five years of experience in medical and scientific photography. He has worked at Karolinska
Institutet, Stockholm County Council and the Royal Institute of Technology (KTH). As a photographer his
work has illustrated science and medicine. He is co-author of The Focal Encyclopedia of Photography
and the recently published Laboratory Imaging and Photography. Staffan Larsson was instrumental in
the formation of the Lennart Nilsson Award and developed numerous initiatives supporting its mission.
ENT

research at

Karolinska Institutet

meets the future
Who cares for and facilitates your day?
Who specializes in the interplay,
lets music, talk and noise into your head,
helps understand a word that someone said.

What if those great opinions of your choice
are stuck because of problems with your voice? Or, when you sit there in your stunning gown you find the party dinner won’t go down?

Sometimes the aching nose is hard to blow yet there’s a constant and annoying flow.
It does not take a master mind to see that what you need is us from ENT!

Per-Åke Lindestad
This telegram dated 4th of November 1915, is from the prisoner of war Dr Barany to Professor Gunnar Holmgren. Barany expresses his warmest thanks to the Medical Faculty in Stockholm for awarding him the Nobel Prize.
In 1960, Carl-Axel Hamberger was appointed professor at the Karolinska and successor as the head of the department and remained so until he resigned in 1975. After his studies at Memorial Hospital in New York under John Conley he introduced advanced tumour surgery of the head and neck at the Karolinska, including transnasal surgery of the pituitary gland, which became the dominating approach for the following decades. A close cooperation was established with Radiumhemmet, the oncological institution at Karolinska and multidisciplinary conferences with representatives from head and neck surgeons and oncologists were introduced for all cancer patients. An Audiological section with Lennart Holmgren and later Bengt Barr was also established during this time.

At the research laboratory Gustav Vth at Karolinska an expanding “Ear-lab” was formed under Jan Wersäll. Important morphological animal studies were performed of the inner ear using electron microscopy, a novel technique at that time. With Åke Flock the field was expanded to physiological studies of the inner ear including studies of ototoxicity and physiology of single hair cells.

In the 1960s the ENT clinic comprised of four wards with altogether 86 beds. Thanks to improvement in methods of general anesthesia, improved treatment modalities and transition to outpatient surgery the number of beds have successively been reduced over decades. The question today is whether or not this reduction has gone too far, as the number of beds per inhabitant in Stockholm today is among the lowest in Sweden and in Europe.

In 1972 the Huddinge Hospital was opened and was at that time the largest hospital in Sweden. Two years later an ENT department was opened with professor Jan Wersäll as the head of this novel university clinic, fully staffed with a professor, teachers and teaching-assistants, and linked to the Karolinska Institute. Jan Wersäll returned to Karolinska Hospital in Solna as the head of the department after Carl-Axel Hamberger’s retirement in 1975.

During the 1990s and 2000s a series of reorganizations were promoted by the political regime of the county council including a new financial system. In 1997, all head and neck surgery in Stockholm was concentrated to Karolinska Hospital in Solna. The profile of Huddinge Hospital was advanced ear surgery, cochlear implants and phoniatry.

In 2004 the Karolinska Hospital, Solna and University Hospital, Huddinge, joined together as Karolinska University Hospital.
Ongoing projects

Earlier presented in “Courage with ethics and responsibility. Scientific report 2017” from the Department of Clinical Science, Intervention and Technology (CLINTEC), Karolinska Insitutet
LENA - a new and Innovative research instrument
(www.lenafoundation.org)
Language Environmental Analysis (LENA) - “a pedometer of words”, is an objective measurement instrument, with software that can distinguish between different audio-verbal communication parameters, e.g. automatically count the number of audio-verbal turns between a child and caregivers, number of child utterances and the number of adult words, during a whole recording day (12–16 hours), from the child’s everyday environment. LENA also measures which kind of auditory environment the child was exposed to like silence, electronic sounds (iPad/TV), noise, speech close to the child (meaningful) and speech at a distance.

LENA is used in research and clinical work with norms in American English, and is so far also validated in Mandarin, Spanish and French, and soon also in Swedish. LENA will evaluate the spoken language environment of 0–48 month old children with HI and in comparison to age-matched children with normal hearing.
The ENT Airway Inflammation Group

The group lead by professor Cardell, studies inflammation in: 1) Rhinitis and Asthma and 2) Head and Neck cancer. Inflammation is a key feature of both allergic and non-allergic rhinitis, nasal polyposis, asthma and epithelial derived cancer in the head and neck region. The mediators involved appear to be the same even though their profiles vary depending on the diseases involved.

1. Functional studies of freshly isolated airways from patients can be used to test and develop new medicines for allergy and asthma.

2. Microscopic visualization of nerve cell interaction unlocks the mysteries of neuroimmunology (how nerve signaling affects our immune system).

3. Biopsies and cell samples from patients obtained in the clinic are immediately processed in the lab in order to characterize diseases and the mechanisms involved in their origin.

4. The laboratory crew at Solna Campus (Eric Hjalmarsson Lab. Ing, Olivia Larsson PostDoc, Prof. Lars Olaf Cardell, Valtteri Häyry PostDoc, Lotta Tengroth PhD student, Susanna Kumlien Georén PhD Senior Lab Manager, Cecilia Drakske MSc, Sandra Ekstedt PhD Student).
Oropharyngeal cancer is increasing

Oropharyngeal cancer includes cancer of the base of the tongue, tonsils, soft palate and pharyngeal walls. In contrast to most other head and neck malignances the number of new patients with oropharyngeal cancer have markedly increased the last decades in Sweden. Together with malignant melanoma, tonsillar cancer has escalated most of all tumor types in Sweden. We have reported almost a doubling in the incidence of HPV-positive tumors per decade 1970-2007, and at a nationwide setting the incidence is continuing to rise.

Human papillomavirus caused tonsillar cancer: An epidemic of viral induced carcinoma?

Cancer in the head and neck region comprises 3-4% of all cancer cases in Sweden. Well known risk factors for head and neck cancer are tobacco usage and alcohol consumption. Although, during the past two decades human papilloma virus (HPV) has been recognized as a risk factor for the development of oropharyngeal cancer, which together with malignant melanoma is the tumor type that has increased the most the last decades in Sweden.

Future challenges

Patients with HPV positive oropharyngeal cancer have a significantly better survival than HPV negative oropharyngeal cancer. However a few patients respond poorly to treatment. A challenge is to find those patients with poor prognosis who will need intense chemotherapy. We have found a number of tumor markers that can distinguish them and created a model to predict the outcome. Another question is the predictive value of HPV positive or negative metastases.

Increased presence/prevalence of HPV in oropharyngeal cancer in Sweden

The prevalence of HPV in tonsillar cancer has increased dramatically in Stockholm over the latest decades, from 23% in the 1970s to today where over 80% of all tonsillar cancers are caused by HPV. This represent a sevenfold increase since the 1970s.
Breathing obstruction during sleep – dangerous to health

Obstructive sleep apnea syndrome (OSAS) is common (~10% of the population), and could be dangerous with increased morbidity (cardiovascular diseases, impaired cognition), and even mortality.

The obstruction site is often the soft palate in adults, and tonsil hyperplasia in children. A research group of specialists in sleep medicine and in ENT has several ongoing randomized controlled trials on surgery for sleep apnea in children and in adults as well as collaboration studies with maxillofacial surgeons, Rehabilitation Medicine for chronic fatigue syndrome, the Stress Research Institute at Stockholm University among others.

The sleep laboratory

We investigate both children and adults with a capacity of more than 800 full-night, in-lab polysomnographies each year. This provides a unique possibility to perform high quality research in the field of sleep medicine, with focus on OSAS.

Polysomnography

is the gold standard to diagnose OSAS (Left) This is an example of monitoring of a child with obstructed airways during Rapid-Eye-Movement, (dream) sleep, showing repetitive obstructive hypopneas, apneas and desaturations.

Karolinska Uvulo-PalatoPharyngoPlasty (UPPP)

UPPP at Karolinska is a modification of earlier more aggressive techniques and vital tissues are preserved resulting in less side effects. It is performed during general anesthesia to treat OSAS in adults who do not tolerate non-surgical treatment (CPAP, dental device).

Evidence based surgery

This is the first published randomised controlled trial comparing surgery (UPPP) with an untreated control group, in 65 adults with moderate to severe OSAS. The results show a highly significant and clinically relevant group difference in nocturnal respiration (AHI reduction), in favor of UPPP. With courtesy to Thorax, Browaldh et al 2013.

Before and 6 months after surgery.
Botox for health

Botox is most known for its use in the cosmetics industry, but has long before been used for different medical disorders with muscular overactivity, i.e. spasticity. The purified bacterial toxin decreases or inhibits the release and the uptake of acetylcholine with resulting distal denervation and subsequent reinnervation which explains the normal effect duration of 3 months. At that point the botox has left the body long since.

The use of Botox in ENT includes injection treatment of spasmodic dysphonia, i.e. vocal cramps (picture), laryngeal dystonia, biting and mouth opening dystonia, bruxism, drooling, treatment of abnormal sweating after parotic surgery and treatment of heavy tension headaches.
Five most valuable publications from the research group 2014-2017


Sandra Ekstedt  
PhD-student

Previous studies have focused on eosinophils as the main contributors to allergic asthma with less attention given to neutrophils. This project introduces a new concept for neutrophils, one that includes a primary role for a specific, active subset of neutrophils. It conjures a translational approach including bronchial provocation, in vitro analysis and in vivo animal experiments.

Eric Hjalmarsson  
PhD-student

This project investigates how intra lymphatic immunotherapy (ILIT) induces tolerance in grass and birch allergic patients. Fine needle aspirates from the allergen injected lymph node are analyzed along with samples from peripheral blood and brush samples from nasal mucosa. The immunological analyses are mainly focused on B and T-cell differentiation.

Åsa Kågedal  
MD, PhD-student

Cancer Immunology is a fast-developing field of research. Our use of flow cytometry to investigate the metastatic status of the lymph nodes shortens the time to diagnosis. It will also provide new information about the immunological status of the cancer, with a special focus on sentinel nodes, something that, might provide a better guide for future treatment decisions.

Karin Jonstam  
MD, PhD-student

This project is designed to further determine the inflammatory pathophysiology of chronic rhinosinusitis with and without nasal polyps. This includes the identification of potential biomarkers for endotyping, investigation of the role ALK-receptors and neutrophins and development of novel treatments as well as different surgical approaches.

Laila Hellkvist  
MD, Specialist in ENT, PhD-student

Intralymphatic immunotherapy for allergic rhinitis is proposed as a safer and faster alternative to conventional subcutaneous administration. The safety and clinical effects of this therapy is evaluated in a series of clinical trials. Markers predicting a successful outcome are assessed by collecting samples from nasal mucosa, blood and lymph node tissue for immunological investigations.

Magnus Starkhammar  
MD, PhD-student

Respiratory tract infections are a common cause for acute asthma exacerbations. The overall aim of this project is to analyze the role of Toll-like receptors (TLRs) in the development of local airway hyperresponsiveness (AHR). TLRs with an ability to identify viruses are investigated in an in vivo mouse model, where the AHR and the inflammatory response are used as read outs.
Five most valuable publications from the research group 2014-2017


**David Landin**  
PhD-student, Head of Patient flow, Craniofacial Diseases

Does Human papillomavirus (HPV) analysis safely distinguish branchial cleft cysts from cystic metastases? To distinguish branchial cleft cysts from cystic metastases can be challenging. Today, many centers oncologically treat cystic lesions on the basis of cytology results only, with the support of HPV positivity and thus many patients are spared neck dissection. In order to do so safely we need to investigate whether HPV DNA and p16 protein expression can be found exclusively in cystic metastasis and not in branchial cleft cysts.

**Malin Wendt**  
MD, PhD-student, Senior Consultant

Benign cysts in the head and neck area such as ranulas and branchial cleft cysts are traditionally treated with surgery. A less harmful method that is used treating other cystic lesions is sclerotherapy with OK 432. To evaluate this treatment as an alternative to surgery also for benign cysts in the head and neck area we are running a prospective, randomized, double-blinded placebo-controlled study.

**Daniel Danielsson**  
PhD-student, Head of Patient flow, Craniofacial Diseases

Main research interest is adverse effects after irradiation due to head and neck cancer. Current focus areas include detection of biomarkers for individual radiosensitivity and prospective quality of life analysis for patients treated with mandibular microvascular reconstruction after grade III osteoradionecrosis.
Five most valuable publications from the research group 2014-2017


Five most valuable publications from the research group 2014-2017

Five most valuable publications from the research group 2014-2017


Andreas Kaiser
MD, PhD-student

I work in a group that is presently based in a laboratory in Uppsala. Our overall aim is to facilitate nerve restoration in the auditory system. We mainly do in vitro work, with running projects using human stem and progenitor cells. We have established an auditory nerve system model that we utilize to serve as cell transplantation target and to evaluate cell transplant strategies.

Malin Siegbahn
MD, PhD-student

Congenital unilateral hearing loss affects educational results when untreated. Knowledge about the effects on the central auditory pathways, caused by untreated congenital aural atresia and associated conductive hearing loss is limited. This project aims to examine these effects, through MRI, of both adult human patients and animal models.

Stefan Toth
MD, PhD-student

My PhD-project focuses on peripheral facial palsy of unknown origin (Bell's palsy) and neuroborreliosis. Bell's palsy can cause severe sequelae and subjective suffering but is poorly investigated. This study about incidence, outcome and subjective suffering will therefore be of great importance for increasing the knowledge of this disease. It will also add value for new guide lines.

Rebecka Ohm
MD, PhD-student

I aim to describe the cohort of patients that develop long term sequelae after inflammatory peripheral facial palsy and to study whether early cross facial nerve transplantation will give patients good facial function without the need of additional microvascular muscle transplantation. I will also study the occurrence of synkinesis and surgical treatment options for patients with severe synkinesis.

Malin Siegbahn
MD, PhD-student

Congenital unilateral hearing loss affects educational results when untreated. Knowledge about the effects on the central auditory pathways, caused by untreated congenital aural atresia and associated conductive hearing loss is limited. This project aims to examine these effects, through MRI, of both adult human patients and animal models.

Stefan Toth
MD, PhD-student

My PhD-project focuses on peripheral facial palsy of unknown origin (Bell's palsy) and neuroborreliosis. Bell's palsy can cause severe sequelae and subjective suffering but is poorly investigated. This study about incidence, outcome and subjective suffering will therefore be of great importance for increasing the knowledge of this disease. It will also add value for new guide lines.

Other co-workers within the research group

Malin Berglund, MD, PhD student, SUS/NÄL, Gothenburg
Måns Eeg-Olofsson, MD, Docent, University of Gothenburg
PO Eriksson, MD, PhD, Uppsala
Bo Håkansson, Professor, Chalmers University of Technology
Mervi Kanerva, MD, Docent, Helsingfors Univ. Finland
Rodrigo Moreno, Docent, Royal Technical Highschool, Stockholm
Eva Westman, MD, PhD, lecturer, Umeå
Five most valuable publications from the research group 2014-2017


Five most valuable publications from the research group 2014-2017

Inger Uhlén
MD, PhD

The present research project aims at investigating the prevalence and etiology of congenital and late onset childhood hearing impairment. Through studies of the regional (Stockholm County Council) databases Audioscreen and Audiohab, the efficacy, sensitivity and specificity of the universal newborn hearing-screening program will be evaluated. The EU-project EUSCREEN will provide similar information.

Bo Tideholm
MD, PhD

The research scope is to elucidate language development in children with bilateral and unilateral cochlear implantation. Furthermore, to study how binaural hearing with cochlear implants effect the ability to detect and localize sound sources and its relation to language acquisition and communication outcomes.

Elisabet Engström
MD, PhD-student

Cognitive development and central auditory processes are studied in children with hearing aids and/or cochlear implants. A specific purpose is to examine how a phonological intervention programme can affect neurophysiological and cognitive development and reading skills. The children were between 5-7 years old with a follow-up after 3 years. Language development is dependent on training.

Martin Eklöf
MScEE, PhD-student

The PhD project involves development of a method to assess latencies in a horizontal sound localization task. The measure is extracted from optimization of an arctangent function to the eye tracking data from each sound shift. This technique is used to study the coding of fine structure in the stimulation strategies of cochlear implants (CIs). Lateralization seems to depend on CI processing parameters.

Elisabet Engström
MD, PhD-student

The overall aim is to describe the causes and mechanisms behind pediatric congenital unilateral sensorineural hearing loss (uSNHL), as well as the effect of early intervention on auditory abilities and maturation of the central auditory pathways. Congenital uSNHL is studied with objective and subjective methods from birth in order to identify and develop the most appropriate treatment protocols.

Satu Turunen-Taheri
MSc, PhD-student

The study will present the quality and the usefulness of audiological rehabilitation and examine sex equality in the Swedish hearing health care for patients with severe-to-profound hearing loss. We will study reasons for not being rehabilitated with cochlear implants, prevalence of mental fatigue in this patient group, experiences and factors affecting daily life for patients with deaf-blindness.
Five most valuable publications from the research group 2014-2017

Five most valuable publications from the research group 2014-2017


Stig Rudblad 2004
Nasal mucosal reactivity after long-time exposure to building dampness.

Jörgen Palm 2004
Nasal airway nitric oxide: Methodological aspects and influence of inflammation.

Sushma Nordemar 2004
Methods for early diagnosis of head and neck cancer.

Ebba Hedén Blomqvist 2004
Evaluation of medical and/or surgical treatment of anosmia/hyposmia in association with inflammatory disease of the upper airway.

Andreas Ekborn 2003
Cisplatin induced ototoxicity: Pharmacokinetics, prediction and prevention.

Georgios Papatziamos 2003
Immunological studies of adenoids in children. Relation and atopy.

Anne-Charlotte Hessén Söderman 2002
Morbidity in Meniere’s disease; aspects on quality of life and triggering factors.

Christina Larsson 2002
Stiffness changes of the tympanic membrane in otitis media.

Michael Lysdahl 2002
Rhonchopathy: Long-term clinical results after palatal surgery.

Esma Idrizbegovic 2001
Calcium binding protein immunoreactivity in the central auditory system correlations with the auditory periphery. The effects of noise and aging in mice.

Annikà Elmqvist Stenberg 2001
Ear and hearing problems in Turner syndrome.

Urban Knutsson 2000
Individual glucocorticoid sensitivity in the human.

Erik Berninger 2000
Quinine as a model for the study of cochlear hearing loss in humans.

Karín Lindberg 2000
Nasopharynx and mucosa associated lymphatic tissue. Studies on mucosal immunity, nasopharyngeal colonization with non-encapsulated non-typhable Haemophilus influenzae and local administration of immunoglobulin in the upper respiratory tract.

Hans Grudemo 2000
Rhinostereometry and laser doppler flowmetry. Simultaneous measurements of inflammation and steroid effects in normal and allergic human nasal mucosa.

Marie Forseni Flosin 2000
Inflammation mediators and immunocompetent cells in the middle ear with particular regards to otitis media and tympanic lerosis.

Karin Forsgren 1999
Mucosal regeneration following sinus surgery.

Anders Westermark 1999
On inferior alveolar nerve function after sagittal split osteotomy of the mandible.

Anders Högmo 1999
Squamous cell carcinoma and preneoplastic lesions of the oral cavity. Biological factors and prognosis.

Wanie Jäger 1998
Physiological aspects of cochlear excitation and neurotransmitter release.

Mats Lidgren 1998
Effects of drugs and irradiation on the laryngeal mucosa of the rat, with special reference to mast cells and neuropeptides.

Karin Ågren 1997
Immune response in human tonsil tissue.

Danielle Friberg 1997
Nerve lesions in pharynx - an aetiology of obstructive sleep apnoea.

Tomas Norlander 1997
Effects of the inflammatory response and formation of polyps in the nasal and sinus mucosa.

Wiveka Westergren 1997
Ventilator-associated sinusitis.

Jonas Karling 1997
Speech and velopharyngeal function in patients with hypernasality.

Anders Samuelsson 1994
Non-capulated Haemophilus influenzae. Aspects of epidemiology and pathogenicity with special reference to recurrent respiratory tract infections.

Joa-chim Forsgren 1994
Nasopharyngeal host-parasite interactions with special reference to non-encapsulated Haemophilus influenzae.

Xi Zheng 1994
Studies on etiological factors in nasopharyngeal carcinoma.

Magnus von Unge 1994
Mechanical properties of the tympanic membrane. An experimental study.

Claes Hemlin 1994
Secretory otitis media. Bacteriology and immunology of the nasopharynx.

Hans Hallén 1994
Nasal mucosa reactivity in healthy subjects, in patients with non-allergic nasal hyperreactivity and in patients with nasal polyps.

Peter Graf 1994
Doctoral dissertations

- Anders Ånggård 1974
  Autonomic nervous control of blood circulation and secretion in the nasal mucosa.
- Christer Lundberg 1974
  Concentration of penicillin and tetracycline in maxillary sinus mucosa and secretion.
- Jan Kinnman 1973
  Acromegaly. An ultrastructural analysis of 51 adenomas and a clinical study in 80 patients treated by transanthro-sphenoidal operation.
- Stig Haglund 1973
  Electromyography in the diagnosis of laryngeal motor disorders.
- Rolf Leandersson 1972
  On the functional organization of facial muscles in speech.
- Stefan Ersson 1972
  The waltzing guinea pig. A study on inherited inner-ear degeneration.
- Lennart Mendel 1971
  Vestibular recruitment.
- Ulf Engzell 1971
- Henry Andersson 1969
  Acoustic intra-aural reflexes in clinical diagnosis.
- Bertil Mårtensson 1967
  Transconioscopy.
- Lars Ånggård 1965
  An electrophysiological study of the development of cochlear functions in the rabbit.
- Helge Schiratzki 1965
  Studier över extra thorakala luftvägsmotståndet hos normala och patienter med en eller dubbelbägared reccurrensares.
- Per-Gotthard Lundquist 1965
  The endolymphatic duct and sac in the guinea pig. An electron microscopic and experimental investigation.
- Åke Flock 1965
  Electron microscopic and electrophysiological studies on the lateral line canal organ.
- Gösta Ewert 1965
  On the mucus flow rate in human nose.
- Tomas Gejrot 1965
  Diagnostik och behandling av glomus jugulare tumöer.
- Carl Magnus Eneroth 1964
  Histological and clinical aspects on parotid tumors.
- Bo Enfors 1962
  The parotid and submandibular secretion in man.
- Ingemar Klockhoff 1961
  Middle ear muscle reflexes in man. A clinical and experimental study with special reference to diagnostic problems in hearing impairment.
- Jan Wersäll, 1956
  Studies on the structure and innervation of the sensory epithelia of the cristae ampullares in the guinea pig
- Bengt Barr 1955
  Pure tone audiometry for preschool children.
- Gunnar Lidén 1954
  Speech audiometry. An experimental and clinical study with Swedish language material.
- Herman Diamant 1954
  Cholinesterase inhibitors and vestibular function.
- Lars-Erik Floberg 1953
  Vestibular symptoms in carbon monoxide poisoning after unilateral ligation of the common carotid artery.
- Gunnar Nilsson 1952
  The immediate improvement of hearing following fenestration operation.
- Tore Lundborg 1952
  Diagnostic problems concerning acoustic tumor.
- Erik Wedenberg 1951
  Auditory training of deaf and hard of hearing children.
- Gunnar Mårtensson 1950
  Dental injuries following radical surgery on the maxillary sinus.
- Rutger Heyden 1950
  The respiratory function in laryngectomized patients.
- Erik Carlens 1943
  Otitic infections due to pneumococcus type 3.
- Carl-Axel Hamberger 1942
  Über die behandlung der otitis media acuta und gewisser otogener komplikationen mit sulfanilamidderivaten.
Publications 2014 - 2017


Publications 2014 - 2017


Jonstam K, Westman M, Holttappels G, Holweg CTJ, Bachert C. Serum periostin, IgE, and SE-IgE can be used as biomarkers to identify moderate to severe chronic rhinosinusitis with nasal polyps. J Allergy Clin Immunol. 2017;[Epub ahead of print]


Publications 2014 - 2017


Publications 2014 - 2017


Publications 2014 - 2017


