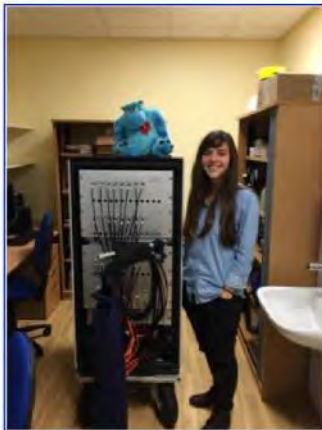
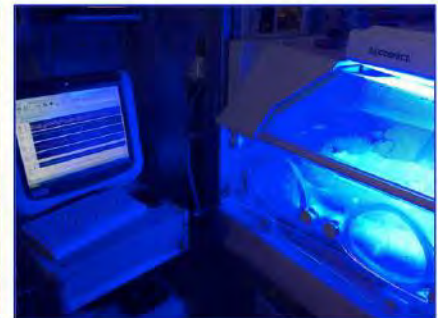
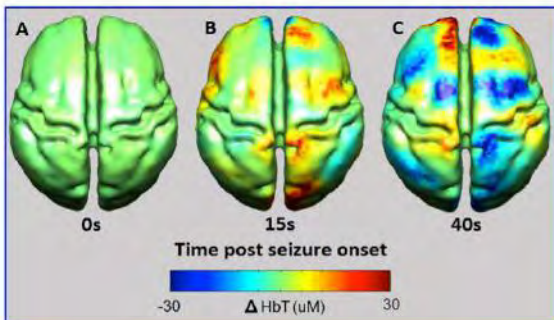




The Evelyn Perinatal Imaging Centre



Report to the Evelyn Trust

April 2017



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Introduction

This report provides a summary of the Development of the Evelyn Perinatal Imaging Centre, opened in 2013; this includes a review of the research projects, collaborations and public engagement activities undertaken in the centre as well as a summary of grants, publications and abstracts by the group.

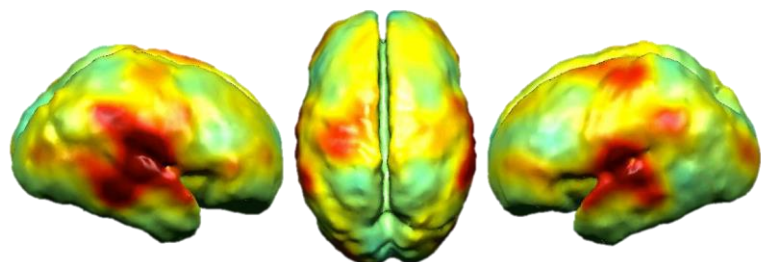
In the original proposal to the Evelyn Trust, the case was made to develop the imaging shell space in the new Rosie Hospital to 'create an internationally competitive programme of research using multimodal non-invasive imaging and monitoring of the fetus and neonate to identify vulnerable infants at an early stage.' Over the past 4 years the Evelyn Perinatal Imaging Centre has established itself as a unique facility attracting a diverse range of investigators and projects. The close proximity of a dedicated research unit to the birthing centre, postnatal wards and neonatal intensive care unit (NICU) enables both newborn infants in the first few hours of life as well as critically ill babies to be studied safely in a family friendly environment.

In 2015, the second phase of the imaging centre was completed with the installation of an MRI scanner. Administered by the radiology department, the scanner enables sick infants to be transferred down easily from the NICU and has facilitated a programme of fetal and neonatal brain imaging research.

This report summarises the work that has been carried out by investigators based in the Evelyn Perinatal Imaging Centre. Quantifying success in a facility such as this can be judged at many different levels. The outputs in terms of grants and publications are summarised at the end. Successful collaborations with researchers in Cambridge and London have been established in projects ranging from optimal blood pressure monitoring in preterm infants on NICU to the study of biomarkers in newborn infants at risk of dyslexia. The central collaboration is with the Department of Medical Physics and Bioengineering at University College London; **neoLAB**, the name for this collaborative group, brings together physicists, engineers and clinicians to develop genuinely novel and innovative technologies to study the newborn brain. The Evelyn Perinatal Imaging Centre also provides a venue for the public to engage with the research being carried out at the Rosie Hospital, playing an important role in the public understanding of medicine and science.

There are many people who have contributed to the success of the imaging centre through their hard work, commitment and support. From Cambridge, this includes Professors David Rowitch, John Suckling, Simon Baron-Cohen and Marek Czosnyka and Drs Vicky Leong and Peter Smielewski as well as all my past and present neonatal consultant colleagues; and from London Professor Jem Hebden and Dr Rob Cooper from UCL. I have been extremely fortunate to have worked with a highly talented and motivated group of PhD, MD and MPhil students, clinical and research nurses, physicists and engineers, whose output forms the bulk of this report. Finally, I would like to thank the Evelyn Trust in their support and belief in this project and the importance they have placed on research into the newborn brain.

Topun Austin
April 2017



Summary

The Evelyn Perinatal Imaging Centre brings together scientists and clinicians across different specialties with a common interest in the developing brain.

The aims of the centre are to:

- Provide a high-quality clinical imaging service for high-risk mothers and newborn infants in the Rosie Hospital, Cambridge.
- Create a major programme of research into perinatal brain injury, imaging and repair.
- Develop active collaborations in developmental neuroscientists with research groups around the UK.

There are currently three main themes of the group:

- 1) Understanding cerebrovascular control in sick and preterm infants in the immediate days after birth.
- 2) Developing novel technologies to study neurovascular development in newborn infants.
- 3) Investigating the newborn infant, relating optical, electrophysiological and genetic markers in specific population groups with cognitive development.

To date the centre has received over £3M of research grants and capital funding and facilitated the following projects and collaborations:

- Formation of **neoLAB**, a collaboration with University College London, to develop new technologies to study the developing brain (www.neoLABresearch.com).
- Study of Autoregulatory Monitoring in BABies (SAMBA): collaboration with Professor Marek Czosnyka and Dr Peter Smielewski, Clinical Neuroscience, Cambridge. Cambridge Trust PhD studentship for Dr. Cristine Costa.
- Behaviour and Resting state Activity In Newborns (BRAIN): Evelyn Trust and MRC PhD studentship for Dr. Chuen Wai Lee.
- Optical-EEG study: Evelyn Trust MD studentship for Dr. Maria Chalia.
- Fast Optical Tomography On Neonates (FOTON): EPSRC funded collaboration with neoLAB.
- BRain Imaging for Global HealTh (BRIGHT): Gates Foundation funded project in collaboration with UCL, Birkbeck London, MRC Human Nutrition Research.
- SPELL – biomarkers of dyslexia in newborns: collaboration with Dr. Vicky Leong, Psychology, Cambridge.
- Cambridge Human Imaging and Longitudinal Development (CHILD): collaboration with Professor Simon Baron-Cohen (Autism Research Centre).

The Evelyn Perinatal Imaging Centre (EPIC) is closely affiliated to the Department of Paediatrics (Head of Department **Professor David Rowitch**) with the development of neonatal neurocritical care being a major theme of the new NIHR Cambridge Biomedical Research Centre (C-BRC) in 2017. C-BRC will fund a lead nurse for neonatal neurocritical care and lead nurse for neonatal and paediatric research, both based in the EPIC. As well as a number of research associates and PhD students associated with specific collaborative projects, the following are directly associated with the centre:

Professor Topun Austin: Director of the Evelyn Perinatal Imaging Centre, Co-director of neoLAB

Professor John Suckling: Lead for Imaging

Dr. Robert Cooper: Co-director of neoLAB

Dr. Cristine Costa: PhD student

Dr. Chuen Wai Lee: PhD student

Dr. Maria Chalia: MD student

Ms. Laura Dempsey: PhD student

Ms. Emma Porter: Clinical research nurse*

Dr. Elham Nabavi: Post-doctoral research physicist*

Information on the Evelyn Perinatal Imaging Centre and current research projects and collaborations can be found on the website: www.neolabresearch.com

* starting in 2017

Background

The human and social cost of neurological disability

Advances in medical technology and expertise have improved survival rates for vulnerable babies. Neonatal mortality rates (deaths under 28 days) for England and Wales fell by 62% from 7.7 to 2.9 deaths per 1,000 live births between 1980 and 2010. However, improvements in neurodevelopmental outcomes have lagged behind these improvements in survival and a significant number of vulnerable infants go on to develop cerebral palsy, epilepsy and other forms of neurological disability. These outcomes place an enormous physical, psychological and financial burden on individuals, families and society. The cost of preterm birth to the public sector has been estimated at over £2.9 billion a year; the additional lifetime cost of looking after a severely disabled child runs into the millions of pounds.



The newborn brain is a unique organ, both vulnerable to injury and sensitive to repair. Brain injury can affect babies born prematurely, where the rapid and complex cortical development, which normally unfolds in the warm, dark and protected environment of the womb, must instead take place in the harsh environment of the world outside. It also occurs in babies born at full term, where adverse events during childbirth can critically impair oxygen and blood flow to the baby's brain.

The goal of neonatal care must therefore be to protect and repair the damaged brain.

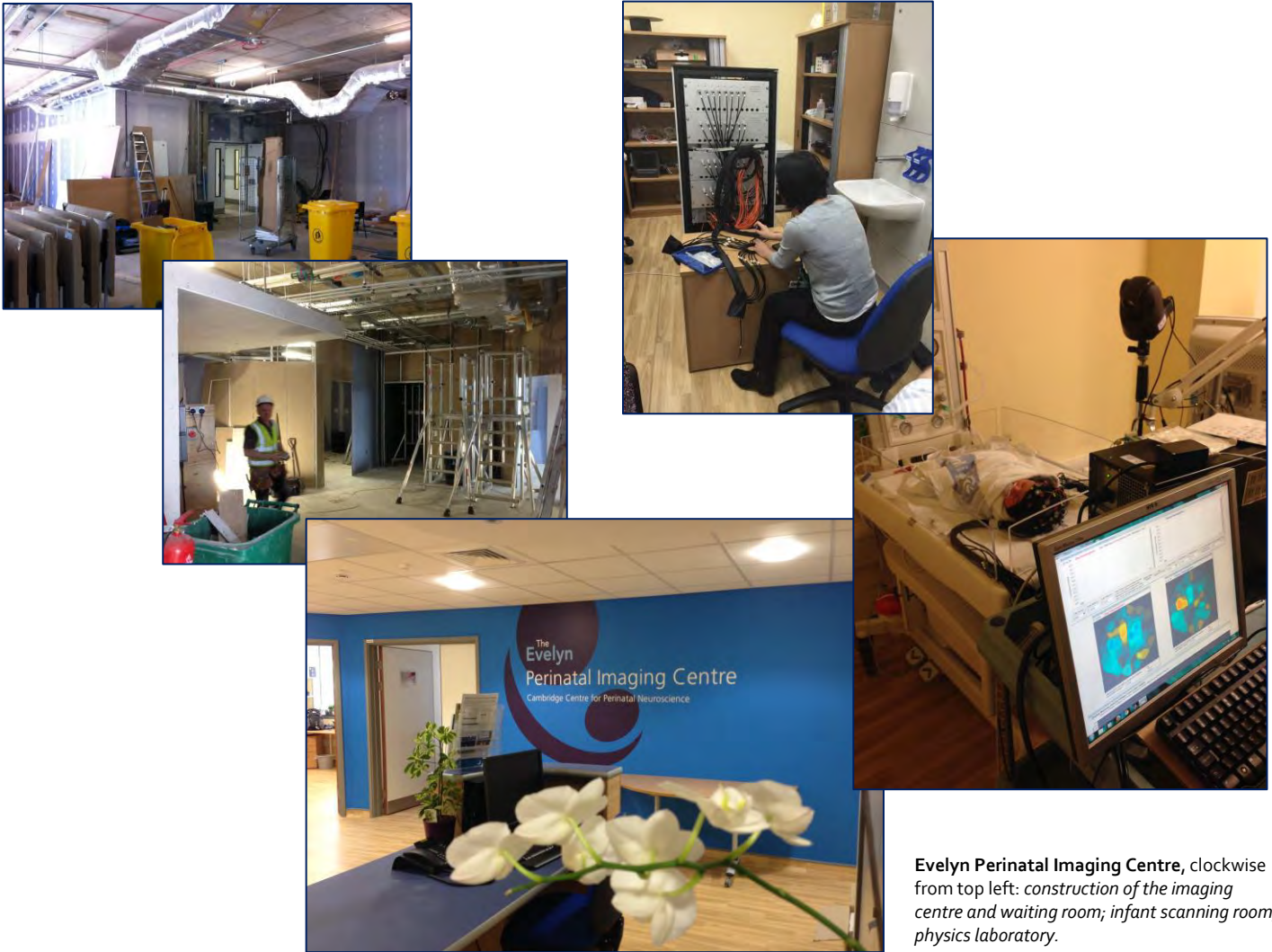
Early identification of infants at risk will allow targeted therapies to be developed with non-invasive techniques playing a key role in their assessment, monitoring and follow up.

Development of the Evelyn Perinatal Imaging Centre

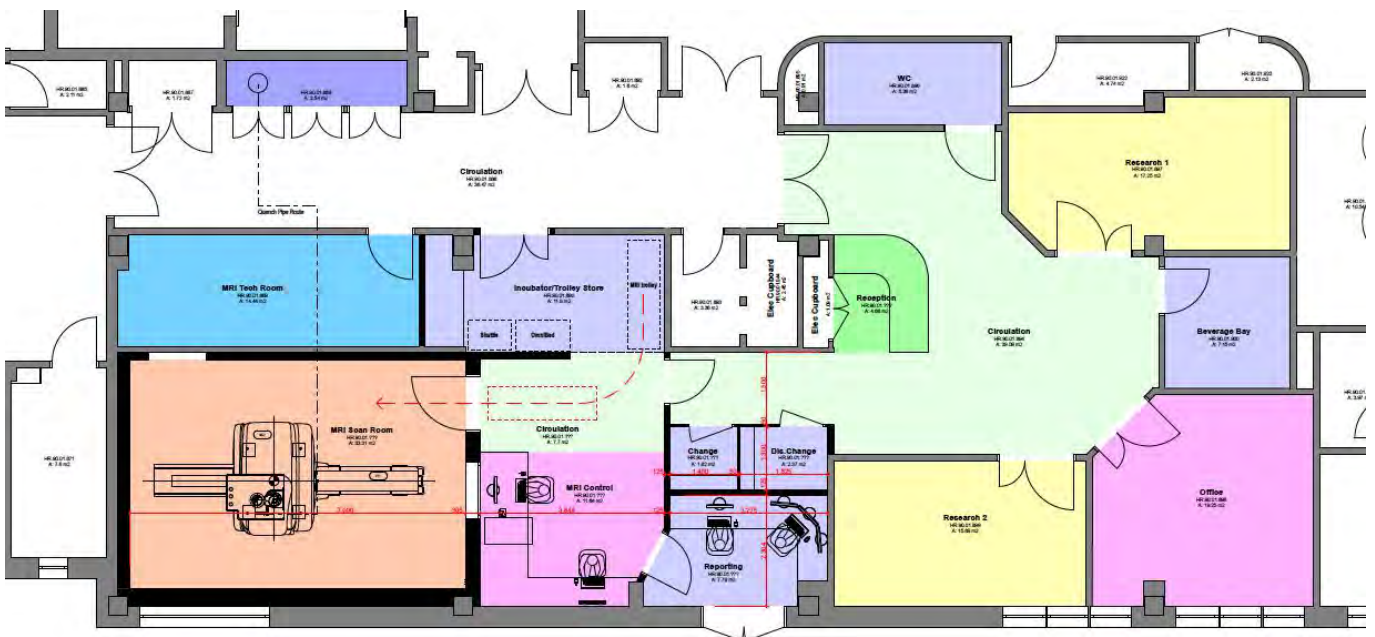
Cambridge University and Addenbrooke's Hospital together represent one of the world's premier centres for neuroscience research with specific interests in brain injury, imaging and repair. Since 2009 Cambridge University Hospitals NHS Foundation Trust (CUHFT) has attracted over £3M of research funding in neonatal neuroscience and has led the development of a regional service for neonatal neuroprotection in the East of England. With the expansion of the Rosie Maternity Hospital in 2012 there was an opportunity to create an exciting new clinical-research facility to develop a programme of research into the study of function and development in the newborn brain.

The Evelyn Perinatal Imaging Centre was opened in 2013. The unit consists of a physics laboratory and infant scanning room, designed to develop novel optical and electrophysiological imaging technologies to study the developing brain as well as dedicated office space for staff. In the design of the new Rosie hospital, space was made available for an MRI scanner for women and children. In consultation with the Department of Radiology a clinical 1.5T MRI scanner was installed in the imaging centre in January 2015, with facilities to scan newborn infants.

In 2016 Professor David Rowitch was appointed as Head of the Department of Paediatrics. Professor Rowitch previously was Chief of Neonatology and Professor of Pediatrics and Neurosurgery at the University of California, San Francisco. His major academic interest is in the genetic factors that determine cellular development in the brain and its response to injury; clinically he led the development of the Neonatal Neurointensive Care Nursery at UCSF, providing a clinical-research platform for newborn infants at risk of brain injury. As part of the Women's and Children's theme of the NIHR Cambridge Biomedical Research Centre, the development of the NeuroNICU is one of the key objectives for which the facilities in Evelyn Perinatal Imaging Centre will play a central role.

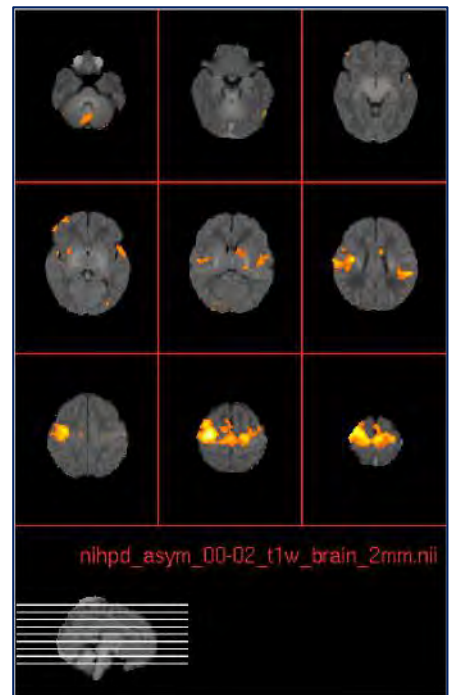


Evelyn Perinatal Imaging Centre, clockwise from top left: construction of the imaging centre and waiting room; infant scanning room, physics laboratory.





Rosie MRI scanner in the Evelyn Perinatal Imaging Centre:
clockwise from top left: *installation of MRI scanner, January 2015. Infant in the MRI scanner; moving a sick newborn infant into the scanner; functional connectivity images obtained from a healthy control infant; MRI scanner in EPIC.*



Research Team

Central to the development of the Evelyn Perinatal Imaging Centre has been to provide a stimulating environment to attract high caliber clinical research fellows, research nurses and scientists. To this end the Evelyn Trust funded two clinical research fellowships in neonatal neuroscience. Through these, and other fellowships and research grants, the centre has been home to 3 PhD students, 1 MD student, 2 MPhil students, 3 research physicists/computer scientists and 4 clinical research nurses.



Research Team at the Evelyn Perinatal Imaging Centre past and present: from left: *Dr. Robert Cooper, Dr. Chuen Wai Lee, Dr. Maria Chalia, Dr. Cristine Costa, Laura Dempsey, Kelly Spike, Hubin Zhao, Andrea Edwards, Harsimrat Singh, Claire Kem-, Gordon Stevenson, and Peppar Cyr.*

Current Group Members

Dr. Robert Cooper is a post-doctoral research associate at UCL and co-director of neoLAB. He was awarded the UCL Centre for Neuroimaging Techniques' Young Investigator of the Year Award in 2010 for his thesis on multimodal imaging of neonatal seizures. He has recently been awarded a prestigious EPSRC Early Career Fellowship to develop the next generation of wearable optical-imaging devices for neonates. He holds an honorary contract with Cambridge University.

Dr. Chuen Wai Lee is an Academic Clinical Fellow, who was awarded the first Evelyn Trust Clinical Research Fellowship in Neonatal Neuroscience and went on to obtain a highly competitive MRC Clinical Training Fellowship to investigate behaviour and resting state functional activation in newborn infants. She is currently writing up her PhD thesis and expecting her first baby!

Dr. Maria Chalia is a neonatal 'national grid' trainee and was awarded a 2-year fellowship from the Evelyn Trust to study neurovascular coupling in infants with brain injury. She is currently writing up her MD thesis and is currently working at the Royal London Hospital and will return to Cambridge later in 2017 to complete her clinical training.

Dr. Cristine Costa is a clinical fellow from Brazil and was awarded a Cambridge Overseas Trust (COT) and Brazil Federal Agency for the Support and Evaluation of Graduate Education (CAPES) PhD scholarship. She is undertaking a project investigating cardiac function and cerebrovascular reactivity in preterm infants. She is currently writing up her PhD thesis and is working in Cambridge as a Locum Consultant Neonatologist.

Laura Dempsey is a research engineer from the US, who successfully completed an MPhil investigating neurovascular coupling in newborn infants. She is now undertaking a PhD at UCL, but working across both London and Cambridge sites, developing the 3D optical imaging system for neonatal brain imaging (the FOTON project).

Kelly Spike is a neonatal nurse who is the lead for neonatal neurocritical care, and works in both a clinical and research capacity to develop the neonatal neurocritical care service on the NICU and coordinate clinical MRI scans in the Evelyn Perinatal Imaging Centre.

Dr. Hubin Zhao is a post-doctoral research associate at UCL, working with Dr. Robert Cooper on his EPSRC-funded fellowship to develop the next generation of wearable optical-imaging systems.

Dr. Silvia Martini is a neonatologist who is on a visiting scholarship from Italy, undertaking clinical training as well as working in the Evelyn Perinatal Imaging Centre on both the SPELL project, with Dr. Vicky Leong and FOTON project with Laura Dempsey.

Former Group Members

Andrea Edwards is a neonatal and clinical research nurse who has worked on a number of studies, including SafeBoosC, Optical-EEG and FOTON (see below). In 2015, she was awarded a one-year fellowship, funded by Addenbrooke's Charitable Trust and the Cambridge Biomedical Research Centre to undertake a pilot study on the effect of environmental noise on sleep-wake cycling and cerebral oxygenation in preterm infants. She is currently working as a Research Nurse Team Leader at the Eastern Clinical Research Network.

Harsimrat Singh is a neuro-engineer who worked as a Research Associate on the Action Medical Research funded project to develop a neonatal optical-EEG imaging system. He is currently working as a research associate at Imperial College London on human-robot interaction.

Claire Kemp is a neonatal nurse who worked on the SPARKS funded SAMBA study alongside Cristine Costa and Gordon Stevenson. She is now working as a neonatal sister on the Acute Neonatal Transfer Service (ANTS).

Gordon Stevenson is a biomedical engineer who worked on the SPARKS funded SAMBA study alongside Cristine Costa and Claire Kemp. He is now working as a post-doctoral research fellow in the School of Women's and Children's Health in the University of New South Wales, Sydney, Australia, on the development of Doppler ultrasound in perinatal medicine.

Peppar Cyr is a research student from the US, who successfully completed an MPhil investigating neuro-oscillatory biomarkers of dyslexia in the newborn. She has returned to the US to start medical training as a doctor, however is applying to continue her research studies as part of an MD-PhD program.

Future Group Members

Elham Nabavi is a post-doctoral research physicist who has been appointed to the Evelyn Trust funded project to investigate neonatal stroke due to start later in 2017.

Emma Porter is a neonatal nurse who has been appointed to the Evelyn Trust funded project to investigate neonatal stroke due to start later in 2017.

Collaborations

The facilities within the Evelyn Perinatal Imaging Centre has enabled a number of diverse and successful collaborations to be made with researchers in Cambridge, London and Europe. This has been strengthened by the



appointment of **Professor David Rowitch** (left), as Head of the Department of Paediatrics at Cambridge. As part of the NIHR Cambridge Biomedical Research Centre, the aim is to develop the 'Neuro-NICU' to identify neonatal neurodevelopmental disorders and brain injury. The early identification of vulnerable infants will include the development of imaging, EEG and blood biomarkers and an ambitious project, in collaboration with the Department of Clinical Genetics, to undertake whole genome sequencing on infants with altered neurology and seizures.

The Evelyn Perinatal Imaging Centre will play a central role in the development of the Neuro-NICU.

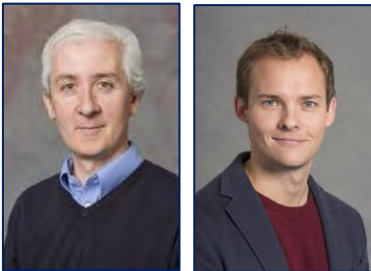


Kelly Spike (right) was appointed as our lead nurse for neonatal neurocritical care in 2015, pictured here in the imaging centre showcasing a mock-up of a 'Neuro-NICU' cot.



neoLAB is a formal collaboration set up in 2012 between the Biomedical Optics Laboratory (BORL) at University College London and Cambridge, with its clinical home in the Evelyn Perinatal Imaging Centre. The Biomedical Optics Research Laboratory, led by **Professor Jem Hebden**, is one of the world's leading medical optics group in

Europe. For over thirty years, BORL has pioneered the development of new optical instruments and techniques for monitoring tissue oxygenation and metabolism. The unique collaboration between BORL and the Evelyn Perinatal Imaging Centre has enabled successful translation of state-of-the-art systems to study the neonatal brain in a dedicated infant-friendly facility, in close proximity to the Neonatal Intensive Care Unit. neoLAB is run jointly by **Professor Topun Austin** and **Dr. Robert Cooper**. To date the collaboration has generated over £1M joint grants.



More information on neoLAB can be found here: www.neoLABresearch.com

From left: *Professor Jem Hebden, Head of the Department of Medical Physics and Biomedical Engineering, UCL; Dr. Rob Cooper, Co-Director of neoLAB.*

Department of Psychiatry, University of Cambridge

Professor John Suckling (right), from the Department of Psychiatry, is the lead for imaging science in the Evelyn Perinatal Imaging Centre. In conjunction with Professor David Lomas and Dr. Martin Graves (Radiology), he has played a major role in the installation of the MRI scanner in the Evelyn Perinatal Imaging Centre and undertook the initial pilot research scans of infants.



Department of Clinical Neuroscience, University of Cambridge



Professor Marek Czosnyka and **Dr. Peter Smielewski** (left) in the Department of Academic Neurosurgery, have been longstanding collaborators, helping develop the multi-modal neuromonitoring platform on the NICU and were co-applicants on successful grants from the Evelyn Trust and SPARKS, as well as co-supervising Dr. Cristine Costa. The ICM+ software developed by the group has been used to obtain physiological data from newborn infants on the NICU.

www.neurosurg.cam.ac.uk/pages/ICM

Department of Psychology, University of Cambridge

Dr. Vicky Leong (right) is an Assistant Professor of Psychology at the Nanyang Technological University (Singapore) and Affiliated Lecturer in the Department of Psychology in Cambridge. With funding from the Rosetrees Trust, she has run a successful pilot project investigating electrophysiological and genetic biomarkers of newborn infants at risk of dyslexia. This work was carried out by MPhil student, **Peppar Cyr**.



UCL-BORL, Birkbeck University of London, MRC Human Nutrition Unit, University of Cambridge



This multi-institutional collaboration, funded by the Bill & Melinda Gates Foundation is a multidisciplinary project dedicated to advancing global health initiatives using low cost, portable and non-invasive optical imaging technology. Led by **Professor Clare Elwell** (left) at UCL-BORL, the project is being run simultaneously in Cambridge and at the MRC Unit in the Gambia.



Further information can be found at: www.globalfnirs.org

Autism Research Centre

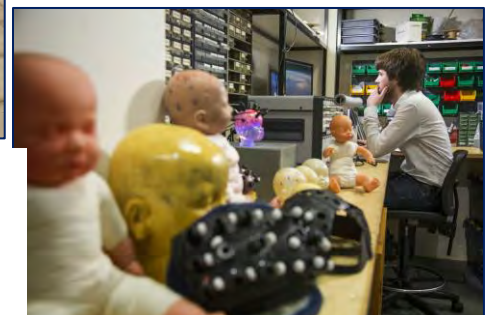
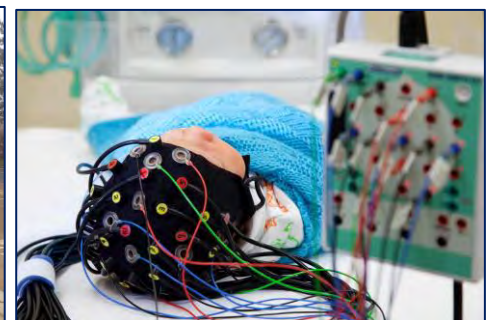


The Cambridge Human Infant Longitudinal Development study (CHILD) is led by **Professor Simon Baron-Cohen** (right). The study focuses on understanding the different effects of prenatal and postnatal hormones on brain development and behaviour in typically developing children and in siblings of children with a diagnosis of autism and parents with a diagnosis of autism. The study includes antenatal and postnatal MRI scans which are carried out in the Evelyn Perinatal Imaging Centre.



GOWERLABS

Gowerlabs is a new company focused on creating high-quality functional imaging devices for the research and healthcare communities. The NTS Optical Imaging System, which has been used in various projects in the Evelyn Perinatal Imaging Centre, was developed by a team of engineers and physicists at UCL-BORL. Gowerlabs is led by engineer, Dr. Nick Everdell, and receives theoretical input from biomedical optics experts including Professors Jem Hebden, Clare Elwell and Adam Gibson and Dr. Rob Cooper. Further information on Gowerlabs can be found here: www.gowerlabs.co.uk



UCL-NTS system (left), arrives at the Rosie Hospital in 2012 (above), the sensors are integrated with EEG electrodes to study neurovascular coupling in an infant (top right) and Gowerlab laboratory at UCL (bottom right).

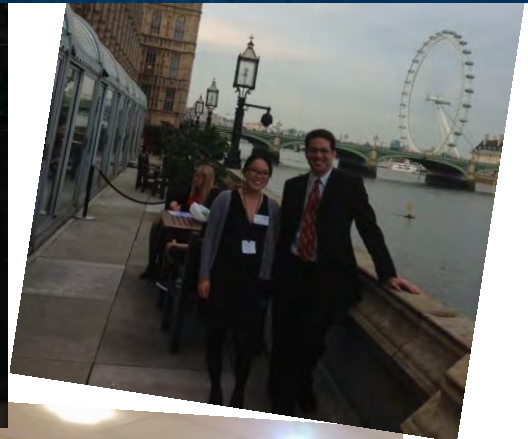
Public Engagement

Since opening in 2013, the Evelyn Perinatal Imaging Centre has hosted a number of public engagement events, including open days as part of the Cambridge Science Festival and study days for staff. Families who participated in research studies have also been invited back to provide feedback of their experience as well as find out results of the research they participated in. Several members of the research team have also been involved in public science events, highlighting the work carried out at the centre.

Specific events include:

- Opening of the Evelyn Perinatal Imaging Centre to the public as part of the 2014 and 2015 Cambridge Science Festival.
- Presentation at the SET for Britain exhibition 2014 at the Houses of Parliament.
- Presentation at 10 Downing Street on behalf of Action Medical Research, 2014.
- Public lectures on 'Shining Light in the Newborn' as part of the Cambridge Science Festival (2015) and Addenbrooke's Members (2016).
- The film 'The Golden Window', a collaboration with Anglia Ruskin University, shortlisted for the British Universities Film & Video Council Learning on Screen awards 2015.
- Presentation at the 2016 Hay Festival (www.cam.ac.uk/public-engagement/hay-festival-2016)





Grants and Research Projects at the Evelyn Perinatal Imaging Centre

Below is a summary of research project carried out or run from the Evelyn Perinatal Imaging Centre. Research in the group is divided into three themes: **Cerebrovascular physiology, Neurophotonics and Developmental Psychology.**

Cerebrovascular Physiology

Study of Autoregulatory Monitoring in BABies (SAMBA)

Prospective cohort study investigating cardiac function and cerebral autoregulation in preterm infants.

Investigators	Cristine Costa (PhD student), Gordon Stevenson, Claire Kemp, Topun Austin
Collaborators	Marek Czosnyka, Peter Smielewski, Department of Clinical Neuroscience, Cambridge University
Funding	COT/CAPES (CC PhD), SPARKS (2013-2015)
Start date	March 2013
End date	September 2016
Portfolio	Adopted
Study Population	Preterm <32 weeks <6hours old
Recruitment	121



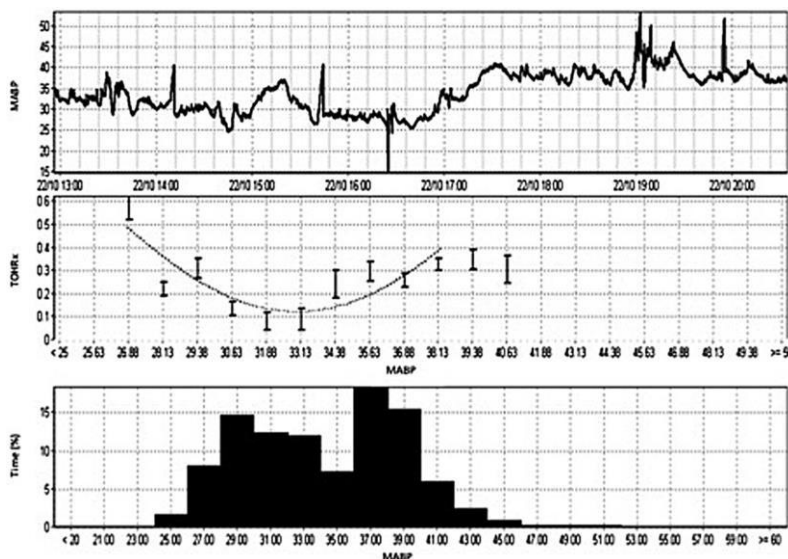
This project aims to refine the methodology for continuous, quantitative assessment of cerebral autoregulation (CA) in preterm infants using the technique of near-infrared spectroscopy (NIRS), in order to define the 'optimal' mean arterial blood pressure (MABP) for individual infants undergoing intensive care.

Key outputs from the project to date have been:

- 1) Description of a novel index of cerebrovascular regulation – the heart rate-cerebral oxygenation index (TOHRx) and demonstration of impaired cerebrovascular regulation associated with severity of clinical illness.
- 2) Calculating optimal blood pressure based on the strength of cerebrovascular regulation as defined by TOHRx.
- 3) Demonstration of increased mortality associated with deviation away from the optimal blood pressure.
- 4) Calculation of the 'burden of cerebral hypoxia' in these infants based on continuous measurements of cerebral oxygen saturation and demonstration of increased risk of mortality and morbidity associated with cerebral oxygen saturation <60%.
- 5) Investigation of the degree of entropy in physiological and cerebral signals, showing that loss of complexity of brain signals was associated with increased mortality and intraventricular haemorrhage.

Publications

- Mitra S, Czosnyka M, Smielewski P, O'Reilly H, Brady K, Austin T. Heart rate passivity of cerebral tissue oxygenation as an indicator of cerebrovascular reactivity in preterm infants. *Acta Paediatr.* 2014;103(9):e374-82
- Costa CS, Czosnyka M, Mitra S, Smielewski P, Austin T. Monitoring of cerebrovascular reactivity allows determination of optimal blood pressure in preterm infants. *J Pediatr.* 2015;167:86-91.
- Costa CS, Placed MM, Czosnyka M, Cabella B, Kasproicz M, Austin T, Smielewski P. Complexity of brain signals is associated with outcome in preterm infants. *JCBFM* Jan 1:271678X16687314. doi: 10.1177/0271678X16687314.



Measurement of optimal blood pressure using the index of cerebrovascular reactivity, TOHRx: example of TOHRx over mean arterial blood pressure (MABP) plot to determine the MABP_{OPT} in a single patient: a male preterm infant born at 25+2 weeks' gestational age with a birth weight of 860 g who was studied within his first 36 h of life for 23 h. This infant was ventilated and was not on inotropes during the recording study period. The first graph shows the infant's actual MABP during the recording period. The second graph shows the MABP_{OPT} curve. MABP_{OPT} is defined by the lowest values of TOHRx, in this case 0.1, corresponding to a MABP of 31–33 mm Hg. The frequency histogram shows the percentage of time spent in each value of MABP.

Adapted from da Costa et al. *J Pediatr.* 2015; **167**:86-91.

SAFEguarding the Brain Of Our Smallest Children (SafeBoosC)

European multicenter phase 2 RCT comparing cerebral oxygen targeted therapy vs conventional therapy in preterm infants in the first 48 hours of life.



Investigators Andrea Edwards, Topun Austin
Collaborators Gorm Greisen, Copenhagen, Denmark
Funding Danish Medical Research Council
Start date June 2012
End date December 2013
Portfolio Adopted
Study Population 165 Preterm <28 weeks < 3hours of age
Recruitment 165 (Cambridge 6)

The SAFEguarding the Brains Of Our Smallest Children project (www.safeboosc.eu) aims at testing the benefits and harms of cerebral NIRS in the first days of life in extremely preterm infants. Cerebral rStO₂ monitoring and a dedicated treatment guideline are the cornerstones of a brain orientated protection strategy, with the goal of reducing periods of deleterious imbalance between oxygen delivery and consumption.

Key outputs from the project to date have been:

- 1) The pilot study showed that clinical implementation of this combined intervention in a single centre was feasible.
- 2) A phase II trial across 8 units in Europe found a significant reduction in the burden of hypoxia in the experimental group, demonstrating that cerebral oxygenation can be stabilized in extremely preterm infants using a dedicated treatment guideline in combination with cerebral NIRS monitoring.
- 3) The ultimate goal is to increase the survival of preterm infants without severe neurodevelopmental impairment.

Publications

- Hyttel-Sørensen S, Austin T, van Bel F, Benders M, Claris O, Dempsey EM, Fumagalli M, Glud C, Hagmann C, Hellström-Westas L, Lemmers P, Naulaers G, van Oeveren W, Pellicer A, Pichler G, Roll C, Støy LS, Wolf M, Greisen G. Clinical use of cerebral oximetry in extremely preterm infants is feasible. *Dan Med J.* 2013;**60**:A4533.
- Hyttel-Sørensen S, Austin T, van Bel F, Benders M, Claris O, Dempsey EM, Fumagalli M, Greisen G, Grevstad B, Hagmann C, Hellström-Westas L, Lemmers P, Naulaers G, van Oeveren W, Pellicer A, Pichler G, Roll C, Skoog M, Winkel P, Wolf M, Glud C. A phase II randomized clinical trial on cerebral near-infrared spectroscopy plus a treatment guideline versus treatment as usual for extremely preterm infants during the first three days of life (SafeBoosC): study protocol for a randomized controlled trial. *Trials* 2013;**14**:120.
- Pellicer A, Benders M, Claris O, Dempsey EM, Fumagalli M, Glud C, Greisen G, Hagmann C, Hellström-Westas L, Hyttel-Sørensen S, Lemmers P, Naulaers G, Pichler G, Roll C, van Bel F, van Oeveren W, Skoog M, Wolf M, Austin T. The SafeBoosC phase II randomized clinical trial: a treatment guideline for targeted near-infrared derived cerebral tissue oxygenation in extremely preterm infants. *Neonatology* 2013;**104**:171–178.
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