

Celebrating achievement and a new beginning

Nottingham has a high standing in hearing healthcare and research. This industrious city provided the first child with a cochlear implant in the UK. Nottingham also rolled out the nationwide Newborn Hearing Screening Programme. Thanks to the work of the late Nobel laureate Sir Peter Mansfield, (1933-2017), Nottingham is also the birthplace of functional magnetic resonance imaging. This technology has added so much to our understanding of the human body, the brain and disease.

In recognition of this excellent track record, the National Institute for Health Research established in Nottingham the country's only Biomedical Research Unit dedicated to hearing research. Since 2008, our focus has been on research that brings real benefits to people with a range of hearing issues including hearing loss, tinnitus, deafness and cochlear implantation.

Research is built on teamwork. People like yourselves – patients and members of the public – are vital members of the team. Since 2008, over 12,000 of you have taken part in 93 studies, which could not have completed without your support. We are particularly indebted to many of you who volunteer your time to work with us in designing and running our research. Insights drawn from your own experiences of hearing health and healthcare, are vital in ensuring our research is relevant to what patients need.

Our work has had a number of notable impacts. In the following pages, you will find summaries of achievements from each of our six research themes.



Professors Deborah Hall and David Baguley, Director and Deputy Director of the Nottingham Hearing Biomedical Research Unit.

From 1 April, 2017, the Nottingham Hearing Biomedical Research Unit will continue its work as part of a much larger Biomedical Research Centre.

The National Institute for Health Research has invested £23.6m in a broad programme of research that focuses on five health themes:

- Deafness and hearing loss
- Digestive (gut) and liver diseases
- Respiratory (breathing) disease
- Musculoskeletal (muscle and bone) disease
- Mental health and technology.

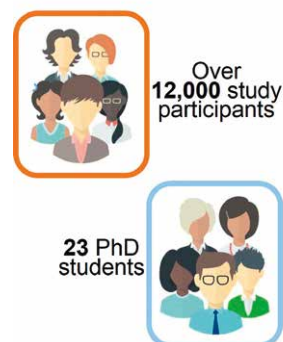
All these themes shall be underpinned by a theme in magnetic resonance imaging methods. Our current Director, Prof Deborah Hall, will remain the Hearing theme lead.

Looking forward, our work will focus on our existing strengths and branch out into new areas including hyperacusis (reduced sound tolerance), as well as hearing damage and tinnitus caused by some cancer treatments. We shall also work to harmonise which hearing complaints are measured and how they are reported in clinical trials across the world.

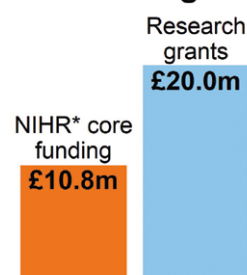
As one chapter ends, another begins. We look forward to the new beginning.

Facts and figures for our Unit from 2008 to 2017

People



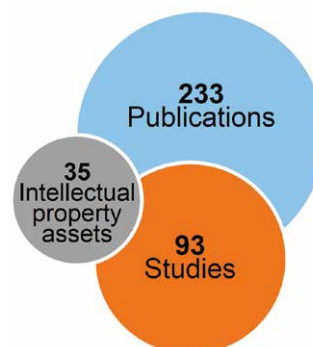
Funding



Research grants



Outputs



*National Institute for Health Research

Tinnitus etiology and management

We have worked carefully to define priorities for tinnitus research with patients and the public through a James Lind Alliance Tinnitus Priority Setting Partnership. This identified the top 10 unanswered research questions. These have since formed the basis for our research, ensuring that what we do is in the interests of tinnitus patients.

In 2014 we received National Institute for Health Research funding to develop audiologist-delivered counselling for tinnitus. This study, led by Dr Derek Hoare, produced a clinical practice guideline which is now being trialled in audiology departments in the East Midlands.

We have also run the first oral drug trial for tinnitus in the UK. Funded by the Government (Innovate UK) and the drug company Autifony, the team tested Autifony drug compound AUT00063. Unfortunately, it had no effect on tinnitus but it provided important lessons for future research.

In 2015 Dr Magdalena Sereda was appointed as the British Tinnitus Association

Head of Research. She is now leading a new programme of research to investigate the effectiveness of digital hearing aids and combination hearing aids for tinnitus.

We have published widely in the last five years, winning the British Tinnitus Association Marie and Jack Shapiro prize three times. Many publications have featured in new national clinical practice guidelines developed in America and Germany. Najibah Mohamad, Jeff Davis, Kathryn Fackrell, and Kate Greenwell recently completed their PhDs with us.

Last year we were delighted to be joined by Prof David Baguley, President of the British Tinnitus Association and one of the top clinical experts in tinnitus.



Theme lead,
Prof Deborah Hall



The Tinnitus team promoting
Tinnitus Awareness Week, 2017

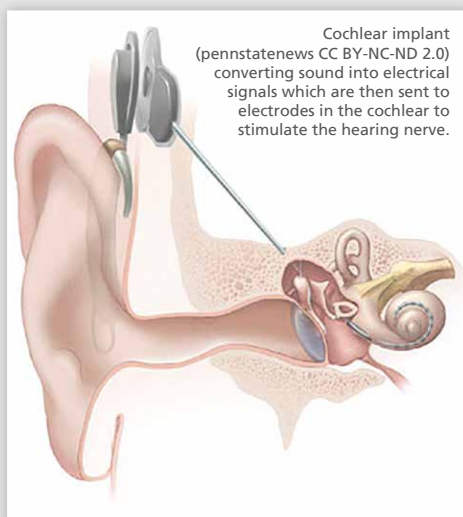
Cochlear Implantation

Cochlear implantation continues to change the lives of adults and children with severe-profound hearing loss in the UK.

Our team has looked at who the NHS gives cochlear implants to, whether implants could provide benefit to people with other forms of hearing loss, and whether that would be a good use of NHS resources.

We conducted the first trial of cochlear implantation in adults with single-sided deafness (one deaf ear and one normally-hearing ear). We also produced a large review of all the existing trials involving these patients and made recommendations for future research.

We have worked with providers of cochlear implants across the UK to study whether adults who have a cochlear implant also use a hearing aid. Together



Cochlear implant
(pennstatenews CC BY-NC-ND 2.0)
converting sound into electrical signals which are then sent to electrodes in the cochlear to stimulate the hearing nerve.

with clinicians, we examined how these two devices are fitted together and maintained by the clinicians.

Using information from the UK Biobank, a large database of health information, we looked at how many implant users experience ringing or other sounds in their ears (tinnitus). We explored whether their implant helps with their tinnitus.

We made a major contribution to a journal supplement on the subject of access to cochlear implants in the UK (available at <http://www.tandfonline.com/toc/ycii20/17/sup1>). We are leading on a national project to identify who patients and clinicians think should be able to receive cochlear implants (<http://www.cicandidacy.co.uk>).

We have also received a large grant to test how feasible it will be to run a trial on providing adults with two cochlear implants (one in each ear) in the UK.



Scientific lead,
Dr Padraig Kitterick



Clinical lead,
Prof Gerry O'Donoghue

Habilitation for Hearing Loss

Our research has made good progress in understanding if and how interventions to support people with hearing loss work. Working closely with patients, the public, clinicians, charities, policymakers and researchers, we ensure our research has both clinical and research impact.

One example is C2Hear, a series of multimedia interactive videos produced with and for hearing aid users.

C2Hear improves patients' knowledge, handling and use of hearing aids and is freely available on YouTube (over 25,000 views worldwide last year).

The C2Hear team won the Nottingham University Hospitals 'Research Impact of the Year 2016' award. We are personalising C2Hear to meet an individual's needs.

Other work on auditory (listening) and cognitive (memory) training has shown that auditory training can improve listening skills (speech understanding, memory and attention). A publication from this work in a leading international hearing research journal won the Editor's Award 2014.

We also led a James Lind Alliance Priority Setting Partnership to generate future research priorities for adults with hearing loss. The partnership of patients, relatives and clinicians agreed the most important unanswered questions to shape future research.

We are currently producing a Cochrane review of hearing aid effectiveness, contributing to NICE guidelines for hearing loss and best-practice guidelines for improving communication in care homes for those with dementia. This work will impact both policy and practice.

Future research will examine alternative devices to hearing aids and develop a

comprehensive self-management programme for people with hearing loss and hearing aid users.



Theme lead,
Dr Mel Ferguson

C2Hear
Online Getting more from your hearing just got easy



**James
Lind
Alliance**

Priority Setting Partnerships

Large Scale Studies

Our team, led by Dr Heather Fortnum (now retired), studied patterns, causes and effects of hearing conditions in the population (epidemiology). The UK Biobank proved a vital resource for us. This was a nationwide survey of more than 500,000 people aged 40 to 69 years. It was run between 2006 and 2010. It gathered data on genetic, environmental and lifestyle causes of disease of middle and older age. Our team had the opportunity to analyse the data relating to hearing and tinnitus.

Our findings revealed associations between personality and tinnitus, with 'neuroticism' being a trait associated with tinnitus distress. We also found that tinnitus patients were at higher risk of depression and anxiety, regardless of

the level of neuroticism. More research is needed to determine the clinical significance of this association.

Other work included reviewing the research evidence on the reporting of how common (prevalent) and severe tinnitus is in the population.

Termed a systematic review, we assessed 39 international studies and found they varied widely in defining and reporting tinnitus and thus in measuring tinnitus prevalence (ranging from 5 to 43%).

Our review recommended a more consistent, or standardised, approach so that in the future, global estimates of the prevalence of tinnitus can be made with more certainty to help with healthcare planning.

We also performed a Health Technology Assessment on the diagnostic accuracy and cost-effectiveness of providing hearing screening in schools.

Outcomes and our recommendations will inform commissioning of screening services in the future.



Theme lead,
Dr Heather Fortnum



Part of our work explored associations between diet and tinnitus.

Advanced imaging and translational neuroscience

The ability of the brain to reorganise itself (e.g. after stroke) is generally considered a good thing. But, under certain conditions it may have negative consequences, especially for hearing ability.

In 2012-2017, the NIHR Nottingham BRU supported two programmes within the 'Advanced Imaging and Translational Neuroscience' research area. These have both addressed important clinical questions about brain reorganisation after hearing loss and are summarised below.

Advanced Imaging

Our programme of magnetic resonance imaging has been co-led by a cross-

disciplinary team of experts: Deborah Hall (Director), Richard Bowtell and Susan Francis (School of Physics & Astronomy), Alan Palmer, Katrin Krumbholz and Peyman Adjamian (Medical Research Council Institute of Hearing Research). Our work has done much to further the science around brain processes related to hearing and hearing conditions.

We have shared our findings widely, including guest editing a Special Issue of the internationally leading journal Hearing Research. This issue entitled



'Human Auditory Neuroimaging' brought together pairs of academics, who had not previously worked together, to offer novel perspectives on this growing field. Articles have been highly cited by other scientists in the field. Advanced Imaging lead Prof Deborah Hall, with Prof Susan Francis, were also co-applicants on a £1.4 million Medical Research

Council Programme grant with the University of Manchester. This project applies brain imaging to understand the physiological bases of 'hidden' noise-induced hearing loss.

Sensorineural Plasticity and Rehabilitation

We are working to develop new ways to predict how much help a patient will receive from a cochlear implant.

A cochlear implant is a surgically implanted device that can provide a deaf person with a sense of hearing. Some patients do very well with their implant. For example, they are able to listen to conversation over the telephone. Others don't get as much help in understanding speech. It is hard to predict who will find most help from their implants.

We use a technique called functional near-infrared spectroscopy (fNIRS). This works by shining infrared light through the scalp to measure the activity of different parts of the brain. Unlike other techniques, fNIRS can be used on people who have cochlear implants.

One of our key achievements so far has been in showing that it may be possible to predict how much help someone would get from their implant before they have it implanted. This is done through measuring and understanding patterns

of brain activity using fNIRS. In the future, fNIRS could be used as a clinical tool to help counsel patients on the difference that a cochlear implant may make.

We are now exploring whether fNIRS can predict how well young children do with a cochlear implant. If it can, this will help us improve the support available for young patients.



Theme lead,
Dr Doug Hartley



fNIRS head apparatus in use

In 2014, leads from both programmes, Prof Deborah Hall and Dr Doug Hartley, were part of a successful £7.7 million award to the University of Nottingham through its Medical Research Council Clinical Research Capital Initiative.

We led on the cross-disciplinary hearing research theme which gained us a specialised hearing assessment booth in the Sir Peter Mansfield Imaging Centre and a new functional near-infrared spectroscopy system.

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