The Impact of a World-Class Civic University

Focus on Global Research
• Future Cities
• Icy Secrets of Antarctica
• Halting the ‘Superbug’

Spotlight on global security | Changing lives with literature | Fighting cancer, saving lives | Detecting disease via mobile phone | Diagnosing arthritis in children
We made 28 submissions to 27 units of assessments and 113 impact case studies. We are ranked 16th for research power out of 154 higher education institutions in the UK. The vast majority of our research (78%) is world-leading or internationally excellent (4* or 3*). 952 staff members submitted research to the assessment. That’s 80% of our eligible staff. Ranked 3rd for English, with 100% of research rated world-leading for impact. We are ranked in the top 12 for Geography, Architecture and Planning, and Cultural and Media Studies research quality.

Ranking 4th amongst UK medical schools for Clinical Medicine research intensity. Ranked 5th amongst dental schools for research quality. Ranked 5th for Biological Sciences research quality and Psychology, Psychiatry and Neuroscience research impact. Ranked 1st in the UK for Computing Science research impact, ranked 3rd in the UK for Civil Engineering research power and ranked 11th in the UK for Mathematical Sciences research.

As a world-class civic university Newcastle’s research is focused on addressing some of society’s most pressing issues. We believe it is not enough to ask what we are good at, but we must also ask what we are good for. In other words, we want our research to have the maximum impact in Newcastle and the North East, the UK and the world.

The recent Research Excellence Framework (REF), which assessed all UK universities’ research impact, showed how Newcastle University’s work is making a difference to global society – reinforcing our philosophy of ‘Excellence with a Purpose’.

The REF confirmed our position as one of the most powerful research universities in the UK – ranking Newcastle University 16th out of 154 in this measure. In these pages we highlight some of our world-leading research areas and the academics who are pioneering in their fields. Importantly, we explain the impact our research is having on areas as diverse as health, policy, culture and the environment across the globe and how we are building on this for the future.

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Changing lives with literature

Every so often a book comes along that has the power to change lives. Professor Jackie Kay’s memoir, Red Dust Road, is one such book.

Named Scottish Book of the Year in 2011, it details her childhood in Glasgow. Her realisation that her skin is a different colour to that of her beloved mother and father and the search to find her birth parents.

Kay, who is Professor of Creative Writing at Newcastle University, has a complicated take on her ethnicity in that she is female, Scottish and black. Her writing gives rise to discussions around adoption, ethnicity and diversity, and she talks movingly about the fact that you don’t need to choose simply one identity. Red Dust Road has become an important reference tool for social policymakers, offering a very human example of how Newcastle University’s work is making a difference to global society – reinforcing our philosophy of ‘Excellence with a Purpose’.
Excellence in Civil Engineering and Neuromuscular Disease

**Engineering a halt to the ‘superbug’**

Antibiotic resistance and the associated spread of untreatable ‘superbugs’ has emerged as one of the major public health concerns of the 21st century. Now, water pollution studies in the Upper Ganges River by a team of experts from Newcastle University and the Indian Institute of Technology in Delhi are shedding new light on how to tackle this global problem.

Every year hundreds of thousands of pilgrims descend on sacred sites along the Upper Ganges River, in the foothills of the Himalayas, to bathe at the water’s edge. For these hallowed sites, pollution from local sanitation and waste treatment – we have a consistent understanding that such antibiotic-resistant genes locally – possibly through improved sanitation and waste treatment – could lead to a worldwide rise in sea level of three metres. Dr Neil Ross, a lecturer in physical geography at Newcastle University, is among a team of UK experts working to build up an accurate picture of the icy secrets of Antarctica.

Newcastle University Professor of Ecosystems Engineering, David Graham, said: “In the age of international travel, antibiotic resistance genes and organisms in the gut of individuals as a result of inadequate sanitation can be carried anywhere, exposing visitor populations to such resistance. ‘We know that many ‘hotspots’ of antibiotic resistance exist around the world, particularly in densely populated areas such as urban Africa, the Subcontinent and Latin America, where there is inconsistent sanitation and generally poorer water quality. If we can stem the spread of such antibiotic-resistant genes locally – possibly through improved local sanitation and waste treatment – we have a better chance of limiting its spread on a global scale. We are now using our research to call on policymakers to recognise the importance of clean drinking water as key to solving this global issue.’

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**Advancing gene therapy**

Research and clinical practice pioneered by the internationally renowned neuromuscular group based at the University’s Institute for Genetic Medicine, which is also part of the Medical Research Council’s Centre for Neuromuscular Diseases, has already helped double the life expectancy of boys born with Duchenne muscular dystrophy (MD).

In the 1960s, boys with the condition – which occurs in one of every 3,500 male births and causes severe weakness leading to heart and breathing problems – generally lived until they were aged just 14 or 15. Today, many young men with DMD can live to around 30 years of age, with a significantly improved quality of life thanks to patient care guidelines developed by an international working group led by Newcastle University’s Professor Kate Bushby, who is recognised as one of the world’s top medical specialists in DMD research and treatment.

Now the team of 80 experts, led by Professors Bushby, Volker Dietz and Hanno Lohmüller, has launched the Newcastle University John Walton Muscular Dystrophy Research Centre, where work will continue on the development of translational research, innovative clinical trials and international networking, which currently involves over 15,000 patients in more than 30 countries.

The group is also calling for more investment in research for treatments into rare diseases after its latest study, published in Neurology, the medical journal of the American Academy of Neurology, revealed the full cost of DMD to the international economy.

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**Dementia: is prevention better than cure?**

Twenty years of research by academics at Newcastle University, working with colleagues from Cambridge and Nottingham, suggests that prevention rather than cure is the solution to the dementia time bomb that faces our rapidly ageing population.

Rates of dementia in the UK have fallen substantially over the past two decades, according to the Medical Research Council Cognitive Function and Ageing Study (CFAS), which compared the prevalence of dementia in two large samples over the 20-year period. The latest phase of the study indicates there are currently around 670,000 people with dementia in the UK, much lower than the previous estimate of over 800,000 predicted in the early 1990s. A follow up to the CFAS paper published in The Lancet in 2013, recently earned Professor Louise Robinson and the CFAS team the Royal College of General Practitioners’ Neurology and Mental Health Research Paper of the Year.

The CFAS study, involving over 20,000 people aged 65 years and over, was the first to prove that age was the single most important risk factor for dementia – the older we get, the more likely we are to develop it.

From the first CFAS study, the team predicted that 3.8% of the general population would be expected to have dementia by 2011. Yet, following the introduction of health strategies informed by the research, in the follow-up study published in 2009 this figure was found to be much lower, at 6.5%.

Professor Robinson, Director of the Newcastle University Institute for Ageing and a GP in the city for 20 years, said: ‘Dementia continues to pose a significant challenge to our healthcare systems and communities but while others have been seeking ways to treat it we have established that prevention could actually be the new cure. Our latest studies show roles of dementia are substantially lower than the predictions made in the 1990s based on our ageing population. ‘We suspect that these improvements are largely due to primary prevention strategies to reduce vascular risk and improvements in care initiatives that were informed by our work. The public health approach to promoting ‘healthy lifestyle, healthy mind’, is not only preventing heart attacks but also dementia and we plan to build on these promising results.’

Professor Robinson’s research has shaped high-level policy such as the Prime Minister’s 2012 Challenge on Dementia and helped instigate MRC services to provide a more timely diagnosis, as well as raising the quality of care for those living with the condition.

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**Uncovering the icy secrets of Antarctica**

Anticipating the response of the Antarctic ice sheet to future climate change is critical to our planet’s survival. It is estimated that the melting of the West Antarctic Ice Sheet alone could lead to a worldwide rise in sea level of three metres, Dr Neil Ross, a lecturer in physical geography at Newcastle University, is among a team of UK experts working to build up an accurate picture of the ice sheet and the landscape beneath to predict how it might behave in a warmer world.

A major airborne geophysical survey of a previously little studied part of the West Antarctic ice sheet by Dr Ross and the team revealed a huge ancient valley – deeper than the Grand Canyon – hidden beneath the ice.

The findings of the survey, published in the Geological Society of America Bulletin, provided an unprecedented insight into the length, thickness and behaviour of an ancient subglacial valley, which was formed when the climate of West Antarctica was much warmer than it is today. This subglacial landscape indicates from where, and how, the West Antarctic Ice Sheet originated and grew, and provides important clues as to the most probable extent of ice in West Antarctica in a future, warmer world.

The survey team’s data also made a major contribution to a large-scale international Antarctic mapping project led by the British Antarctic Survey, which led to the discovery that the continent contains more ice than previously thought. Fifty scientists from institutions in 30 countries were involved in the project which used data collected from ice-penetrating radar measurements, seismic techniques, satellite readings and cartographic data, to create the most detailed map of what lies beneath Antarctica’s ice sheets.

Dr Neil Ross has made several key advances in knowledge of this part of Antarctica, including the idea that a whole sector of the West Antarctic ice sheet is far more prone to change than previously thought.

Professor Martin Siegert
Deputy Director, Centre for Ice and Climate, Imperial College London

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**Joint research from Newcastle, Cambridge and Nottingham, into the factors which influence the prevalence and earlier diagnosis of dementia has been instrumental in shaping UK national policy and practice.**

**Professor Alistair Burns**
VHF English National Clinical Director for Dementia

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**Excellence in Gerontology and Geography**

The landscape of research into genetic muscle-wasting conditions, particularly Duchenne muscular dystrophy, has transformed over the past 20 years. Many people who would once have not lived past their teenage years are now seeing their 30s and 40s, with a vastly improved quality of life thanks to our work. The public health approach to promoting ‘healthy lifestyle, healthy mind’, is not only preventing heart attacks but also dementia and we plan to build on these promising results.

Professor Robinson’s research has shaped high-level policy such as the Prime Minister’s 2012 Challenge on Dementia and helped instigate MRC services to provide a more timely diagnosis, as well as raising the quality of care for those living with the condition.

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Hear our academics talk about their research at ncl.ac.uk/impact
Cancer researchers at Newcastle University are internationally renowned for translating ground-breaking scientific discovery into life-changing therapies for people fighting the disease. Recent developments include ambitious plans to speed up the delivery of new and less toxic therapies.

The Newcastle University is the UK’s leading centre for research into childhood cancer and one of the major centres in Europe with internationally celebrated researchers in the fields of childhood leukaeas, brain tumours and neuroblastomas.

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**Statisticians discover a way to improve kidney dialysis**

John Matthews, Professor of Medical Statistics in Newcastle University’s School of Mathematics and Statistics, has conducted research to devise a new statistical methodology to help improve treatment for children with renal failure.

Children undergoing haemodialysis can suffer substantial distress and delay to therapy when the various central lines (CVLs), by which their treatment is delivered, are blocked by blood clots. Using a novel form of crossover design, the research showed that a new form of anticoagulant – alteplase – was much more successful than the cheaper heparin, significantly reducing clotting and preventing blockage.

A crossover design is where each patient receives a sequence of the treatments being tested. This trial required very long sequences with many possibilities – the research identified the best possible ones.

Following the trial in 2004, the Children’s Kidney Unit at the Royal Victoria Infirmary in Newcastle changed its policy so that alteplase was used in place of heparin as the routine anticoagulant for venous central lines.

At any one time, there are about 10 young patients receiving this form of treatment at the Children’s Kidney Unit. Each one needs around 150 doses of anticoagulant a year and most will continue to need this treatment until a transplant organ becomes available.

Clots form easily in relatively large central lines, such as those used for haemodialysis. Although the lines are cleaned out before each use, small, subclinical clots still occur which accumulate over time and can lead to thrombosis.

Prior to 2004, the annual probability of CVL replacement due to thrombosis was 0.7. The waiting caused a significant amount of distress and also carried with it a number of risks.

Since alteplase has been used (2005–2012), no lines have had to be replaced because of thrombosis. This represents a remarkable reduction in the levels of distress to children and, by eliminating the delays associated with line replacement, effects financial savings for the NHS.

Following the research, alteplase is now used in 12 of the 14 paediatric kidney units in the UK and Ireland and five centres – Newcastle, Cardiff, Gwy, Glasgow and Manchester – have used it as their routine treatment.

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**Research with real bite**

Dentistry experts at Newcastle University are helping to shape England’s dental services, radically steering the focus away from invasive treatments and towards preventive care.

Their research, which dates back to the mid-1990s, highlighted the need for a review of services in England in line with a rapidly changing dental health profile of children and adults.

Researchers at the School of Dental Sciences discovered the number of people with no natural teeth was falling and a new generation of people were emerging whose teeth were decayed but were being filled, were extracted or were not available.

At the same time, further changes started to emerge in young adults, which showed a sustained reduction in decay rates due to improved diet and education. Policymakers recognised that substantial reform of NHS dental services in England would be required if the projected future needs of the population were to be met and in 2003, Newcastle University’s Head of Dentistry, Professor James Steele was asked by the Secretary of State to carry out a review of the NHS dental contract.

Professor Steele explains: ‘We were seeing a very clear shift, not just in dental health but also in the treatments being offered to patients by dentists.

What was needed was now a focus on prevention, but because the dental contract was designed to pay dentists for the treatments they provide – such as the number of fillings they did – there was a discrepancy between what was being offered and what was actually needed.

Our review suggested a change: a pathway of care that focuses on prevention and advice, and rewards dentists for helping people to look after their teeth so they don’t need the fillings – or at least not until much later in life.’

The review recommended a number of improvements around better access, prevention and long-term patient care and this has been adopted at selected dentists around the UK. The results of the pilots will inform prototype contracts with a view to a final contract for all dentists in the next few years.

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**Action speaks louder than words**

James Law, a Professor of Speech and Language Sciences at Newcastle University, is leading a project to establish a European network of experts that will improve the difficulties learning their first language.

For most of us, acquiring the personal, social and academic skills that enable us to participate fully in society is a natural part of our development. But for an estimated 5.8 million people aged under 18 across Europe who suffer from language impairment, this is not the case.

The inability of children to communicate, either with their peers or with others including their teachers, is a scourge that blights their lives in our communication-focused society,” explains Professor Law. ‘It has a knock-on effect on many aspects of their schooling and on their future opportunities in the workforce. The boredom and frustration of children who cannot engage properly with their education can lead to inactivity or exclusion.

There is evidence that intervention – such as training children and their parents to interact more efficiently – is effective in improving the development of language skills, but this information is not well-disseminated, and the services available are inconsistent across Europe.

Beginning this year, Professor Law is leading a four-year COST (European Cooperation in Science and Technology) Action project to establish a network of established and early-stage researchers and practitioners in the field, including speech and language therapists, linguists and psychologists, to focus on the role of intervention.

The aim of the network is to enhance the science in the field, both to improve the effectiveness of services for children with language impairment and to develop a sustainable network of researchers well placed to answer key questions in this area. This is the first time that a joined-up approach has been attempted, despite there being services for children with language impairment in all European countries.

This new project builds on Professor Law’s previous involvement in the biggest ever review of speech and language support for children in the UK. He was one of four academics who led the three-year £1.5 million Better Communication Research Programme that ran from the 2009 Bercow Review of Services for Children and Young People (0-19) with Speech, Language and Communication Needs. He subsequently set up the All Party Parliamentary Group on Speech and Language Difficulties chaired by Lord Ramsbotham. Their report, on the links between speech, language and communication needs and social disadvantage in children, was published in February 2013.

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**Research with real bite**

Hear our academics talk about their research at ncl.ac.uk/impact
The other casualties of war

Research by Professor Peter Stone OBE, Head of Newcastle University’s School of Arts and Citizenship, focuses on the obstacles to the protection of archaeological sites and historic buildings in zones of armed conflict. Once destroyed, cultural heritage cannot simply be rebuilt.

Over the last decade, Professor Stone has been working with the UK Ministry of Defence and NATO in an attempt to encourage the military to take cultural property protection (CPP) more seriously. This has been identified to identify where CPP overlaps with military interests. "While individual officers usually understand and fully accept the importance of cultural heritage, its protection during conflict has not, until recently, been high on their agenda," he explains.

A number of avoidable events during relatively recent overseas deployments have focused military minds; these have included a failure to prevent the looting of museums, the unnecessary damage to significant archaeological sites and transport systems through the construction of military bases, along with insensitive deployments of troops. Professors Stone’s most recent publication, Tier Approach to CPP, elaborates by two protocols, in 1954 and 1999. The 1954 Convention includes the Blue Shield as an emblem to be used to identify property to be protected. By 1999, the Blue Shield is mentioned in the protocol as the organisation with responsibility for CPP.

Blue Shield has recently adopted Professor Stone’s 4 Tier Approach as international policy as a means of setting a framework within which liaison between cultural heritage experts and the military can take place.

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A new wave of subsea technology

Technology developed by Jeff Nasrallah and colleagues from the School of Electrical and Electronic Engineering has been incorporated into a range of products that have revolutionised underwater communications.

One of these is the MicroRay, manufactured under licence by company Trellech International Ltd. It has become the preferred solution for tracking underwater remotely operated vehicles manufactured by companies including SeaBotix Inc and Vardarine Inc, with over 12m of licensed products sold to date.

The research has improved underwater transmission and tracking, both in terms of range and reliability, and the development of a number of bespoke, high-performance data telemetry systems also enabled previously impossible subsea operations to be completed.

Originally developed for communicating with subsea vehicles or instruments, the technology has been further minimised for use in devices designed to improve diver safety.

A prototype, named DiveTrack, showed how a small, low-cost device could enable a diver in difficulties to send a distress signal to a boat up to 1km away alerting the crew to their location. TechLink won an international design competition in 2007 and the British Sub Aqua Club (BSAC) described it as ‘one of the most significant contributions to diver safety in the last 50 years’.

The team went on to become involved in an ambitious European research project (www.caddy-fp7.eu) to develop a new generation of miniature subsea devices aimed at making dive missions safer and more efficient by enabling divers and underwater robots to cooperate with one another.

Newcastle’s technology enables an underwater robot to act as a virtual dive buddy, monitoring the diver, guiding and navigating, assisting with tasks and carrying equipment. The robot tracks and follows the diver who can exchange data and commands with it using an underwater tablet. The technology has now been commercialised as the Subsafe range of products, manufactured under licence by UK company Blueprint Subsea.

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Spotlight on global security

Professor Steve Graham’s research into the increasing use of military-style surveillance in our cities is influencing global discussions on matters of security and privacy.

For over ten years, Professor Graham has been studying how the line between military and civilian technologies has become increasingly blurred.

His research shows that military-style surveillance is commonplace in our cities – and residents are in danger of accepting it without question. Small-scale drones were even one of last year’s ‘must-haves’ for Christmas, raising new issues about privacy.

In his book Cities Under Siege (published by Verso in 2011) Professor Graham, of Newcastle University’s School of Architecture, Planning and Landscape, offers increasing evidence of a crossover between surveillance and control of everyday life in Western cities and technology used in war zones.

Instead of legal or human rights based on universal citizenship, his research shows the emerging security politics of cities are founded on the privatisation of public spaces, combined with the profiling of individuals, places, behaviours, associations and groups in innocence of any potential misdemeanor or crime.

This in turn is creating the biggest shift in our ideas of citizenship and national boundaries since the mid-17th century.

As well as being used as scenarios for governments’ foresight studies, Professor Graham’s research raises awareness of the influence that ordinary people can have on situations, such as the global wave of urban occupations protesting against extreme austerity measures implemented since the financial crisis.

The phrase ‘new military urbanism’, which was coined in Cities Under Siege, is now used throughout the world in discussions about security and it is regularly cited within the activist and social movements.

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Using computers to revolutionise drug discovery

A Newcastle University spin-out hopes to make headway in disease such as cancer by taking a new approach to drug discovery.

Computational drug discovery firm eTHERapeutics was founded in 2002 and was listed on the London Stock Exchange’s Alternative Investment Market in 2007. By 2013, it was the eighth-largest pharmaceutical/biotechnology company in the AIM by market capitalisation, with a valuation of £50.7 million.

University research played an important role in this patented approach, including work by Professor Anil Wipat (pictured) on algorithm development and the structure of a protein network, and analysis led by Professor Peter Andras, now at Kyoto University. The company’s team worked alongside experts in the University’s Institute of Neuroscience.

The aim was to develop an accurate understanding of the effect and impact new drugs will have on cells before clinical trials even begin.

For decades, neuroanatomists have used tracer chemicals to highlight the neural connections between different areas of the brain. This technique is both invasive and expensive and the complexity it revealed was very difficult to interpret.

In 1999, collaboration between colleagues at Newcastle University developed computer methods for integrating the very large quantities of data, and these analyses that showed how brain systems were organised and which parts of them were vulnerable.

The company’s patented network pharmacology technology predicts the effects of chemical interventions on proteins in cells and this is now being used to discover new drugs for the treatment of cancer and degenerative diseases.

Using algorithms to map the networks of interaction between parasitic bacteria and host cells, the technology is used to select a drug that can target the most crucial proteins in that network, and thus disrupt the disease process.

An anti-cancer drug and an anti-depression drug are currently in clinical trials.

The company believes its method will be effective in tackling complex diseases. It could also enable companies to find new uses for drugs that are already on the market, rather than invest large amounts in new ones. Drugs based on new chemistry cost £1.2 billion to develop on average, and can take 10 to 15 years to reach the market.

Since 2008, research and development spending by the company has topped £11 million, and 20 highly-skilled staff are employed across two sites in Oustonbridge and Newcastle.

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Hear our academics talk about their research at ncl.ac.uk/impact
Detecting disease via mobile phone

Protein technology developed in a laboratory at Newcastle University could soon be used in remote parts of the developing world to diagnose infectious diseases, and in homes in the Western world to manage chronic illnesses.

The science behind the technology, designed by biochemist Professor Jeremy Lakey, has inspired the commercial development of a hand-held disease detector which enables tests to be carried out quickly, easily and on the spot. The device contains a biochip which tests samples of saliva, blood, serum or urine that can be read using smartphone technology to give accurate results within minutes and without samples being sent for lab analysis.

The flu virus and respiratory conditions are the first targets for the device, but there is potential for it to be adapted to diagnose other infectious diseases. Clinical studies are already under way into the potential of the device in testing for gum disease and HIV.

Trials of the device for the flu virus will start in the next 12 months, after five years of prototype development and work with Public Health England to prove its capability. It is being brought to the market by OJ-Bio, a joint venture between Professor Lakey’s spinout biotechnology company, Orla Protein Technologies, based in Newcastle, and electronics giant the Japan Radio Company.

Professor Lakey said: ‘We are at the leading edge of wireless point-of-care diagnostics. There is a lot of buzz around the concept, but few places are as advanced as we are in bringing a truly mobile device to market, and that is incredibly exciting. With increasing mobile phone coverage in even the most remote areas of the world, the possible applications for our technology – and the opportunities to deliver improvements to healthcare and the environment – are enormous.’

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Diagnosing arthritis in children

Doctors all over the world are now using a simple clinical skill to help recognise the most common form of childhood arthritis, thanks to research by paediatric rheumatologists at Newcastle University.

Early diagnosis of juvenile idiopathic arthritis (JIA) is critical, as the disease – which affects one in every 1,000 children – is most aggressive in its initial stages and can lead to joint deformities, poor quality of life and even blindness if not treated promptly.

Research led by Professor Helen Foster found that many youngsters with JIA were being seen by doctors who were not confident in their ability to examine children’s joints due to a lack of professional consensus about how to do this properly as well as a failure to address this issue in clinical teaching. As a result, children’s joints were not being properly assessed, leading to delays in referrals to specialists for appropriate treatments so that, often, children were being subjected to costly and unnecessary invasive investigations.

The Newcastle team has developed a new tool for the examination of joints called pGALS (paediatric Gait Arms Legs and Spine), which is now taught as a simple clinical skill to medical students and is being used by doctors worldwide. Following the success of pGALS and free teaching aids, which to date have been translated into Mandarin and Spanish, the Newcastle team began developing a more detailed examination of children’s joints, called pREMS (paediatric Regional Examination of the Musculoskeletal System). pREMS is targeted at postgraduate training and includes free teaching resources including video demonstrations.

Professor Foster has collated much of her teaching material including pGALS and pREMS to create a new website (www.pmmonline.org/doctor) which has been launched in the UK, India and Africa. She said: ‘This exciting new phase of work will provide comprehensive support to ensure medical students and doctors have the tools to identify arthritis in children and know what to do after making their diagnosis. It is hoped that the new website will enable improved access to specialist care so that children will receive treatment more quickly, preventing significant long-term consequences for more children with arthritis around the world.’

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