



THE UNIVERSITY  
*of* EDINBURGH

**EDINBURGH**  
**IMPACT**



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# EDINBURGH IMPACT

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# Foreword

The University of Edinburgh has an outstanding history of discovery, invention and innovation, improving the lives of ordinary people. Our 450-year history of influencing the world is well known.

Research conducted at Edinburgh laid the foundations of the Enlightenment, the study of English literature, our understanding of geology, modern economics and sociology, quantum mechanics, electromagnetism, thermodynamics, antiseptic surgery, nephrology and the theory of evolution.

Our researchers discovered carbon dioxide, latent and specific heat, chloroform anaesthesia, SARS, the Higgs boson particle, and developed the Hepatitis B vaccine, the hypodermic syringe, the kaleidoscope, the vacuum flask, the ATM, the diving chamber and in-vitro fertilisation.

In the most recent independent assessment of our research endeavours, the 2014 Research Excellence Framework, 83 per cent of the University's research activity was classified as world leading or internationally excellent, and we were one of a select group of universities to achieve outstanding results when demonstrating the ongoing impact our research has on communities – locally, EU-wide and internationally.

Our researchers are committed to ensuring that decisions made by governments are based on secure evidence, brought about by their own – often collaborative – research activities.

As an institution the University is committed to its mission “to make a significant, sustainable and socially responsible contribution to Scotland, the UK and the world, promoting health, economic growth and cultural wellbeing”.

The dedicated efforts of our researchers are improving the effectiveness and sustainability of public, private and third sector organisations, improving social welfare and cohesion, increasing economic prosperity and regeneration, and enhancing cultural enrichment and quality of life – for all walks of life.

Here in *Edinburgh Impact* we present and share with you a selection of the work of our research colleagues, across the breadth of what are global priorities. Themed around Culture, Economy, Environment, Health and Wellbeing, International Development, Justice, Policy, Science and Technology, and Society, in the following pages you'll find a wide variety of highlights of, and insights to, the sort of achievements and impacts we are making across these essential areas.

Without the support of funding bodies and the commitment of our staff, students and friends this work would not be possible. It is to this end we invite you to read these demonstrative stories about the power of such investments.

**Professor Charlie Jeffery**  
Senior Vice-Principal

# Introducing *Edinburgh Impact*



Research at the University is constantly expanding the depth of human knowledge and making an impact on the wider world.

Whether it is changing the nature of documentary film-making; uncovering ways to reduce the need for blood transfusions; preventing future deforestation; improving survival rates from stroke; giving infants in Zimbabwe life-saving treatments; preventing young people from entering the criminal justice system in the UK; sharing expertise around events such as the Scottish and European referendums; developing gene technology and improving patient care, or offering free online education, the University never stands still.

Our researchers enable us to forge links with charities, businesses, policy makers and other universities, so that together we can tackle long-standing challenges at home and overseas.

*Edinburgh Impact* highlights just some of the University's most recent projects, driven by dedicated teams, international partnerships and individuals. Its aim is to provide a flavour of the University community's ongoing efforts to change the inequalities of the world.

To download this publication as a PDF, and to find out more about these projects and other research underway at Edinburgh, please visit:

**[www.ed.ac.uk/research/impact](http://www.ed.ac.uk/research/impact)**.

# Culture

## Raising awareness through creative documentary

In 2008, motor neurone disease (MND) sufferer Neil Platt, and his wife Louise Oswald, approached their friend and fellow alumna of Edinburgh College of Art, filmmaker Morag McKinnon, and her colleague Emma Davie, to help them document the last months of Neil's life. The result is the Scottish BAFTA award-winning *I Am Breathing*, a film that has raised awareness, across the globe, of the devastation this illness brings to people's lives.

*I Am Breathing* was chosen as the campaign centrepiece for the MND Global Awareness Day in 2013, screening in more than 240 venues across 45 countries that day; it still continues to travel.

Within filmmaking, *I Am Breathing* has suggested new ways of enabling the subjects of films to engage with audiences. Emma Davie and Morag McKinnon wanted to find an original, filmic form that could empower Neil Platt to communicate the ineffably hard experience of living with MND and allow audiences to feel this on a visceral level.

"Ranks among the year's most moving films... so firmly have Neil's particular wishes been expressed that *I Am Breathing* never feels in any way intrusive or exploitative." From a review by Neil Young in *The Hollywood Reporter*, December 2012.

Emma Davie explains the experimentation behind the film's production: "A driving question for me is how can a narrative form in documentary be developed and interrogated so it reflects the experience of the subject you are filming, without cajoling them into a story which feels ethically problematic?"

"What enabled us to make this film was Neil's collaboration in the process, where we talked a lot about not only what we'd film but how we'd edit and structure it with him. This resulted in us using words he had written in a blog to shape the film and this gave us permission to actually find a visual language for his mental state".



Neil Platt with filmmaker Emma Davie.

*"I promised I would turn our story into something beautiful, so that people would want to listen rather than look away"*

Louise Oswald

As well as a **SCOTTISH BAFTA** the film also won the **AUDIENCE AWARD** at Document Festival in the UK and **BEST DOCUMENTARY** at the **RIVER RUN FESTIVAL** in the US. It's been seen in a wide variety of influential contexts, including the UK Houses of Parliament, and, significantly, medics and researchers working with MND have reported real changes in the way they think about the disease.

To download the film please visit: [www.iambreathing.com](http://www.iambreathing.com)

### Mapping Edinburgh's Social History

With AHRC funding a team of historians have launched a project called MESH to create an atlas of Edinburgh's social history, spanning 1000–2000 CE. The end result will be an open-source tool that will make it possible for anyone to map historical data. The digital historical atlas will be built around themes that reflect the development of the city through time: population dynamics, economy, teaching and learning, worshipping, streets and utilities,

and leisure pursuits. Staff and students have been volunteering to create a database of current addresses, and, using Geographical Information Systems, are helping to build the historical data associated with citywide addresses. Once meshed together, historians will offer a unique, free to use, digital tool for anyone with an interest in the history of Edinburgh.

[www.mesh.ed.ac.uk](http://www.mesh.ed.ac.uk)



A statue of characters from Robert Louis Stevenson's *Kidnapped*, Edinburgh.

### Creating new adventures in literary tourism

Edinburgh has a unique literary heritage, which can now be enjoyed in an innovative way thanks to the collaboration of experts in data mining and literature at the University. Edinburgh researchers, in collaboration with colleagues at St Andrews University, used computer software to read thousands of books, searching for the use of place names that indicated Edinburgh as a setting. The resulting digital tool LitLong: Edinburgh, which can be filtered by keyword, location or author, links more than **47,000 LITERARY EXCERPTS TO MORE THAN 1,600 LOCATIONS AROUND THE CITY**.

Project Director James Loxley, Professor of Early Modern Literature, says: "Lit Long: Edinburgh offers readers a genuinely new way to get inside literary Edinburgh. It has the potential to shape the experience and understanding of critics and editors, residents and visitors, readers and writers. It could readily be adopted by other cities around the world."

[www.litlong.org](http://www.litlong.org)

### Finding a route to fitness

Edinburgh's Professor Nanette Mutrie, with members of the Physical Activity for Health Research Centre, developed a walking programme that helped people increase activity. The programme was graduated over 12 weeks and used a pedometer to help people monitor progress. The walking programme was a key element of a unique collaborative project led by the University of Glasgow, and involving Scottish Premier League football clubs, called Football Fans in Training.

The aim of the football project was to help overweight men lose weight through a combination of changes to eating habits and increasing physical activity. The aim was achieved and men lost on average five kilograms after 12 months. The walking programme helped men achieve and sustain for 12 months increases in physical activity.

[www.ffit.org.uk](http://www.ffit.org.uk)

## Giving a voice to the silenced

Professor Charlotte Clarke, Head of the School of Health in Social Science at Edinburgh, has found a unique way of using art to share her research findings, not only with fellow academics, and with students under her guidance, but with an international audience of festival goers and theatre lovers.

*Jack and Jill and the Red Post Box* is now an acclaimed play, which developed from underpinning research into risk and resilience and the lived experience of dementia, undertaken with Cathy Bailey, Northumbria University and funded by North of Tyne Primary Care Trust. Professor Clarke used 89 anonymous transcripts collected during her research project, to tell the fictional story of dementia sufferer Jill, and her husband, Jack. She commissioned Skimstone Arts to create a piece of art that would reach as wide a section of the community as possible. The play has toured the UK ever since appearing at the Edinburgh Festival Fringe in August 2013.

Dementia affects 800,000 people in the UK and is predicted to increase to 1.7 million by 2050. *Jack and Jill and The Red Postbox* encourages us to think about how we live and work alongside those in our communities who have the diagnosis.



Live performance of *Jack and Jill and the Red Postbox* at Edinburgh Festival Fringe.

"We have a strong commitment to reach as wide a range of people as possible," says Professor Clarke. "This means the general public as well as practitioners and other academics. We need to communicate our work. The arts are an incredibly powerful tool for doing just that," she explains.

In 2015, building on the success of the play, and at the request of many health and social care organisations, a film of *Jack and Jill*, has been produced. Professor Clarke tells us: "The availability of a filmed version will mean that the messages about identity, purpose, risk and resilience will be accessible to very many more people than can participate in live performances, extending the reach and significance of its impact considerably."

The School of Health in Social Science is at the forefront of using the arts to share its research, collaborate with groups and teach students, employing storytelling, drama, photography, literature, and in 2012 the first Leverhulme writer in residence, to achieve its core ambition: to communicate the needs of those who have silenced voices.

# Economy

## Saving the NHS £100 million a year

Blood is a scarce, expensive and vital medical resource. In the UK, more than 500,000 people a year receive a red blood cell (RBC) transfusion. However, immediate blood supply for transfusions is limited and there are increasing pressures on future supply.

Edinburgh's Professor Tim Walsh undertook a programme of clinical and implementation research, and analysed transfusion data from more than 1,000 patients. Founded on this research, Professor Walsh chaired the committee drawing up the UK's first evidence-based guidelines for RBC transfusion practice in critical care.

New guidance promotes the use of 'restrictive transfusion', administered when a patient's haemoglobin level drops below seven grams per decilitre (7g/dl) compared to the standard 'liberal transfusion' level of 10g/dl. This reduced intensive care blood transfusions from 40 per cent in 2001 to 33 per cent in 2006. This meant 7,000 fewer patients received transfusions in 2006 than 2001, and saved more than 400,000 RBC units a year.

Recognising RBC transfusions should be avoided where possible, Professor Walsh also supported the widespread introduction of cell salvage – recovering blood lost during surgery and re-infusing it into the patient. He initiated a Scotland-wide programme that saw red blood cell salvage increase from 90 cases per million population in 2005 to 650 cases per million population in 2010. The technology is now used nationwide. The overall economic impact of Professor Walsh's research has been significant. **BETWEEN 2001 AND 2012**

**THERE WAS A 22 PER CENT REDUCTION IN ANNUAL RBC TRANSFUSIONS, EQUIVALENT TO AN ANNUAL SAVING OF AROUND £100 MILLION.**

*“Our projects have helped develop new guidelines and changed practice to ensure patients only receive blood transfusions when they are likely to contribute to their recovery.”*

**Professor Tim Walsh**



New guidance ensures transfusions are minimal.

## Increasing understanding of student finance

A practical guide designed to improve young people's knowledge of student finance in higher education has been published by the University's Moray House School of Education. Sarah Minty, a Research Fellow in the Centre for Research in Education, Inclusion & Diversity (CREID), worked with S5/S6 pupils and current undergraduates to write *Student Finance – a Guide to Higher Education in Scotland*.

Launched in September 2015, the guide is written for 16–19 year olds considering studying at HNC/D or degree level. It will assist

them and their parents in making post-school decisions and **DEBUNKS STUDENT FINANCE MYTHS**. Research previously conducted by CREID showed many students, particularly from less affluent backgrounds, were confused by higher education funding and needed clearer information.

Financed by an ESRC grant, a knowledge exchange project brought together NUS Scotland, the Student Awards Association Scotland, Lothians Equal Access Programme for Schools and Gateway Shared Services to produce the guide.

## Improving patient experience and saving £21 million a year

A study conducted with more than 5,000 volunteer stroke patients **HAS CHANGED HEALTHCARE GUIDELINES WORLDWIDE**. Graduated compression stockings were historically the treatment of choice for immobile post-stroke patients at risk of deep vein thrombosis (DVT) and pulmonary emboli. Although the stockings were believed to increase blood flow in the veins of the legs, reducing the risk of DVT and subsequent embolism, there was no reliable trial evidence supporting this.

A team of researchers led by Edinburgh's Professor Martin Dennis conducted a series of studies that has since disproven the effectiveness of this often uncomfortable treatment.

This Edinburgh based study has changed health guidelines in the UK, Singapore, Canada, the US, Italy and South Africa, as they no longer recommend the use of stockings for stroke patients. However, not only has this policy change eased unnecessary patient discomfort, the changes have saved an estimated £21 million to the NHS, in associated healthcare costs.



The ECCI was the first refurbished historic building in the UK to achieve a BREEAM Outstanding award for building sustainability.

## Adding £80 million to the Scottish economy

Since its inception in 2010, ECCI has become Scotland's national hub for low carbon innovation and activities with a public policy, economic or social impact. It has actively **ENGAGED MORE THAN 1,000 ENTERPRISES** and organisations so far. Of these, it has worked intensively with more than 200, to help develop new products and services that have already contributed an estimated £20 million to the Scottish economy.

The Edinburgh Centre for Carbon Innovation (ECCI) is well on its way to its expected economic impact of £80 million in its first 10 years.

ECCI Executive Director Andy Kerr believes the ambitious target is achievable: “The sheer vibrancy of the engagement with big social challenges by different enterprises – public, private, academic and community – and by people across Scotland, suggests a bright future.

“Making public promises is easy. Delivering on such promises, on contested topics, is very difficult. But when engaged politicians, vibrant social and business enterprise, a supportive public sector and a strong University base are able to work together, delivery starts to look a lot easier.”

ECCI has been at the heart of major public policy impacts in climate change, land use and energy and has helped develop 12 large-scale 'smart city' and 'sustainable island' projects creating resource efficient, low carbon locations in Scotland. Its work has attracted increasing interest from China, Ecuador and Chile, in research, training and innovation partnerships to deliver practical, low carbon outcomes.

In July 2015 ECCI opened **A NEW BASE IN HONG KONG** – becoming the first education institution in the world to establish a low carbon research and innovation centre in another country. This will help deliver closer partnerships to address key challenges of climate change, lower carbon economies, and will provide Scottish companies with a gateway to China. ECCI continues to grow its global networks and is also building towards future low-carbon bases in Asia and South and Central America.

[www.edinburghcentre.org](http://www.edinburghcentre.org)



The Bank of England.

## Influencing a radical monetary policy

Research conducted by Professor John Hardman Moore, from the School of Economics, **WAS INSTRUMENTAL IN MAKING SENSE OF THE 2008 FINANCIAL CRISIS**. It also informed the unconventional monetary policy – quantitative easing – undertaken by central banks including the Federal Reserve and the Bank of England

Professor Moore's research demonstrated that an injection of liquidity into the economy could help mitigate the adverse effects of a financial crisis. His unconventional policy advice – to conduct open market operations that exchanged illiquid assets for liquid ones – resembles important aspects of the quantitative easing policy conducted by the Federal Reserve Bank of Chicago.

His innovative research has been **IMPLEMENTED ACROSS THE GLOBE**. Professor Moore has presented a series of invited lectures for the Bank of England, Bank for International Settlements, Banque de France, Bundesbank, Sveriges Riksbank and the Banco Central de Uruguay.

# Environment

## Protecting at-risk forests across the globe

**NEW WAYS OF MONITORING AND MODELLING CARBON GAINS AND LOSSES IN FORESTS ARE BEING ADOPTED WORLDWIDE** as a result of research conducted at the University of Edinburgh.

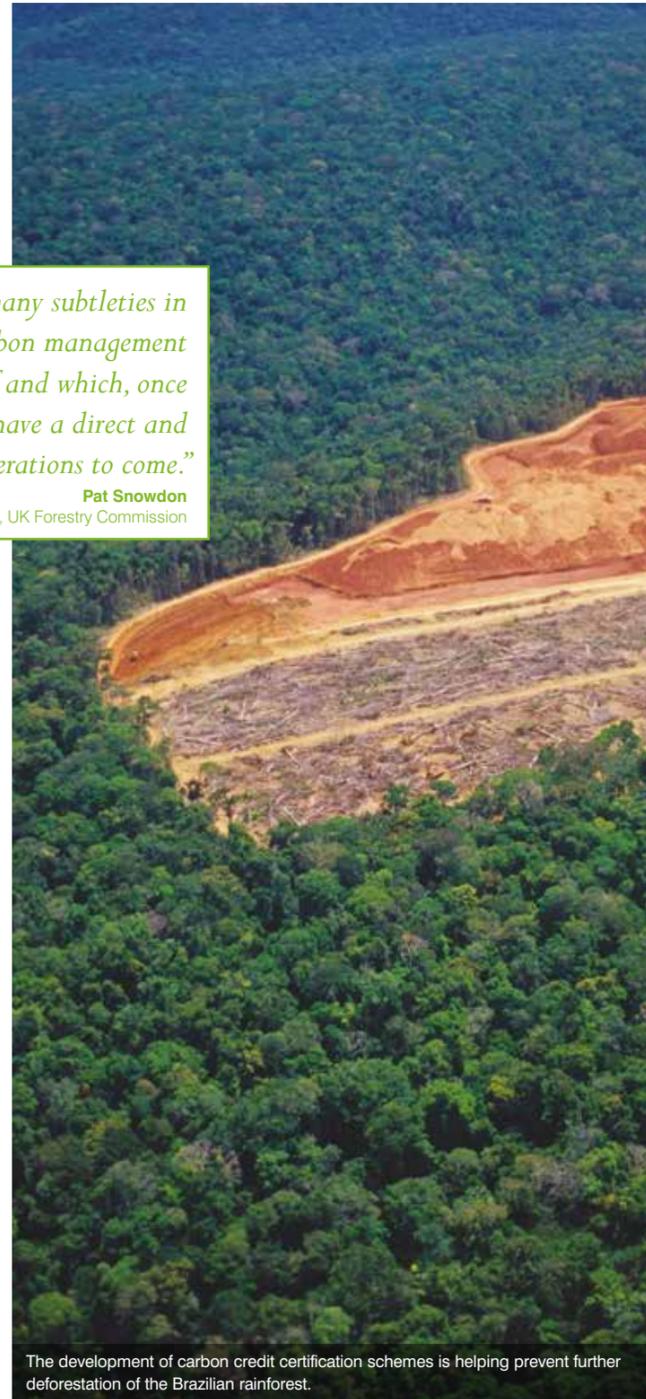
Teams led by Dr Genevieve Patenaude have perfected tools to assess the impact of natural disasters on forest ecosystems. These include models and remote-sensing techniques, which are also being used to improve our quantification of carbon stocks in forests. The techniques have advanced the inclusion of forest carbon in the global carbon market and aided the development of appropriate carbon credit certification schemes.

Dr Patenaude advised the Gold Standard Foundation, the largest international certification standard for carbon mitigation, on the extension of their scheme into forest, agriculture and land-use carbon. The Foundation now represents nine forestry projects worldwide, **BENEFITING ALMOST 8,700 PEOPLE** and covering more than 20,000 hectares.

Dr Patenaude also led the technical panel of the Natural Forest Standard – a unique, voluntary carbon standard that is now used by two projects in Brazil, **PROTECTING MORE THAN 1.8 MILLION HECTARES OF LAND** from deforestation and forest degradation.

The cross-sector Forest Finance Risk Network (FFRN), established by Dr Patenaude in 2011, **BRINGS TOGETHER MORE THAN 80 GLOBAL ORGANISATIONS** including non-governmental organisations, insurers and investors. FFRN has helped to develop forest-specific products that aid risk assessments, such as a novel wind risk insurance product, developed by UK company, ForestRe Ltd, as well as pest and disease risk products much needed in the forestry management sector.

Dr Patenaude is also co-creator, with colleague Dr Iain Woodhouse, of Carbomap Ltd – an Edinburgh spin-out. The company provides forest health, structure and carbon surveys. In 2014 they used satellite radar data to map forest and carbon loss for the UK Forestry Commission. The development of their patent-pending multi-spectral canopy LiDAR also opens up new possibilities for mapping understory vegetation and fire risk.



The development of carbon credit certification schemes is helping prevent further deforestation of the Brazilian rainforest.

*“Their work has thrown up many subtleties in relation to forestry and carbon management that we were unaware of and which, once implemented, are likely to have a direct and positive impact for generations to come.”*

**Pat Snowdon**  
Head of Economics and Climate Change, UK Forestry Commission

## Making waves in power generation

Edinburgh's FloWave Ocean Energy Research Facility is **THE WORLD'S FIRST COMPLEX, WIDE-AREA, MULTIDIRECTIONAL WAVE AND CURRENT TANK**. It provides a unique environment for energy and climate change research, simulating ocean conditions for the testing of tidal and wave energy devices.

Central to the facility is a 25-metre diameter, circular tank containing 2.4 million litres of water. This is circumferentially ringed by 168 absorbing wave-making machines, while 28 submerged, flow-drive units can drive currents across the tank in any relative direction. This permits controlled environment testing in realistic and repeatable ocean conditions at a meaningful scale, which corresponds to up to 28 metre waves, 12 knot currents and a sea-area of approximately two square kilometres.

Spin-out company Edinburgh Designs is now the world-leading supplier of scientific and recreational wave-making technology, with **DESIGNS IN 19 COUNTRIES**.

[www.flowavett.co.uk](http://www.flowavett.co.uk)

## Improving bioenergy use in East Africa

The University's work promoting sustainable bioenergy practices in Kenya and Tanzania is helping east Africa achieve a United Nations target of sustainable energy for all by 2030.

Dr Thomas Molony researched the countries' use of biofuels for the PISCES – Policy Innovation Systems for Clean Energy Security – project on east Africa and south Asia. By 2030 more than three billion people may rely almost entirely on biofuel for their energy needs. The project explored how to make biofuel production more efficient, ensure people have better access to energy and eliminate wastage.

Dr Molony's work has contributed to Kenya's National Biofuel Policy and to a gender working group in Tanzania promoting equality in bioenergy policy. It has also helped **IMPROVE THE LIVES AND ENERGY SECURITY OF MORE THAN 300,000 PEOPLE** in east Africa, identifying local agricultural waste products – rice husks and jatropha cakes – as valuable fuel sources for a more efficient, cleaner-burning, biofuel stove.

## Backing a US-China carbon capture deal

Academic expertise provided by the University of Edinburgh Business School is at the heart of a partnership between the US and China. The deal will support the development of new carbon capture, utilisation and storage (CCUS) technologies.

The University is one of the key partners behind China's Guangdong CCUS Centre, founded in 2013 as a joint project between UK and Chinese engineers and scientists. Now the University of Texas at Austin, American not-for-profit The Clean Air Task Force and the energy generator Southern Company Services, have agreed to collaborate with the Guangdong CCUS Centre.

Their partnership will assess CO<sub>2</sub> capture technologies and evaluate the viability of novel, safe carbon storage options such as offshore geological formations.

## Shaping earthquake risk estimation and forecasting policy

Research conducted at the University of Edinburgh on earthquake predictability has directly influenced the policies of the International Commission on Earthquake Forecasting (ICEF).

Professor Ian Main, from the School of Geosciences, combines both statistical and rock physics data in his research. This has shown that, while increases in the probability of an earthquake can be identified, deterministic predictive models for individual events are unreliable. He has also shown that models for seismic hazard can be easily skewed by individual, extreme events such as the 2004 earthquake off the coast of Sumatra that led to the devastating Boxing Day tsunami.

Reliable, short-term prediction of individual earthquakes remains elusive but Professor Main's long-term probabilistic forecasting provides a useful baseline for **DEVELOPING BUILDING DESIGN CODES IN EARTHQUAKE REGIONS** and in the shorter term, clustering properties provides an opportunity to calculate and communicate periods of heightened risk.

Italy's Director of Civil Protection appointed Professor Main the UK's sole representative to the ICEF in 2009, following a 6.3 magnitude earthquake near L'Aquila that resulted in 309 fatalities. Six members of the Italian Grand Risks Commission were convicted of manslaughter as a result of their perceived poor communication of the earthquake risk, although they were later acquitted on appeal.

Professor Main's research directly impacted the ICEF final report, which stated: "Any information about the future occurrence of earthquakes contains large uncertainties and, therefore, can only be evaluated and provided in terms of probabilities". It emphasised the lack of clear and reliable precursors needed for deterministic prediction, and recommended investment in 'operational' forecasting with clear communication of probability and uncertainty.

The report **STIMULATED POLICY INNOVATION AROUND THE WORLD**. The Italian Department of Civil Protection committed €1 billion to a 10-year research project on operational earthquake forecasting and implemented a public education programme to communicate probability and risk. Authorities in the US and New Zealand began similar programmes and the report also influenced policy development in Greece, Japan and Russia.



An earthquake devastated L'Aquila, Italy, in 2009.

# Health and wellbeing

## Improving treatment for stroke patients

Researchers at the University of Edinburgh are helping to change treatment guidelines to **HELP THE 15 MILLION PEOPLE WHO SUFFER A STROKE WORLDWIDE EACH YEAR**. The International Stroke Trial, led by the University's Professor of Medical Neurology Peter Sandercock, recruited 19,453 patients and showed that for every 1,000 patients treated immediately with aspirin, ten patients avoid early recurrent stroke or death, and at six months after stroke onset, thirteen more were alive and independent. As a result, the use of aspirin was introduced into stroke treatment guidelines worldwide, reaching up to 50 million patients annually.

Professor Sandercock and his team of researchers went on to conduct the Third International Stroke Trial, which demonstrated that immediate intravenous thrombolysis with the clot-busting drug rt-PA; alteplase is a long-term effective treatment for acute ischaemic stroke in a wide range of patients. Today, in the UK, the administration of thrombolysis within three hours is a quality standard against which services are judged nationwide. The study, supported by the MRC, among others, is testament to the University's ability to attract funding partnerships that can contribute to life-changing scientific discoveries. Professor Sandercock praises the skills of his colleagues, including Applied Neuroimaging Professor Joanna Wardlaw, who handled the brain imaging studies that were a key part of the research.

Elsewhere, Professor Wardlaw's research has shown that immediate computerised tomography scanning in acute stroke improves outcomes for patients and is very cost effective, whereas arteriography and magnetic resonance scanning are not cost-effective in secondary prevention. **THE FINDINGS LED TO CHANGES TO THE GUIDELINES ON STROKE MANAGEMENT IN THE UK, EUROPEAN, CANADA, AUSTRALIA AND AMERICA** and have helped to reduce scanning waiting times for stroke patients.

*"The MRC provided one of the main building blocks, which was the staff here in Edinburgh working on the trial."*

Professor Peter Sandercock



From left: Dr William Whitely, Professor Peter Sandercock and Professor Joanna Wardlaw at the Brain Research Imaging Centre in Edinburgh.

### Reducing child pneumonia mortality

Professors Harry Campbell and Igor Rudan are pneumonia experts at the University of Edinburgh. They were founding members of the Child Health Epidemiology Reference Group (CHERG), established by the World Health Organisation (WHO) and the United Nations Children's Fund (UNICEF) to prepare global child disease burden estimates and **ADVISE INTERNATIONAL AGENCIES AND NATIONAL GOVERNMENTS**.

Through CHERG, the researchers demonstrated that pneumonia, an acute respiratory infection affecting the lungs, has been the

largest single cause of global child mortality since 2000. It also showed that it was receiving less priority than other diseases such as HIV and malaria which caused fewer child deaths.

Their work contributed to the establishment by the WHO and UNICEF, in 2009, of **A GLOBAL ACTION PLAN ON PNEUMONIA**. This resulted in major reductions in child deaths from pneumonia and helped to reduce overall child deaths globally from 9.9 million per year in 2000 to 6.3 million per year in 2013.

## Boosting baby survival rates

Edinburgh's Professor Jane Norman and her team of researchers are making discoveries that are **SAVING THE LIVES OF BABIES WORLDWIDE**.

"Pregnancy is a happy time and safe for most women, but for too many women something goes wrong in pregnancy causing the baby harm," explains Professor Norman. "Around 4,000 babies are stillborn in each year the UK, and a further 60,000 babies are born too early. Our group aims to try and understand what goes wrong in these pregnancies, and to develop and test treatments to improve outcomes."



With backing from the MRC, the charity Tommy's and Scotland's Chief Scientist Office the team has been producing clear results. In a study of more than 1.2 million pregnant women at term, conducted between 2008 and 2011, researchers found that elective induction of labour at time points from 37 weeks' gestation progressively reduces perinatal mortality, particularly in mothers over 40 years of age. As a result the Royal College of Obstetricians and Gynaecologists has recommended that induction of labour at 39 weeks should be routinely offered to older women. This is estimated to **PREVENT 17 STILLBIRTHS PER YEAR IN THE UK ALONE**.

The team has also been looking at the effects of progesterone on the preterm birth of twins. The team conducted a double-blind, placebo-controlled trial involving 500 women pregnant with twins. The study revealed that progesterone was ineffective in women with twin pregnancy, and has led to clear guidelines published in Europe, North America and Australia that progesterone should not be used for this purpose. The excess cost of treating women with twin pregnancy with progesterone was £2,334 per patient.

### Connecting mobility, mood and place

A three-year research project (2013–2016) called Mobility, Mood and Place explores how places can be designed collaboratively to **MAKE PEDESTRIAN MOBILITY EASY**, enjoyable and meaningful for older people. Funded by the EPSRC, ESRC and AHRC, the project brings together experts from the Universities of Edinburgh, Heriot-Watt, York and King's College London.

The researchers are using innovative co-design and mobile neural imaging methods to explore emotional responses to place. Working with the Lothian Birth Cohort of people in their 70s, the project is also the first to consider the influence of local environments in which people have lived from childhood.

Edinburgh's Professor Catharine Ward Thompson explains: "It's particularly important for people who don't have access to vehicles, or can't easily get about, to have everyday contact with the natural environment. For older people, nearby access to attractive, usable streets and open space is absolutely the key to wellbeing."

[www.mobilitymoodplace.ac.uk](http://www.mobilitymoodplace.ac.uk)

## Assessing heart attack risk with GRACE

A 10-year research programme resulted in the Global Registry of Acute Coronary Events (GRACE) risk score, which has **SAVED LIVES BY HELPING DOCTORS BETTER MANAGE THE TREATMENT OF CARDIOVASCULAR DISEASE**. A critical form of cardiovascular disease is Acute Coronary Syndrome (ACS), which includes heart attack and unstable angina. There are more than 100,000 heart attacks in the UK each year.

Keith Fox, Professor of Cardiology at the University of Edinburgh and colleagues at the University of Massachusetts established the largest multinational study of ACS, involving more than 100,000 patients in 30 countries. The GRACE programme characterised ACS and identified a worldwide 'treatment-risk paradox' that lower risk rather than higher risk patients received more intensive medical treatment.

The team developed the GRACE risk score, made up of factors predicting risk of heart attack and/or death: age; heart rate; systolic blood pressure; renal function; congestive heart failure; ST-segment deviation; cardiac arrest; and elevated biomarkers.



The National Institute for Health and Care Excellence (NICE) tested all the published risk scores for ACS using an unselected population of 70,000 patients in the UK. The GRACE risk score came out top and NICE, the European Society of Cardiology (ESC), American Heart Association and American College of Cardiology all recommend its usage.

Modelling by the researchers suggests that using the GRACE risk score **SAVES 30–80 LIVES FOR EVERY 10,000 PATIENTS**. The GRACE risk score is freely available as an app, which has been **DOWNLOADED MORE THAN 10,000 TIMES**, and is also incorporated into a 'pocket guidelines' app developed by the European Society of Cardiology for distribution to clinicians in 55 countries.

"GRACE is now the international reference standard for defining ACS and its outcomes and the basis for designing major randomised trials and quality improvement programmes. What's more, the app has helped to reverse the treatment-risk paradox so that high-risk patients can get the best evidence-based treatment," explains Professor Fox.

# International development

## Protecting against parasitic disease

Through a combination of world-class expertise and resources the University of Edinburgh is helping to **PROTECT FUTURE GENERATIONS OF AFRICAN CHILDREN AGAINST SCHISTOSOMIASIS**, the second most deadly parasitic infection across the continent after malaria.

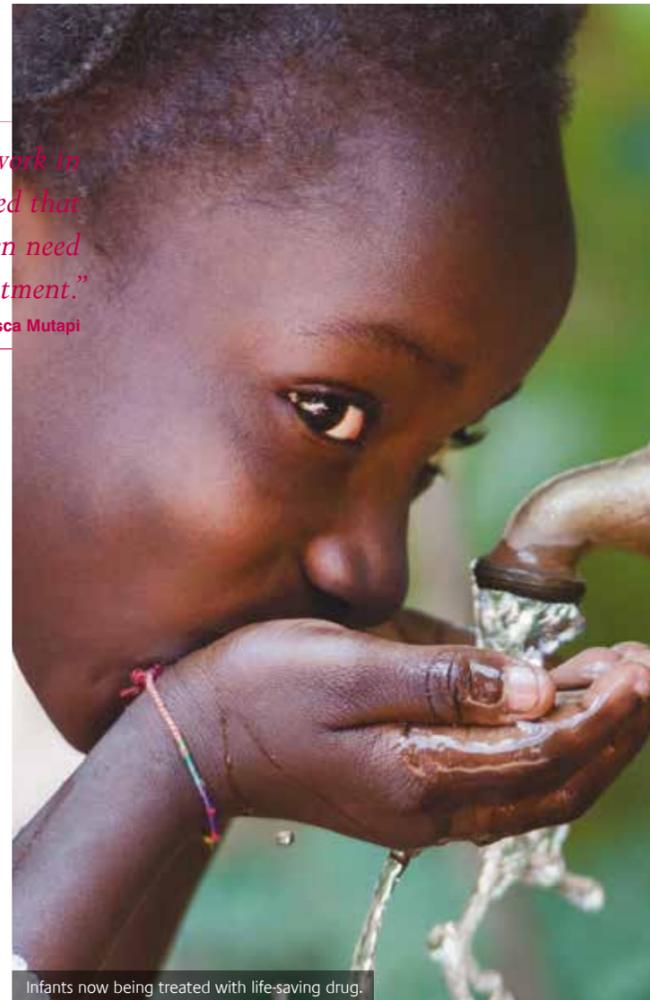
Schistosomiasis affects more than 100 million people in sub-Saharan Africa and is caused by contact with fresh water infested with the larval forms of parasitic worms, known as schistosomes. The adult worms live in the veins draining the urinary tract and intestines, and can cause severe and chronic physical and immune-mediated damage.

Until recently children under the age of five were thought to be low risk and excluded from mass drug administration (MDA) programmes of the only available control measure – Praziquantel (PZQ). However, a team of researchers at the University, led by Dr Francisca Mutapi, have collaborated with colleagues at the University of Zimbabwe and elsewhere in Mali and Sudan to demonstrate that schistosome infection rates in under-fives are actually higher than in adults already enrolled in MDA programmes. Dr Mutapi explains: “Our laboratory work in Edinburgh proved that PZQ is both safe and efficacious in that age group.”

The results were presented at a World Health Organization (WHO) workshop in 2010 and in 2013 a new MDA programme was launched in Zimbabwe, which has already **TREATED ALMOST 350,000 PRESCHOOL CHILDREN** for the first time. The Chair of the workshop said: “This ongoing programme and evaluation study in Zimbabwe will help many thousands of children in the short term and several million in the long term.” The University is now collaborating with other experts through a WHO committee (of which Dr Mutapi is a member) in researching paediatric PZQ formulations and optimal delivery strategies of the drug for under-fives.

*“Our field work in Zimbabwe showed that young children need treatment.”*

**Dr Francisca Mutapi**



Infants now being treated with life-saving drug.

### Saving savannas by satellite

Building on existing research that revealed the global significance of savannas for biodiversity, the University's Dr Neil Stuart has shown that savanna habitats can be mapped in detail using satellite data.

Dr Stuart led the first comprehensive mapping and botanical assessment of savannas in Belize, and the results, published in 2011 revealed that 10 per cent of the country's savanna had been lost in the previous 20 years. The study guided a nationwide programme of plant collecting that led to **54 SPECIES BEING**

**FOUND FOR THE FIRST TIME** in Belize. The data was combined with historical collections to produce the first comprehensive botanical checklist of Belize's savanna flora.

Dr Stuart's project also supported the creation of the Environmental Research Institute at the University of Belize, where local professionals, trained by UK scientists, are now able to fulfil Belize's monitoring requirements, for example to the United Nations Convention on Biodiversity.

## Eradicating sleeping sickness

The University's Global Health Academy brings staff together to collaborate on global health challenges, including neglected tropical diseases such as rabies, malaria and sleeping sickness. Professor Sue Welburn, Vice-Principal Global Access and the Founding Director of the academy leads its Stamp Out Sleeping Sickness (SOS) campaign.

Sleeping sickness is caused by two forms of a parasite found across sub-Saharan Africa. In Uganda, the cattle population act as a reservoir of parasite infection, which is then passed from the cows to humans by the bite of the tsetse fly. The disease is a cause of great concern in the country where for every person receiving treatment for acute human sleeping sickness, 12 people die undiagnosed. By controlling the disease in cattle it is possible to greatly reduce transmission to humans while also protecting the animals.



Spraying cattle against tsetse fly.

“At the moment we're working with various donors so that **WE HAVE THE TOOLS, THE WHEREWITHAL AND THE COMMITMENT TO ERADICATE ACUTE HUMAN SLEEPING SICKNESS** from Uganda,” says Professor Welburn.

The growing list of public and private sector partners supporting the research includes Makerere University in Uganda, the UK Department for International Development, IKARE – a venture philanthropy charity, supported by IK Investment Partners, Ceva Santé Animale – a global veterinary health company and the WHO.

Taking a multidisciplinary approach, the SOS campaign draws on the skills of disease control professionals, researchers and students from Uganda and the UK, along with local livestock owners and has, to date, provided **EMERGENCY TREATMENT FOR AROUND 500,000 CATTLE IN NORTHERN UGANDA**. The campaign's success was acknowledged by the Ugandan government in 2013 with a Collaboration and Networking Across Government Award, and in 2015 Professor Welburn became a Fellow of the Royal Society of Edinburgh in recognition of her outstanding contribution to the field.

[www.ed.ac.uk/global-health](http://www.ed.ac.uk/global-health)

### Preventing pesticide self-poisoning

Researchers at Edinburgh are helping to reduce deaths from pesticide and plant self-poisoning in rural Asia, a cause of more than 350,000 deaths each year and the number one global means of suicide.

In the early 1990s Sri Lanka had one of the world's highest suicide rates at around 52 per 100,000, which was linked to the introduction of pesticides into poor rural homes from the late 1960s, making self-poisoning possible. A team, led by Professor of Clinical Toxicology Michael Eddleston, produced the first description of the clinical presentation and outcome of poisoning with a wide range of pesticides. The results led to banning of several toxic pesticides and a decision to not list the poorly effective antidote pralidoxime in the WHO's Essential Drug List. These findings and ongoing clinical trials are estimated to be **SAVING AROUND 10,000 LIVES PER YEAR IN ASIA**.



## Putting solar energy under the spotlight

Jamie Cross is a Senior Lecturer in Social Anthropology and Development at Edinburgh whose ESRC, EPSRC and Leverhulme Trust-funded research focuses on off-the-grid communities in South Asia.

Dr Cross, who is also a Director of the Global Development Academy, which harnesses the University's international teaching, research and partnerships to ensure it plays a central role in transforming the world, explains:

“Since 2011 I have been following the work of solar engineers and non-governmental organisations involved in **DESIGNING AND DISTRIBUTING SOLAR PHOTOVOLTAIC LIGHTING SYSTEMS TO PEOPLE WHO LIVE WITHOUT RELIABLE ACCESS TO MAINS ELECTRICITY**.

“As governments, international development donors and businesses commit themselves to realising targets for universal energy access, this research examines the relationships involved in creating markets for renewable energy technologies in contexts of global poverty and the values, practices and meanings that mediate the consumption of energy, particularly lighting.”

By creating case studies of designers, manufacturers and users of solar technology, the research has helped to develop a social history of the solar lantern in South Asia and increased the understanding of how gender, kinship and caste affect the perception of solar technology.

Dr Cross continues: “Any practical solution to the challenges of energy access must understand that energy poverty is a social relationship. In rural India, the engagement of poor people with renewable energy technology is shaped by histories of social exclusion and experiences of inequality.”

In May 2014 in partnership with Scene, a renewable energy specialist, Dr Cross was awarded a grant from the Scottish Government that builds upon his insights into the effective take up of solar energy in rural India by focusing on what happens when solar technology breaks down. The funding is being used to launch ‘Urjaa Samadhan’ a non-profit social enterprise that connects people with broken solar equipment to local repair and maintenance services. In the Indian state of Odisha the platform aims to **PROLONG THE LIFETIME OF MORE THAN 40,000 RURAL SOLAR INSTALLATIONS**.

[www.ed.ac.uk/global-development](http://www.ed.ac.uk/global-development)

# Justice

## Reforming youth justice

The Edinburgh Study of Youth Transitions and Crime (ESYTC) has increased understanding of youth offending and the impact of interventions. It has led to reform of youth justice policy and practice in Scotland, and has had international influence.

The ESYTC, led by Professor Lesley McAra and Professor Susan McVie, is a prospective longitudinal study of routes into and out of offending among a cohort of around 4,300 young people in the city of Edinburgh, established in 1997. It is one of the largest studies of its kind in the world, and one of a small number of studies in this field that have been influential worldwide. It is innovative in its breadth – using a census approach to maximise inclusion – and complexity of data management. Data collection included six annual sweeps of self-report surveys, spanning the ages of 12 to 17, records from police, social work, children’s hearings and schools, surveys of parents and teachers and compilation of a geographic information system.

The findings of the study formed the evidence base for the Scottish Government’s Early and Effective Intervention Programme for under 16s and the Whole System Approach for under 18s. The Whole System Approach is a major shift away from punitive measures towards maximum use of diversion as a means to **KEEP YOUNG PEOPLE OUT OF THE CRIMINAL JUSTICE SYSTEM**. It is underpinned by the ESYTC evidence that contact with the criminal justice system can be detrimental to behaviour and longer-term life chances. The ESYTC also led to amendment of the Children’s Hearings (Scotland) Act 2011, changing the status of childhood offences at Children’s Hearings.

The changes to national policy have resulted in reductions in youth offending. The Policing Performance Framework has collected data on youth crime since 2008–9, and recorded **CRIMES AND OFFENCES COMMITTEE BY CHILDREN AND YOUNG PEOPLE (AGED EIGHT TO 17) FELL BY 32 PER CENT BETWEEN 2008–2009 AND 2011–2012**.

Professor Lesley McAra, Chair of Penology at the University of Edinburgh, says: “If we truly wish to build an inclusive and respectful society, one in which all people and all communities live in safety and security, then we must adopt a compassionate approach to the problems caused by serious and persistent offenders.”

[www.esytc.ed.ac.uk](http://www.esytc.ed.ac.uk)

*“The Edinburgh study is the most significant large scale piece of research in this area undertaken in the last several decades.”*

**John Drew**  
retired Chief Executive of the Youth Justice Board

## Protecting children online

Dr Ethel Quayle has for the first time identified the demographics of child victims of online sexual crimes. A subsequent G8 meeting to discuss Dr Quayle’s findings, which were based on police data, led to the publication of a book that has been **USED BY SPECIALIST POLICE FORCES, THE JUDICIARY, CHILD PROTECTION WORKERS AND NON-GOVERNMENTAL ORGANISATIONS**.

Also as a result of the G8 meeting, the US Department of Justice and the European Commission co-hosted the Global Alliance Against Child Sexual Abuse Online, which formally agreed to enhance efforts to identify and support victims, prosecute offenders and raise public awareness, and to **REDUCE THE AVAILABILITY OF CHILD PORNOGRAPHY ONLINE**.

As part of her membership of the UN’s Child Online Protection initiative, Dr Quayle co-authored *Guidelines for Parents, Guardians and Educators*, which is available in English, French, Spanish, Arabic, Chinese and Russian. Dr Quayle has also advised the US Sentencing Commission.

## Accelerating expertise in crime scene decision making

Researchers are applying the latest knowledge of decision-making processes to crime scene examination, and have developed a training tool to help ensure best practice throughout Scottish Police Authority Forensic Services.

The research, led by Dr Amanda Martindale, has “made thinking visible” through capturing the thought processes of experienced Scene Examiners. Applied cognitive task analysis was used to understand the cognitive demands facing Scene Examiners and to identify the tasks needed to perform proficiently.

The findings have offered a unique window on thought processes, producing detailed, observable information about situation assessment, the use of critical cues, and action taken. Supported by the Forensic Services’ Multimedia Unit, the research has led to the development of a scenario-based training tool for complex and major incidents. The product has highlighted regional differences in the approach to the examination of a crime scene. Ongoing work with the Scottish Police Authority aims to increase the expertise across Scottish Police Authority Forensic Services.

## Influencing licencing policy

Research, led by Dr Niamh Shortt, mapping alcohol and tobacco outlets in Scotland against social deprivation and health indicators has **INFORMED CAMPAIGN GROUPS AND INFLUENCED LICENCING POLICY**.

Researchers produced infographics highlighting the key findings and a website that maps the density of alcohol and tobacco outlets in neighbourhoods alongside illness and death rates linked to alcohol and lung disease. The ESRC-funded website has been widely used by Police Scotland, local authorities, licencing boards and community groups. Dr Shortt addressed the Scottish Parliament’s Cross Party Group on Tobacco and Health, receiving support from MSPs.

<http://cresh.org.uk/webmap>



## Informing forensic evidence protocols

New statistical methods have transformed the way forensic evidence is gathered and assessed, and have **LED TO NEW PROTOCOLS BEING RECOMMENDED NATIONALLY AND INTERNATIONALLY**.

Forensic scientific evidence needs to be evaluated objectively and interpreted clearly for the courts, since failure to do so can lead to appeals or miscarriages of justice.

If, for example, fragments of glass at a crime scene are believed to come from a broken bottle found in the possession of a suspect, how much weight should be given to similarities in the chemical composition of the samples?

The University’s Professor Colin Aitken and his collaborators have developed Bayesian statistical methods to aid the evaluation and interpretation of such evidence. The researchers pioneered the use of the likelihood ratio (LR) for evidence evaluation. LR takes into account, for example, variations within glass bottles and between bottles, first assuming the fragments come from the suspect’s bottle and second assuming they do not.

**MANY FORENSIC SCIENTISTS HAVE SINCE ADOPTED THE USE OF LR, INCLUDING IN SWEDEN, SWITZERLAND, THE NETHERLANDS, NEW ZEALAND AND PARTS OF THE US.**

Professor Aitken also developed procedures for determining the optimal size of samples that should be examined when assessing large amounts of potential evidence, for example when large consignments of potentially incriminating material is seized. The new methods mean investigators can sample fewer items and still provide evidence that is fit for use in a criminal trial.

Sampling software based on Professor Aitken’s statistical methods is available through the European Network of Forensic Science Institutes. This software allows forensic scientists without a strong background in statistics to benefit from cutting-edge Bayesian statistical methods.

Professor Aitken’s sampling protocols have been widely adopted. They have been recommended to forensic laboratories by the Crown Office in Scotland and in guidelines by the United Nations Office on Drugs and Crime.

# Policy

## Informing the referendum debate

As the UK approached its biggest potential constitutional upheaval in nearly a century – Scotland's independence referendum of September 2014 – Professor Charlie Jeffery and his research team played a unique role in informing the debate among politicians, academics, the media and the public. Professor Jeffery, Senior Vice-Principal and Founding Director of the Academy of Government, ensured the work of a large number of researchers had direct impact through his leadership of several major organisations.

For example, Professor Jeffery was Coordinator of the ESRC Future of UK and Scotland programme, whose 60-strong research team was recognised as a key source of impartial expertise by business, voluntary sector and media organisations, and the general public. He was also Director of the ESRC Devolution and Constitutional Change programme, which established confidence and trust in academic research among those that would benefit from its findings. He ensured that the programme's research **SET THE AGENDA FOR OFFICIAL DEVOLUTION ENQUIRIES AND COMMISSIONS LAUNCHED IN THE RUN-UP TO THE REFERENDUM.**

Professor Jeffery also advised the Scottish Parliament's Commission on Scottish Devolution (2008–2009), and the Scotland Bill Committee of the Scottish Parliament (2011–2012), and he served as a member of the UK Government's McKay Commission on the West Lothian Question (2012–2014). As the 2014 referendum approached, Professor Jeffery and his team were providing analysis and political commentary to more than 400 international news platforms **REACHING AN AUDIENCE OF TENS OF MILLIONS.** Professor Jeffery was one of BBC Scotland's expert commentators throughout the television coverage of the referendum on the night of 18–19 September 2014.

He has developed innovative and interactive forms of communication and dissemination of research. The Future of Scotland and UK website was visited by 40,000 users a month ahead of the referendum, and **THE EBOOK SCOTLAND'S DECISION, CO-EDITED BY PROFESSOR JEFFERY, WAS DOWNLOADED MORE THAN 100,000 TIMES.**

Some 10,000 people participated in a six-week massive open online course (MOOC), *Understanding the Referendum*. Professor Jeffery says: "Using the possibilities offered by digital communications, it's possible for social sciences now to have an impact on a much wider front and engage more citizens than has ever been possible in the past."

Professor Jeffery was named Impact Champion of 2015 by the ESRC.



Senior Vice-Principal Charlie Jeffery.

*"Doing impact well depends on accumulating a stock of academic expertise and then carefully and tactfully building the goodwill and trust of the potential users of that research."*

Professor Charlie Jeffery

## Improving air-quality public policy

Research led by Dr Mathew Heal into air pollution from particulate matter (PM<sub>2.5</sub>), ozone (O<sub>3</sub>) and nitrogen dioxide (NO<sub>2</sub>) **HAS INFORMED GOVERNMENT POLICY, RAISED AWARENESS AND HELPED PROTECT PUBLIC HEALTH.** Researchers from the Heal group have improved methods for measuring these pollutants, modelling their movement and predicting the impacts of air pollution emissions.

Dr Heal's more accurate methods for measuring NO<sub>2</sub> by passive sampler have been incorporated into NO<sub>2</sub> measurements across the UK, of which more than 139,000 are made annually. The Heal research group also discovered that less of the carbon in PM<sub>2.5</sub> samples than previously thought comes from fossil fuels, helping **INFORM GOVERNMENT POLICY ON MEASURES TO REDUCE PM<sub>2.5</sub>.** Dr Heal's work has raised awareness of the health risks of O<sub>3</sub>, contributing to the strengthening of ozone air pollution alerts.

## Uncovering extra costs in public health care

An analysis by Edinburgh researchers of private finance initiative (PFI) contracts in the National Health Service has influenced an overhaul of UK policy, including the **SCRAPPING OF THE ORIGINAL PFI MODEL.**

Dr Mark Hellowell and Professor Allyson Pollock uncovered extra costs associated with PFI contracts and a detrimental impact of those costs on the NHS's ability to meet public health needs. The researchers gave evidence to the House of Commons Public Accounts and Treasury Committees, the House of Lords Economic Affairs Committee and the Scottish Parliament's Finance Committee. Dr Hellowell was a Special Adviser to the Treasury Select Committee's inquiry into the successor to PFI, Private Finance 2. Many of its features are designed to address shortcomings identified by the Edinburgh researchers.

The research has also been **INCORPORATED INTO WORLD BANK CAPACITY-BUILDING PROGRAMMES** for developing country governments.

## Creating a forum for EU future debate

A new multi-author blog, European Futures, brings together commentary and analysis on European affairs by academics and practitioners from around the world. The blog provokes debate on the issues facing Europe and explores its potential futures. Its focus extends to the politics, economics and law of European integration, both within the EU and in other organisations.

Building on the way many of the University's staff engaged with the Scottish independence referendum in 2014, the blog will contribute evidence and informed commentary in the public debate leading up to the referendum on UK membership of the EU.

European Futures was launched with 20 authors. The academic editors are Professor Laura Cram and the three Co-Directors of the Europa Institute. European Futures is funded by an ESRC Impact Acceleration Account.

[www.europeanfutures.ed.ac.uk](http://www.europeanfutures.ed.ac.uk)

## Leading the field of Big Data

The University's researchers are at the forefront of the rapidly developing field of data science, which presents major opportunities in many areas of public policy.

In 2015 the University formed Edinburgh Data Science (EDS), a unique initiative to bring data science expertise together, with an emphasis on communication, sharing of best practice and future development. Professor Andrew Morris, the Scottish Government's Chief Scientist for Health and the UK's leading research authority in medical informatics, leads EDS as the University's new Vice-Principal of Data Science.

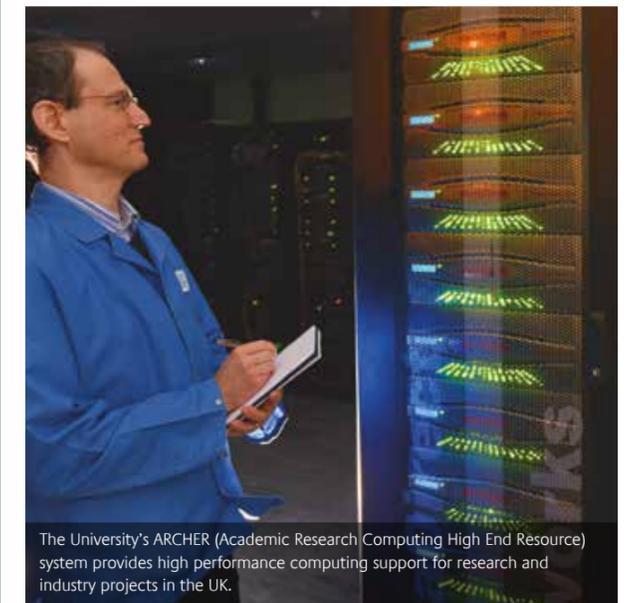
Edinburgh's standing is reflected in its selection for several high-profile initiatives on the use of data science in public policy.

The University is one of the UK's four Administrative Data Research Centres, part of a £64-million investment by the ESRC. The centres will make use of the vast amounts of data routinely collected by government departments and public services, to help policy makers decide how to tackle complex social, economic, environmental and health issues.

Edinburgh co-hosts the Farr Institute Scotland, led by Professor Morris, which is part of a collaboration of 19 universities across the UK to develop the safe use of patient data for medical research. The Farr Institute in Edinburgh's Bioquarter hosts access to Scotland's National Data Safe Haven.

The University also hosts two of the eight Innovation Centres established with £120 million from the Scottish Funding Council: the Digital Health Institute, and Data Lab.

To support the University's work on health-focused data science, the Usher Institute of Population Health Sciences & Informatics has been launched at the University's College of Medicine and Veterinary Medicine, with **A MISSION TO CONDUCT TRANSFORMATIVE RESEARCH THAT IMPROVES THE HEALTH AND WELLBEING OF PATIENTS, COMMUNITIES AND POPULATIONS** locally and globally.



The University's ARCHER (Academic Research Computing High End Resource) system provides high performance computing support for research and industry projects in the UK.

# Science and technology

## Developing gene technology for clinical trials

Rett syndrome, a neurological disorder affecting girls, was previously thought to be untreatable, but research led by Edinburgh's Professor Sir Adrian Bird has brought hope that a cure could one day be possible.

Rett syndrome is a severe autistic spectrum disorder with delayed onset that affects one in 10,000 girls. It is regressive, causing loss of speech and hand movement, an undersized brain and growth retardation. Affected girls develop normally for around 18 months then regress, losing abilities they once had and requiring increasing levels of care as they age. The condition was believed to be developmental or neurodegenerative because of its early appearance and the gradual deterioration of those affected. A cure or therapy was thought to be most unlikely.

In 2001, researchers led by Sir Adrian developed a mouse model for Rett syndrome, by introducing a mutation into the mouse MeCP2 gene. Female mice carrying this mutation had symptoms similar to those of girls with Rett syndrome. This mouse model is now used in hundreds of labs across the world.

In 2007, Dr Jacky Guy and other scientists in Sir Adrian's group introduced a modified MeCP2 gene into Rett model mice that allowed controlled expression of normal MeCP2 protein. When that normal expression was activated in the mice, they rapidly regained normal behaviour.

This striking result indicated that the degenerative changes in Rett patients are reversible, **OVERTURNING PREVIOUS UNDERSTANDING OF THE DISEASE.**

"That's one of those exciting moments in research, a sort of eureka moment," says Professor Sir Adrian Bird.

As a direct result of the 2007 findings, a small group of US parents of children with Rett syndrome formed the Rett Syndrome Research Trust (RSRT), a charity devoted to finding a cure for the condition. The RSRT has so far **RAISED MORE THAN \$25 MILLION IN DONATIONS**, and 96 per cent of funding raised is committed to research seeking to cure Rett syndrome.

The UK charity ReverseRett was formed in July 2010 by families across the UK who wanted to contribute to RSRT's efforts to accelerate treatments for Rett syndrome. The UK charity has raised £2 million since 2010.

In response to the Edinburgh findings, **MULTIPLE CLINICAL TRIALS ARE UNDERWAY IN BOTH EUROPE AND THE US** to test a variety of drugs in the hope of achieving symptom improvement.



Rett syndrome sufferers require increasing levels of care as they age.

*"The expectation was that we'd get a mixed result, but in fact we got a crystal clear result. Everything got dramatically better."*

Professor Sir Adrian Bird

## Modernising fire safety

The University's BRE Centre for Fire Safety Engineering is transforming industry thinking, practice and regulation worldwide on structural design for fire safety in new buildings. A world leader in the performance-based structural design of buildings for fire resistance, the Centre has made research into fires in buildings its unique strength for more than 40 years.

Since 2008 a key advance has been the creation of an integrated approach to addressing fire safety problems in modern buildings, including detection and suppression at incipient and early fire development phases, organising fire service intervention, and forensic assessment of damage after the fire.

Internationally, structural and fire safety bodies and engineers are using the Centre's expertise to design safer, more economical and more sustainable buildings. Engineering consultancy giant Arup says the Centre's "design tools and methodologies are now **BEING USED IN SOME OF THE WORLD'S MOST ICONIC NEW STRUCTURES** including Heron Tower, the Shard, and others".



## Creating software to protect public health

Researchers at Edinburgh developed critical software that has been used to understand the spread of, and inform the response to, global pandemics such as H1N1 swine flu.

Edinburgh's Professor Andrew Rambaut, together with Dr Alexei Drummond of the University of Auckland, co-led the phylogenetic research and developed Bayesian Evolutionary Analysis Sampling Trees (BEAST) – a numerical estimation framework for evolutionary analysis, with a particular emphasis on infectious disease.

Professor Rambaut explains: "This open-source free software has been developed with a powerful but easy-to-use interface to make it accessible to those working in public health. It also provides a set of post-analysis visualisation tools to allow both statistical and visual representation of the results."

BEAST has been used to **INFORM PUBLIC HEALTH DECISION MAKING AT EARLY STAGES OF AN EPIDEMIC** or outbreak when little other information is available, most notably in public health assessments and approaches taken by the World Health Organization during and after the 2009 human influenza (H1N1 swine flu) pandemic.

Professor Rambaut also maintained a public website during the swine flu pandemic on which he published all available current analyses, including analyses using BEAST. The site was used by journalists and Professor Rambaut was interviewed for more than 20 general interest, news and popular science publications, including *Wired* magazine, *The China Post* and United Press International.

As well as having an impact on public health and society, the software has also been used in international court cases. For example, the expert report for a large criminal case in Valencia, Spain, where an anaesthetist was convicted of infecting hundreds of patients with hepatitis C virus, used BEAST in determining the likely nature and timing of the infection, which was important evidence in determining responsibility.

## Making translation toolkits accessible

One of the world's most widely used automatic translation programmes was developed at the University's School of Informatics. Moses, a machine translation toolkit that can be 'trained' to automatically convert documents from one natural language to another, was developed by Professor Philipp Koehn.

The free, open-source software has made machine translation, once the preserve of government and large IT companies, widely accessible to small and medium-sized companies leading to a significant increase in its use. Moses' benefits include increased productivity and lower prices, **OPENING UP NEW MARKETS FOR MACHINE TRANSLATION.**

Unlike some commercial software, Moses can be installed on a user's own server, allowing the translation of commercially or politically sensitive material without the security risk of sending documents outside the company. The European Commission's Europe Media Monitor, which has used Moses since 2009, **TRANSLATES MORE THAN 100,000 ARTICLES A DAY IN 50 LANGUAGES FOR DISSEMINATION** within the Commission.

## Identifying genome markers

Researchers have developed methods of identifying salmon that are resistant to infection, helping fish breeders select disease-resistant breeding stock.

Working alongside salmon breeding company Landcatch Natural Selection and other collaborators, studies led by the University's Roslin Institute demonstrated that resistance to the infectious pancreatic necrosis (IPN) virus is a heritable trait. Dr Ross Houston at the Roslin Institute then used high-throughput sequencing to identify single nucleotide polymorphism (SNP) markers associated with resistance to the IPN virus. These projects led to **THE FIRST COMMERCIAL SUCCESSFUL MARKER-ASSISTED SELECTION FOR DISEASE RESISTANCE** in aquaculture.

# Society

## Widening access to education

The University of Edinburgh was the first university in the UK to offer Massive Open Online Courses (MOOCs), a new way to design courses and teach them on a large scale. Requiring no application process, no qualifications and no fees, MOOCs directly increase the number of learners from socially and economically challenging backgrounds, as well as reaching learners overseas.

The University has long been committed to developing and investing in online learning. Through its Distance Education Initiative it offers a plethora of postgraduate qualifications.

MOOCs have been found to complement degree qualifications, offering would-be degree level students the chance to participate in free courses before committing to further study. The University currently reaches **MORE THAN A MILLION LEARNERS** through its extensive MOOCs programme, across Australia, Brazil, Canada, the Czech Republic, Germany, Greece, India, Russia, Spain, and the US.

Every learner has access to the world-leading researchers at Edinburgh, just as they would if they continue on to higher education.

The University's Dr Siân Bayne, based in Moray House School of Education, was an early adopter of online learning, and was also involved in teaching the first set of MOOCs. She sees many advantages:

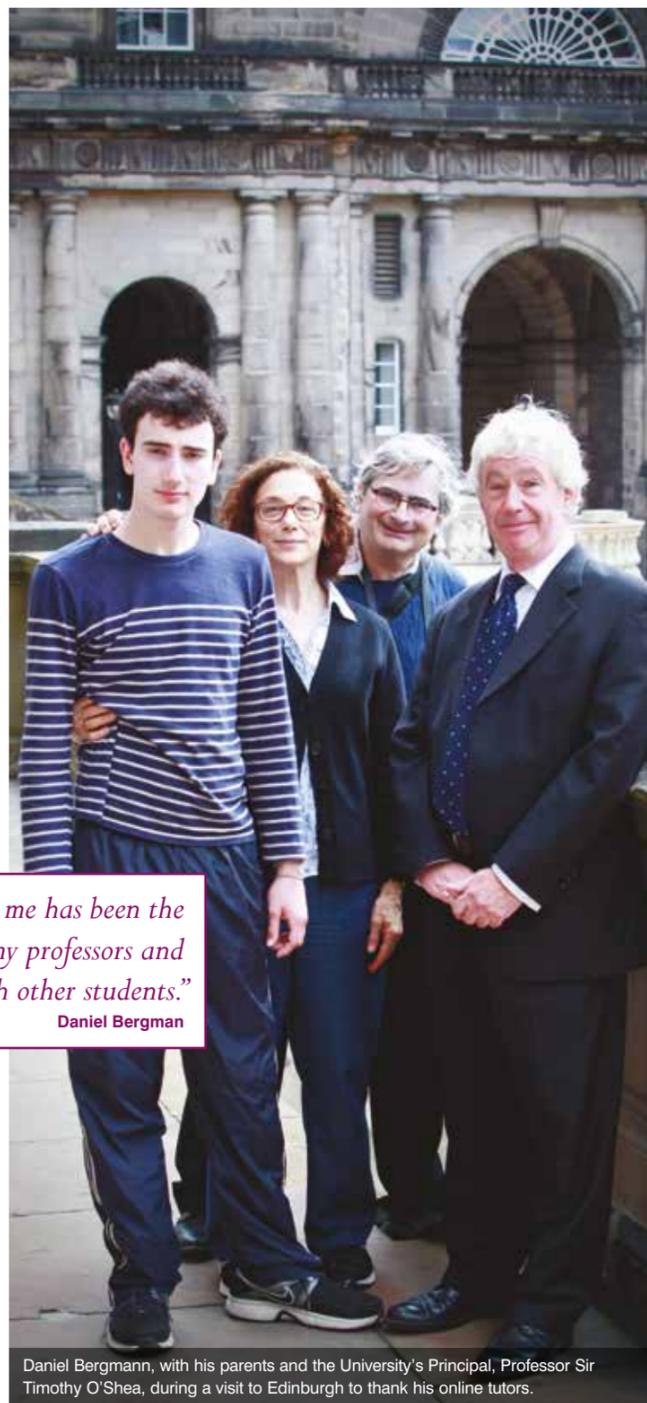
"Digital and open education are important trends for universities globally: our research in this area takes a step back from the hype to consider the effects of technological change on learning, policy and society. Alongside investment in digital education, universities need to better understand who benefits, how it helps people learn, and where its risks lie. A strong body of research in digital education has helped to make our innovative programmes in massive open education, on-campus innovation and distance learning a success."

The ecumenical nature of online learning is never more apparent than in the story of Daniel Bergman, a severely autistic 17 year old from New York, for whom learning in a traditional classroom setting is extremely challenging. He undertook the Philosophy and Critical Thinking MOOC and, so enthused by his experience online, he undertook to visit the University with his parents in person, to thank the people behind the online course.

[www.ed.ac.uk/moocs](http://www.ed.ac.uk/moocs)

*"The real treasure for me has been the real-time contact with my professors and online interaction with other students."*

Daniel Bergman



Daniel Bergman, with his parents and the University's Principal, Professor Sir Timothy O'Shea, during a visit to Edinburgh to thank his online tutors.

## Improving behaviour in schools

With behaviour in schools under the spotlight, the University's Dr Gillean McCluskey's work on alternatives to exclusion has helped lower levels of indiscipline and improved teacher confidence. Dr McCluskey's research into restorative practices focused on the need to restore good relationships when there has been conflict and to develop a school ethos that reduces the possibilities of such conflict arising. Her research led to a Scottish Government backed two-year pilot by four local authorities adopting restorative practices, and in turn, advising the Government on a new national policy for use in all schools: Better Relationships, Better Learning, Better Behaviour.

Dr McCluskey's research has **POSITIONED SCOTLAND AS A LEADER** on behaviour and relationships in schools. At the invitation of respected education bodies and institutions, Dr McCluskey has provided insights into the use of restorative approaches in the US, Canada, Spain and Korea.

## Increasing our understanding of ageing

In 1921 and 1936, two groups of school pupils took a test of mental ability. Many years later, the people involved were contacted by the University's Professor Ian Deary and his team, and invited to undertake a similar series of tests. The aim of the research was to delve into the causes of cognitive change during ageing. Professor Deary's study found that reduced mental ageing is related to factors such as not smoking, being physically active and speaking more than one language. His research also revealed that children with higher mental capabilities are less likely to develop certain illnesses that affect thinking skills, and some factors previously thought to influence the ageing brain were shown to be unrelated.

The results have featured in numerous science festivals; have been the focus of a series of artworks created for The Art of Ageing exhibition, and been the inspiration for a book of short stories. Professor Deary also provided valuable information for government and NHS groups.

## Enhancing inter-religious dialogue

The Edinburgh Alwaleed Centre aims to encourage **A BETTER UNDERSTANDING OF ISLAM AND ISLAMIC CULTURE**, through groundbreaking research and outreach projects. Its researchers created a residential conference, Breaking Barriers, which brought together young Christians and Muslims from across Scotland for scriptural reasoning sessions comparing Qur'anic and Biblical verses, and introduced them to the history of Christian-Muslim relations. The impact of the conference continues: delegates took the lead in organising four further day-long conferences to continue what the Centre had started.

The Centre recently rolled out a series of CPD seminars for Scottish police officers. Seminars led by University staff provided officers with essential information about Islam in both a national and international context. The success of the training led to further engagement between the University and Police Scotland with researchers invited to sit on the Association of Chief Police Officers Religion and Belief Reference Group.



The Tegola project has developed into HUBS (high speed universal broadband for Scotland), a joint enterprise between Edinburgh and the universities of Stirling, and the Highlands and Islands, funded by the Carnegie University Trust. HUBs currently supports 20 communities across Scotland.

## Inventing broadband solutions to support communities

What began in 2007 as a research project, called Tegola, for the University's Professor Peter Buneman, Dr Giacomo Bernardi and Dr Mahesh Marina evolved over several years into a community endeavour that resulted in bringing superfast broadband to an otherwise unconnected part of the Scottish Highlands.

The advent of superfast broadband has had a significant impact on businesses, organisations, education and home consumers alike, with an ever-growing range of commerce and communication dependent on high-speed internet access. Much of rural Scotland is without high-quality web access. University researchers realised the Tegola network demonstrated the suitability of long-distance WiFi technology even for areas like rural Scotland. To increase the stability and sustainability of the network, the up-to-the-minute resources of the School were used to develop certain engineering measures, and use of solar and wind power for self-powered masts that would strengthen and protect the network.

The project corresponded with the ambitions of the Scottish Government:

"Broadband should not be considered a luxury in places like the Highlands and Islands. It is essential to enhance the quality of life of communities and to **STIMULATE THE GROWTH OF THE LOCAL ECONOMY.**" Nicola Sturgeon

The head of BT Scotland had expressed the opinion that mesh networks like Tegola were not robust however, experience has shown otherwise. In 2011 Tegola was successfully used for emergency medical services when a lightning strike knocked out the telephones to a wider area.

As a direct result of the Edinburgh team's research, some of Scotland's most remote communities are now enjoying superfast broadband for the first time.

Tegola has become a replicable model for community-driven local access network deployments in Scotland. It has also inspired research into tools, systems and techniques to aid communities in deploying and maintaining similar rural networks in other parts of the globe.

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