Life-saving science

Recent discoveries from our research

British Heart Foundation

No.1

We're the number one funder of heart research in UK universities.

£157

On average we invest £157 in heart research every minute.

1,200

We fund around 1,200 research projects throughout the UK.

Welcome

When the British Heart Foundation (BHF) was launched in 1961, by concerned doctors hoping to address the epidemic of heart disease, around 166,000 people in the UK died annually of coronary heart disease (CHD). Since then, donations from our supporters have helped us contribute to a halving of this figure – in 2009 around 80,000 died of CHD.

We've come a long way, but there is a great deal still to be done – heart disease remains the UK's single biggest killer. That's why we need to keep funding the best research alongside our vital prevention and care initiatives.

This booklet gives you a snapshot of some of the recent discoveries made by BHF-funded research all over the UK. You will meet people doing the research and read real stories of people who it could help.

BHF-funded researchers are helping to improve diagnosis and treatment of heart disease (page 45) and have already helped to identify people with a dangerous inherited condition (page 49).

We are also giving regenerative medicine research a major boost through our Mending Broken Hearts appeal (page 35). With your support, we will fund the science to repair the heart after a heart attack, within the next ten years.

Thank you for your support.

We fund the work of thousands of researchers around the UK. These stories are some recent discoveries they've made thanks to your help.

BHF Professor
Andrew Baker
University of Glasgow

Find out more at
bhf.org.uk/heartscience

As of January 2012 we fund 29 BHF Professors – world leading experts in their field – based all around the UK from up in Edinburgh down to Southampton.

First gene therapy trials for coronary bypass patients

After 15 years of laboratory science, BHF Professor Andrew Baker is taking his gene therapy technique out of the lab and into the first clinical trials of its kind. If successful, the therapy could prevent heart bypass failure.

One of the best ways to treat angina – pain or discomfort in the chest caused by heart disease – is through bypass surgery where blood is re-routed to avoid a blocked artery. Every year more than 25,000 people in the UK undergo this procedure and the majority involve grafting a piece of vein to carry the re-routed blood.

"This vein suddenly has to take over the workload of an artery, which carries blood at higher pressure," explained Professor Baker. "And this can eventually cause the grafted vein to thicken and narrow becoming just like the blocked artery it was meant to replace."

Professor Baker and his team at Glasgow are now starting trials in patients to test the safety and effectiveness of a gene therapy technique that could prevent the bypass vein thickening. "If the clinical trials show our therapy is safe and works then it could eventually be offered to people at risk of bypass failure and prevent recurrence of angina," said Professor Baker.

Researchers have revealed how an unhealthy lifestyle can prematurely age our arteries causing heart disease. The project is also giving an insight into how we could reduce the impact normal ageing has on our heart health.

Healthy arteries are vital for a healthy heart. The heart is a hard working muscle and it needs a constant, regular supply of oxygen from your blood. Without this oxygen the heart can't keep pumping blood around your body. As you get older, your arteries age too and gradually harden making them not as good at carrying blood to the heart and rest of the body. But scientists have discovered that this ageing process can happen prematurely partly through the effects of smoking and an unhealthy diet.

Professor Cathy Shanahan led the research at King's College London that made this discovery. Cathy and her colleagues were studying a rare genetic disease called Progeria that causes premature ageing. People with Progeria are particularly susceptible to heart and circulatory diseases at a young age. This is because the disease affects the smooth muscle cells that form the walls of blood vessels – they become hard like bone and accumulate fat that can cause blockages. "This led us to wonder whether this rapid degeneration of smooth muscle cells might be the same process that occurs in normal ageing but in fast-forward" explains Professor Shanahan.

The researchers found that a protein called prelamin A, albeit in slightly different forms, is present in people with Progeria and older people who have aged normally. They also found that prelamin A was present in people with coronary heart disease, no matter their age. Professor Shanahan found: "When prelamin A is present, it shows the blood vessels have aged but its presence in diseased vessels indicates that it speeds up this ageing process." Prelamin A builds up naturally with age, causing harm to blood vessels but it seems to happen quicker in response to the damaging effects of smoking and an unhealthy diet.

Cathy and her colleagues at King's College's BHF Centre of Research Excellence are continuing this work by looking at the effects of prelamin A on the blood vessels in the laboratory. They also want to see what's happening at the detailed molecular level. Professor Shanahan is excited about the findings so far: "People used to think age was an unmodifiable risk factor in heart disease but now we're starting to understand what happens when we age. Hopefully we'll be able to reduce the effects of ageing in the future."

Professor Cathy Shanahan
Kings College London

The genes behind increased diabetes risk in South Asians

Professor Jaspal Kooner
Imperial College London

Find out more at bhf.org.uk/heartscience

50%

Diabetes increases heart disease risk by 50 per cent.

Type 2 diabetes is much more common in the South Asian community than the rest of the population but it's not clear why. Researchers are hunting for genes that might explain why South Asians are at increased risk.

Rates of diabetes differ between ethnic groups and the UK South Asian population is more than twice as likely to have diabetes compared to the general population. The risk of type 2 diabetes can be increased by an unhealthy diet and being physically inactive but we know that genetics also contribute. Diabetes increases someone's risk of heart disease by 50 per cent.

"As a consultant cardiologist in West London nearly 20 years ago, I noticed highly disproportionate levels of diabetes in my South Asian patients," said Professor Jaspal Kooner who recently led a study, part-funded by us, into the genetics of South Asians with diabetes. "This observation prompted me to start researching the causes, including the genetics."

Professor Kooner launched the Lolipop Study where he and his colleagues followed the health of 30,000 South Asian volunteers from West London over the past decade. By observing these people over the long-term, the researchers have learnt a lot about the causes of ill health.

The prevalence of type 2 diabetes for people of African Caribbean and South Asian ethnicity is much higher than in the rest of the UK population.

£1.5bn

Over the last 50 years the BHF has invested an estimated £1.5 billion in today's money funding research into the causes of and treatments for diseases of the heart and circulation.

In the UK coronary heart disease rates are highest in South Asian communities.

"Through Lolipop, we have learnt more about behavioural causes of heart disease and diabetes such as the influence of bad diet and lack of exercise but now, thanks to advances in technology and collaborations with researchers from different fields, we are learning about the genetic causes too," said Professor Kooner.

In recent research the scientists did something called a genome wide association study (GWAS). This is a technique used to identify genes involved in a disease – in this case type 2 diabetes. The scientists compared the genetic codes of tens of thousands of South Asians who developed type 2 diabetes with those who didn't and searched for minor genetic variations more common in the diabetics.

"GWAS identified six new genes linked to type 2 diabetes but we later discovered these were not unique to South Asians so we're still looking," said Professor Kooner. "Previous work has shown that it isn't environmental factors causing this increased risk and so far the genetic clues have proved hard to find." Once the researchers find these elusive genes they hope to start identifying people at risk of diabetes earlier and then take steps to reduce that risk.

80%

In 2010/11 almost 80 per cent of our charitable expenditure was invested in research.

Professor Paul Evans
Imperial College London

Find out more at bhf.org.uk/heartscience

Green veg protects blood vessels

BHF-funded research has shown why green vegetables are healthy by finding a chemical in them that has protective effects against heart disease.

The build-up of fatty deposits in arteries feeding the heart and brain can cause angina, heart attack or stroke. This mostly occurs at branches and bends in arteries where blood flow is low and disrupted. Professor Paul Evans at Imperial College London wants to understand how blood flow influences the disease process.

"We studied a number of genes that protect arteries from disease – many protective genes are switched off in cells at branches and bends which could explain why these regions are susceptible to disease" explains Professor Evans. One particular gene normally switched off in regions of low blood flow is called Nrf2.

Professor Evans and his team found that a naturally occurring chemical, called sulphoraphane, found in some vegetables such as broccoli can switch on Nrf2.

Evans' team gave sulphoraphane to mice and found it protected their arteries from disease. Professor Evans adds: "Ultimately we would like to use this knowledge to develop new drugs that could protect arteries against disease." But the research also shows the benefits of a good diet.

Scientists clarify the role of harmful fats in the blood

As well as cholesterol, we also have fats in our blood called triglycerides. For years scientists have been uncertain about whether these fats cause heart disease. Research part-funded by the BHF has settled this controversy.

The blood fat that gets most attention is cholesterol but University of Cambridge researchers have improved our understanding of another group called triglycerides that also affect heart health. These energy-rich fat molecules are naturally produced by the liver but can also come from eating certain types of fat-rich food.

Scientists have known for some time that high levels of triglycerides are associated with heart disease but despite this research had not found conclusive proof that high levels could be causing disease. Dr Emanuele Di Angelantonio and his colleagues at Cambridge decided to look for an answer by analysing the results of over 100 of these studies using what's called a 'meta-analysis'.

"By doing a meta-analysis, we could combine the results of lots of different studies to get some certainty where individually these studies had not produced significant results about the importance of triglycerides," explained Dr Di Angelantonio. With his colleagues he looked at data from studies that assessed the impact on triglyceride levels and risk of heart disease of having a particular version of a gene. "We focused on a variant of a gene, called APOA5, known to influence triglyceride levels," said Dr Di Angelantonio. This variant causes increased triglyceride levels in the blood. "People with this variant had an 18 per cent greater risk of heart disease than people without the variant of APOA5," added Dr Di Angelantonio.

The results indicated that triglycerides were causing heart disease but it was not exactly clear how. "More research is needed to show whether action to reduce levels of triglyceride in the blood actually reduces the risk of heart disease," said Dr Di Angelantonio. This would involve doing large clinical trials over extended periods of time.

These kinds of meta-analysis studies, where lots of different sets of results are looked at together, are important because they allow researchers to see clearer pictures than they might get from just one study. Similar work done by BHF Professor Sir Rory Collins led to large scale clinical trials, funded by the BHF, which showed the effectiveness of statins. Many lives are being saved already by people taking these drugs to reduce their cholesterol level. Perhaps in the future more people will take drugs similar to statins that reduce their triglycerides to reduce their heart disease risk.

Dr Emanuele Di Angelantonio
University of Cambridge

Analysing our aspirin advice

Professor Gerry Fowkes
University of Edinburgh

Find out more at bhf.org.uk/heartscience

98%

In 2009/10, 98 per cent of patients who went to hospital with a heart attack in England and Wales were prescribed aspirin.

Researchers examined the benefits of taking a daily aspirin. The results affirmed our advice that only people with symptomatic or diagnosed heart disease should take aspirin every day.

Aspirin is vital for treating heart disease – it reduces the risk of blood clots that might otherwise lead to heart attacks. But this positive effect has the side effect of increasing the chance of internal bleeding, so it's important to understand when the risks might outweigh the benefits.

"We examined aspirin treatment and its impact on a group at risk of heart attack – people with evidence of artery disease in their legs" explained Professor Gerry Fowkes. The researchers analysed data from 16 previous studies carried out world-wide to see any patterns that might otherwise be hidden in just one study.

This kind of research is crucial for providing evidence to show which treatments work and what improvements can be made. "Our study showed that this group, though at increased risk of heart attack, should not take daily aspirin to reduce that risk because of the side effects," said Professor Fowkes.

But recently there has been increasing evidence that aspirin can reduce the risk of cancer. This means our advice could change so please visit bhf.org.uk for up-to-date information.

BHF-funded researchers at Queen's University Belfast have found a way that could reduce the heart-damaging properties of chemotherapy.

Many vital drugs used to treat cancer are 'cardiotoxic' – they can cause heart failure – so they have to be used at low doses. But BHF-funded research could change this.

"Because chemotherapy agents can have cardiotoxic effects the clinical doses currently used are kept quite low. This means they are not as effective as they could be against cancer," explains Dr David Grieve. Research in Dr Grieve's lab at Queen's University Belfast investigates why some cancer drugs have cardiotoxic effects and how this can be prevented.

Dr Grieve's work focuses on a drug called Doxorubicin, used to treat a variety of cancers including breast, ovarian and bladder. "Virtually all chemotherapy drugs have some kind of cardiotoxic action but we focused on Doxorubicin because it's one of the most widely used," says Dr Grieve.

Dr Grieve and his team found out how an enzyme called NADPH oxidase can cause heart failure due to chemotherapy. Healthy people normally have low levels of NADPH oxidase in their cells. The body's response to the chemotherapy can cause levels of it to increase. The researchers believe this may damage the heart.

The researchers mimicked the sort of treatment given to cancer patients by giving mice Doxorubicin. They then looked at the effects of switching off NADPH oxidase, and found that Doxorubicin treatment no longer led to heart damage. This remained the case even after several rounds of treatment with the drug.

Their next aim is to understand the precise role of NADPH oxidase in causing human heart failure. This knowledge could help us find a practical way to prevent cardiotoxicity during chemotherapy. Dr Grieve adds, "If we can discover a co-therapy to prevent the cardiotoxic effects it would mean that the cancer treatment could be given at a much higher dose thereby saving lots of lives."

As well as producing a drug to block NADPH oxidase in cancer patients, Dr Grieve hopes that their work could one day lead to a simple blood test to assess a person's NADPH oxidase activity levels. If cancer patients are found to have high levels of NADPH oxidase, they might be at greater risk of heart failure while on some treatments. Doctors could then adjust their medication accordingly, potentially saving lives.

Dr David Grieve
Queen's University Belfast

Unlocking the secrets of fish oil

In 1961 someone died from cardiovascular disease in the UK every 98 seconds but in 2009 it was every 174 seconds.

Professor Ed Rainger
University of Birmingham

Find out more at bhf.org.uk/heartscience

University of Birmingham researchers have demonstrated why fish oils are good for our circulatory health. Harnessing this knowledge could lead to exciting new ways to help prevent heart disease.

The benefits of eating oily fish are frequently discussed but less is said about exactly how these oils are beneficial. Professor Ed Rainger and his colleagues have shed some light on this 'super food' and his results could, he hopes, eventually lead to new drugs that harness the power of fish oils.

The researchers tested the effects of an Omega-3 molecule, an essential polyunsaturated fatty acid found in fish oil, on our blood vessels. "We found these fatty acids naturally dampen inflammation and they appear to do this in a way we'd been unaware of," says Professor Rainger. Inflammation is part of the body's natural defences but too much inflammation can cause damage. It can contribute to heart disease where the arteries harden and narrow.

Professor Rainger hopes this work could eventually lead to drugs that mimic the effects of Omega-3: "These fatty acids are helping us identify new steps in the inflammatory process and showing us how inflammation is regulated. They could allow us to develop new therapies that can step in when inflammation is harming and not healing."

£100m

In 2010/11 our annual investment in research topped £100 million for the first time.

Dr Nick Mills
University of Edinburgh

Find out more at bhf.org.uk/heartscience

Tiny particles in exhaust fumes that cause big problems

BHF-funded research has discovered the potential damage to heart health caused by air pollution including the discovery that diesel contains tiny particles that increase the risk of clots that can cause a heart attack.

Researchers at our University of Edinburgh Centre of Research Excellence including BHF Professor David Newby and BHF Intermediate Research Fellow Dr Nick Mills have made great strides into finding out how pollution affects heart health.

"People understand that air pollution can damage the lungs, but at Edinburgh we've found that pollution also has important effects on the heart and circulatory system," said Dr Mills. This research is boosted by collaborations with specialist research teams in the Netherlands and Sweden. They have also carried out testing in Beijing – one of the most polluted cities in the world – to see if reducing exposure to air pollution could have benefits for heart and circulatory health.

In Beijing, local people with heart disease volunteered to walk around the city hooked up to portable blood pressure and heart rate monitors while wearing trendy backpacks. "But these backpacks were not just a fashion accessory; they contained specialist monitoring equipment that measured their heart function and exposure to air pollutants," explained Dr Mills.

Dr Mills and his colleagues found that when the volunteers wore a highly efficient facemask that filtered out pollution particles, measurements showing their heart and circulatory health appeared to improve – their blood pressure was lower and their heart activity was healthier. The scientists have since found out which constituents of pollution could be having this negative effect on the heart and circulatory system.

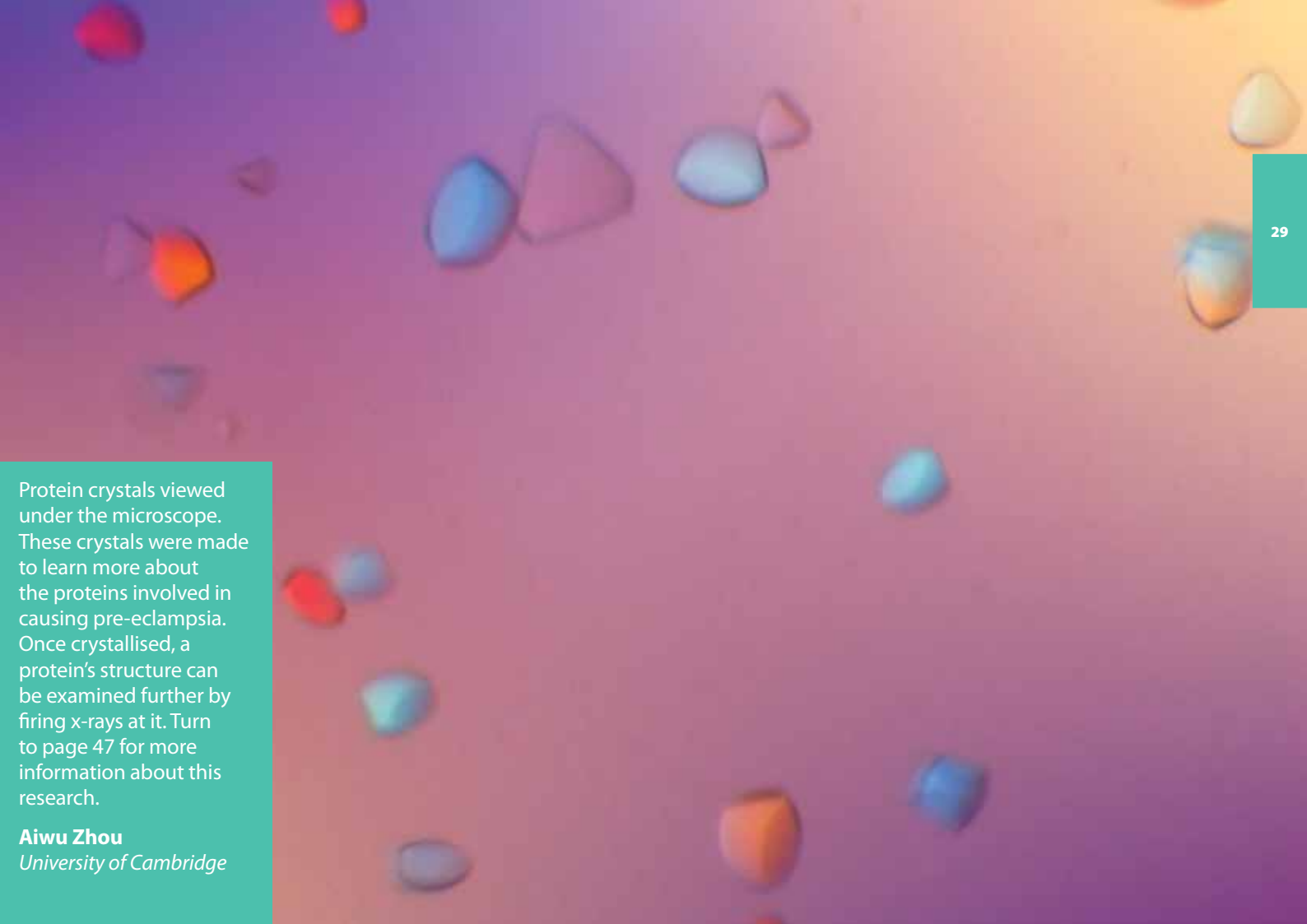
"We found that tiny 'nanoparticles' in diesel exhaust produce highly reactive molecules called free radicals that can injure blood vessels and lead to disease," said Dr Mills. These nanoparticles – less than a thousandth of a millimetre wide – prevent blood vessels from relaxing and contracting properly, which is vital for keeping them free from disease. The disturbance to blood vessel function means there is increased risk of clots developing in coronary arteries, which can cause a heart attack.

"We are now looking at ways to remove these particles so that we can prevent some of the negative health effects of vehicle emissions," said Dr Mills. In the future lives could be saved by designing equipment that filters these particles out of vehicle exhaust fumes or by finding ways to prevent the particles from being released when the fuel is burnt.

Heart research and treatment has benefited from great advances in imaging technology. These pictures show how far we've come.

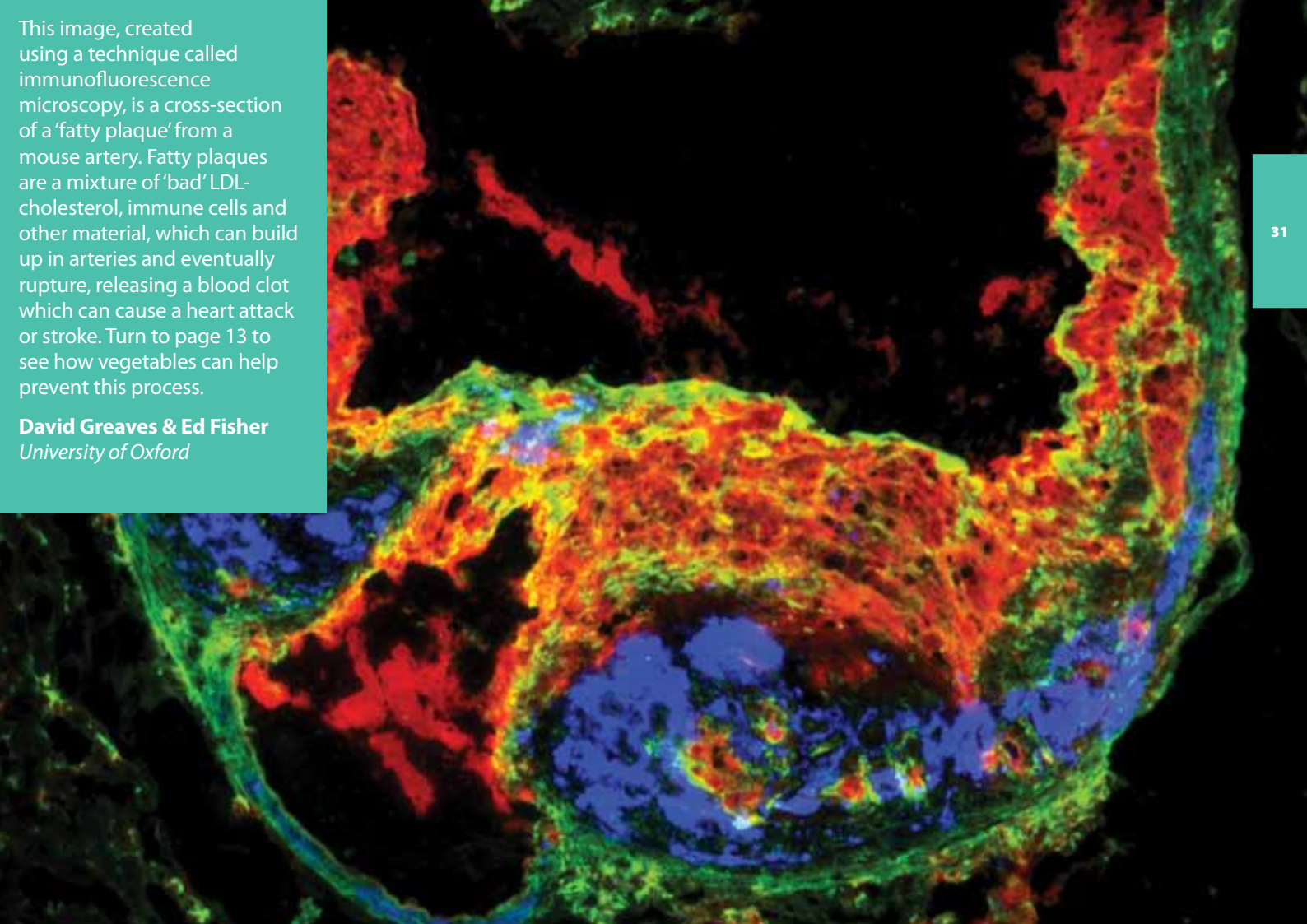
Megakaryocytes are cells in the bone marrow that produce blood cells called platelets, which are vital for blood clotting. This megakaryocyte has been stained with fluorescent dyes. Some bleeding disorders are due to people not having enough platelets, which impairs the blood's ability to clot. Studying how platelets come from megakaryocytes is improving our understanding of how to control platelet numbers. This could lead to new treatments for bleeding disorders.

Hannah Schachtner
University of Glasgow



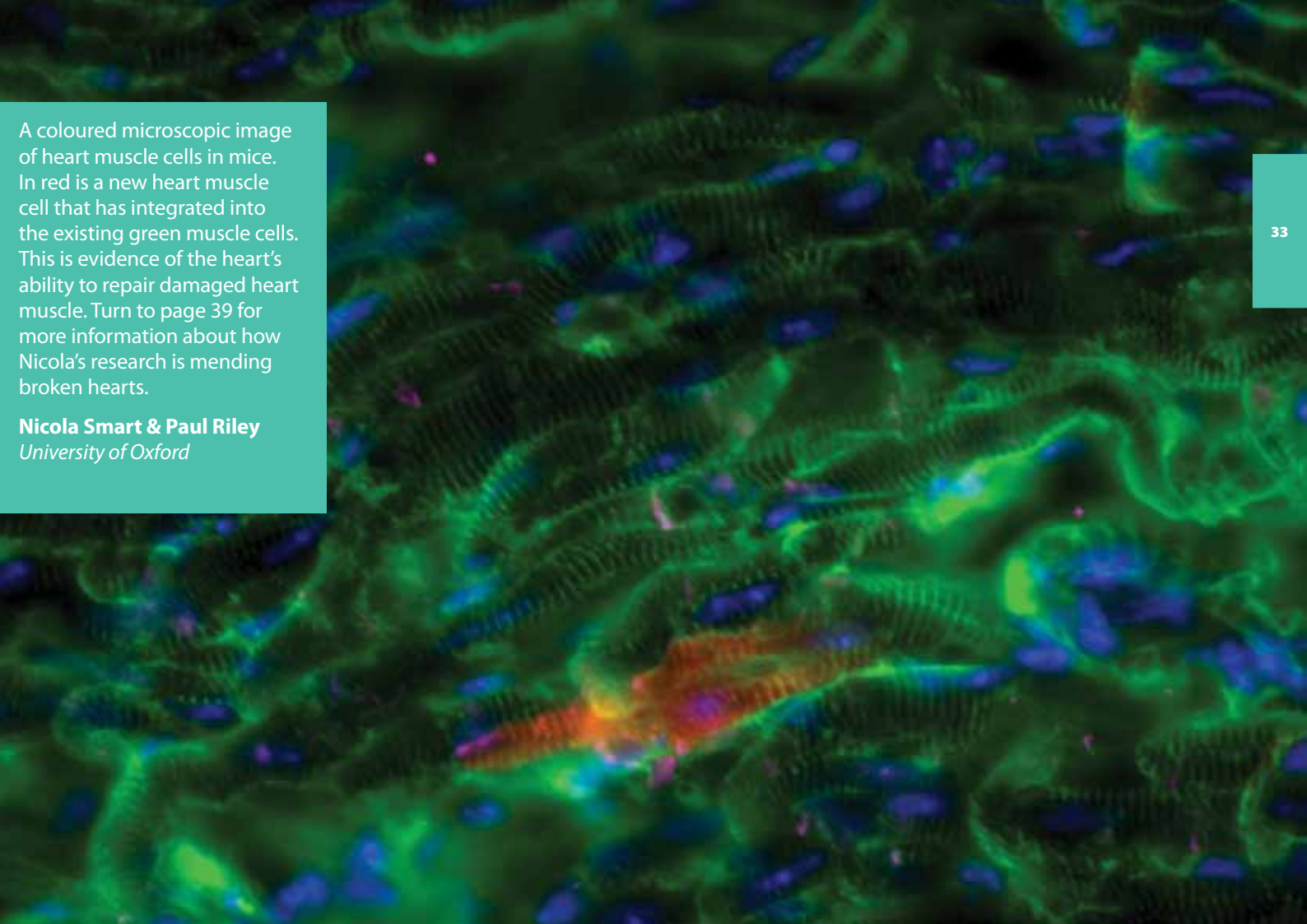
Protein crystals viewed under the microscope. These crystals were made to learn more about the proteins involved in causing pre-eclampsia. Once crystallised, a protein's structure can be examined further by firing x-rays at it. Turn to page 47 for more information about this research.

Aiwu Zhou
University of Cambridge



This image, created using a technique called immunofluorescence microscopy, is a cross-section of a 'fatty plaque' from a mouse artery. Fatty plaques are a mixture of 'bad' LDL-cholesterol, immune cells and other material, which can build up in arteries and eventually rupture, releasing a blood clot which can cause a heart attack or stroke. Turn to page 13 to see how vegetables can help prevent this process.

David Greaves & Ed Fisher
University of Oxford



A coloured microscopic image of heart muscle cells in mice. In red is a new heart muscle cell that has integrated into the existing green muscle cells. This is evidence of the heart's ability to repair damaged heart muscle. Turn to page 39 for more information about how Nicola's research is mending broken hearts.

Nicola Smart & Paul Riley
University of Oxford

This image shows heart muscle cells grown from stem cells. The cells are stained with fluorescent pigment to show the muscle proteins in blue and green. Each cell's control centre – the nucleus – is seen in red. Hopefully this technique of growing tissue could be used to mend broken hearts. Turn to page 37 for more information about how our scientists are making new heart cells.

Gabor Foldes, Sian Harding, Michael Schneider & Nadire Ali
Imperial College London

Through our Mending Broken Hearts Appeal we hope to spend £50 million on funding groundbreaking research, like this, that could 'mend broken hearts' in as little as 10 years' time.

Turning skin cells into heart cells

BHF-funded researchers can now turn a heart patient's skin cells into new heart cells that could be used to learn more about their condition and test drug therapies.

The heart is a pump made up of tiny muscle cells that contract – co-ordinated by waves of electrical activity. Faults in this co-ordination system, for example in people with the rare condition Long QT Syndrome, can be deadly.

"If you have Long QT, your heart cells take longer to recover after being electrically charged," explains Professor Chris Denning, who studies the condition at the University of Nottingham. "This is because proteins in the heart cells that allow this recovery don't work properly."

These proteins are gates that allow electrically charged ions to leave the cell. In Long QT these gates are closed and ions accumulate in the cell, disrupting heart rhythm. "The heart of someone with Long QT might go from beating normally to a chaotic rhythm that can be so extreme it causes the heart to stop – the person goes into cardiac arrest," said Professor Denning.

Scientists need to find ways to fix these faulty proteins but until now they couldn't study these heart cells in the laboratory because the researchers need living heart cells and once removed from someone, these cells are hard to keep alive.

Stem cell research has made this possible. Professor Denning takes skin cells from patients with Long QT and turns them into heart muscle cells in the lab. "We do this by growing their small sample of skin cells into a big batch of them. But these cells are specialised – they are built to do the job of skin. They can't be heart cells without us first making them unspecialised".

While unspecialised, the cell is an induced pluripotent stem (iPS) cell. The iPS cells can become many different cell types. "We made heart muscle cells from the iPS cells of people with Long QT and measured their electrical activity, just as a cardiologist might measure the electrics of the person's heart using an ECG," said Professor Denning. "We found that each cell's electrical activity matched what doctors saw in their whole heart."

The scientists even saw that when given a drug, each new cell responded in the same way as the whole heart did. Professor Denning can now use this method to test new drugs that could be used to control the abnormal heart rhythms in people with Long QT Syndrome.

Professor Chris Denning
University of Nottingham

Dr Nicola Smart
University of Oxford

Find out more at bhf.org.uk/heartscience

£50m

In 2011 we launched the Mending Broken Hearts Appeal which aims to spend £50 million on an ambitious programme of regenerative medicine research over the next five to ten years.

Teaching the heart to repair itself

A world-leading research team has demonstrated that heart muscle damage could one day be repaired after a heart attack. The scientists have taken a step towards Mending Broken Hearts.

Dr Nicola Smart works with BHF Professor Paul Riley; together they successfully coaxed cells on the outer edges of the heart in mice to grow new blood vessels in damaged hearts. Dr Smart has continued that good work with Professor Riley by demonstrating these epicardial cells on the outside of the heart can help grow new heart muscle after heart damage.

"We used a protein called thymosin beta-4 to restart the heart's inherent capacity for repair," said Dr Smart. This self-repair mechanism is an essential requirement for the developing hearts of babies in the womb. But it becomes dormant soon after birth.

Now Dr Smart and her team plan to examine how to apply the finding in humans. The research was carried out at University College London but with additional BHF support they have now moved to Oxford to link up with the BHF Centre of Research Excellence there.

"At Oxford we intend to take advantage of their facilities for testing alternatives to thymosin beta-4 that might be even more effective at kick-starting heart repair after heart attack," explained Dr Smart.

When is a stem cell not a stem cell?

Professor Manuel Mayr and his colleagues, at our King's College London Centre of Research Excellence, have shown that a special technique for identifying proteins is key for telling scientists which cells are stem cells.

Stem cell research is one of the most exciting areas of science. These amazing cells have the potential to turn from being unspecialised 'blank canvases' into specialist cells for the brain, eye, and many other organs including the heart. One promising source of stem cells is our bone marrow.

But unfortunately for scientists there are lots of different cell types in bone marrow. So researchers need to be sure when they use bone marrow samples that they have separated out the stem cells from the rest.

"At King's we're using a technique called proteomics to identify the proteins in cells. We can use this to say for certain whether cells that seem to have beneficial effects are really what we think they are," explained Professor Manuel Mayr. When cells are taken from the body, it can be difficult to obtain a pure sample. For example, if the cells come from a blood vessel, the sample contains lots of blood cells too.

This is important because if the sample seems to show a beneficial or harmful effect in laboratory tests, the scientist needs to be sure exactly which cell type is causing these effects. Different cells contain unique sets of proteins. So Professor Mayr can use proteomics to find the identity of cells based on the proteins present.

"We create a 'fingerprint' of all the proteins present in the cells we're testing and then compare that fingerprint to the known fingerprint of a pure sample of stem cells," said Professor Mayr. If the fingerprints contain proteins that shouldn't be there, they know there are other cells in the sample.

Professor Mayr's work is making stem cell research more robust and reducing the likelihood of raising false hopes. In recent research, he used proteomics to show that conventional methods for isolating one particular type of stem cell – endothelial progenitor cells (EPCs) – led to contamination from a type of blood cell called a platelet. "We found that these platelets allowed other cells to masquerade as EPCs and this was only discovered by using proteomics," said Professor Mayr. His research means that when stem cell therapies are trialled on people, scientists can be more certain that any positive effect is due to stem cells and not something else.

Professor Manuel Mayr
Kings College London

Learning from zebrafish how to mend broken hearts

Unlike ours, if a zebrafish's heart is damaged it will repair itself. To mend broken hearts and prevent heart failure, we need to know how that happens – Professor Roger Patient has found a key molecule in the process.

Zebrafish may not look much like us, but we share very many genes. This means they can teach us a lot about repairing human hearts. Professor Patient found the specific protein molecule that tells certain stem cells in the zebrafish embryo to grow either new heart muscle or blood vessels.

It raises the possibility of using the equivalent human protein to instruct our stem cells to turn into heart cells. "By knowing the signal that controls whether a stem cell becomes heart muscle or vessel, we could manipulate it to create heart cells for repair after heart attack," explained Professor Patient. His established team at Oxford will now be able to share knowledge and skills with Dr Nicola Smart (see page 39) and her colleagues who recently moved to Oxford.

Professor Roger Patient
University of Oxford

Your support is helping people now and could help even more people in the future. These are some of their stories.

Dick's story
Improving heart disease diagnosis

After Dick began feeling breathless while out walking, he visited the doctor and was checked for suspected heart disease. Dick received the standard tests but also had an MRI scan as part of a BHF-funded clinical trial. The scan gave a clear picture of Dick's condition and the trial demonstrated MRI could be taken up more widely as a more informative and safer alternative to current investigations of the heart.

As a keen walker Dick Downing, 64, is lucky to have the beautiful Yorkshire Dales on his doorstep. But in 2008, while hiking with a friend, Dick was surprised to find that he was struggling to climb even moderate slopes. "I became terribly out of breath, which was unusual for me, so I told my friend we'd have to stop and head back," remembers Dick.

"I went to the doctor and she did an ECG and promptly called an ambulance – I had no idea I had a significant heart problem," says Dick. At the cardiology department doctors followed the standard procedure and carried out a number of diagnostic tests followed by an angiogram – an invasive exploratory procedure that uses x-rays to look inside the coronary arteries. But Dick also had the opportunity to volunteer to be part of a BHF-funded clinical trial led by Dr John Greenwood from the University of Leeds.

Dr Greenwood's trial involved testing the effectiveness of a different diagnostic test – magnetic resonance imaging (MRI). "Although this test has been around for many years, it was not a routinely used test in the NHS for suspected coronary heart disease," explains Dr Greenwood. "We wanted to benchmark MRI's accuracy against the current gold standard – x ray angiography – and compare it to the mainstream non-invasive equivalent – SPECT," adds Dr Greenwood.

The trial showed that doctors could more accurately diagnose Dick and the other patients' heart disease using MRI. After the success of this trial Dr Greenwood is going to see whether MRI alone could become standard practice instead of the other diagnostic tests.

It was vital Dick visited the doctor when he did. "I was 99 per cent blocked in one blood vessel so I needed a stent to unblock the artery," recalls Dick. "Afterwards I immediately felt fantastic. It was unbelievable – an instant improvement," he says. Dick now takes tablets to prevent problems with his coronary arteries in the future and he's now able to get back out walking in the Dales.

Dick Downing

Karen's story
Hope for a cure for pre-eclampsia

Karen suffered from pre-eclampsia during two of her pregnancies – fortunately, in both cases, she and the babies got through the births well. They were lucky – the condition kills six women and hundreds of babies every year in the UK. There's currently no cure but our researchers have made a breakthrough that offers real hope that a therapy can be developed in the future.

"Twenty two years ago, when I was carrying my first child Laura, doctors realised my blood pressure was dangerously high," says Karen Partridge, aged 46. Karen was suffering from pre-eclampsia – a condition in pregnancy, caused by problems in the placenta, where blood pressure rockets. "I was really worried that my baby and I could die."

Doctors had to induce labour to deliver Laura as soon as possible – this is the only way to stop pre-eclampsia. "It was a terrifying time for everyone but fortunately the birth went well and Laura is 22 and enjoying life to the full," says Karen. There's no other treatment, so babies sometimes have to be delivered very prematurely.

But BHF-funded scientists at the University of Cambridge have made some discoveries in the lab that may offer hope for a future treatment. "I've spent the last twenty years trying to understand how blood pressure is controlled and then what goes wrong with this system to cause pre-eclampsia," says Professor Robin Carrell. "In recent years, thanks to the BHF we've had Aiwu, who's been key to helping us improve our understanding," adds Professor Carrell.

Dr Aiwu Zhou is a BHF Senior Research Fellow and, working with Professor Carrell, he's shed light on how blood pressure is controlled by hormones called angiotensins. "We've found that angiotensins carried in the blood exist in two interchangeable forms – one more active than the other. Women with pre-eclampsia appear to have more of the active form causing raised blood pressure. Hopefully we can come up with a way to tip the balance in favour of the less active form so blood pressure can go back to normal," explains Dr Zhou.

"We were lucky but hopefully in the future Robin and Aiwu's laboratory discoveries can help lead to a treatment and possibly a cure for pre-eclampsia so no-one else has to go through the same experience," says Karen. If the researchers can come up with a way to treat the high blood pressure in pre-eclampsia, they may also be able to come up with something to prevent high blood pressure generally, reducing the risk of people developing heart disease.

Karen Partridge

It is estimated that around 100,000 people with familial hypercholesterolaemia in the UK are undiagnosed.

Suzanne Sheppard

Find out more at bhf.org.uk/heartscience

Suzanne's story

Familial hypercholesterolaemia: a silent killer

Suzanne didn't know she had an inherited condition called familial hypercholesterolaemia, which put her at very high risk of heart disease. Thanks to BHF-funded research and a new testing service we part-funded in Wales, she's got a diagnosis that could save her life.

Suzanne is 39 years old, works part-time as a paralegal, and has a five year old son. Despite a healthy lifestyle, Suzanne is at higher risk of heart disease than most people because of her genes. "I have a condition called familial hypercholesterolaemia or FH that causes me to have high cholesterol that if left untreated could mean I get heart disease at a younger age," explains Suzanne. Her body can't process cholesterol normally so it stays in the blood where it can begin to form fatty plaques on the walls of arteries.

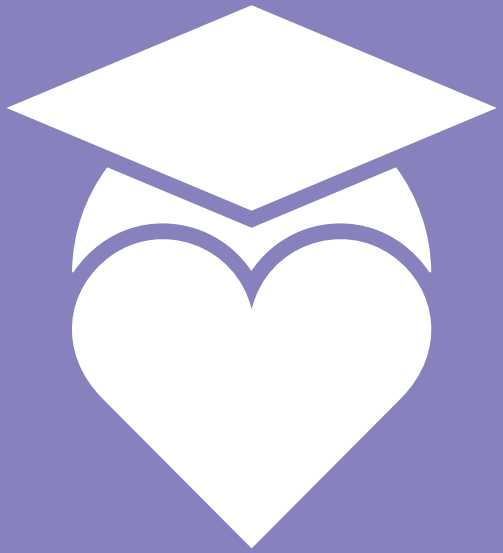
FH is caused by a genetic mutation – a slight variation in the DNA that makes up Suzanne's genes. BHF Professor Steve Humphries has studied FH for almost 30 years and has made a major contribution to our knowledge of the condition. Professor Humphries was one of the first to show a DNA test could be used to see whether relatives of someone with FH also have the condition. "Since then we've put a lot of work into developing faster and faster, more accurate, and cheaper ways to test and find the genetic mutation in a person if he or she is suspected of having FH," says Professor Humphries.

Suzanne was suspected of having FH because her cholesterol levels were unusually high. Doctors recommended checking her cholesterol because her father died of a heart attack aged just 41. "I had a DNA test where scientists checked to see if I had a mutation that causes FH," says Suzanne. This test is now being used as part of a screening programme, part-funded by the BHF, in Wales.

Now, if someone in Wales has an unusually high cholesterol level their DNA can be tested for FH genes. If one is found, then their immediate family can be contacted to see if they want to be tested. "My son will be tested to see if I've passed my FH gene onto him. Hopefully he won't have it but if he does, thankfully we'll know early so doctors can give him medication and advice to reduce its impact," says Suzanne.

FH, once diagnosed, is a very manageable condition. Suzanne now takes cholesterol lowering drugs and is careful to lead a healthy lifestyle to keep her cholesterol as low as possible.

We've invested £34 million in establishing four BHF Centres of Research Excellence that are raising the pulse of UK heart research.



In 2008 we began a six-year, £34 million, investment strategy to support four top UK universities as BHF Centres of Research Excellence. This scheme aimed to secure the UK's future as a world-leading force in heart research by attracting the best young scientists into the field.

£7.6 million

University of Edinburgh

£8.9 million

Imperial College London

Thanks to this strategy, we're encouraging innovative approaches in the fight against heart disease and by 2014 an additional 150 heart scientists will have been trained. The funding has also sparked 85 brand new research projects to advance the fight against heart disease.

£9 million

Kings College London

£8.4 million

University of Oxford

University of Edinburgh

Led by Professor John Mullins, Edinburgh's Centre is identifying and exploring risk factors of heart disease such as stress and exposure to air pollution (page 23) and learning how these risks can be managed in people. Edinburgh's two BHF Professors, Keith Fox and David Newby, are leading research programmes there to help beat heart disease.

Edinburgh is also home to a world-leading regenerative medicine facility – Scottish Centre for Regenerative Medicine – thanks in part to money raised through our Mending Broken Hearts Appeal (page 35). Scientists there such as stem cell expert Professor Bruno Péault are working on healing hearts damaged by heart attack.

Imperial College London

World-leading stem cell researcher BHF Professor Michael Schneider heads our Imperial College Centre. Professor Schneider and his team are hoping to come up with ways to mend the broken heart using stem cells. The university carries out high quality clinical research as well as laboratory study (pages 9 and 13).

In addition, we helped fund a new cutting-edge research facility that will bring all their heart research under one roof. Leading scientists from different specialities will be able to collaborate more effectively. Imperial's Centre already has strong collaborative work where biologists are working with engineers, chemists and mathematicians, for example, to help beat heart disease.

Kings College London

Under BHF Professor Ajay Shah's leadership, the King's College London Centre is making great strides in understanding the structure of the heart at a molecular level. This includes BHF Professor Mathias Gautel who is advancing our understanding of heart muscle diseases by studying the muscle cells involved and the latest new BHF Professor, Kinya Otsu from Japan who is researching new treatments for heart failure.

They have world-leading imaging facilities that are improving how doctors can see the damaged heart so that they can make the right decisions about treatment. But they're also coming up with ways to make stem cell research more robust and effective (page 41).

University of Oxford

BHF Professor Hugh Watkins, who has led the way in genetic screening methods to detect inherited heart conditions, leads our Oxford Centre. Fellow BHF Professor Sir Rory Collins is leading research studying the frequency of heart disease in populations and conducting clinical trials to find ways to reduce its burden.

World leading regenerative medicine specialists (pages 39 and 42) at Oxford are coming up with ways to mend broken hearts. These scientists plan to take advantage of a unit there, the BHF Centre for Cardiovascular Target Discovery, to screen large numbers of molecules for their potential to help regenerate damaged hearts.

We rely on your donations of time and money – together we can beat heart disease.

Supporting the BHF

In 2011 we supported over 400 researchers through fellowships and Chair awards, ranging from PhD students to BHF Professors. But we couldn't support leading scientists without vital support through volunteering, donations and fundraising.

"The BHF has supported my science career so I really wanted to give something back," says PhD student Carina Mill who raised around £1,000 for us by cycling over 1,000 miles in two weeks, with seven friends, from her home city of Bristol to Barcelona. "We were so tired by the end but we were spurred on by thinking of all the people who donated money. It's great to give something back because I know how important research is if we're going to beat heart disease – every pound raised can make a real difference."

Please help us to fight heart disease by giving a donation of time or money. You can use the cash donation form included in this booklet, or visit our website – bhf.org.uk/heartscience – for other ways to donate time or money, including volunteering opportunities or fundraising events.

Carina Mill
University of Bristol

Help the BHF save more lives by supporting us with a donation today

Title ☐ First Name ☐ Surname ☐

Address ☐

☐ Postcode ☐

Phone ☐

Email ☐

We would like to keep in touch with you to let you know how your support has made a difference. By supplying your email address you agree that the BHF may use this to contact you about our work.

Please accept my gift of either **£10** ☐ **£15** ☐ **£20** ☐ **Other** ☐

(Please make your cheque/postal order / CAF voucher payable to The British Heart Foundation.)

OR please debit the above sum from my:

☐ AMEX ☐ CAF Card ☐ Master Card ☐ Visa/Delta ☐ Maestro

Card No. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ☐☐☐ (Maestro only)

Valid from ☐☐/☐☐ Expiry date ☐☐/☐☐ ☐☐☐ (security code) Issue no ☐☐ (Maestro only)

Signature ☐ Date ☐☐/☐☐/☐☐

The British Heart Foundation is the nation's heart charity, registered charity number 225971 (England and Wales) and SC039426 (Scotland).

Once completed, please return the whole of this form to:
Freepost RRZJ-LCHX-EKCR, British Heart Foundation, Greater London House, 180 Hampstead Road, London NW1 7AW.

giftaid it

Make your gift worth almost a third more – at no extra cost to you!

Are you a UK taxpayer? If you are a UK taxpayer please tick the **first box** so we can claim back up to **25p** for every **£1** you give **at no extra cost to you.**

GA1 ☐ Yes, I am a UK taxpayer and would like the BHF to reclaim the tax on any of the donations I have made in the last four years and any future donations I may make.*

Date ☐☐/☐☐/☐☐

GA2 ☐ **No**, I am a non-taxpayer.

* To qualify for Gift Aid, you must pay an amount of UK Income Tax and/or Capital Gains Tax at least equal to the tax that the BHF will reclaim on your donations in the appropriate tax year (6 April one year to 5 April the next). Your donation must be of your own money and cannot be a collection.

☐ If you do **not** wish to be contacted by post, please tick this box. (MP0074)

☐ If you do **not** wish to hear from us by phone, please tick this box. (MP0075)

☐ From time to time we allow other similar organisations to contact our supporters. If you do **not** wish to be contacted by them, please tick this box. (MP0060)

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Carina Mill
University of Bristol

Nearly 2.7 million people in the UK are living with coronary heart disease.

Coronary heart disease, by itself, is the most common cause of death in people under 75 in the UK.

1 in 5

Almost one in five men and one in eight women die from heart disease.

Help the BHF save more lives by supporting us with a donation today

Title ☐ First Name ☐ Surname ☐

Address ☐

☐ Postcode ☐

Phone ☐

Email ☐

We would like to keep in touch with you to let you know how your support has made a difference.
By supplying your email address you agree that the BHF may use this to contact you about our work.

Please accept my gift of either **£10** ☐ **£15** ☐ **£20** ☐ **Other** ☐

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Card No. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ☐☐☐ (Maestro only)

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We are the nation's heart charity, dedicated to saving lives through pioneering research, patient care, campaigning for change and by providing vital information. But we urgently need your help. We rely on your donations of time and money to continue our life-saving work. Because together we can beat heart disease.

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bhf.org.uk/publications

Heart Helpline
0300 330 3311
bhf.org.uk

Information & support on anything heart-related. Phone lines open 9am to 5pm Monday to Friday. Similar cost to 01 or 02 numbers.

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F 020 7554 0100

Life-saving science

Recent discoveries from our research

British Heart Foundation