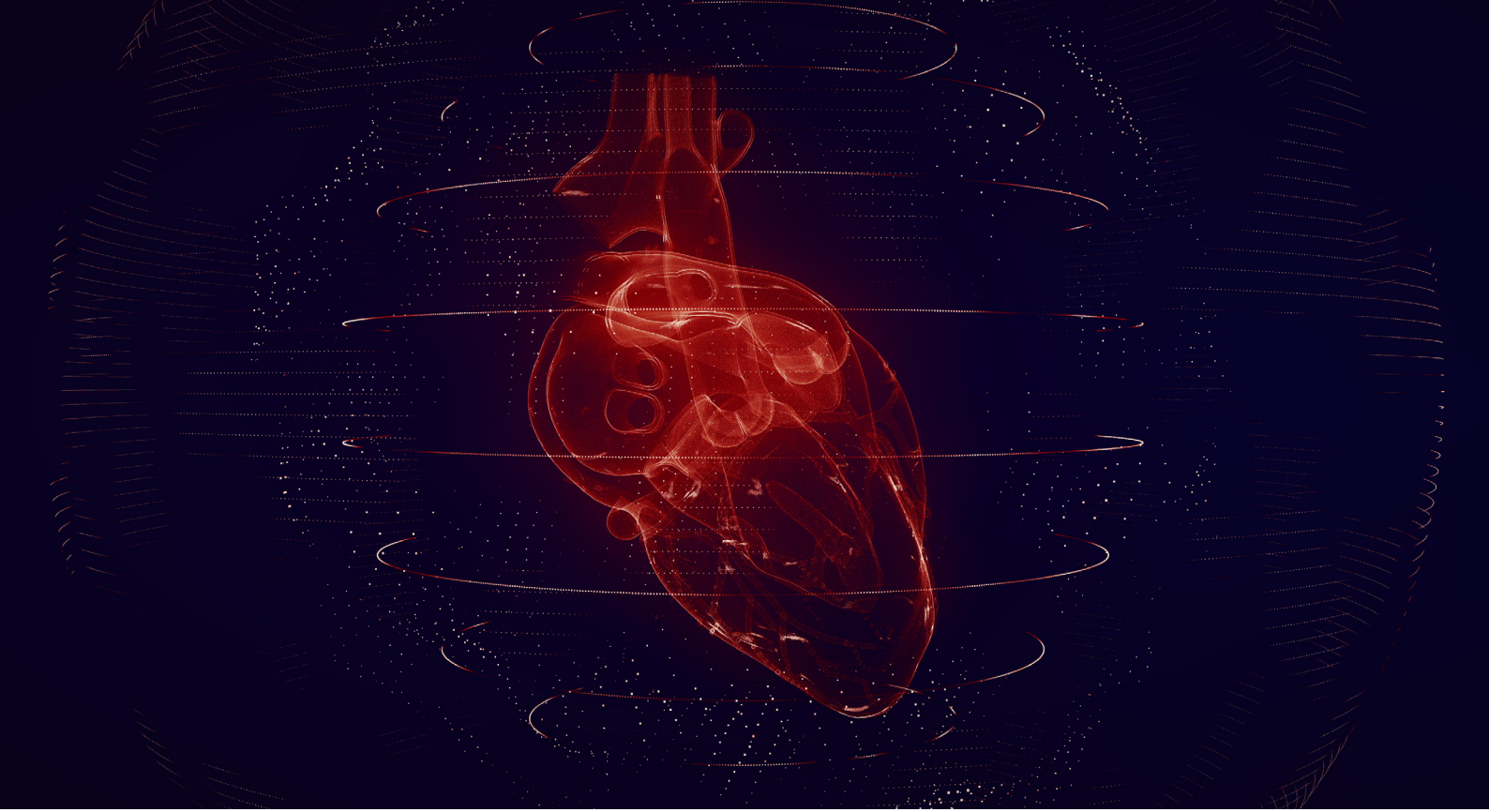


Pumping progress

Impact of British Heart Foundation support for heart failure research

Impact Thematic Review Series | Volume 6 | March 2025

British Heart Foundation

Contents

This review was supported by **Cesare Terracciano**,
Professor of Cardiac Electrophysiology at Imperial College London

Message from our Chief Scientific and Medical Officer

Since British Heart Foundation (BHF) was founded in 1961, it has funded pioneering research that has improved the lives of millions of people affected by cardiovascular diseases. Powered by our supporters and volunteers, BHF-funded researchers have made fundamental discoveries and translated promising science into revolutionary breakthroughs. To crystallise the impact of this research, we are producing reviews that showcase the impact of BHF-supported research in specific areas of cardiovascular medicine. We highlight key research leaders whose work has advanced knowledge, developed new technologies, and improved clinical practice, with the aim of improving the lives of patients living with, or at risk of cardiovascular diseases.

The following pages focus on heart failure, a devastating condition that has huge effects on quality of life. There's currently no cure other than heart transplant. Over the last 60 years, BHF-funded research has contributed to improved outcomes for people with heart failure, allowing them to live longer, healthier lives. Exciting new developments in the field of regenerative medicine offer hope for the treatment of heart failure, and our new gene therapy research centre in partnership with the Medical Research Council (MRC) could bring us closer to a cure.

I look forward to seeing BHF's continued progress in the decades to come.

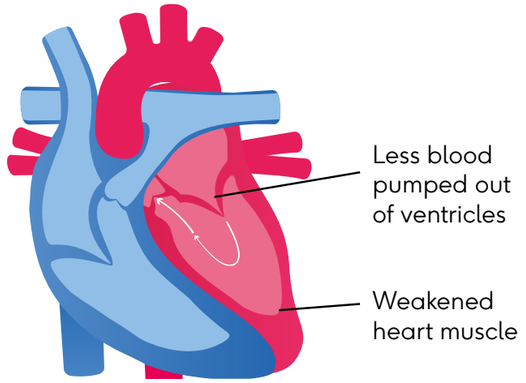
Professor Bryan Williams OBE MD FMedSci
Chief Scientific and Medical Officer,
British Heart Foundation

What is heart failure?

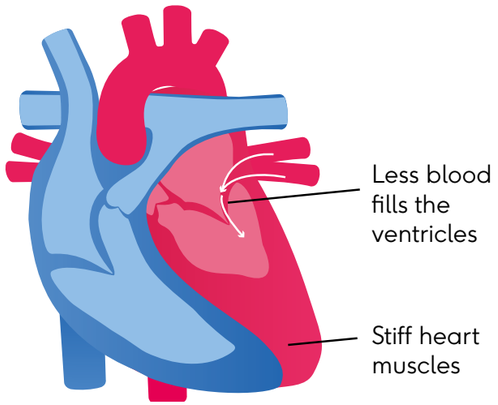
Heart failure is a condition where the heart can't pump blood around the body as well as it should. The heart cannot keep up with its workload, and the body may not get the oxygen it needs. This causes symptoms such as shortness of breath, feeling increasingly tired, feeling lightheaded, and swollen legs and ankles.

Heart failure can happen suddenly (acute) or it can progress slowly over months or years (chronic). It can occur at any age, but is most common in older people.

Heart failure with reduced ejection fraction (HFrEF)



Heart failure with preserved ejection fraction (HFpEF)



Common causes of heart failure

Heart attack
Can cause long-term damage, affecting how the heart can pump blood around the body.

Cardiomyopathy
A group of diseases that affect the heart muscle.

High blood pressure
This puts strain on the heart, which can lead to heart failure over time.

Types of heart failure

Heart failure can be put into different groups depending on ejection fraction (EF) and symptom presentation. EF represents the percentage of blood pumped out of the heart's main chamber with each heartbeat. Heart failure may be classed as the following:

Heart failure with preserved ejection fraction (HFpEF)
EF is greater than 50%. Here the heart's pumping ability is preserved, but symptoms may occur.

Heart failure with mildly reduced ejection fraction (HFmrEF)
EF ranges from 40%-49%. Here the heart's pumping function is slightly reduced.

Heart failure with reduced ejection fraction (HFrEF)
EF is less than 40%. Here the heart's pumping function is significantly reduced.

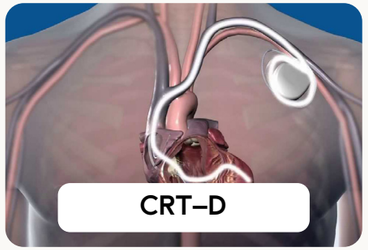
Treating heart failure

There isn't a cure for heart failure but available treatments can help manage symptoms and improve quality of life. Treatments for heart failure include:

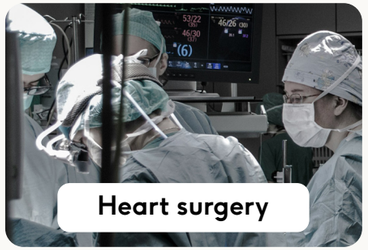
To protect and improve heart function, reduce workload for the heart, improve symptoms and reduce fluid build-up.

A pacemaker helps control the heart rate and heart rhythm to reduce the demand on the heart.

An implantable cardioverter defibrillator (ICD) detects and treats dangerous, irregular heartbeats.



Cardiac resynchronisation therapy with a defibrillator (CRT-D) is a device which acts as both a pacemaker and an ICD, helping both sides of the heart beat together.



To improve blood flow to the heart or to repair/replace a faulty valve that is putting strain on the heart.

The only option for end-stage heart failure.

Our support for heart failure research

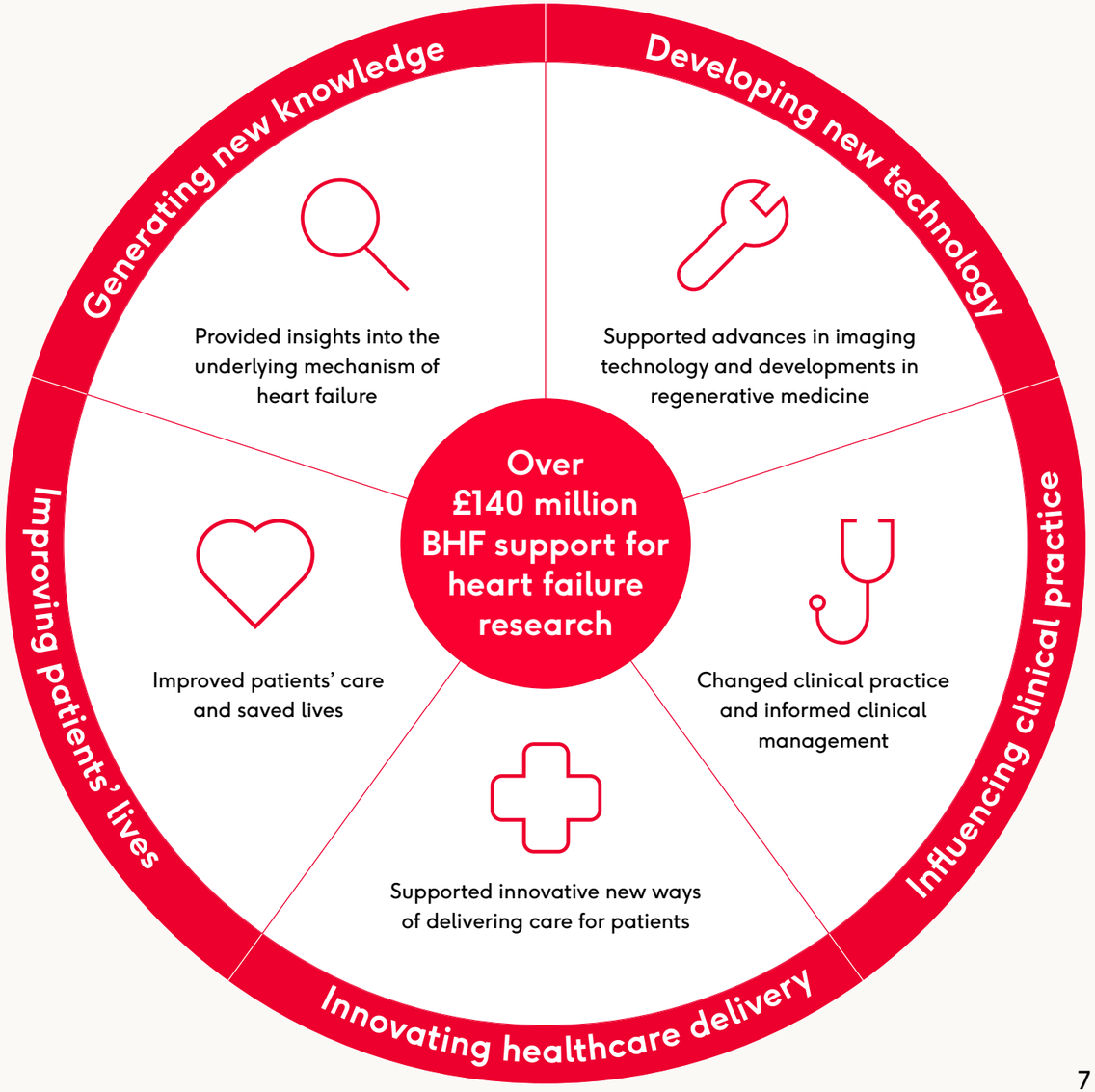
Since its foundation in 1961, BHF has been instrumental in transforming the landscape of heart failure treatment. At that time, the options to treat heart failure were limited and the condition was difficult to manage.

Fast forward to today, and the picture is very different. BHF-funded research has contributed to this change, leading to a significant expansion in treatment options. Diagnostic techniques have advanced, substantial progress has been made in drug therapies, and heart transplant methods have improved. BHF-funded research has helped to transform the outlook for those affected by heart failure, increasing survival rates and improving quality of life.

Thanks partly to advances in the treatment and management of a range of conditions associated with heart failure, the number of people living with the condition is increasing. This increase is further amplified by the UK's ageing population, as older individuals are more likely to develop heart-related conditions. There are around 200,000 new diagnoses of heart failure every year in the UK. To meet this growing need, BHF has worked alongside healthcare services to test new ways of delivering care for heart failure patients to improve lives and relieve pressure on the NHS.

Over **420 grants** worth more than **£140 million**

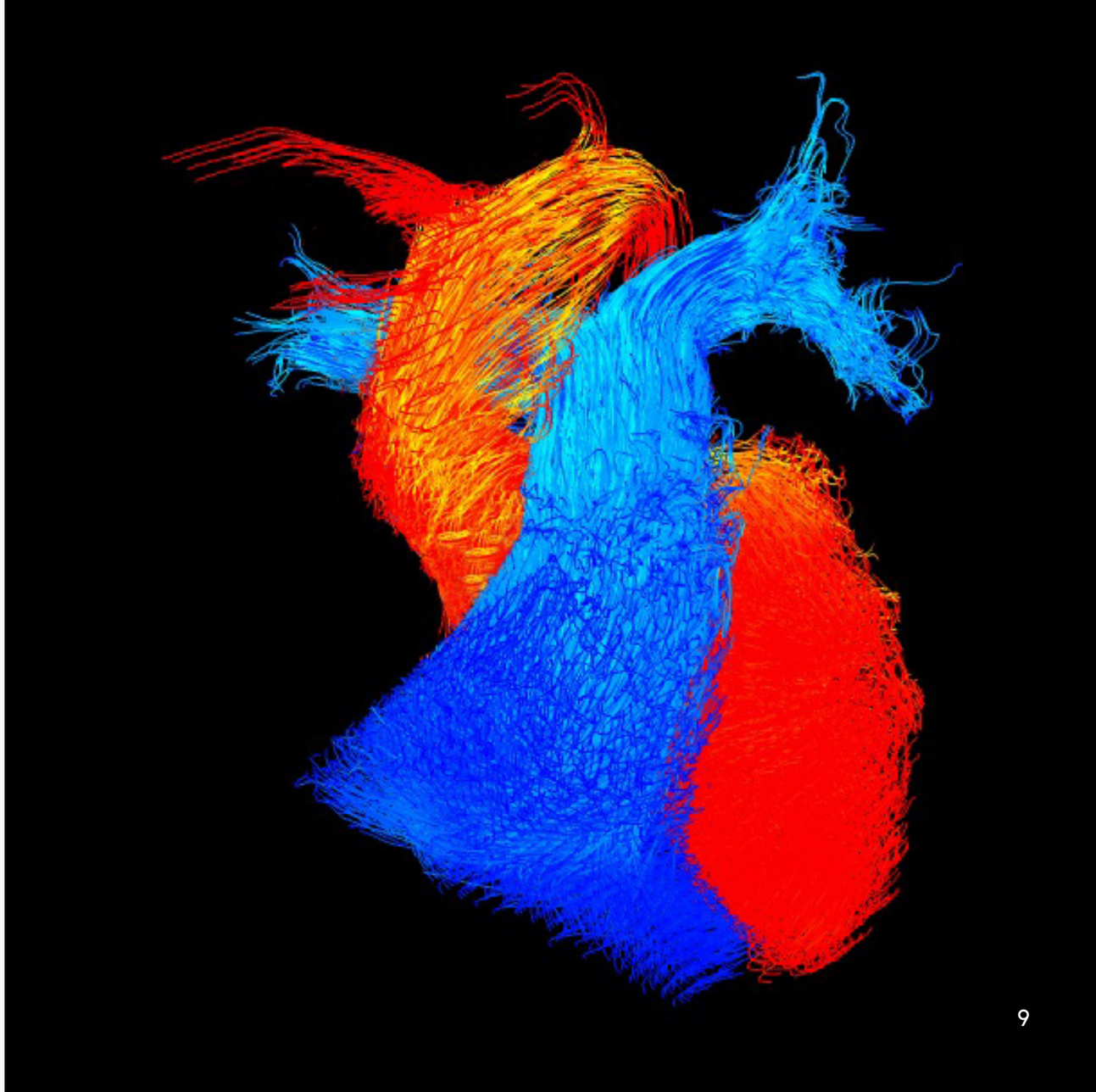
Supporting the training of **>50 PhD students** and career development of **>100 fellows**

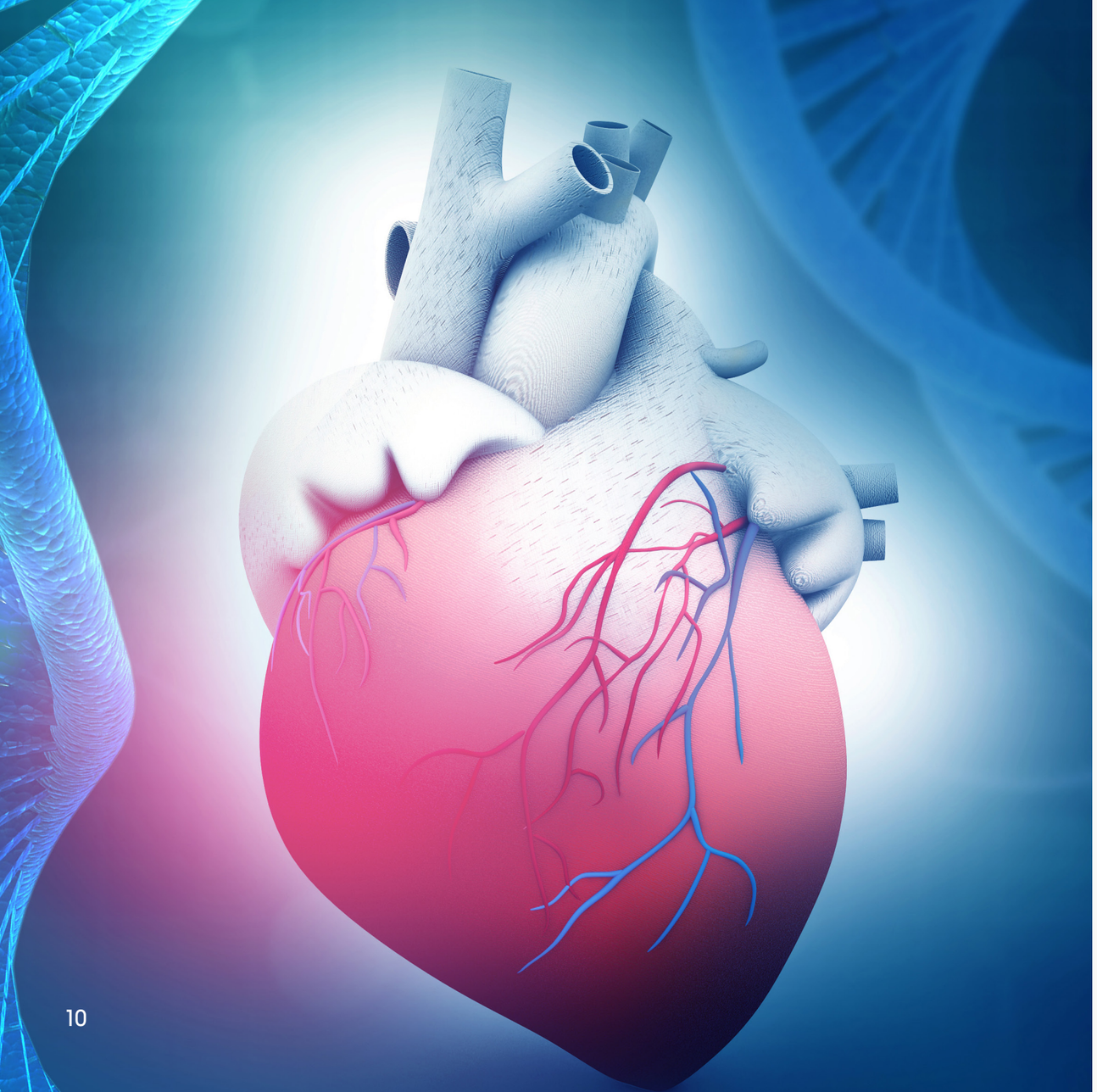


Generating new knowledge

Over the past 60 years, BHF-funded research has contributed to our understanding of how the heart pumps blood around the body and how changes in heart function can affect this process, leading to heart failure. This includes:

- Understanding how the heart's electrical signals, physical movements and energy use are involved in heart contraction, both in healthy hearts and in heart failure.
- Understanding how a hormone system called the renin-angiotensin-aldosterone system (RAAS) is involved in the development of high blood pressure and kidney failure, two conditions that can lead to heart failure. Today several drugs used to treat heart failure target the RAAS.
- Studying the genetics of heart failure, and working to discover new pathways that either contribute to the disease's development or offer protection against it.
- Studying the role of the hormones adrenaline and noradrenaline in heart failure, and studying the effect of drugs that block their action, called beta-blockers. Beta-blockers are now a gold standard treatment for heart failure
- Examining how changes to the heart's structure and function, which occur in response to stressors like a heart attack, contribute to the progression of heart failure.





Rewinding the heart's biological clock

In humans, ageing can affect many parts of the body, including the heart and blood vessels. By the time someone reaches 20, the heart's function can begin to decline as part of normal ageing.

BHF-funded research led by Professor Paolo Madeddu has shown that an anti-ageing gene, discovered in centenarians (people who live to 100 years), can rewind the heart's biological age by 10 years. The scientists from the University of Bristol and the MultiMedica Group in Italy say that the breakthrough could offer a possible way to treat patients with heart failure.

The team found that a single administration of the anti-ageing gene halted the decay of heart function in middle aged mice. When given to elderly mice, whose hearts have changes that are similar to those found in older patients, the gene rewound the heart's biological clock age by the human equivalent of more than 10 years.

Now, the team is exploring an alternative approach. Instead of injecting the gene, they are investigating whether providing the protein coded by the gene directly to mice can achieve similar results. This protein can be taken as a tablet every three days, and the hope is that its effects will last longer than those of gene therapy. This practical method could pave the way for future interventions to keep ageing hearts healthy.

Developing new technology

Imaging is instrumental in the management of heart failure, serving as a diagnostic as well as a prognostic tool. BHF-funded research has contributed to advances in imaging by:

- Supporting key technological developments in cardiac magnetic resonance imaging (MRI), which creates detailed images of the heart.
- Developing a new ultrasound-based tool that could be used for screening and monitoring people at risk of or suffering from heart failure.
- Creating a promising programme called 4D survival that uses AI to analyse the pumping motion of the heart from scans, helping identify early signs of heart failure.

Regenerative medicine is an exciting field of research that uses advanced techniques to repair or regenerate damaged heart tissue. BHF has been at the forefront of this area by:

- Investing in three Regenerative Medicine Centres, which have led UK efforts to develop new therapies using stem cells (cells that can become any type of cell in the body), drugs, gene therapy, and biomaterials to repair or regenerate damaged heart tissue and combat heart failure.
- Investigating how stem cells could help repair heart tissue damaged by a heart attack.
- Developing a ‘heart healing patch’ that in the future could be applied to damaged human hearts like a plaster to help them repair.
- Discovering three proteins that can be injected into the heart after a heart attack, which could potentially prevent heart failure.
- Joining forces with the Medical Research Council (MRC) to establish a new research centre focused on developing gene therapies for heart failure.

Preventing heart failure

Every five minutes someone is admitted to hospital with a heart attack in the UK. When someone has a heart attack, the coronary arteries that supply the heart with oxygen rich blood become blocked. When this happens, the heart muscle cells can die, and this can lead to heart failure.

Professor Mauro Giacca and his BHF-funded team at King's College London have discovered three proteins that can be injected into the heart after a heart attack, which could prevent heart failure.

The three proteins (Chrdl1, Fam3c and Fam3b) were identified using an innovative technology called FunSel. FunSel is a protein 'search engine' that screens a library of human proteins to detect those with therapeutic potential. The three identified proteins were shown to prevent heart muscle damage after a heart attack in mice and preserve heart function over time.

After preclinical testing, the team plans to take the innovative treatment to human clinical trials. If successful this would be the first biological therapy that could protect heart cells following a heart attack.

In 2022, Professor Giacca founded the spin-out company Forcefield Therapeutics, backed by leading healthcare investor Syncona, with the aim of accelerating clinical translation.

Up to a third
of heart failure patients in England and Wales have previously had a heart attack

Influencing clinical practice

From developing new ways to diagnose heart failure, to finding the best treatments to improve survival and quality of life, BHF-funded research has influenced the way heart failure patients are treated. Some examples include:

- Developing a blood test to allow for an earlier diagnosis of heart failure.
- Revealing the benefits of beta-blockers to limit the development of heart failure after heart attack and improve outcomes in heart failure.
- Discovering that ACE-inhibitors given to patients with signs of heart failure following heart attack, save lives. And subsequently showing that the addition of a diuretic (water tablet) increases their beneficial effect.
- Providing evidence to show that patients with dilated cardiomyopathy (a disease of the heart muscle) should continue taking heart failure medication, even if their symptoms have resolved.
- Highlighting that regular iron infusions can reduce the risk of hospitalisation for heart failure in patients who already have low iron levels.
- Developing a new type of pacemaker therapy that is linked to improved heart failure symptoms and quality of life.
- Confirming that high risk heart failure patients should receive lifesaving ICDs earlier.
- Transforming heart transplant practice, one of the few available treatments for advanced heart failure.

A blood test to help diagnose heart failure

Diagnosing heart failure early is essential so that patients can be started on the right treatment. However, heart failure can be difficult to diagnose as many of its symptoms such as breathlessness and fatigue, can be caused by other conditions. Until the late 1990s, when a GP suspected that a patient had heart failure, they did not have an easily available way to test for the condition.

In 1997, a team of doctors including BHF-funded Professor Alan Struthers and BHF Professor Phillip Poole-Wilson discovered that a simple blood test could transform the early diagnosis of heart failure. The test measured levels of a chemical called B-type natriuretic peptide (BNP) in the blood. Their research found that people with heart failure had higher levels of BNP, meaning people with a low reading were unlikely to have heart failure, and those with a higher reading needed further investigation.

In 2010, national guidelines for doctors included the BNP test as part of the gold standard for heart failure diagnosis. By 2016, MPs were urging all GP surgeries to adopt the test, as it allows them to make faster referrals for further tests, so patients can get the care and medication they need as quickly as possible. However, a report published by BHF in 2020 revealed that BNP testing is still not routinely available or appropriately used in primary and secondary care across the country. This means that many people with heart failure are diagnosed late. The report, 'Heart failure: a blueprint for change' emphasises the importance of using BNP testing to diagnose heart failure earlier, allowing people to access the right treatments.

Innovating healthcare delivery

BHF has been developing and testing new ways of delivering care for heart failure patients, including at home. This approach aims to improve lives and relieve pressure on the NHS, ensuring that more people can be treated.

Home-based care

Between 2004 and 2007, BHF tested a home-based heart failure programme led by heart failure specialist nurses. The programme led to a 35% drop in hospital admissions and significant cost savings, leading to them being established across the UK. In 2011, BHF assessed the safety and effectiveness of specialist nurses administering intravenous (IV) diuretics at home, instead of in hospital. The programme found that home-based treatment was safe, cost effective, and preferred by patients.

Cardiac rehabilitation

Cardiac rehabilitation improves the day-to-day life of people with heart failure. However, their access to this service is limited and this was exacerbated by the COVID-19 pandemic. In 2020, BHF created a cardiac rehabilitation at home digital product to offer information about exercising safely, healthy eating and medications. By early 2025, the hub and its resources had been viewed more than half a million times.

End-of-life care

People with heart failure are less likely than those with cancer to be offered specialist palliative care. In 2011, BHF partnered with Marie Curie and NHS Greater Glasgow and Clyde on the 'Caring Together' programme to improve end of life care for people with advanced heart failure. The initiative led to better improved quality of life, personalised care planning, and reduced hospital admissions.

77% reduction
in costs when heart failure specialist nurses deliver community-based intravenous services

BHF estimates that more than
50,000 patients
are discharged to the community with heart failure in the UK each year

Hope for hearts

In 2019, BHF launched the Hope for Hearts Fund, a £1 million funding scheme to transform UK heart failure services. The fund encouraged innovators from all sectors to partner with heart failure specialists and patients to develop new ideas to improve heart failure diagnosis and treatment. Key projects included:

Automating MRI for enhanced patient care

Research led by Dr Rhodri Davies and Professor James Moon at University College London used artificial intelligence to speed up cardiac MRI and help automate image analysis to detect changes to the heart structure and function. They were able to reduce scan times from 36 to 23 minutes, improve patient comfort, and increase scan precision. The technology has been adopted in five UK centres and is being used internationally.

Improving patient access to MRI

Dr Anish Bhuva's team at Barts Health Trust and University College London launched 'MRI MyPacemaker', a campaign to make sure patients with pacemakers or ICDs have access to MRI scans. The team developed guidelines and educational resources as well as creating an online referral management platform, significantly reducing referral times and improving access to MRI scans.

Enhancing cardiac rehabilitation access

Dr Hasnain Dalal's team at the University of Exeter developed a digital version of a home-based cardiac rehabilitation program called REACH-HF. Offering heart failure patients a digital option in addition to the traditional modes of delivery could help to address the low uptake of cardiac rehabilitation.

Improving patients' lives

Patients with heart failure experience various physical and emotional symptoms, which can impact quality of life. Around 80% of patients admitted to hospital with heart failure in the UK are considered to have heart failure that is significantly or extremely life-limiting. Over the years, BHF has funded research to help heart failure patients live longer and have a better quality of life. Some examples include:

- Developing treatments that give heart failure patients an increased chance of recovery. The AIRE study tested the use of ACE inhibitors in people who had suffered a heart attack. The study found that for every 18 patients treated, they were able to prevent the death of one patient.

- Exploring new ways ICDs and pacemakers can be used to prevent or treat heart failure. The HOPE-HF trial showed that a new type of pacemaker therapy was linked to improved symptoms for people with a specific type of heart failure. BHF is now funding another trial, PROTECT-HF, to establish whether physiological pacing results in better long-term outcomes compared to right ventricular pacing.

- Investigating whether heart failure patients can safely reduce the number of medications they take.

Exploring safe withdrawal of heart failure medication

Dilated cardiomyopathy (DCM) is a disease of the heart muscle where the heart chambers become enlarged (dilated) and the heart's muscle wall becomes thinner and weaker. DCM often leads to heart failure.

In many people with DCM and heart failure, heart function improves with treatment. And in some people, symptoms can resolve completely. Many patients without symptoms want to know whether they still need lifelong treatment, especially if they are experiencing side-effects.

In 2016, BHF funded the TRED-HF trial, led by Dr Brian Halliday and Professor Sanjay Prasad at the Royal Brompton Hospital, Imperial College London. The study aimed to understand whether it's safe to withdraw treatment from patients whose symptoms have resolved.

The team found that it is not advisable to withdraw heart failure medication in DCM patients, even if they have no symptoms.

Although the findings were disappointing to people with DCM, the results provoked much interest among cardiologists.

Mike Gosden was one of the participants who took part in TRED-HF.

"A year after starting ACE inhibitors I developed a 'rare' side effect - I became borderline anaemic. So because of that I wanted to try to get off the medication.

Even though the withdrawal was not successful for me, my experience of participating was positive. Normally when you see a doctor through the NHS things can seem rushed, but during the trial there was time to have proper discussions with Dr Halliday and the rest of the team."

In 2023, BHF funded a follow up trial, TRED-HF2 led by Dr Brian Halliday. The team hopes to investigate further to see if some types of medication can be withdrawn so that patients do not need as many tablets.

Looking to the future

From increasing understanding about how the heart contracts and identifying the mechanisms that lead to heart failure, to pioneering lifesaving treatments, BHF-funded research has achieved remarkable strides in the field of heart failure. Over the past six decades, significant progress has been made to improve the lives of those affected by heart failure. However, there remains no cure, apart from heart transplant which is only possible in a small number of cases.

The incidence of heart failure is likely to increase both because of an ageing population and an increase in the number of people surviving a heart attack due to medical advances. In particular, heart failure with preserved fraction (HFpEF) is a growing health concern, making up around half of all heart failure cases, with few drugs that have proved successful.

Looking ahead, the field of regenerative medicine offers hope. Researchers around the world are actively investigating new methods to repair damaged heart tissue and restore heart function. The new BHF/MRC Centre of Research Excellence in Advanced Cardiac Therapies aims to develop the first therapies which can reawaken these regenerative processes within the cells of damaged human hearts. These endeavours may pave the way for a new era of heart failure management.

For references, supplementary information and more on the impact of BHF-funded research into heart failure please visit bhf.org.uk/impactofheartfailure

bhf.org.uk

British Heart Foundation