Science fiction becomes SCIENCE FACT

Futuristic films contain mind-boggling ideas, but thanks to research we're funding, some of them aren't as far from reality as you'd think, as **Lauren Tedaldi** and **Sarah Kidner** discover

★★★★★
"We will be able to design new treatments"
– Dr Wilson Wong

★★★★★
"We saw we could prevent disease"
– Professor Magdi Yacoub

★★★★★
"We used to tell surgeons what they were going to find. Now we just give them a 3D model"
– Dr Tarique Hussain

STARRING: STEM CELLS FROZEN IN TIME, SPACE-AGE IMAGING MACHINES, 3D-PRINTED BODY PARTS AND MORE!
VISIT **bhf.org.uk/sciencefiction**

Face/Off: transplants

In *Face/Off*, FBI agent Sean Archer (John Travolta) undergoes a face transplant to swap identities with super-criminal Castor Troy (Nicolas Cage). Archer believes Troy was responsible for his son's death, so seeing the criminal's face in the mirror repulses him.

The BHF-funded reality

Organ rejection is a common and potentially fatal complication of transplants and the most common cause of a donor heart failing. Helped by a BHF grant, Dr Wilson Wong is studying the lymphatic system, a key part of the immune system, to discover why donor hearts may be rejected. Speaking to Heart Matters in January 2014, he said "The better we understand the rejection process, the better we will be able to design new treatments to help prevent it."

Dr Wong, a Reader in Transplant Immunology at King's College London, is using an adapted CT scan to study the lymphatic system in mice, post heart transplant. If the research is successful and Dr Wong receives additional funding, it could "help to reveal new ways in which the lymphatic system can be modified to help combat rejection and reduce the need for current long-term immunosuppressant drugs".

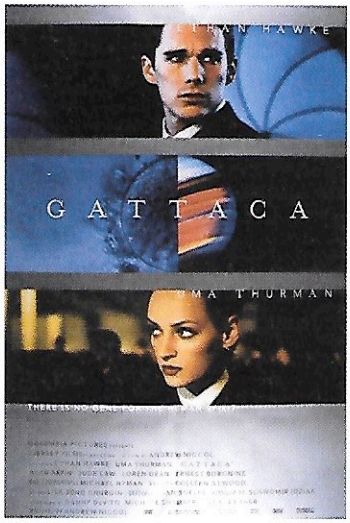
Gattaca: genetics

Gattaca **tells the story of Vincent Freeman (Ethan Hawke), born with a genetic heart condition that consigns him to an 'underclass' of humans, deemed useful only for menial jobs. To move ahead, he assumes the identity of Jerome Morrow (Jude Law), a genetically perfect man who, due to a car accident, is paraplegic.**

The BHF-funded reality

Genetics holds great potential for predicting who is at risk of cardiovascular and related diseases, then treating them either at an earlier stage or more effectively.

The BHF and the Welsh Assembly jointly created a genetic testing service for ***familial hypercholesterolaemia (FH)***[D], a genetic condition that causes very high cholesterol levels. The service focuses on finding 'index cases' – people with FH who can undergo genetic testing. People that have FH can be successfully treated with cholesterol-lowering statins alongside making lifestyle changes.



The BHF spent £115m on research in 2014

A 2008 study, part-funded by the BHF, found that people with FH who are diagnosed and treated before they develop ***coronary heart disease***[D] generally live as long as people who don't have FH.

In Time: living longer

Welcome to a world where time is the ultimate currency. In the film *In Time*, everybody stops ageing when they reach 25, but they are genetically engineered to live only one more year, unless they can buy their way out of it. The rich 'earn' decades at a time, while the rest beg, borrow or steal enough hours to make it through the day.

The BHF-funded reality

Eight out of 10 babies born with a congenital heart condition now grow up to be adults, largely thanks to research we helped to fund. Before the BHF was set up, only one in five babies born with heart disease saw their first birthdays.

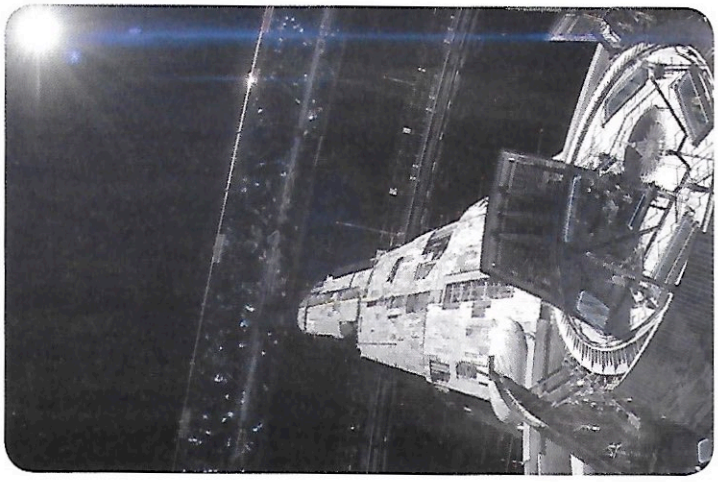
Former BHF professors Robert Anderson and Sir Magdi Yacoub have both been influential in the field of congenital research. Early in his career, Professor Anderson specialised in cardiac morphology (studying the anatomy of the heart). While helping a Liverpool colleague investigate potential complications to the heart's electrical system during surgery, he made a discovery that led to a crucial change in heart surgery procedures on children.

Sir Magdi pioneered 'the switch' operation, which has transformed the lives of babies born with transposition of the great arteries.

80% of babies born with heart conditions now survive to adulthood

We also provide support for children living with congenital heart conditions. In 2007, we launched Yheart (**yheart.net**), an online hub where 13- to 19-year-olds can share advice, stories, news, ideas and support. BHF Professor John Deanfield and Dr Jane Somerville are also working to establish the new cardiology specialty of grown-up congenital heart disease. »

Photography: Kobal, Rex Features



Elysium: imaging technologies

Earth is over populated and decimated by pollution and disease, so the wealthy have relocated to a space colony called *Elysium*. Special body scanners find and treat every potential health threat. The poor try smuggling themselves to Elysium to be healed by the scanners.

The BHF-funded reality

High-tech imaging equipment we've funded is advancing understanding of ***cardiovascular disease***[D] and how to diagnose and treat it.

We've contributed over £1.8m to help fund the Centre for Translational Cardiovascular Imaging at the University of Leeds, which is led by BHF Senior Research Fellow Professor Sven Plein.

In 2012, Professor Plein and his research team published the results of a BHF-funded study demonstrating that magnetic resonance imaging (MRI) is an accurate and reliable method for detecting ***coronary heart disease***[D].

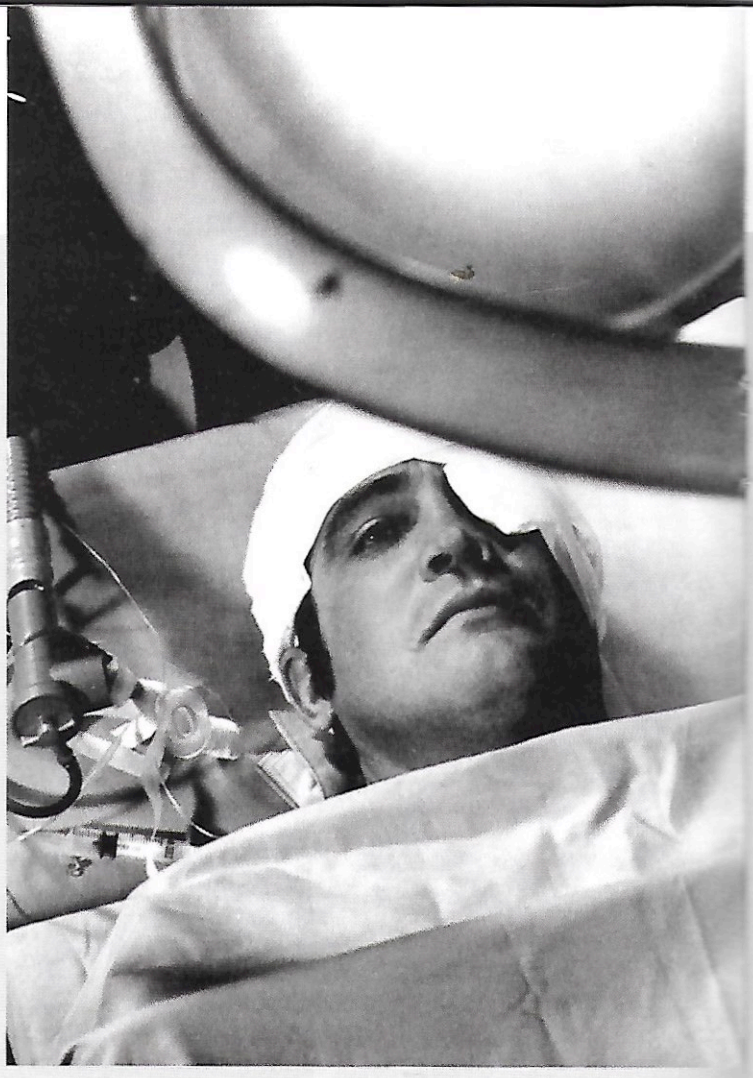
Meanwhile, in Edinburgh, BHF Clinical Lecturer Dr Marc Dweck has developed a test that may identify patients at high risk of ***heart attack***[D] using an imaging technology called PET/CT.

Cambridge-based BHF Professor Martin Bennett and his colleagues have pioneered an imaging technique called

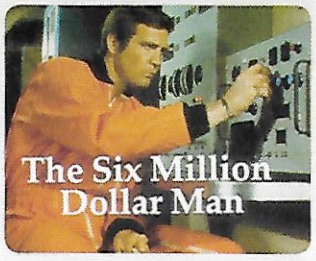
£2.5m
invested into imaging studies

virtual histology intravascular ultrasound (VH-IVUS), which looks at the specific components of plaques.

The technique is currently only used in research, but eventually VH-IVUS may identify not just the presence of disease, but specific plaques at higher risk of rupture. Treating these patients with medications might then prevent heart attacks.



The Six Million Dollar Man: what we've spent



In *The Six Million Dollar Man*, astronaut Steve Austin is 'rebuilt' after his spaceship crashes. Using cutting-edge research, scientists spend a total of $6m (£2.4m) bringing him back to health.

The BHF-funded reality

In 1973, the year *The Six Million Dollar Man* was made, we were spending the equivalent of £5m. Last year, we spent £115m on research. Over our 50-year history, generous donations from the public have funded life saving projects, from gene therapy to population studies.

In today's money, Steve Austin's rejuvenation would cost £28m. How many research projects could we fund with that?

£10m on regenerative medicine

Last year, we put around £10m into regenerative medicine projects in the UK, including three £2.5m Centres of Regenerative Medicine. This involves finding ways to repair damaged hearts and

blood vessels using stem cells, enhancing the body's own repair mechanism and engineering heart 'patches' to mend broken hearts.

- **£3m on genetics, genomics and biomarkers**

Some diseases of the heart and circulatory system occur because of a person's genetics – the building blocks in our DNA that make us who we are. We invested £3m last year to better understand which genes are important in these conditions, and which we could target for treatment or prevention.

- **£2.5m on imaging studies**

Improved technology means heart scientists have a better idea than ever what's going on inside our bodies and what happens when things go wrong.

- **£6.5m on population studies**

Researching large populations can help us find the causes of heart and circulatory diseases.

- **£4m on intervention trials**

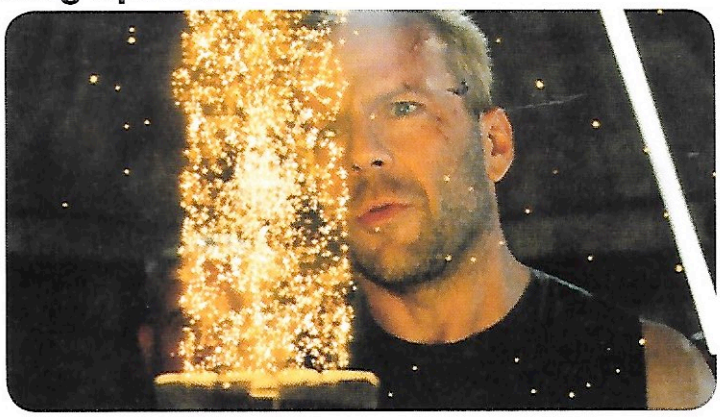
Intervention trials are when researchers intervene in a way that could affect the outcome they are measuring – for example, they could give people a medication or a scan that may affect their diagnosis and then observe the effects of this intervention. We spent £4m on this sort of research in 2014.

- **£2m on infrastructure**

Last year, we gave around £2m towards the cost of essential infrastructure like [illegible] and major pieces [illegible] equipment.

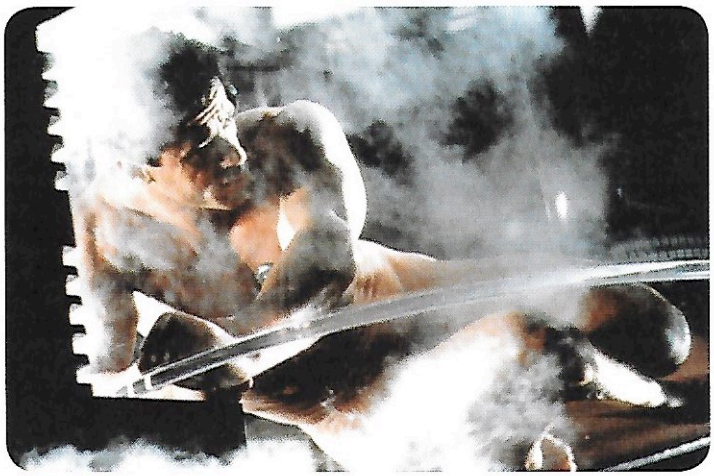
The Fifth Element: printing a person

In the 23rd century, the future of mankind depends on *The Fifth Element*. She only comes to Earth every 5,000 years to protect the human race and this time, the spacecraft bringing her back to Earth is destroyed. A team of scientists uses DNA remains to rebuild her. She is recreated using a machine that seems to 'print' a three-dimensional person.



The BHF-funded reality

We're not suggesting that we can 'print' a person or a new heart (yet) but the use of 3D printers is already making great leaps forward in planning surgery. Using complex and detailed MRID imaging, BHF-funded scientist Dr Tarique Hussain and his team at King's College London are able to create exact replicas of a patient's heart. These models can be used to work out where a hole lies in a child's heart, allowing surgeons to precisely plan what repairs to make and where before the operation.



Demolition Man: frozen cells

Policeman John Spartan (Sylvester Stallone) is frozen into CryoPrison with crime lord Simon Phoenix (Wesley Snipes). After 22 years, Phoenix is released in a utopian society that can't *deal with violence. Spartan is defrosted to save the day.*

The BHF-funded reality

While we're not deep-freezing heroes for the future, scientists at one of our three BHF Centres of Regenerative Medicine are investigating whether stem cells, derived from defrosted blood cells, can grow heart muscle that could be grafted *onto a damaged heart, such as after a **heart attack**[D]*.

Stem cells are immature cells that have the potential to grow into any kind of cell.

-196°C

The temperature blood cells can be kept frozen at for 50 years

BHF-funded scientists want to know more about these potentially life saving cells. But stem cells are fragile, not to mention expensive to obtain and maintain, making them difficult to work with.

Dr Amer Rana and his colleagues at the University of Cambridge are developing a way to generate stem cells from defrosted blood cells. Researchers can freeze and store blood cells (at -196°C for longer than 50 years), then turn them into stem cells when they need them, rather than having to use them as soon as they are made. This will have huge practical value, prolonging the 'use by date' of patient samples. HM

Go online

For even more examples of the BHF turning science fiction into reality, including self-mending hearts, at **bhf.org.uk/sciencefiction**.

Kobal, Rex Features