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Stroke
association

Saving lives

20 years of investing in vital stroke research



We are the Stroke Association

The Stroke Association is the leading stroke charity in the UK. We believe in the power of research to save lives, prevent stroke and ensure that people make the best recovery they can after a stroke.

Our research programme is led by the foremost medical experts on stroke in the UK to ensure that our limited resources have the greatest impact. We are guided by those who have been personally affected by stroke. This means that we can focus our research on areas that really matter to stroke survivors and their families and carers.

Our research programme is totally funded by voluntary donations. Please help us to fund more vital research. Call our Donations line on **0300 3300740**, visit **stroke.org.uk** or send your donation to us at:

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Written by Dr Clare Walton
Designed by Gavin Ingram

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Forewords

Twenty years ago our charity made a crucial decision. We decided to make stroke our cause and take the lead in fighting against this devastating disease. We made a commitment to change the world for people affected by stroke by promoting stroke prevention, investing in world-class research and supporting stroke survivors and their families to make the best recovery possible. We became the Stroke Association.

We've been funding stroke research for the last 20 years because we believe in the power of research to change lives. The studies included in this report provide compelling examples of the ways that research can advance, and sometimes transform, stroke care. Today more people than ever before walk out of hospital after their stroke and get their life back. As this report shows, our research has helped people every step of the way on their journey back from stroke. Although we are only able to present the highlights here, we are enormously grateful to all the talented research groups we have worked with over the years. Without their dedicated efforts, none of these tremendous achievements would have been possible.

Our life-saving progress brings new challenges. There are almost 1.2 million stroke survivors in the UK and they need our support. Stroke research receives far less money per patient than other conditions with a comparable impact on society. Championed by our Princess Margaret Fund, we are committed to working with donors to raise as much money as possible for future research into stroke. We are only able to do this with the generous donations from our supporters. Join us and together we can win the fight against stroke.

Jon Barrick
Chief Executive,
Stroke Association



Forewords

Research funding from the Stroke Association has provided a lifeline of support for researchers like me. When I qualified as an occupational therapist in 1980, there was very little research being conducted into stroke recovery and virtually no research opportunities for therapists. Through a number of early research grants, the Stroke Association funded me to complete my PhD and rise through the ranks to become a Professor in Stroke Rehabilitation.

This report demonstrates the powerful impact that research funded by Stroke Association has had on all aspects of stroke treatment and care. By supporting some of the earliest rehabilitation trials and providing research bursaries for the Allied Health Professionals, the charity has established a world-class rehabilitation research community in the UK. As a leader in rehabilitation, I am fortunate that Stroke Association funding has enabled me to dedicate my professional career to helping people recover from stroke. Thousands of stroke survivors benefit directly from the work we do.

Research funding decisions at the Stroke Association are guided by those who have been personally affected by stroke. This means we can focus our research on areas that really matter to survivors and their families and carers. As the current Chair of the Stroke Association's Strategic Research Committee I am looking forward to continuing their strong legacy for success. Stroke is one of the greatest health challenges of our time. I congratulate the Stroke Association for their commitment to championing the cause and their determination to change the world for people affected by stroke.

Marion Walker
Professor in Stroke Rehabilitation,
University of Nottingham



Forewords

Medical care for stroke has changed beyond recognition in the last two decades. Stroke was considered by many health professionals as a sad but untreatable condition. UK stroke services were very poor; many stroke patients were not given a brain scan and stroke units only existed in a few pioneering academic centres. In some hospitals, about a third of patients died from their stroke.

Today the UK has some of the best stroke services in the world. Our patients can expect to be assessed rapidly, have an urgent brain scan, be treated with clot busting drugs if suitable, receive coordinated multidisciplinary care on a stroke unit, and have rehabilitation in the community once they leave hospital.

Stroke research has been instrumental in the transformation of stroke care. Research has found ways to improve patient outcomes after stroke and stroke teams have put this evidence into practice. The UK is fortunate to have high quality researchers and a research charity- the Stroke Association- that has supported many of the studies that changed practice. By campaigning for and funding stroke research at a time when it was less well supported by other funding agencies, the Stroke Association has played a critical role in establishing the UK as world-leader in stroke research. Their funding continues to be a vital source of research training for young healthcare professionals, ensuring a strong stroke workforce for the future.

Although our stroke care is the best it has ever been there is still much more to be done. Stroke is responsible for 9 per cent of all deaths in the UK and remains a leading cause of adult disability. Research is the key to finding new and improved treatments. Stroke can devastate a life in an instant but through research we are finding new ways to change the world for people affected by stroke. The Stroke Association is currently funding some promising new therapies for stroke, such as the mechanical retrieval of blood clots and the use of magnetic brain stimulation to boost recovery.

This report demonstrates the range of important contributions research funded by the Stroke Association has made to all areas of stroke care in the last 20 years. The Stroke Association has always been a strong advocate of research and I commend them for their support. I am confident that the research they fund will have an even greater impact in the next two decades.

Gary Ford
Director,
NIHR Stroke Research Network



20 years of investing in vital stroke research

In a matter of minutes, stroke can change a life forever. It can happen at any time and at any age with devastating consequences. Medical research can and does prevent strokes and save lives. It is essential to develop new treatments and therapies to ensure stroke survivors make the best recovery they can. Our research is led by the foremost medical experts in stroke in the UK.

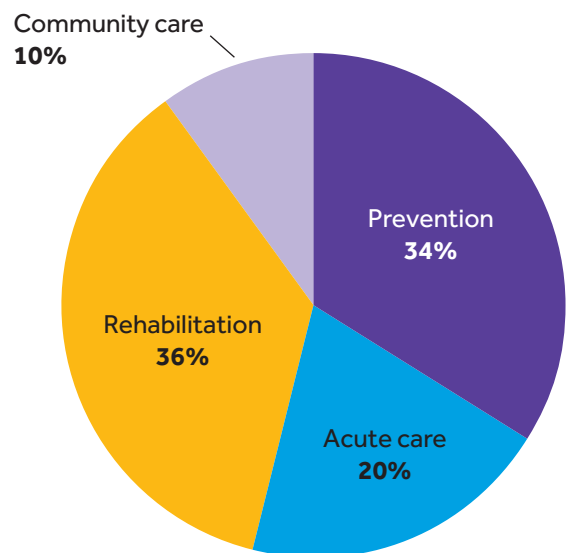
Between 1991 and 2011, the Stroke Association spent more than £40 million supporting vital stroke research. This research has had a big impact on our understanding of stroke, on the way stroke is treated in the UK, and ultimately on the lives of stroke survivors and their families.

Our funding has provided a lifeline for stroke researchers and clinicians at a time when funding for stroke research was notoriously low. Our priority has been to fund *clinical research* that makes the maximum possible difference to the lives of people affected by stroke. This includes research into stroke prevention, emergency treatment, brain research, rehabilitation, and community care.

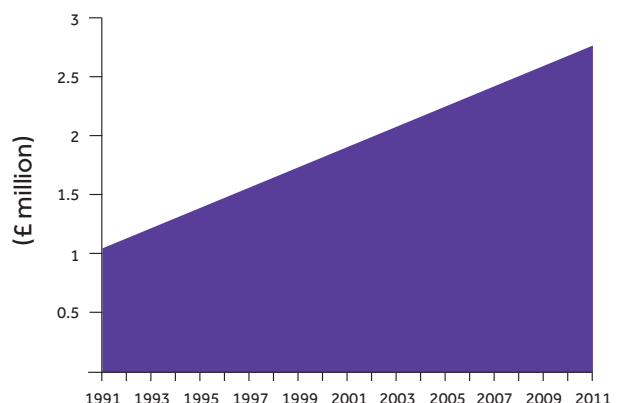
Clinical research is essential to determine the safety and effectiveness of any medical interventions intended for use with humans. All medications, medical devices, diagnostic products and treatment programmes must be evaluated in clinical research studies and trials before they can be used by the medical community.

As the Stroke Association has grown, so too has our commitment to the UK stroke research community. When we formed, we were able to spend just over £1 million a year on research. Now we fund almost £3 million of new awards each year. With further public donations, we hope to raise our research spending even more.

Breakdown of our spending by research area



New research grants awarded each year



The majority of our research funding goes to support *project grants*. These projects run over three years and aim to address a very specific question in the field of stroke.

Ground-breaking science requires the commitment of top academic and clinical researchers. Through our research bursaries and fellowships, we have attracted many talented individuals to the field of stroke, helping to establish the UK as a world leader in clinical stroke research^[1].

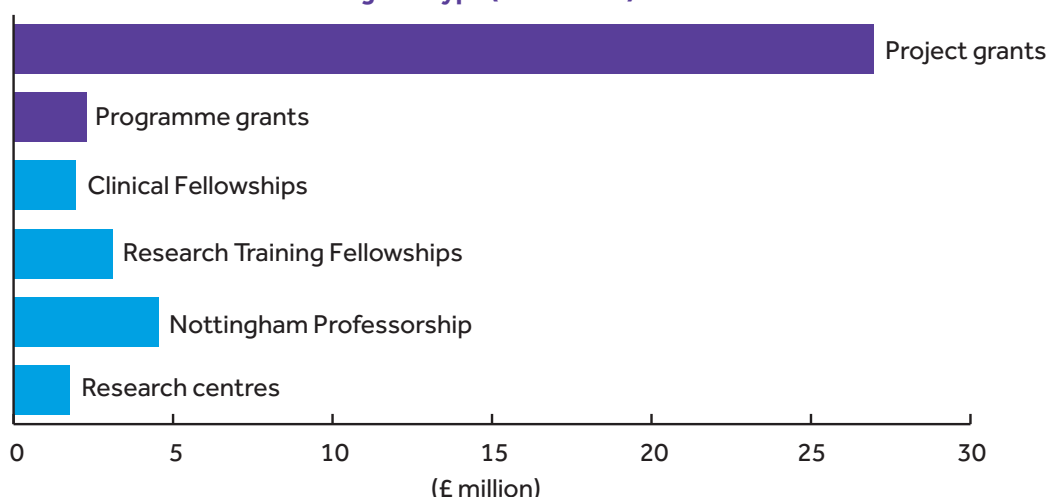
After a stroke, people need a wide range of support from different kinds of healthcare professionals. Our *research training fellowships* enable nurses, physiotherapists, speech and language therapists and occupational therapists to gain valuable research experience and complete a PhD degree. These fellowships have dramatically improved the quality of rehabilitation research in the UK and this has, in turn, ensured patients receive the most effective rehabilitation care available.

Our *clinical fellowship* awards were created in 1996 to provide doctors with specialist training in stroke medicine, which was not readily available through the National Health Service (NHS) at the time. These fellowships were a huge success, bringing and retaining many talented clinicians into the field of stroke.

The first ever Professor of Stroke Medicine in the UK was appointed at the University of Nottingham by the Stroke Association in 1992. The creation of this post has established the university as a leader in clinical trials for stroke and led to the UK's participation in several large international stroke research trials. Following our lead, there are now Stroke Professors at many universities around the UK.

Research is a long-term endeavour. It can take considerable investment in an idea and many years of work to make the kind of breakthroughs that change lives. To foster these ambitious projects, we funded a number of larger *programme grants* in areas requiring a more sustained effort. These awards support researchers for five years with the option to extend for a further five years if more work is required. Within our programme grants, we have also funded a number of *research centres* that support teams of researchers working together on a common theme.

Total amount awarded for each grant type (1991-2011)



There are approximately 152,000 strokes a year in the UK. That is more than one every five minutes.

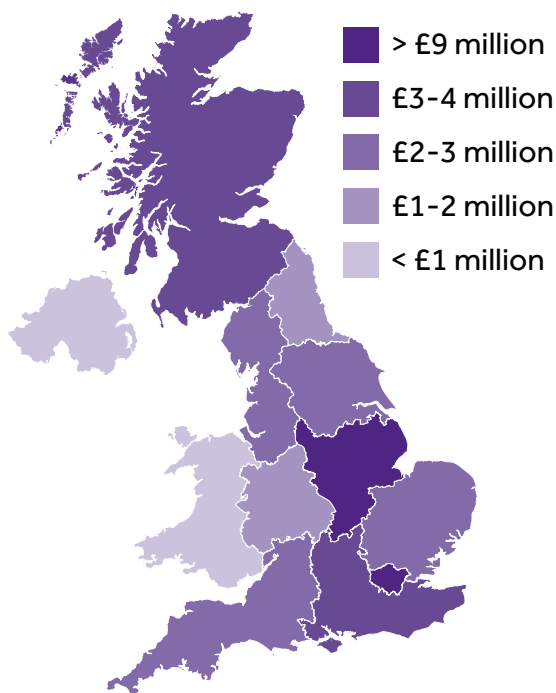
One in five strokes is fatal, with stroke accounting for 9 per cent of all deaths in the UK

Stroke is a leading cause of adult disability. More than half of people who survive a stroke are left dependent on others for everyday activities.

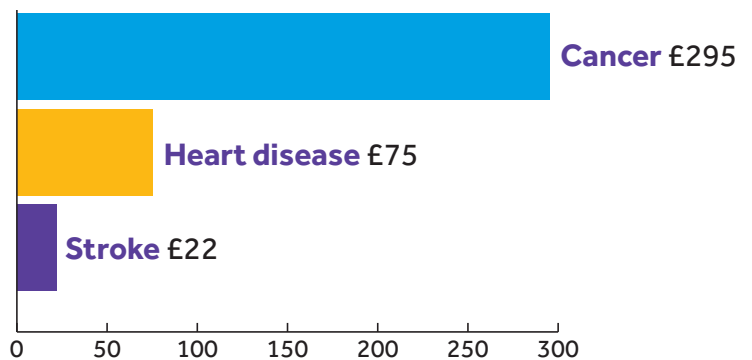
Despite substantial increases in the last decade, stroke research is still seriously underfunded compared with other major health conditions like cancer and heart disease. This imbalance is true for both government spending on research and spending by the major health charities ^[1] ^[2]. For every cancer patient living in the UK, £295 is spent per year on medical research compared to just £22 per year for every stroke patient ^[2].

Total amount spent in 2007/08 on research into cancer, heart disease and stroke by government funding agencies and charities per patient living with the disease in the UK ^[2].

Research spend by region (1991 - 2011)



The Stroke Association is a UK-wide charity and we fund grant applications from across the four nations. Historically, the majority of our research funding has been awarded to researchers in England and Scotland because these countries have more established stroke research communities. We are working hard to increase our support in Northern Ireland and Wales in the coming years.



The Stroke Association has achieved a great deal over the last 20 years but there is so much more that we want to do. We cannot afford to fund large clinical trials so we typically fund smaller pilot studies which then provide the necessary evidence for researchers to acquire funding for the next stage of their research. This strategy has been very successful; many of the small studies we have funded over the years have led on to large national and international trials that have affected the way stroke is treated around the world.

Over the following pages you can read about some of the highlights of the projects and researchers we have supported. This is by no means a comprehensive account but it demonstrates the diversity of ways in which Stroke Association-funded research can make a difference to the lives of people affected by stroke.



Research prevents stroke

Research is increasing our understanding of the underlying causes of stroke and leading the development of more effective ways to prevent stroke. As a result, there has been a dramatic reduction in the number of people having strokes over the last 20 years.

Our researchers have identified many of the factors that place people at risk of stroke and the warning signs that indicate a major stroke may be on its way. This knowledge is helping doctors to get better at targeting people at risk with appropriate medications or recommending lifestyle changes to prevent stroke.

The improvements in stroke prevention, combined with an increase in public awareness of a healthy lifestyle, have led to a 40 per cent reduction in the number of people having major strokes over the last 20 years ^[3] ^[4].

What causes a stroke?

A stroke is a brain injury caused when the blood supply to an area of the brain is cut off. Without blood, the brain tissue becomes starved of vital oxygen, energy and nutrients and can become permanently damaged.

There are two common causes of stroke. About 80 per cent of all strokes are caused when a blood vessel taking blood to the brain becomes blocked. The blockage can be caused by a blood clot or by fatty material building up on the inside of the blood vessel. A stroke caused by a blocked blood vessel is called an **ischaemic stroke**.

In the other 20 per cent of cases, a stroke is caused by bleeding into the brain. This can be due to a blood vessel bursting or becoming leaky. A stroke caused by bleeding in the brain is called a **haemorrhagic stroke**.

Stroke can cause a wide range of problems depending on which area of the brain is affected. Common symptoms of a stroke include:

- muscle weakness or paralysis
- numbness and tingling
- problems with speech and language
- visual problems
- fatigue, anxiety and depression.

Mini-strokes are an urgent warning sign

A mini-stroke, called a *transient ischaemic attack* (TIA), is a stroke-like event where the symptoms are only temporary. Just like during a full stroke, symptoms such as numbness, weakness, speech problems and confusion can appear suddenly but then they disappear again within 24 hours. Often, the symptoms only last a couple of minutes.

A mini-stroke is caused by a temporary lack of blood flow to the brain, which can indicate the presence of the same underlying problems that can cause a full stroke.

Through a series of grants beginning in 1996, the Stroke Association funded Professor Peter Rothwell and his colleagues at the University of Oxford to investigate people who have experienced a mini-stroke. The researchers knew that a TIA could suggest a major stroke was on its way, but did not know how likely it was or which patients were most at risk.

They found the risk was strikingly high, with one in ten TIA patients going on to have a full stroke within a week^[5]. At the time, patients with a suspected TIA were being referred for assessment by a specialist and often waited up to two weeks to be seen. Clearly, more needed to be done to prevent strokes in this high risk group.

The researchers organised a special emergency TIA clinic in Oxfordshire where patients reporting symptoms could have an immediate medical assessment by a stroke specialist. Clinic patients were typically seen within one day of their TIA and immediately started on appropriate medications, such as aspirin to reduce the risk of blood clots or others to lower blood pressure.

The urgent treatment of TIA patients had dramatic effects: the number of patients having a major stroke within three months was cut by 80 per cent^[6]. The researchers had found a clear way to prevent strokes. This study predicted that if all patients experiencing a mini-stroke in the UK could receive care in an emergency TIA clinic, almost 10,000 strokes could be avoided each year.

“This research clearly shows that thousands of people could be saved from life shattering strokes every year, simply by making sure that everyone who has a transient ischaemic attack (TIA) or minor stroke gets currently available treatment quickly. It is not about a brand new technology, or a costly intervention. It is about organising our services so that a TIA or minor stroke is always treated, and treated urgently.”

Joe Korner, Director of Communications at the Stroke Association, commenting on Professor Peter Rothwell’s research, which was published in the Lancet in 2007.

This research had an immediate impact on the way TIA patients were treated; the national guidelines for doctors were changed to recommend that all patients be referred for a proper medical examination within seven days of the transient symptoms^[7].

But one week was still too long for some patients. Professor Rothwell and colleagues wanted to find ways to identify those that are most at risk in order to prioritise who should receive immediate medical care. With funding from the Stroke Association, they studied the characteristics of the TIA patients being treated in their emergency clinic and found that four key criteria could be used to predict those with the highest risk of stroke: the **A**ge of the patient; their **B**lood pressure; the **C**linical symptoms experienced during the transient episode; and the **D**uration that the symptoms lasted.

This research led to the '**ABCD** Score', a simple tool for doctors^[8], which is now used worldwide to identify which TIA patients need to be referred for immediate medical attention.

Our investment in these ground-breaking research projects has been hugely important for people at risk of stroke. It has led to the transient ischaemic attack being recognised as an emergency by the medical profession, ensuring preventative action is taken in those at risk of a disabling or fatal stroke. The national guidelines for doctors^{[9][10]} now recommend that all TIA patients are assessed with the ABCD score and those found to be at high risk are immediately prescribed daily aspirin and seen by a stroke specialist within 24 hours. Those at lower risk should also be prescribed daily aspirin and be seen by a stroke specialist within one week.

“The ABCD score provides a simple way of identifying people who are at very high risk of having a major stroke following their TIA. It is an excellent example of a really practical application of clinical research having an impact on clinical practice. The publicity about the score has also raised the profile of TIA, making doctors and the public much more aware that TIA is a medical emergency.”

**Tony Rudd, Professor of Stroke Medicine,
Guy's & St Thomas' NHS Foundation Trust**



Carotid artery surgery prevents major strokes

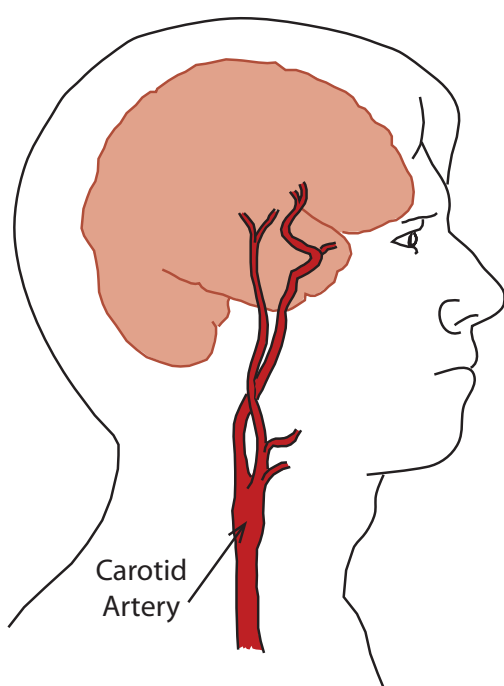
Most strokes occur when an artery that carries blood to the brain becomes blocked. Research funded by the Stroke Association has shown that carotid artery surgery can halve the risk of stroke in people with substantial narrowing of their carotid arteries.

The **carotid artery** is the major blood vessel bringing blood from the heart to the brain. Fatty material in the blood, like cholesterol, can get deposited on the inside walls of the artery, causing it to become narrowed. These fatty deposits, called *plaques*, are a significant risk factor for ischaemic stroke. Blood clots can form on the surface of the plaques and in some cases pieces of the plaque can break off. If either blood clots or plaque debris travel up to the brain, they can cause a stroke.

In the 1950s, a surgical technique was developed in the United States to help reduce the risk of stroke in patients with narrowing of their carotid arteries. The surgery, called *carotid endarterectomy* (CEA), involves opening up the artery in the neck and cleaning out the plaque and debris from the inside walls. Carotid endarterectomy can prevent major strokes but the surgery can also be risky. In about five per cent of cases, blood clots or debris dislodged from the artery during the operation can travel to the brain and cause a stroke.

It was not known whether the long-term benefits of CEA surgery would outweigh the risks and so doctors were cautiously only recommending it to people with very severe artery narrowing that were at a high risk of stroke without surgery. Since the early 1990s, the Stroke Association has been funding important research projects to address the following issues relating to CEA surgery:

- Which patients will get the most benefit from the surgery?
- When do the risks of surgery outweigh the potential benefits?
- When is it safest and most favourable to perform the surgery?
- How can the surgery be made safer?



To see whether more patients should be referred for this potentially life-saving surgery, we provided funding towards a large European clinical trial of carotid endarterectomy, called the 'Asymptomatic Carotid Surgery Trial' (ACST). The trial, initiated by Professor Averil Mansfield at St Mary's Hospital in London, included 3,000 patients with narrowed carotid arteries. It found that immediate CEA surgery can halve the chance of having a disabling or fatal stroke within five years, but only in patients under 75 with greater than 70 per cent narrowing of their carotid artery^[11]. In older patients or those with less severe narrowing, the reduction in stroke risk provided by the surgery did not outweigh the risks from the surgery itself.

The ACST trial focused on *asymptomatic* patients – patients that had not yet experienced any symptoms from their narrow arteries, such as a *transient ischaemic attack* (TIA) or a stroke. In 1999 we funded the CEA Trialists' Collaboration to look at the benefits of CEA surgery in *symptomatic* patients in which narrowing of the carotid artery had already caused a TIA or a minor stroke.

The researchers found that symptomatic patients were much more likely to have a major stroke within five years than those who had not yet experienced any symptoms. Therefore, in order to prevent more strokes in patients with severe narrowing of the carotid arteries, symptomatic patients should be prioritised for CEA surgery. This research evidence has allowed CEA surgery to be used more effectively in the UK and has made sure that patients who are unlikely to benefit are not placed at unnecessary risk from the surgical procedure.

When should CEA surgery be performed?

The CEA Trialists' Collaboration also found that the timing of surgery was vitally important in stroke prevention. They discovered that after a TIA or a minor stroke, the chance of going on to have a major stroke due to narrowed carotid arteries drops off rapidly with time^[12]. Therefore, to prevent major strokes CEA surgery needs to be carried out as soon as possible after the first symptoms are reported. This urgency was particularly pronounced in women who experienced no overall benefits from surgery if it was performed more than 14 days after the appearance of their symptoms^[12].

Before this study, surgeons were waiting at least six weeks to perform the operation because they thought the risks of causing a stroke from the surgical intervention itself was high soon after a first stroke or TIA. On average, CEA surgery in the UK was being performed two to three months after detection of artery narrowing, which meant many patients were having a major stroke before they could receive the operation.

Professor Peter Rothwell, a consultant neurologist at the John Radcliffe Hospital in Oxford and co-ordinator of the CEA Trialists' Collaboration, explained:

“The results of our study showed that surgery should be performed in the first few days after a patient has a TIA or minor stroke. Many patients in the UK were waiting for months for this treatment, by which time the benefits are very much reduced or absent. Sadly, the high risk of stroke without the operation meant that many patients had a major disabling stroke before they could be treated.”

This study had a major influence on the management of TIA patients in the UK and around the world. National guidelines for doctors in England, Wales and Northern Ireland now recommend that eligible patients are operated on within 14 days^[13] and a national audit of CEA shows that the delay experienced by patients in practice has been steadily declining in the UK^[14]. Thus, because of research funded by the Stroke Association, major strokes have been prevented by bringing surgery to the right patients in the time window when it is effective.

Can the surgery be made safer?

The Stroke Association funded Professor Ross Naylor and his colleagues at Leicester Royal Infirmary through a whole series of research grants to improve the quality and outcomes of CEA surgery. These projects developed new ways to monitor the safety of CEA surgery and have led to dramatic reductions in surgical complications.

The most common complication of carotid endarterectomy is the formation of blood clots on the newly exposed inner surface of the artery after the plaque is cleared away. These blood clots can travel to the brain to cause a stroke. When this research programme started in 1991, post-surgery strokes were occurring in about six per cent of patients. Professor Naylor and his colleagues pioneered the use of a special kind of ultrasound monitoring during and after surgery in combination with a micro-camera inserted into the blood vessel to identify and remove blood clots as they formed. The combination of these two techniques at the Leicester Royal Infirmary led to an immediate reduction in the number of post-surgery strokes.

The researchers also looked in detail at the blood clotting process in patients at risk of stroke after surgery. They discovered they could predict whose blood was likely to clot during and after surgery on the basis of their blood sensitivity to a chemical called ADP. When they gave patients a drug called clopidogrel to block ADP activity the night before surgery, it virtually abolished the number of post-surgery strokes^[15]. Pre-treatment with clopidogrel the night before surgery has now been adopted as a cheap and effective way of reducing the complications of CEA surgery.



“Since 1992 there has been a 70 per cent reduction in complications following carotid surgery at Leicester Royal Infirmary. The 30 day death or stroke rate after carotid surgery has fallen from six per cent in 1992 to one per cent in 2011. This improvement is the result of many advances in our understanding of what causes stroke after surgery and in care before, during and after the operation itself. The Stroke Association has funded our research in all of these areas.”

Professor Ross Naylor, Leicester Royal Infirmary.



Ageing is the biggest risk factor for stroke. The average age of the population is increasing and it will continue to do so. Although the number of strokes has been steadily declining in recent decades, this decline is predicted to level off over the next 20 years as the population gets older. It is, therefore, imperative that we continue to raise money to support stroke prevention research.



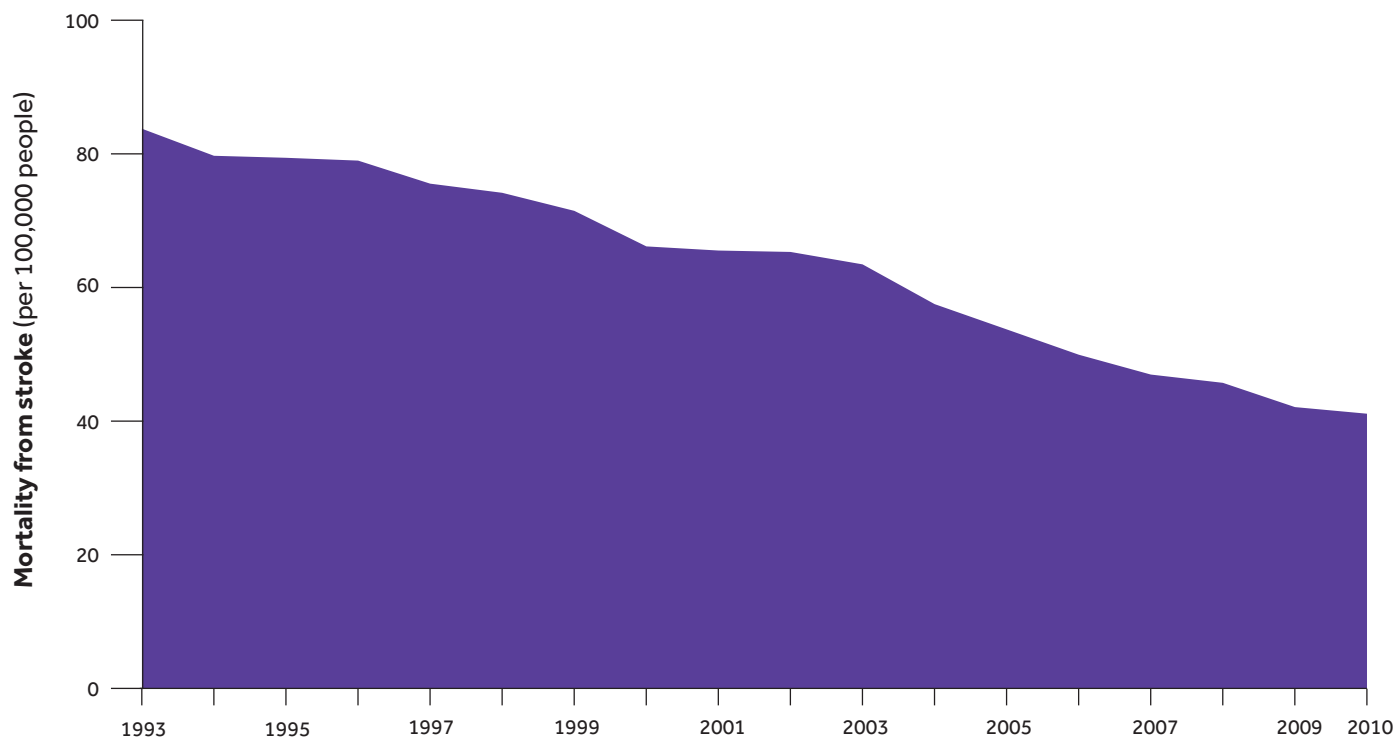
Research saves lives

Vast improvements in the way strokes are recognised and treated in the UK means they are killing fewer people than ever before. Research can and does save lives.

Over the last 20 years, the number of people dying as a result of a stroke in the UK has halved. Following years of research, scientists and doctors now recognise that stroke is a medical emergency and should always be treated as such. On the basis of clear research evidence, the NHS has reorganised stroke services to provide access to life-saving care as quickly as possible.

Research funded by the Stroke Association has been vital in driving forward the advances in emergency care for stroke. Thanks to the FAST stroke recognition campaign, the public and emergency services are better at identifying stroke and getting people to hospital without delay. Hospital care has advanced dramatically through the streamlining of stroke care pathways and the creation of multidisciplinary stroke units. Our researchers have been instrumental in moving things forward. Each small improvement in the way stroke patients are treated in hospital has contributed to fewer deaths and better outcomes for stroke survivors.

Stroke mortality in England and Wales



Data taken from the National Office of Statistics, *Compendium of Population Health Indicators*, Portal code P00680 (www.indicators.ic.nhs.uk).

Time saved is brain saved

When you have a stroke, the blood supply is cut off to a part of your brain, causing brain tissue that is starved of oxygen to become damaged. If medical treatment can be given early enough, it is possible in some patients to limit the amount of brain that gets permanently damaged. Time saved can mean brain saved, which can be the difference between living with a severe disability or making a good recovery.

In 2004, we funded Professor Gary Ford and colleagues at the University of Newcastle to study the ability of ambulance paramedics to recognise stroke using the Face Arm Speech (FAST) test. The researchers found that paramedics using the FAST test could identify a stroke just as accurately as specially trained doctors. Over 85 per cent of the suspected stroke patients brought to the accident and emergency department had actually had a stroke and were able to receive more rapid medical treatment as a result of their early diagnosis.

Professor Ford's research findings formed the basis of a Stroke Association public awareness campaign using the FAST acronym: Face, Arm, Speech, Time to call 999. In 2009 the campaign was adopted by the Department of Health. They spent £1 million over three years on advertisements to inform emergency paramedics and the public about how to identify the signs of stroke and to treat it as a medical emergency.

FAST has been a hugely successful campaign. In its first four months emergency 999 calls for stroke increased by 55 per cent ^[16], bringing life-saving medical attention to thousands more stroke patients in the UK.



“FAST is one of the most successful government public awareness campaigns ever, that has undoubtedly contributed to saving lives and reducing consequent disability from stroke for many people”.

Sir Roger Boyle, the former National Clinical Director for Heart Disease and Stroke ^[17].

Without the original research study, the FAST campaign would not have happened. It showed that it was feasible and effective to train paramedics to correctly identify stroke patients without overloading emergency departments with people who had not actually had a stroke. The emergency services are now an essential component of stroke services in the UK; they use the FAST test to identify stroke patients and deliver them to a specialist stroke unit for urgent treatment that can protect the brain, reduce disability and save lives.



Marney Williams had a stroke in May 2009, two months after the FAST campaign first aired on TV. She was at home with her teenage daughter when she started to feel strange. The newspaper she was reading was not making sense and, although her daughter was talking to her, she didn't understand what she was trying to say. Marney's face had also dropped on one side and her daughter, recognising the signs of stroke, immediately called 999. Paramedics came and took Marney to the nearby Charing Cross Hospital, which has since been designated as a specialist unit for emergency stroke care. Within two hours of the start of her symptoms, Marney was given a thrombolytic drug to dissolve the blood clot that was blocking the blood supply to her brain.

Thanks to the emergency care she received, Marney was able to make a full recovery from her stroke. Her speech and reading ability were markedly improved within 24 hours and now, three years post-stroke, she feels no effects of the stroke on her language or mental abilities.

"I am deeply grateful to my daughter, and everyone was impressed by the mature way in which she reacted to my stroke."

"I am sure that the FAST campaign, which was showing on television just months before, had a role to play in her quick response. It is thanks to her, the speed with which I got to hospital, and the care of the staff who were waiting for my arrival, that I have made such a good recovery."

Specialist stroke units

Treating patients on a specialist stroke unit remains the most effective medical intervention for stroke. The Stroke Association has been actively supporting the development of stroke units since the early 1990s. By funding essential research and lobbying the Government, we have fought to ensure every stroke patient in the UK has access to this life-saving service.

We funded the Nottingham Stroke Unit Study, one of the first UK trials testing whether treating patients on a dedicated stroke unit helped them to make a better recovery. The trial was very positive; the patients treated on a specialised stroke unit were more independent in their daily activities one year after their stroke compared to patients treated on a general hospital ward ^[18].

With a second Stroke Association grant, the researchers followed up the patients five years after their stroke. Treatment on the Nottingham Stroke Unit had significantly reduced the number of deaths and the amount of disability amongst stroke patients and resulted in fewer stroke survivors being admitted to a care home after their stroke ^[19].

The trial results were included in a review that combined the results of several trials and showed without a doubt that patients treated on a dedicated stroke unit were more likely to survive, regain independence and return home after their stroke ^[20]. When we funded the Nottingham Stroke Unit Study, the unit was one of only three stroke units in the UK. Now there is a specialist stroke unit in every emergency hospital and all stroke patients should expect to be treated in one.

What is a stroke unit?

A **stroke unit** is a ward in a hospital dedicated to the treatment of stroke patients. The ward is staffed by a multidisciplinary team that has been specially trained in the care and rehabilitation of stroke patients. The core team consists of doctors, nurses, physiotherapists, occupational therapists, speech and language therapists, dieticians, therapy assistants, psychologists and social workers.



Aspirin after stroke: simple but effective

The International Stroke Trial was one of the largest trials ever conducted in emergency stroke medicine. Two hundred hospitals in the UK participated and the Stroke Association funded the research at half of these locations. Two different drugs, aspirin or heparin, were given to patients for 14 days immediately after an ischaemic stroke to see which, if any, could reduce the risk of death, disability or further stroke.

Neither drug appeared to have an effect on patient recovery from the original stroke but treatment with aspirin was beneficial for longer-term outcomes. Stroke survivors treated with aspirin were less likely to have a second stroke within two weeks and were more likely to be alive and independent six months after their first stroke compared to patients given no treatment^[21]. In contrast, patients given heparin showed no reduction in the likelihood of subsequent ischaemic strokes but were at greater risk of experiencing a dangerous bleed in the brain.

After the results of this trial were published, medical guidelines in many countries were modified to recommend that aspirin should be started as soon as possible in patients with ischaemic stroke^[9]. This recommendation has made a significant difference to patient care: in the 2010 National Stroke Audit for England, Wales and Northern Ireland, 93 per cent of eligible stroke patients began treatment on aspirin within 48 hours of their stroke^[13].

Treatment with aspirin is cheap and easy to administer. Although it does not improve recovery from stroke, in some patients it prevents a dangerous or fatal second stroke if given in time. The International Stroke Trial results provided doctors with the evidence they needed to begin giving the drug as soon as possible.



Feeding stroke patients the right way

Problems with swallowing are common after stroke, typically affecting more than 40 per cent of hospitalised stroke survivors^[22]. Swallowing difficulties can be dangerous and are associated with greater levels of disability and early death. Many patients will experience spontaneous recovery over the first two weeks but immediate identification of problems and appropriate feeding is required to prevent poor nutrition or inhalation of food. Food inhalation often leads to chest infections like pneumonia, which can be life threatening to people after their stroke.

Since the early 1990s, we have funded several studies to address swallowing after stroke and to develop better ways to safely manage feeding in stroke survivors. In 1992, we funded Professor David Barer, then at the University of Liverpool, to investigate the use of swallowing assessments in stroke patients. He found that swallowing was not being correctly managed: 46 per cent of stroke patients with unsafe swallowing were receiving unrestricted feeding and were therefore at significant risk of inhaling liquids and food^[23].



The researchers tried to address the problem by training hospital ward nurses to safely administer a swallowing assessment in stroke patients. They found this was feasible^[24], which paved the way for a large UK multicentre clinical trial: the Collaborative Dysphagia Audit (CODA).

Before CODA, stroke patients were waiting up to several days to have their swallowing assessed by a specialist speech and language therapist. While they waited, they were potentially receiving dangerous feeding methods or having food withheld unnecessarily. CODA proved that nurses could effectively administer a water swallow test to accurately identify which patients needed referral for a specialist assessment^[25]. These studies were key to demonstrating the importance of early swallowing assessments after stroke and in offering a practical solution to the delivery of good care.

Because of these early studies, the management of swallowing in stroke patients has greatly improved in the UK. The 2010 National Stroke Audit for England, Wales and Northern Ireland found that 84 per cent of patients admitted to hospital with a stroke received a swallowing assessment within 24 hours of admission^[13]. While this figure needs to be increased to 100 per cent, it is a vast improvement on the figures reported by Professor Barer back in 1992^[23].

Ensuring stroke patients receive a swallowing assessment was a good first step, but more research was needed to develop safe feeding practices for stroke survivors. In 1996 we funded the first studies to examine how stroke patients were being fed in hospital once swallowing difficulties were detected. Professor Martin Dennis and his colleagues at the University of Edinburgh conducted the 'Feed Or Ordinary Diet (FOOD)' trial, the largest international trial of feeding practices in stroke patients. It addressed a number of issues relating to feeding, including the routine use of oral supplements to combat malnutrition and the use of feeding tubes when feeding through the mouth was deemed unsafe.

The FOOD trial compared two types of feeding tube- the *nasogastric tube* that delivers food via the nose and the *percutaneous endoscopic gastrostomy (PEG) tube* that delivers food directly into the stomach through the skin of the abdomen. They found that PEG feeding tubes were associated with higher levels of disability and higher death rates than nasogastric tubes^[26]. Based on this evidence, medical guidelines in the UK^[9] and many other countries now recommend an immediate swallowing assessment upon hospital admission and the early insertion of a nasogastric feeding tube in patients with swallowing difficulties.

Thanks to this research, stroke patients are now receiving standardised feeding care that will give them the best chance of surviving and making a good recovery.

Surgery for brain bleeds

Almost 20 per cent of strokes are caused by an *intracerebral haemorrhage* (ICH) which means bleeding into the brain, often due to the rupturing of a blood vessel. This kind of stroke, called *haemorrhagic* stroke, is more severe: over 40 per cent of patients die and the majority of those that survive are left disabled.

There are currently no good treatments for a haemorrhagic stroke. Doctors can stabilise the patient's blood pressure and try to stop the bleeding with medications. In severe cases, surgery can be performed to remove blood that has collected in the brain or to reduce pressure in the skull caused by the bleed.

In 1996, the Stroke Association funded a study called the 'Surgical Trial in Intracerebral Haemorrhage' (STICH) to test whether performing immediate surgery after haemorrhagic stroke could help patients make a better recovery. The trial went on to receive further funding from the Medical Research Council in the UK to become the largest ever international clinical trial for ICH.



During a haemorrhage, blood can pool and clot in the brain, which can prevent normal blood flow from being restored once the bleeding has stopped. The STICH investigators wanted to see whether performing immediate surgery to remove the clotted blood was better than starting patients on medication and delaying surgery until it became essential. STICH found that performing immediate brain surgery had no effect on the number of patients that died or were left with disability after a haemorrhagic stroke ^[27].

Although the results of the trial were negative, they provided vital evidence to help doctors decide on the best way to treat these challenging patients.

Medical guidelines around the world have incorporated the findings from the STICH trial and now patients with haemorrhagic stroke do not routinely undergo risky brain surgery unless it is specifically recommended by a neurosurgeon ^[9].

Haemorrhagic strokes are the most fatal kind and yet there are still no effective ways to treat them. Much more research into the biology of intracerebral haemorrhage is needed to inform new treatment approaches. In order to find ways to reduce the permanent damage caused by brain haemorrhages, we must continue to support vital research into the condition.

More people than ever are surviving stroke. This means there will be an increasing demand for effective rehabilitation to allow stroke survivors to make the best possible recoveries.

Now more than ever, we need to support research into brain repair and the recovery of lost brain functions so we can help future patients to rebuild their lives after a stroke.



Research improves the lives of stroke survivors

Not all strokes can be prevented. But improvements in treatments and rehabilitation can reduce the lasting effects of stroke and enable stroke survivors to rebuild their lives.

A stroke is a brain injury. How well a person is able to recover from the injury can depend on which area of the brain was affected, how much permanent brain damage was caused and how well the brain is able to adapt and relearn the abilities that were lost. Our research has driven significant advances in stroke treatments over the last 20 years, which have improved life quality for stroke survivors and enabled them to make better long-term recoveries.

Our research has led to:

- the more widespread use of thrombolytic drugs, which improve outcomes after ischaemic stroke
- better in-hospital care for stroke patients
- stroke survivors spending less time in hospital
- the development of more effective rehabilitation therapies
- an increase in the amount of occupational therapy available to stroke survivors living in the community
- an improvement in our understanding and consideration of communication difficulties after stroke
- better tools to identify stroke survivors with psychological problems so they can get adequate care and support at home.

Thrombolysis: using drugs to dissolve blood clots

The use of *thrombolytic drugs* to break up blood clots in the hours after a stroke begins has become much more widespread in the UK in the last decade. If given soon enough, these drugs can restore blood flow to the brain and reduce the amount of permanent brain damage that results from an ischaemic stroke. In eligible patients, treatment with thrombolytic drugs within three hours of stroke onset can significantly improve outcome, leaving fewer patients disabled and dependant on others for daily living. For every 1,000 patients treated, 80 more will live independently after their stroke because of the thrombolysis ^[28].

In the early 1990s, thrombolytic drugs were licensed in the United States but very few patients in the UK were being given the treatment. Doctors were not convinced that the potential benefits outweighed the risk of the drug causing a fatal bleed into the brain. Accordingly, the Stroke Association funded two trials of thrombolysis in UK hospitals: the UK arm of the 'Multicentre Acute Stroke Trial' (MAST-I) and the start-up phase of the 'Third International Stroke Trial' (IST-3), the largest clinical trial of thrombolysis in Europe. The data from these trials contributed to the licensing of the drug in Europe, bringing the most effective treatment for ischaemic stroke to patients in the UK.

Despite licensing of the drug, there were many challenges to its use, mostly stemming from the fact that it is only safe to give within a short time window after stroke. With Stroke Association funding, the IST-3 researchers developed stroke services in several hospitals across Scotland and England so that thrombolytic drugs could be given to 6,000 patients with ischaemic stroke as part of the full IST-3 trial.

The final results of IST-3 were released in May 2012, almost 20 years after we funded the initial start-up study. The trial focused specifically on groups of patients that were not eligible for thrombolysis under the existing drug licence, which included those over 80 years of age and those arriving at hospital more than three hours after their stroke. The trial results were significant: they clearly indicate that patients over 80 years of age experience the same benefits from thrombolysis as younger patients ^[28] and, therefore, should not be excluded from treatment on the basis of their age.

Although thrombolysis can be very effective in some patients, it is not suitable for everyone. Since the drug reduces blood clotting, it can increase the risk of internal bleeding in the body or the brain. Therefore, doctors must be very careful when they decide who is eligible for treatment. There is clearly a tremendous need to develop alternative treatments for ischaemic stroke, ones with fewer risks that can be used with a wider range of stroke patients.





It was about 9.00 am when Marney Williams began to feel the symptoms of her stroke. A blood clot was blocking the blood supply to her brain causing mental sluggishness and difficulty understanding language. Thanks to the rapid response of her daughter and the emergency services, she got to hospital, had a brain scan and began thrombolysis for an ischaemic stroke within an hour and 45 minutes of the start of her stroke.

“At 11.00 am I snapped awake; it was like turning on a computer. Suddenly my mind was running at high speed, doing a self-check. Can I see properly? Are my limbs working? Who am I? Where am I? Where do I live? Can I remember what ought to be familiar facts? It was such a relief to realise that the last 50 years were still in there!”

Because Marney was given thrombolytic drugs so soon after her stroke began, the severe language problems she was experiencing did not become permanent. Within 24 hours her speech had significantly improved and she was able to understand what people were saying to her, and to respond.

Although Marney’s stroke did leave her with some language problems, such as understanding and retaining what she had read, and following speech on the radio, with time and practice she was able to make a complete recovery.

Improving conditions for stroke patients in hospital

In 1994, we funded research to investigate the benefits of thigh-length graded compression stockings for stroke patients in hospital. These elasticated stockings were being put onto stroke patients to prevent the formation of blood clots in their legs (called *Deep Vein Thrombosis, DVT*), which could potentially travel to the lungs or brain and cause serious complications.

The national guidelines for doctors recommended stockings for all stroke patients, even though the evidence that they were effective at preventing DVT and further strokes was unclear^[7]. The researchers found that the stockings were disliked by both patients and staff; they were uncomfortable to wear, could cause skin irritation or leg ulcers, and were incredibly time consuming for nurses to use with their patients. More importantly, the study found no benefit of the stockings in preventing DVT in stroke patients^[29].

This work led on to a large clinical trial of compression stockings for stroke, called the CLOTS trial, which confirmed stockings provided no significant reduction in the risk of deep vein thrombosis or further stroke. The results of CLOTS led to widespread changes in clinical practice in the UK. Before the trial, 60 per cent of hospitalised stroke patients were wearing compression stockings but just three months after the trial results were released in May 2009, this number had dropped down to just four per cent^[30]. This research has saved valuable time for nurses, saved money for the NHS and, above all, made the hospital experience more comfortable for stroke survivors. It also highlighted the need to find alternative treatments to prevent the formation of blood clots in the legs of immobile stroke patients.

“...the use of stockings has all but disappeared from the UK. It is very important that the results of trials, even neutral findings, are implemented, and CLOTS has driven this change in clinical practice.”

Philip Bath, the Stroke Association Professor of Stroke Medicine at the University of Nottingham.

“When my mum had a stroke in 2008, elastic stockings were put on her legs in A&E. By the time she got to the ward, they were round her ankles and one of her feet was blue and cold. Pulling up the stockings was no use; they were too tight and just wouldn't stay up. The skin on her legs became red and irritated but when I asked the nurses to remove the stockings they refused claiming it was 'protocol' for stroke patients to wear them. If only this research was done earlier my mum could have been spared the discomfort. It really was the last thing we wanted to deal with on top of everything else.”

Emma Burgess, Newcastle Under Lyme.



Reducing the length of hospital stays after stroke

In 1994, the Stroke Association co-funded Professors Charles Wolfe and Tony Rudd at Guys and St Thomas' in London to develop and test a new method of stroke care called *Early Supported Discharge* (ESD). The care package aimed to get stroke patients up and out of their hospital beds and back home as soon as was safe and appropriate. Conventional care included a significant portion of a patient's rehabilitation in the hospital. ESD brought together a multidisciplinary team of doctors, nurses and therapists to plan individualised rehabilitation packages that could be administered at home.

This project was the first and largest trial of early supported discharge and has profoundly changed the way stroke survivors are treated in the UK. The trial found that patient outcomes were just as good with the new method as with conventional care, but that those with ESD received 50 per cent more hours of therapy time (including physiotherapy, speech and language therapy and occupational therapy) ^[31]. Stroke survivors with early supported discharge also reported greater levels of satisfaction with their care ^[32]. ESD significantly reduced the length of hospital stay, freeing up critical stroke unit beds for other patients and was actually cheaper per patient than conventional care ^[31].

Prior to the development of ESD, stroke survivors would receive early rehabilitation in hospital, which meant spending large amounts of time in a hospital bed. An intensive amount of research was needed to show that this alternative treatment approach was feasible, safe and beneficial for patients. Combining the results of several ESD trials has found it actually improves patient outcomes over conventional hospital care: for every 100 patients treated, six fewer will die or live dependant on daily support from carers ^[33]. Overall, patients receiving ESD do better at performing their daily activities without assistance.

We now know ESD is extremely effective at improving patient recovery and satisfaction and it has become an essential part of stroke care practice in the UK. About 50 per cent of hospitals offer an ESD service and the National Stroke Strategy for England suggests that the service should be universally available ^[10].

Since the original trial published its results in 2000, the mean length of hospital stay for stroke patients has decreased from 32 days to 20 days in 2010 ^[34], freeing up hospital beds and reducing costs for the NHS. It has also led to considerable improvements in community rehabilitation services, with the 2010 Stroke Audit showing that 94 per cent of stroke patients had rehabilitation goals set by a multidisciplinary team prior to discharge from hospital ^[13].

“The trial was an important milestone in service provision for older people and stroke patients in particular and has influenced National Service Frameworks and the Stroke Strategy. It is very encouraging that ESD is now more widespread, although it will be even better when it is implemented in all stroke units.”

Charles Wolfe, Professor of Public Health, King's College London.

Researching effective rehabilitation

Effective rehabilitation therapies are essential to enable stroke survivors to make the best possible recovery.

Rehabilitation is the process of overcoming or adapting to the effects of a stroke so that the stroke survivor can become as independent as possible. It includes everything that is done to restore the physical, psychological and social functions which have been adversely affected by stroke. Because stroke can cause a wide range of different problems, the kinds of rehabilitation required will depend on the individual needs of each stroke survivor.

In the mid-1980s, the Stroke Association, then called the Chest, Heart and Stroke Association, recognised an urgent need to develop rehabilitation practices that were based on rigorous scientific research rather than tradition or theory. At the time, robust research into rehabilitation was not being conducted so it was not known which treatment methods were the most effective.

By supporting some of the earliest rehabilitation trials, and creating two large stroke rehabilitation research centres, the Stroke Association was responsible for launching stroke rehabilitation as a solid research-based discipline in the UK.



“When I qualified as an occupational therapist in 1980, I didn’t read journals – techniques were developed through trial and error. It is a different era now. Clinical guidelines for rehabilitation therapies are informed by research evidence.” ^[35]

Marion Walker, Professor in Stroke Rehabilitation, University of Nottingham.

At a time when no-one else was funding the allied health professions to do research, we supported physiotherapists, speech and language therapists and occupational therapists to conduct research into the recovery of stroke survivors. Our Allied Health Professional Bursaries have made research a viable career path for therapists and many of the individuals we supported are now at the forefront of rehabilitation research in the UK.

To recover a good quality of life, stroke survivors can require therapy for a wide range of impairments. These can include motor rehabilitation for problems with mobility, balance, hand and arm coordination, or speech. Also cognitive rehabilitation for problems with vision, language, memory, problem solving or mood disorders.

Through our early and continued investment, a culture for rehabilitation research has evolved in the UK. We now have a greater understanding of the rehabilitation needs of stroke survivors and researchers are developing effective therapies to address them.

We were instrumental in developing several of the leading UK rehabilitation research centres:

- The Nottingham Stroke Research Unit was set up at the general hospital in 1983 and was one of the very first stroke units in the UK. The unit's research programme was led by Professor Nadina Lincoln and was largely funded through a series of research grants from the Chest, Heart and Stroke Association. Many of the first clinical trials in stroke rehabilitation were conducted in this reputable unit.
- We supported the Academic Unit of Elderly Care and Rehabilitation in Bradford with a series of research grants, including the first clinical trials in 1987 to look at home rehabilitation after stroke. Based on her work on this trial, Professor Anne Forster was one of the first ever physiotherapists in the UK to receive a research PhD.
- From 1996 to 2002, the Stroke Association's Therapy Research Unit (SATRU) at Hope Hospital in Salford revolutionised the way rehabilitation research was being conducted in the UK.
- To continue the work of SATRU, the Stroke Association's Research Rehabilitation Centre in Southampton was created in 2004 and ran for five years under the direction of Professor Ann Ashburn. The unit made significant contributions to our understanding of balance control and mobility after stroke.

SATRU: unpacking the black box of physical therapy

Under the lead of Professors Raymond Tallis and Valerie Pomeroy, the Stroke Association's Therapy Research Unit (SATRU) took an innovative approach to stroke rehabilitation. Instead of evaluating whole therapy packages, as was the standard at the time, SATRU aimed to break down rehabilitation programmes into their component parts to test how much each activity really helps stroke survivors to make a better recovery.

They began to unpack the 'black box' of physical therapy by asking questions such as: What works? For whom? When after stroke? In what dose? This was a novel approach that has been widely adopted; now almost all research into stroke rehabilitation is conducted this way.

"Just compare the kinds of studies being done now to what was being done in 1996. The field has been completely revolutionised in 15 years."

Valerie Pomeroy, Professor of Neurorehabilitation, University of East Anglia.

During her time as the director of SATRU, Professor Pomeroy began to think about what happens to the brain during stroke recovery. She was one of the first physical therapists in the world to bring neurophysiology – the study of brain function – into rehabilitation research.

Professor Pomeroy now holds the Chair in Neurorehabilitation at the University of East Anglia. She is an international leader in researching the recovery of motor function after stroke. Her research focuses on the interaction between physical therapy and neurophysiology to understand how the brain of stroke survivors can be encouraged to relearn lost movement abilities.

A potential new therapy for arm paralysis

Partial paralysis of upper limbs, typically on just one side, is common after stroke. Only about 15 per cent of these patients will spontaneously recover the use of their hand and arm ^[36]. Clearly, a therapeutic intervention to improve recovery of arm function is much needed.

The Stroke Association funded Dr Paul Taylor at Salisbury District Hospital to develop a wearable electronic device that can assist in recovering arm movement. The device uses a method called *Functional Electrical Stimulation (FES)* to produce movements in paralysed muscles. Small patches on the skin deliver tiny electrical currents to the nerves that would normally activate arm and hand muscles. When strapped to the upper arm, the device can detect when the patient is attempting to reach forward and delivers electrical stimulation to the right muscles to help them complete the movement.

Dr Taylor and his colleagues conducted a pilot study in 2005 to test whether FES, which was already being used for paralysis of lower legs and feet, could be adapted to work for the upper limbs. The study found that the device can induce useful movements in stroke patients such as opening the hand, straightening the elbow and flexing the shoulder. In a small sample of 15 stroke survivors, three months of reaching practice with the FES device led to improved hand and arm function, improvements in completing their daily activities, and they also reported an enhanced quality of life ^[37]. These positive effects were maintained three months after the end of the FES treatment.

Given these promising results, we are now funding the group to conduct a larger trial of FES for the recovery of upper limb function. The trial, which is called REACH – ‘ReEducation of Arm and Hand function following Stroke’ – will compare three months of home practice exercises, with and without the FES device. If the results are positive, FES has the potential to improve the quality of life for the large number of people whose arm and hand function is compromised by stroke.



Bringing occupational therapy into the community

Traditionally, occupational therapy was provided to stroke survivors in hospital during the early stages of their rehabilitation. But this practice meant many people were missing out on therapy when it could really make a difference to their quality of life. We have funded several pieces of research to show that occupational therapy can benefit stroke survivors living in the community and at later stages in their recovery, thus bringing the treatment to many more in need.

What is occupational therapy?

Occupational therapy aims to help stroke survivors become as independent as possible in their daily activities. Simple everyday tasks that seemed easy or automatic before can become challenging after a stroke, making stroke survivors reliant on the help of others to get through their day.

Occupational therapists work with individuals to identify the activities they struggle with and then use a variety of methods to help them improve their performance. Even learning to manage simple tasks like doing up buttons or making a cup of tea can make a huge difference to a stroke survivor, increasing their independence and quality of life.

Our research has demonstrated the importance of occupational therapy for stroke survivors living in the community. In the early 1990s, over 20 per cent of people who had a stroke did not get admitted to hospital ^[38] and remained in their own homes receiving minimal rehabilitation support. We funded Professor Marion Walker to conduct the first and largest trial to test whether providing home-based occupational therapy could benefit this group of stroke survivors.

An occupational therapist by training, Professor Walker visited stroke survivors in their homes and delivered therapy activities that were tailored to meet their individual needs. On average patients received seven therapy visits over a six month period where they practised activities such as: getting on and off the bus, domestic activities like washing and ironing, walking the dog and going to the library. Even this small amount of therapy had very positive effects: it improved their outdoor mobility, helped them to complete their daily activities and reduced the strain on their carers.

This research highlighted the challenges faced by stroke survivors living at home and the lack of support that was available to help them. It showed that providing a home-based occupational therapy service can make a big difference to life quality. This evidence was essential for the development of community occupational therapy services in the UK.



Don't forget about care home residents

About a quarter of all stroke survivors are unable to go home after their stroke and they are moved from hospital directly into a care home. Yet historically, very little research was carried out to find out how to improve the quality of life of some of these most vulnerable stroke survivors.

A pilot study, funded by the Stroke Association in 1999, found that even a small amount of occupational therapy was extremely beneficial for residents in care homes who have had a stroke ^[38]. The study, carried out by Professor Catherine Sackley and colleagues at the University of Oxford found that occupational therapy helped people carry out their daily activities and improved their ability to move around. The results of this study have already made an impact as the national guidelines for stroke care now recommend specialist rehabilitation therapies be made available to all stroke survivors living in care homes ^[22].



In 2009, Professor Sackley was awarded nearly £2 million from the National Institute for Health Research to see whether the results can be reproduced in other care homes. The on-going trial is now testing the positive effects of occupational therapy on stroke survivors in 17 care homes across the UK.

“It seems that the research grant the Stroke Association awarded me more than a decade ago has put occupational therapy for stroke survivors in care homes on the map.”

“I must stress that without the Stroke Association’s original funding of the pilot project, we would never have been in the position to get this major funding. I am very grateful to the Stroke Association and especially to all their donors.”

Catherine Sackley, Professor of Rehabilitation, University of Birmingham.

Helping stroke survivors to get out and about

Not leaving the house as much as one would like can have a very negative impact on a person's quality of life. Despite being physically able, 52 per cent of stroke survivors say they want to get out of the house more often than they currently do ^[39].

Through our funding of the Nottingham Stroke Research Department, we supported Professor Philippa Logan and her colleagues to develop and test an outdoor mobility programme to help stroke survivors overcome the barriers to getting out and about.

An occupational therapist met with 168 stroke survivors in Nottingham to give them information about local transport options and encouragement to leave the house. After this session, half of the participants went on to receive a three-month therapy programme, which involved assessing the stroke survivor's personal barriers, working with them to set mobility goals, and then delivering therapy interventions to help achieve the goals. These interventions were typically a series of sessions with an occupational therapist to practise things like driving, using the bus or walking local routes to the shop or library.

Ten months after the first visit, stroke survivors who received the therapy were significantly more likely to get out of the house as often as they wanted to, compared to those that did not complete the programme ^[40]. Importantly, several of the stroke survivors in the study had had their stroke more than two years previously, showing that even a long time after stroke a short series of therapy sessions can make a difference to life quality.

Although the findings of this research are not unexpected, it is important to show that relatively simple therapy programmes such as these can make a real difference to people's lives. The researchers are now training up other occupational therapists to deliver the outdoor mobility programme and testing it with 700 stroke survivors around the UK.

This research demonstrates that limited outdoor mobility is not an inevitable consequence of having a stroke. As long as the mobility needs of stroke survivors are considered during community rehabilitation, people can be given the information and confidence they need to get out and about as often as they like.



Uncovering cognitive problems

Cognition refers to a group of mental processes that includes attention, memory, producing and understanding language, solving problems, and making decisions. When any of these processes are affected by a stroke, we say the person is experiencing *cognitive problems*.

More than half of stroke survivors report experiencing some cognitive problems after their stroke^[41]. These difficulties are often much harder for doctors to identify than physical problems and can get overlooked during a person's rehabilitation. Cognitive problems can cause stroke survivors to have significant challenges with daily activities, making it harder for them to return to their normal lives.

“Cognitive problems after stroke remain poorly diagnosed despite such problems being key indicators of how well people recover. Being able to detect a problem early after the stroke is a critical first step to rehabilitation.”

Glyn Humphreys, lead of the BCoS project and Watts Professor of Experimental Psychology, University of Oxford.



To address this problem, the Stroke Association started a ten-year programme of research at the University of Birmingham in 2001 to develop a cognitive assessment tool for doctors to use with their stroke patients. If doctors can accurately identify cognitive problems in their stroke patients, they can begin to find ways to help them recover their mental abilities. This large research project has developed the 'Birmingham Cognitive Screen' (BCoS), which has already been used with 800 stroke survivors in the West Midlands area. The screen is currently being made commercially available for use all across the UK.

Research into the cognitive effects of stroke has lagged far behind research into the physical effects. However, researchers are now finding that cognitive rehabilitation therapies can help improve mental functions after stroke in much the same way that physical rehabilitation helps to improve motor abilities. The type of cognitive rehabilitation therapies that are most helpful will vary greatly from person to person. Now that we have an accurate tool to characterise the cognitive problems faced by stroke survivors, researchers can develop better and more specific therapies to help them.



Recovering the ability to communicate

About one third of all stroke survivors have trouble with speech, language and communication^[42]. These problems are among the most debilitating effects of a stroke because they can cut people off from their families and loved ones and leave them feeling isolated and depressed.

Stroke can disrupt communication in a variety of ways: stroke survivors can have trouble speaking and producing sounds, hearing and discriminating sounds, remembering words, reading or understanding what others are saying to them. If a stroke survivor has one or more of these communication difficulties, we say they have *aphasia*.

Because of the diversity of communication difficulties faced by stroke survivors, developing effective therapies to a recovery is complex. Over the last 10 years we have funded a wide range of aphasia research projects. These projects have helped to categorise the different types of language impairments that can occur after a stroke and begun to develop new therapeutic methods for helping stroke survivors recover these vital skills.

In 1995 we funded Dr Sally Byng and colleagues to develop a drawing-based therapy for stroke survivors with severe language impairment. Their study found that drawing therapy could enable people with aphasia to become more effective and efficient communicators with their family and friends^[43]. This research contributed to the development of current drawing therapies and is included in the national guidelines for speech and language therapists^[44]. Drawing therapy is now widely used by speech and language therapists with stroke survivors in the UK.



In 1999 we funded Professor Ray Wilkinson, then at University College London, to develop a conversation-based therapy for use with stroke survivors and their partners. At the time, conversation therapy had focused on training the stroke survivor's regular conversation partner, such as their spouse or carer, to be more successful in having daily conversations with the stroke survivor. This new conversation therapy approach added in strategies for the stroke survivor with communication problems, developing ways that the couple could work together to improve their performance in conversation.

The study was a success: conversation therapy greatly improved the stroke survivor's ability to convey messages to their partner and helped the couple hold more successful conversations despite the effects of the stroke^[45]. Several hundred speech and language therapists from all over the UK have now been trained to use this method of therapy. The approach is being used internationally, meaning that the research is directly benefitting stroke survivors with communication problems both in the UK and other countries.



Jim and his wife Sandra took part in the conversation-focused therapy project around two years after a stroke had left Jim with pronounced communication problems. Like many similar couples, they were struggling to find ways to adapt their style of conversation to cope with Jim's language difficulties.

Jim and Sandra's typical conversations were strained and often consisted of Sandra asking Jim direct questions in an attempt to include him. A speech and language therapist assessed their conversations at home and developed a series of eight behavioural sessions to target their specific problem areas. The sessions included techniques such as role play, video feedback and awareness-raising through discussion and homework.

"Once the therapy had begun, it was wonderful to see how beneficial it was going to be. I learned to do a lot of things to help that I hadn't thought about. The therapist would give us exercises to do at home – and then later I would make up new ones – copying the exercises but using subjects that I knew would interest Jim. We did the exercises every day."

Sandra, a participant in the conversation therapy study.

In 1999 we funded Professor Pam Enderby to develop a computer based therapy programme for stroke survivors with long-lasting communication problems. Typically, speech and language therapy is only available to stroke survivors in the first few months after stroke because the resources of therapy services are limited. Professor Enderby and her colleagues created a computer programme that could be used by stroke survivors in their own homes to help them improve their language abilities beyond the end of traditional therapy.

The researchers designed software, called 'StepByStep', to help people who have trouble finding and using the right words during speech. Stroke survivors were recruited to the study and trained to use the software on their own at home for six months. The training worked; all participants showed significant improvements in their ability to find words and names and reported increased confidence and self-esteem^[46]. Moreover, several participants reported improvements in everyday communication such as calling family members by name, initiating conversations with strangers and using the telephone.



The researchers went on to conduct a larger trial of StepByStep comparing stroke survivors who used the software to a similar group that did not. The trial confirmed that home-based computer training for six months can provide significant improvements in word use in stroke survivors with communication difficulties^[47].

Importantly, the trial participants were between two and twelve years after their stroke when they began using the programme, showing that it is never too late to try and improve speech and language ability. The software has been developed further and is now commercially available to stroke survivors in the UK.

"It's a pity we didn't have this years ago really... although we had a little bit of support at first we've had nothing in between."

Stroke survivor who participated in the research study in 2000.

"GL reported a dramatic improvement in his communication skills and has started to use the phone again two years after his stroke. He has never experienced such a dramatic improvement in previous therapy."

Carer of patient GL, a participant in the research study.

In 2007 we funded Dr Alex Leff at University College London to develop a web-based tool to improve reading in stroke survivors with loss of vision in one eye.

About 20 per cent of stroke survivors experience partial or total loss of vision in just one eye^[48]. This deficit, called *hemianopia*, can severely affect a person's ability to read, especially if it is the right eye that is affected. English readers scan the page from left to right and use visual information to the right of the word they are reading to plan their next eye movements. Patients with right-side hemianopia cannot see what is on the right side of the page, causing them to make incorrect eye movements and to read very slowly. The condition can really affect a person's quality of life; some patients abandon reading altogether and others are unable to perform in their jobs because they cannot read quickly enough.

But there is hope. Stroke survivors with right-side hemianopia can be trained to improve their reading speed by reading text scrolling across a screen. It is unclear why this helps to improve reading but we think it might re-train the brain to perform smoother scanning eye movements that can be carried over to the reading of normal static text.

Dr Leff and his colleagues have created a website called Read-Right (www.readright.ucl.ac.uk) that provides scrolling text therapy for free. This is the first example of a web-based therapy for the rehabilitation of stroke survivors in the UK. It provides an interactive service that stroke survivors and their carers can use to diagnose^[49] and treat reading difficulties due to right-sided hemianopia. The website also contains a tool to test the reading speed of normal static text so that people can monitor their progress as they proceed through the training.

The website went live in June 2010 and by 2012 it had received almost 10,000 visitors. The data collected via the website have shown that the therapy can dramatically improve reading speed. Stroke survivors show improvements with just five hours of training and after 20 hours can speed up their reading by almost 50 per cent^[50]. This research has taken a simple yet effective therapy and made it easily accessible to English-speaking stroke survivors all around the world.

“Participating in the Read-Right study has given me back my confidence at work. Before the training I thought my reading problems were caused by damage to my brain from the stroke. Now I understand it is just a side effect of my visual problems and I have been able to improve my reading speed using the website. Read-Right has restored my self-belief and allowed me to take control of my own recovery.”

Mark Jarvis, a stroke survivor who participated in the Read-Right study.



In 2012 we commissioned Dr Ruth Herbert at the University of Sheffield to test different ways of providing information to stroke survivors with aphasia. After a stroke, people need information to help them understand what has happened to them. This can be a challenge for people with aphasia, who are sometimes left completely unaware that they have had a stroke.

The research team, consisting of academics, speech and language therapists and a graphic designer, worked with stroke survivors and their carers to test a number of different ways of presenting information about stroke. This research led to the publication of the 'Accessible Information Guidelines' ^[51] to help others make their information more accessible for people with aphasia.

“The Stroke Association should be congratulated for their fantastic contribution to aphasia therapy research. In our department at City University London, they have funded projects investigating the use of drawing, writing, gesture and virtual reality environments in aphasia therapy. On a personal level, their funding has enabled me to pursue research questions that hopefully make a difference to the lives of people with communication problems.”

Jane Marshall, Professor of Language and Communication Science, City University London.





Growing stroke research in the UK

In the early 1990s, the Stroke Association was investing in stroke research at a time when it was mostly neglected by the larger funding agencies. Stroke was considered an unfortunate but unavoidable consequence of ageing that did not warrant a great deal of research funding, especially when compared with diseases considered to be more curable or preventable such as cancer and heart disease.

Through our dedicated investment into stroke research and our funding of specialised stroke training for clinicians, we have helped to build a solid foundation of scientists, clinical researchers and consultants in the UK, all with a dedication to stroke. The UK is now a world leader in clinical stroke research, second only to the United States in terms of research output and second only to Sweden in terms of value for money ^[1].

As stroke is increasingly recognised as a major cause of disability, other funding agencies have begun to invest in the UK's research programme for stroke. Without early and continued support from the Stroke Association, stroke research in the UK would not have had the capacity to expand to its current status.



The first UK Professor of Stroke Medicine

Created at the University of Nottingham in 1992, the Stroke Association's Chair of Stroke Medicine was the first professorship dedicated to stroke in the UK. The post has supported two professors and several more senior and junior researchers over the years and has established Nottingham University as a leader in both clinical stroke research and stroke rehabilitation.

The first holder of the chair was Professor Peter Fentem, who was Dean of the Nottingham Medical School when the chair was awarded and previously Professor of Physiology with an interest in elderly people. He turned his attention to stroke for the first time when he was awarded the chair and was instrumental in developing the successful stroke rehabilitation research unit at Nottingham. He has since received an MBE (member of the Order of the British Empire) specifically for his work in stroke medicine.

“When I started, in 1992, stroke was an area of research that the Medical Research Council would barely entertain. In the early 1990s only three people [in the UK] were interested in stroke; about seven years later nearly 100 people were training to be stroke physicians and now 20 years later we have the NIHR Stroke Research Network and all the major research funders investing in stroke.”

Professor Peter Fentem, former Stroke Association Professor of Stroke Medicine, University of Nottingham.



Professor Philip Bath took over the chair in 1997 and has been very successful in leading large clinical trials of blood pressure medication in acute stroke and also the testing of stem cells. Professor Bath has been extremely accomplished in securing further grants to support stroke research. Since he took over the professorship the Stroke Association has invested £4 million into the Division of Stroke at the University of Nottingham. Currently, the Division has £29 million worth of research funding in active grants and has been awarded more than £30 million from sources other than the Stroke Association since 1997. This equates to a seven-fold return on our research investment.

“Clinical trials are the form of research that is most likely to change and improve clinical practice, so it is very gratifying that the Division’s research largely focuses on coordinating these. Trials have to be very big now and two of our studies run around the world involving, and potentially benefitting, thousands of patients.”

Philip Bath, Stroke Association Professor of Stroke Medicine, University of Nottingham.

The Chair in Stroke Medicine funding has also supported several younger stroke researchers and clinicians who are now becoming the new leaders for clinical stroke research. The best example is Professor Marion Walker, whose PhD and first lectureship post at the University of Nottingham were both funded through the Stroke Association chair. Professor Walker was one of the first occupational therapists to receive a PhD. She is considered an international leader in stroke rehabilitation and was awarded an MBE in 2012 for her dedication to the field.



Specialist training in stroke for NHS doctors

One of the biggest successes of the Stroke Association's research funding has been our Clinical Fellowship scheme. Set up in the mid-1990s, this funding scheme provided an extra year of clinical training for young doctors to specialise in stroke at a time when specialist stroke training was not provided by the Department of Health. The funding brought talented young doctors into stroke, equipped them to become stroke consultants and, for many, allowed them to get involved in clinical research.

The scheme has had a significant impact for patients because it produced a cohort of specialised stroke doctors who understand the implications of the latest research and want to be involved in clinical trials. The Department of Health now funds clinical training in stroke, recognising the importance of this speciality to the provision of quality health care to an ageing population. Between 1996 and 2007, we funded 30 talented doctors to become stroke specialists, many of whom are now leading stroke units and services around the country or are actively involved in clinical stroke research.

Some of the Stroke Association Clinical Fellows have been:

- Dr Adrian Blight who now runs the stroke unit at the Royal Surrey County Hospital.
- Dr Ajay Bhalla who is now a Consultant Stroke Physician at St Thomas' and King's College Hospitals and is actively involved in stroke research through the South East Stroke Research Network. His research looks at the organisation of stroke services in the UK and across Europe in order to develop more efficient ways to treat stroke patients.
- Dr Anthony Hemsley who is a consultant in stroke medicine at the Royal Devon and Exeter Hospital. He was involved in setting up a 24/7 thrombolysis service which has increased the number of people receiving thrombolysis in the area.
- Dr David Werring who was actively involved in developing stroke services including the hyper acute stroke unit at the University College Hospital, London, and is now a Reader in Neurology at the UCL Institute for Neurology. He leads a highly successful research programme using brain imaging to explore the role of microbleeds (small sites of brain bleeding) in stroke.



"The Stroke Association – as our only dedicated stroke charity – is absolutely vital to the success of stroke research in the UK; at a personal level, their funding has enabled me to train as a research-active stroke neurologist, and to develop my own stroke research projects as a more senior researcher."

Dr David Werring, Reader in Clinical Neurology, UCL Institute of Neurology, London

- Dr Geoff Cloud who was instrumental in setting up the world-class stroke unit at St George's Hospital, which he still leads. The Stroke Association has heralded this unit as a beacon of good practice for emergency stroke care.
- Dr Nick Ward who is now a Reader in Clinical Neurology at UCL Institute of Neurology leading a £1.4 million research programme examining the ability of the brain to reorganise after stroke.
- Dr Nikola Sprigg, who is now an Associate Professor and stroke clinician at University of Nottingham. She is leading on several big clinical trials including: the STEMS3 trial, which is testing whether stem cells from bone marrow can be used in brain repair after stroke; and the EuroHYP-1 trial, testing whether cooling the body of stroke patients for 24 hours can reduce the amount of brain damage.
- Dr Phyto Kyaw Myint who is the Clinical Senior Lecturer in Ageing and Stroke Medicine at the University of East Anglia. He leads an active research programme looking at stroke risk factors and long-term outcomes, including the recognition and treatment of depression after stroke.
- Dr Roswell Martin who set up a genetic screening and referral system at St George's Hospital for CADASIL, an inherited form of stroke.

“The Clinical Fellowship Scheme provided me with an invaluable year of in-depth training in stroke medicine. Free from the normal constraints of hospital rotas, I was able to visit specialist stroke clinics and gain experience in many different aspects of stroke care. These experiences have given me greater insight into the impact of stroke on patients’ lives, hopefully making me a better doctor and benefitting the patients I treat.”

Dr Nikola Sprigg, Associate Professor, Department of Neurology, University of Nottingham.



Punching above our weight

Charitable research funding accounts for a third of all the money spent on medical research in the UK^[52]. However, only 1 per cent of the total research spending by charities goes to support research into stroke^[2], even though stroke is responsible for 9 per cent of all deaths and is the second biggest cause of adult disability in the UK.

We are constantly striving to increase the amount we spend on supporting stroke research but our current budget is still dwarfed by those of larger medical charities. In 2010, our research budget was 40 times smaller than that of the British Heart Foundation and over 100 times smaller than that of Cancer Research UK^[53]. This discrepancy is largely due to the overall lack of awareness and public understanding of stroke. Stroke is commonly perceived by the public as an untreatable condition that only affects the elderly and therefore not a priority for their donations.

Even though the Stroke Association is not able to fund large expensive clinical trials, our research still makes a big difference to the advancement of stroke healthcare. We do this by strategically funding smaller, riskier pilot studies that are essential in the early stages of developing a new treatment. These studies provide the evidence necessary to show it is feasible to conduct a larger clinical trial. Our funding enables researchers to obtain essential data needed to secure funding from other sources, thus bringing more money in to the field of stroke.

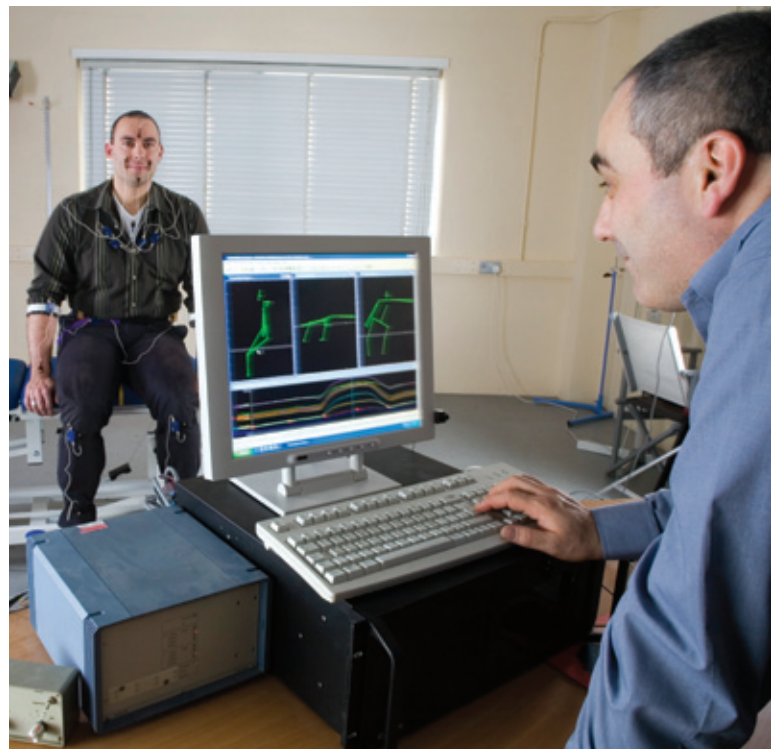
This strategy has been hugely successful; several of the large national and international stroke trials that have taken place in the UK started out as smaller pilot studies funded by the Stroke Association. For example,

- The 'International Stroke Trial-3' (IST3): the world's largest trial to test thrombolytic drugs in patients with ischaemic stroke.
- The 'Surgical Trial in Intracerebral Haemorrhage' (STICH) trial: an international trial to test whether immediate surgery to remove pooled blood from the brain after a haemorrhagic stroke can help patients make a better recovery.
- The 'Asymptomatic Carotid Surgery Trial' (ACST): a large European trial to test whether immediate surgery to clean out a narrowed carotid artery could help prevent stroke in patients who have not yet experienced any symptoms from their narrowed artery.
- The 'International Carotid Stenting Study' (ICSS): an international trial looking at whether reopening the narrowed carotid artery with a stent is safer and/or more effective at preventing stroke than carotid endarterectomy surgery.

- The 'Clots in legs or stockings after Stroke' (CLOTS) trials: three national trials to test whether graded compression stockings can prevent deep vein thrombosis (blood clots in the legs) forming in stroke patients in hospital.
- The 'Control of Hypertension and Hypotension Immediately Post Stroke' (CHIPPS) trial: a national trial to test whether using medication to control blood pressure immediately after stroke can improve patient long-term outcomes.
- The 'Aspirin plus dipyridamole versus aspirin alone after cerebral ischaemia of arterial origin' (ESPRIT) trial: a large international trial to compare two different anti-blood clotting drug regimes in the secondary prevention of stroke.

We encourage other funding bodies to invest in stroke research by offering collaborative funding opportunities. We contribute a certain amount of money and then ask other funding agencies to contribute the same amount or more to the research grant. By working this way, we can amplify the potential for our donations to do more to improve the lives of people affected by stroke.

We currently work with both the Wellcome Trust and the Medical Research Council to fund outstanding stroke researchers through joint fellowship schemes. We also have a joint research programme with the British Heart Foundation that supports stroke research specifically related to blood vessels and a joint grant with the Alzheimer's Society looking at the prevention of cognitive difficulties after stroke. We also contribute to the National Prevention Research Initiative, a consortium of research funders that collectively spend several million pounds on disease prevention research relevant to stroke.



The UK Stroke Research Network

The National Institute of Health Research (NIHR) Clinical Research Network is a partnership between government, the charitable sector and industry that provides the infrastructure to support high-quality medical research in the NHS, namely clinical trials. Support is funded by the Department of Health and includes:

- help with getting ethical approval to conduct a trial
- support staff for the trial
- funding to cover the use of hospital facilities
- help with patient recruitment
- collaborative working practices between researchers, funding bodies and industry.

In 2005, the Department of Health expanded the NIHR Clinical Research Network to support clinical research into six specific health conditions: cancer, mental health, dementia, diabetes, childhood medicine and stroke. The Stroke Association had a significant role in getting stroke included as one of the disease specialities covered by the research network.

Thanks to our continued funding of stroke research groups, there were already many established centres for stroke research dispersed across England and Scotland with a reputation for successful clinical research. We lobbied the Department of Health on the importance of stroke research and worked with them to develop operational models for the proposed network. We also brought together lead researchers in stroke to stimulate their active involvement in developing a successful proposal, which ultimately won the support of the Government.

The creation of the Stroke Research Network in 2006 was a massive leap forward for clinical stroke research in the UK. It has stimulated more and better clinical trials through better patient recruitment and novel collaborative relationships. Since its creation there has been a six-fold increase in the number of stroke patients participating in clinical trials^[54]. It has also attracted top quality physicians to specialise in stroke, thus driving up research quality and ultimately benefitting patients.

The Stroke Association strongly benefits from the Stroke Research Network; in 2012, one in five of the clinical studies being supported by the network were funded by us. This means the Department of Health is supporting some of our research, allowing us to have a bigger impact with the limited research budget we have.



The UK Stroke Forum

The Stroke Association has played a pivotal role in supporting the growing stroke research community, not only through funding but also by encouraging the healthy exchange of ideas and data. Since the mid-1980s, we have held an annual conference to bring together our researchers to present and discuss their latest results. For many years this annual meeting was the only stroke-specific scientific conference being held in the UK and it has always been very well attended by the leading researchers in the field.

As the size of the stroke community grew, so too did the size of the annual conference. In 2007, the Stroke Association's Scientific Conference joined forces with the British Association of Stroke Physicians Annual Conference and the National Stroke Nursing Conference to form one multidisciplinary united national stroke conference: the UK Stroke Forum. What started as the Stroke Association's Scientific Conference with about 100 annual attendees is now attended by about 1,500 delegates each year.

The UK Stroke Forum is committed to promoting multidisciplinary stroke research, care and education. It brings together stroke researchers, doctors, nurses, allied health professionals and stroke survivors to share ideas and expertise. Bringing this diverse set of backgrounds together helps to develop research and health care practices that more effectively address the needs of stroke patients. Working together in this way is a tremendous achievement for the stroke community and something that is rarely seen in other disease areas.

“The formation of the UK Stroke Forum has had a very positive influence on stroke care in the UK. Latest research findings are discussed by people from a whole range of research, medical and political backgrounds, ensuring research evidence is used to inform the entire care pathway for stroke.”

Dawn Good, Chair of the UK Stroke Forum





Hope for a better future

It is an exciting time for stroke research. Over the last two decades, perceptions of stroke in the medical community have changed radically; stroke is no longer seen as an untreatable affliction of the elderly. It is recognised that stroke can strike at any age and that remarkable levels of recovery are possible with the right treatments and support.

As this report illustrates, it takes many years, sometimes decades, for ideas and treatments developed through research to become a routine part of stroke care. The UK stroke research community is the strongest it has ever been. It is currently tackling a wide range of important issues, from genetics to new emergency treatments and the burgeoning field of brain recovery. With continued support, researchers are set to make important advances in the coming decades. The Stroke Association is dedicated to supporting stroke research because it will find ways to stop stroke and help stroke survivors rebuild their lives.

New emergency treatments on the horizon

Body cooling

There is a lot of scientific evidence to suggest that body and brain temperature may play an important role in the brain damage caused by stroke. Doctors already cool patients with other forms of brain injury, such as after a cardiac arrest or in babies with birth injuries. Cooling the brain after it has been deprived of oxygen seems to reduce the amount of permanent tissue damage that occurs, thus helping patients to make better recoveries.

A new large clinical trial of body cooling after ischaemic stroke has just been funded by the European Union. This treatment, called *therapeutic hypothermia*, has already proved to be very effective in animal models; cooling animals to 35°C after an ischaemic stroke reduces the amount of brain damage they suffer by a third^[55]. Moreover, patients whose body temperatures rise after stroke are more likely to have a poor outcome^[56], suggesting that a higher temperature is associated with greater levels of brain damage.

The Stroke Association's Professor of Stroke Medicine, Philip Bath, has shown that body cooling to 35°C is feasible and safe in stroke patients. Now this large clinical trial, called EuroHYP-1, will test whether cooling 1,500 patients across Europe for 24 hours after stroke will improve their recovery. In the UK, the trial is being coordinated by Dr Nikola Sprigg, one of our past Clinical Fellows at the University of Nottingham.

By cooling the body soon after stroke symptoms begin, the EuroHYP-1 trial hopes to reduce the amount of permanent brain damage caused by the stroke. This in turn could reduce the amount of disability experienced by stroke patients.

New emergency treatments on the horizon

Mechanical clot retrieval

When a blood clot travels to the brain and causes a stroke, patients can be given thrombolytic drugs to dissolve the blood clot and restore precious blood flow to the brain. These drugs can be remarkably effective if given early enough after symptoms begin. However, not everyone can be treated this way, and even if they are eligible, the drugs are not always able to dissolve the blood clot, especially if it has blocked a large blood vessel. Stroke caused by blockages in the large arteries are typically the most severe and associated with greater disability.

A number of tiny mechanical devices have recently been developed that can be inserted into the blocked blood vessel and used to physically pull out the blood clot. These *clot retrieval devices* are much better than traditional thrombolytic drugs at clearing away blood clots. In theory they have the potential to be better at restoring blood flow to the brain and thus reducing permanent brain damage and disability. However, before these new tools can be used regularly by doctors in the UK, we need to know whether they are safe and more effective in practice.

Mechanical clot retrieval requires patients to have an invasive procedure, sometimes requiring an anaesthetic, which takes longer to perform than it does to administer a drug. This extra delay in restoring blood flow to the brain could outweigh the benefits of removing the clot in the long run. The devices could also damage the blood vessel and cause bleeding in the brain.

The Stroke Association is currently funding Professor Keith Muir at the University of Glasgow and Dr Phil White at the University of Edinburgh to conduct the start-up phase of a clinical trial (the PISTE trial) to begin to answer these important questions. Several centres around the UK will participate.

“Mechanical clot retrieval has the potential to minimise brain damage in many patients who currently respond poorly to standard treatment with thrombolytic drugs. However, it is a much more complicated procedure so we must test whether it improves patient outcomes in practice.”

Professor Keith Muir, SINAPSE Chair of Clinical Imaging, University of Glasgow.

Remodelling the brain after stroke

Over the last 30 years there has been a dramatic shift in way we think about the adult brain. We used to see it as a stable, rather unchanging structure that once damaged could not be repaired. Through decades of neuroscience and psychology research we now know that this is not the case. The adult brain is capable of remarkable feats of reorganisation in response to changing environments and demands. It is true our brains are less flexible in adulthood than they are during childhood, but they do retain lifelong neuroplasticity.

Neuroplasticity refers to the ability of the brain to change and adapt, both in physical structure and in how it functions. It is this remarkable ability that underlies the process of stroke recovery. When areas of the brain are permanently damaged by a stroke, other brain areas can learn to take over, allowing stroke survivors to recover abilities that were originally lost.



The discovery of neuroplasticity in adulthood is perhaps the most promising finding for the future of stroke medicine. Now we know that the brain can reorganise at any age, we can find ways to encourage the process in the damaged brains of stroke survivors. Researchers are approaching this challenge in the following ways:

- Looking for drugs that can stimulate the biological processes involved in neuroplasticity. For example, testing chemicals that allow brain cells to alter the connections they make with each other. In the future this avenue of research could produce medications that make it easier to recover lost functions such as limb movements or speech.
- Testing whether physical brain stimulation can encourage the reorganisation of brain circuits during rehabilitation. Stimulation can be delivered by magnets in 'Transcranial Magnetic Stimulation' (TMS) or as small electrical currents through the scalp in 'Transcranial Direct Current Stimulation' (tDCS).
- Coupling physical therapy techniques with brain imaging to understand how repetition training affects how the brain controls movement. By exploring how different kinds of physical therapy modify the brain we can identify those that are most effective at allowing the brain to regain motor control after stroke.
- Addressing the role of neuroplasticity in the rehabilitation of cognitive difficulties after stroke. Researchers are looking at how behavioural training can modify brain pathways to help stroke survivors improve their cognitive functions such as memory, language and planning abilities.

Research into brain plasticity is in relatively early stages. Scientists are still studying how the process works during normal learning in order to understand how it can be harnessed during the recovery from brain injury and stroke. But the field is progressing rapidly and some techniques are already being considered for use with patients.

For example, the Stroke Association is currently funding two projects to look at the benefits of using Transcranial Magnetic Stimulation in the rehabilitation of stroke survivors:

- Professor John Rothwell at University College London is testing whether magnetic brain stimulation can improve the effectiveness of arm and shoulder motor therapies on the recovery of movement.
- Professor Glyn Humphrys and colleagues at the University of Birmingham are testing whether magnetic brain stimulation can improve attention and concentration in patients with cognitive impairments after a stroke.



Emotional wellbeing and unmet needs

During 2010, the Stroke Association worked with researchers at King's College London to investigate the long-term needs of stroke survivors and their families. The study found that, of the 800 stroke survivors surveyed, over half had long-term needs that they felt had not been addressed.

The most commonly reported unmet need related to mental problems such as memory and concentration, closely followed by emotional problems and fatigue. For example, 39 per cent of survey responders reported experiencing emotional problems and felt that the emotional impact of their stroke had not received the medical attention it deserved.

To change the way the cognitive and emotional effects of stroke are recognised and treated, we have been organising workshops to raise awareness and prompt further research. The workshops bring together leading scientists in a particular field of research with top stroke researchers to stimulate the development of future stroke research themes. The first two workshops addressed the issues of fatigue and anxiety after stroke.

As a direct result of the fatigue workshop, we are now funding a Senior Research Fellow at University College London to investigate whether changes in the brain are responsible for fatigue after stroke. This research will help us to understand what causes the common feeling of fatigue and therefore contribute to future fatigue management strategies. We are expecting to receive grant applications relating to post-stroke anxiety following the workshop held in spring 2012.

In the past, research into the mental consequences of stroke has lagged behind research into the physical impairments. Clearly we need to do more to recognise the mental and emotional challenges faced by stroke survivors. Further research will be critical for the development of new therapies or coping strategies. The stage is now set to make significant advances over the coming years. Hopefully future stroke survivors will receive better psychological assessment and be given the tools and support needed to cope with the mental impacts of their stroke.



A big thank you

Over the last 20 years, the Stroke Association's research funding has addressed a wide range of issues relating to stroke. Our researchers have made significant contributions in all of these areas and we are immensely proud of what we have achieved together.

We want to thank all the talented scientists, doctors and therapists that have worked with us towards the common goal of fewer strokes and better care for those affected by stroke.

Above all, we want to say a big thank you to everyone who has contributed to funding research over the last 20 years. Without their generous support, none of these achievements would have been possible.

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“The Stroke Association – as our only dedicated stroke charity – is absolutely vital to the success of stroke research in the UK.”

Dr David Werring, Institute of Neurology, University College London

“The Stroke Association has created an enormous impact on the field of stroke research worldwide.”

Professor Ann Ashburn, University of Southampton

“The research funded by the Stroke Association has improved stroke rehabilitation immeasurably and consequently patient care has improved as a result.”

Professor Marion Walker, University of Nottingham

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