NHS

Research demand signalling
National Stroke Programme

March 2022

Contents

Foreword

Stroke is a major cause of death and the leading cause of disability in England. It is estimated that around one-third of long-term stroke survivors in England have a moderate or severe disability, and one-third a mild disability; more than half of them experience anxiety or depression.

Over the last 10–15 years we have made great strides in improving stroke care: thousands of patients every year receive thrombolysis; thrombectomy is dramatically reducing disability for those who receive it; and stroke unit scores, as measured by the Sentinel Stroke National Audit Programme, are improving. More recently, stroke services across England were quick to embrace new ways of working, including adopting remote technologies, in response to the COVID-19 pandemic, bringing about some notable improvements in patient access and experience.

Nonetheless, there is more work to be done. Pre-hospital processes must be developed to ensure that people are taken rapidly to the most suitable stroke centre where they can access high quality, evidence-based hyper-acute stroke care. We must deliver a step-change in stroke rehabilitation; in its intensity and duration of access, and basing it on need rather than time. 'Life after stroke' care must be holistic and support stroke survivors' physical, emotional and cognitive needs.

This document highlights the priority areas for research to inform national policy and support the ambitious, but achievable, NHS Long Term Plan targets for England.

It builds on the excellent work of the Stroke Priority Setting Partnership (PSP) led by the Stroke Association with the James Lind Alliance (JLA). We have used different methods to the Stroke JLA PSP to determine priorities, but reach a closely aligned set of priorities. Overlap includes managing the hidden effects of stroke, including psychological and emotional support needs, more effective rehabilitation, and better ways to diagnose and treat major strokes. We now have clear direction for future research investment and activity. In the coming months, we'll work closely with our partners, including the National Institute for Health Research, UK Research and Innovation and the Stroke Association, to continue to emphasise the importance of stroke research. We owe it to stroke survivors and their families to be ambitious in

stroke research and address the unanswered questions so that together we can save and rebuild more lives after stroke.

We are extremely grateful to the many survivors, their families and carers, and professionals who have contributed to our work and that of the Stroke JLA PSP. Their contributions have been invaluable.
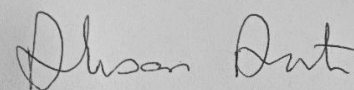
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Summary

The NHS Long Term Plan sets the priorities and ambitions of the NHS until the end of the decade. In some areas existing research evidence and clinical guidelines provide frameworks on which policy can be based, but in others, more research is required to inform policy decisions.

The NHS England and NHS Improvement Research Team developed the research demand signalling process to identify, prioritise and articulate the research questions that NHS services need answers to for them to deliver against the ambitions in the NHS Long Term Plan. The team brought together clinicians, academics, policy experts and people with lived experience from the stroke community to identify the high-priority areas for research. These are:
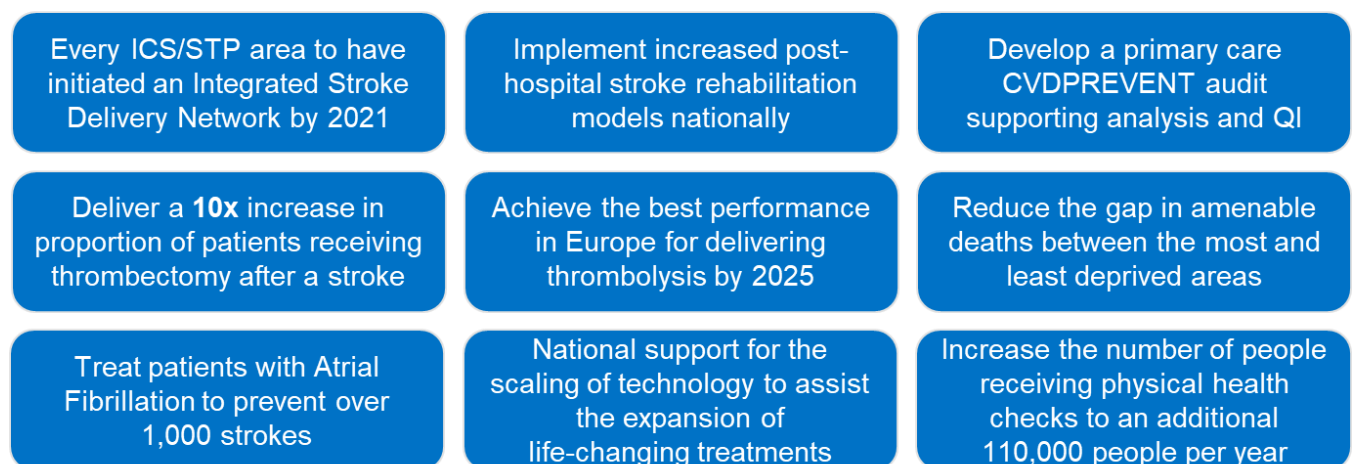
- **Longitudinal research into rehabilitation and life after stroke** with tailored outcome measures for patients, as well as the impact on the health and social care system and local economies.
- Developing and testing **new patient pathways**, including for haemorrhagic stroke, hyper-acute care in rural geographies and personalised secondary prevention.
- **Technology for diagnosis:** artificial Intelligence solutions at a diagnostic level for patients to be put onto the right pathway; innovative triage tools and behavioural insights into referral (pre-hospital); technologies for the early and accurate diagnosis/detection of stroke and how that can reduce inequalities in outcomes and access to services.
- **Long-term supported and monitored active self-management of stroke** to prevent recurrent stroke and deterioration of mental and physical wellbeing.
- **Multiple long-term health conditions across the life course:** how to understand the impact of having multiple long-term health conditions on treatment/acute stay and appropriate decision-making.

This report presents the research questions that were identified through the demand signalling process, alongside the key evidence gaps. These will be used to influence research activity and funding calls.

NHS Long Term Plan ambitions for stroke services

1. The NHS Long Term Plan has committed to improving stroke care across the entire pathway (Figure 1).

2. This includes delivering improvements in hyper-acute treatments such as thrombectomy and thrombolysis, pathway optimisation and reducing unwarranted variation in the provision of integrated community stroke rehabilitation.

Figure 1: Key ambitions for stroke in the NHS Long Term Plan

Every ICS/STP area to have initiated an Integrated Stroke Delivery Network by 2021	Implement increased post-hospital stroke rehabilitation models nationally	Develop a primary care CVDPREVENT audit supporting analysis and QI
Deliver a **10x** increase in proportion of patients receiving thrombectomy after a stroke	Achieve the best performance in Europe for delivering thrombolysis by 2025	Reduce the gap in amenable deaths between the most and least deprived areas
Treat patients with Atrial Fibrillation to prevent over 1,000 strokes	National support for the scaling of technology to assist the expansion of life-changing treatments	Increase the number of people receiving physical health checks to an additional 110,000 people per year

3. Since the publication of the NHS Long Term Plan, NHS England and NHS Improvement have released the first National Stroke Service Model, which outlines best practice for the NHS in preventing and caring for stroke. It presents clear ambitions for every area of the country to develop and implement as part of the strategic delivery of the NHS Long Term Plan.

4. To date, the National Stroke Programme's key achievements include:

- development and launch of 20 integrated stroke delivery networks (ISDNs)
- mobilisation of dedicated stroke rehabilitation pilots testing new models and intensity of care
- production of a comprehensive integrated stroke community service model

- establishment of a Thrombectomy Implementation Group to support the expansion of thrombectomy services across England
- development of a National Optimal Stroke Imaging Pathway
- facilitating the use of software to support the decisions clinicians make when interpreting brain scans
- establishment of a new virtual stroke survivor support service, Stroke Connect, run in partnership with the Stroke Association
- cultivation of strong links with regional and local stroke teams during the COVID-19 pandemic, with strong commitments for ongoing national support.

5. Most notable among these is the launch of 20 ISDNs across England; the key delivery vehicle for transforming stroke care across the country. Using a full care pathway approach, they will improve stroke prevention, reduce health inequalities and ensure better outcomes for those who have a stroke through improved diagnosis and access to treatment in 24/7 specialist stroke units. They will also increase the availability of high-quality rehabilitation and ongoing community care to support stroke survivors rebuild their lives.

6. The National Stroke Programme continues to work closely with Health Education England to modernise the stroke workforce, with a focus on cross-professional competency development.

7. While clear progress has been made since the publication of the NHS Long Term Plan, we recognise that there are gaps in our understanding of what best practice for stroke care should be; it is these areas that have been the focus of the research demand signalling process.

Research demand signalling

8. Numerous methods have been widely adopted for the purposes of priority setting, from the traditional Delphi method through to the more recently developed and increasingly popular CHNRI method. All are systematic in nature and iterative in design, with an aim to build consensus and ownership among the community they serve.

9.	The method underpinning the research demand signalling process developed by the NHS England and NHS Improvement's Research Team is adapted from the Delphi method. It uses a series of workshops and evidence gathering to iteratively refine areas for research of unmet need (see Annex 1). The Research Team led the process, working in partnership with the Stroke National Clinical Director and the NHS England and NHS Improvement Stoke Policy Team.

10.	Starting with senior stakeholders from a range of professional backgrounds and those with lived experience of stroke (see Annex 1), five high-level areas for research were identified and prioritised to meet the NHS Long Term Plan objectives.

11.	The evidence was then reviewed, followed by further stakeholder engagement (see Annex 1) to develop detailed research questions in areas of unmet need.

12.	By following this iterative process and involving representatives from across the stroke community, the agreed outputs can be mapped back to the relevant NHS Long Term Plan ambitions.

13.	Detailed considerations, captured from stakeholder workshops for each of the priority areas, are also given.

14.	Those evidence gaps that were not prioritised for the development of detailed research questions as part of this process can be found in Annex 2.

1. Longitudinal research into rehabilitation and life after stroke

Table 1: Summary of outputs from the demand signalling process related to 'longitudinal research into rehabilitation and life after stroke': detailed research questions alongside the relevant evidence gap and NHS Long Term Plan commitment

NHS Long Term Plan ambition	Key evidence gaps	Detailed research questions
Implement increased post-hospital stroke rehabilitation models nationally	The association between the intensity of therapy and outcomes. The clinical and cost-effectiveness of seven-day rehabilitation, both in hospital and the community. The most effective balance between qualified therapists and therapy assistants in hospital and after discharge in community therapy teams.	What is the most effective way to deliver community-based stroke rehabilitation (eg including tele-rehabilitation) and how can we enhance stroke survivors' experience of the rehabilitation pathway?
		What are the most effective behavioural (physical and psychological) therapies (at what dose and time post stroke) and how can they alleviate the long-term impact of stroke on different groups of stroke survivors?

NHS Long Term Plan ambition	Key evidence gaps	Detailed research questions
	How equipment and technology (eg robotics, telemedicine) could increase intensity of rehabilitation for patients at home. The development and implementation of competencies in such areas as sexual activity and vocational rehabilitation. Occupational therapy interventions regarding, for example, how to optimise toileting independence and the use of adaptations.	What are the optimal ways to manage and treat the non-apparent (hidden) effects of stroke, including incontinence, fatigue, emotional ability, cognitive deficit, memory problems, dysphasia and secondary complications?
	Prevention of immobility-related complications post stroke. Management of common stroke complications, including spasticity, depression, shoulder pain, central post stroke pain and venous thromboembolism. Screening and assessment to improve access to effective treatments, particularly in relation to the psychological impact of stroke, dysphasia, depression and cognition. The aetiology and best systems for managing mood and cognitive disturbance and fatigue after stroke.	What outcomes are most important to stroke survivors and their carers, and how can they be best supported to achieve these?

NHS Long Term Plan ambition	Key evidence gaps	Detailed research questions
	The most effective systems to reduce stroke survivor and carer strain and mood disorders.	
	Information provision, shared decision-making, carer involvement and home visits are all thought to have an impact on outcome but need further evaluation and evidence to understand how the interventions are best used.	

Detailed considerations

- There is an established evidence base for the effectiveness of some interventions in stroke rehabilitation, and the next step is to develop knowledge of which are most appropriate for which individuals and at what time after stroke.

- The numerous stroke-induced impairments influence how people respond to evidenced-based therapy; there is a need for a deeper understanding of the complexity of stroke rehabilitation, and how to adapt therapies in the presence of multiple impairments.

- With increasing emphasis on health service provision in the community, there is a need to increase understanding of how evidenced-based therapies can be delivered for maximum benefit. The current evidence base is under-used. This emphasises the importance of implementation research, especially to understand the context in which interventions will be delivered. It also emphasises the need to ensure there is a clear line of sight between any research programme, clinical guidelines and changing practice or the availability of care. Building the evidence base for the cost benefit of therapies is also needed to inform system decision-makers.

- The next phase of research needs to focus on the identification of those therapies for remediating and alleviating impairments that are less obvious than communication and movement deficit. Assessing the impact of stroke on carers and family members is also important.

- Building on current knowledge, there needs to be an emphasis on incorporating patients' and carers' experience of the impact of stroke and what improvements they would value.

- Methodologically, while randomised controlled trials (RCTs) provide the strongest evidence for causality and therefore the most reliable basis for decision-making, the basic RCT design cannot assess how or why an intervention does or does not achieve outcomes. It is likely that complex rehabilitation interventions operate differently in different contexts. How context influences outcomes needs to be understood to tailor and refine implementation.

- Using mixed methods approaches to collect qualitative data alongside quantitative outcomes (eg process evaluation) and observational studies with routine datasets would enable greater exploration of which aspects of the rehabilitation intervention work for different patients and in which contexts.

- Observational data should also be used more widely to demonstrate 'real-world' outcomes for patients, as well as in situations where ethical or practical considerations mean a RCT is not feasible.

- Appropriate use of alternative designs will ensure a broader range of outcomes can be measured, with a particular emphasis on outcomes that matter to patients and their families.

- These priority research questions closely align with the top 10 priorities in rehabilitation and long-term care identified in the Stroke JLA PSP.

2. New patient pathways

Table 2: Summary of outputs from the demand signalling process related to 'new patient pathways': detailed research questions alongside the relevant evidence gap and NHS Long Term Plan commitment.

NHS Long Term Plan ambition	Key evidence gaps	Detailed research questions
Deliver a 10x increase in proportion of patients receiving thrombectomy after stroke and **Achieve the best performance in Europe for delivering thrombolysis by 2025**	The most effective ways of improving the recognition of stroke by emergency dispatchers and ambulance personnel. Biomarkers or clinical tools to reliably identify stroke, differentiate between haemorrhage and infarct, and identify large vessel occlusion to facilitate transfer of patients to the appropriate hospital for their needs. The role of telemedicine in pre-hospital acute stroke care, particularly in areas with significant practical or geographical barriers to accessing care.	What is the effectiveness of diagnostic criteria and the strategy used by emergency call takers in the detection of stroke; toward the development of a unified emergency call pathway for emergency workers and non-acute health services? Can accurate pre-hospital triage of suspected stroke be achieved using a simple symptom checklist and point of care biomarkers? Can personalised secondary anti-thrombotic prevention reduce the risk of intracranial haemorrhage after ischaemic stroke or transient ischaemic attack (TIA)?

Detailed considerations

- There are significant evidence gaps around ensuring stroke patients are expertly assessed and correctly triaged to receive emergency stroke care. Research is needed to develop strategies to identify those with an atypical stroke presentation, including in younger patients.
- There are still outstanding research questions regarding the efficacy of interventions in the acute care setting, as well as their wider health economic consequences and the level of disability patients have following these interventions.
- These priority research questions closely align with the top 10 priorities in prevention, hospital and pre-hospital care identified in the Stroke JLA PSP.

3. Technology for diagnosis

Table 3: Summary of outputs from the demand signalling process related to 'technology for diagnosis': detailed research questions alongside their relevant evidence gap and NHS Long Term Plan commitment.

NHS Long Term Plan ambition	Key evidence gaps	Detailed research questions
National support for the scaling of technology to assist the expansion of life-changing treatments	The role of artificial intelligence (AI) in interpreting brain imaging and how it is best used in routine clinical practice.	Does MRI improve treatment and reduce the risk of future TIA, stroke or heart attack in all people with suspected minor stroke or TIA? Is there a role for AI in predicting the recovery outcomes and rehabilitation needs of stroke survivors?

Detailed considerations

- Two main cohorts of people could benefit from MRI scanning in the stroke pathway:
  - people suspected of having had a TIA or minor stroke – to confirm this diagnosis
  - people with a confirmed diagnosis of TIA – to inform clinical management.

- Implementation challenges surround research into increased use of MRI. Observational data could be informative. Further discussion would be required to articulate the potential benefits of MRI to clinical management, as well as the health economic consequence, to determine in which cohort research should be pursued.

- There are limited predictive algorithms regarding what patients' outcomes on a particular aspect of rehabilitation are likely to be. This information would be useful for stratifying patients onto rehabilitation packages. More detailed characterisation of rehabilitation packages as well as measurements of impairment will be required to improve the precision of predictive algorithms. Neuroimaging data could be predictive.

- Several available technologies (eg checklists and point of care biomarkers) are already used in pre-hospital assessment. However, as yet these have not gone 'head-to-head' in a trial. Existing literature could be used to home in on the most promising candidates to simplify any trial design.

4. Long-term supported and monitored active self-management of stroke

Table 4: Summary of outputs from the demand signalling process related to 'long-term supported and monitored active self-management of stroke': detailed research questions alongside their relevant evidence gap and NHS Long Term Plan commitment.

NHS Long Term Plan ambition	Key evidence gaps	Detailed research questions
Implement increased post-hospital stroke rehabilitation models nationally	Information provision, shared decision-making, carer involvement and home visits will all have an impact on outcomes but further evaluation and evidence is needed to understand how self-management is best used and promoted. The aetiology of and best systems for managing mood and cognitive disturbance and fatigue after stroke. Systems to prevent and treat carer strain and mood disorders. The effectiveness and outcomes of supported self-care and management programmes designed for stroke survivors needs to be evaluated.	What stroke-specific self-care support can/does the NHS provide, and what methods work best for different cohorts? Could the 'change and resilience training' already being used for the wider workforce be developed and used as part of the rehabilitation process for stroke survivors, where appropriate working alongside their unpaid family carers, to help with mental wellbeing and quality of life? Do group-based self-management interventions (eg Mindfulness Based Stress Reduction) reduce anxiety and depression in adults who have had a stroke?

Detailed considerations:

- There is a need for personalised outcome measures that reflect what is important to stroke survivors and their carers and family.

- Stroke survivors and carers may need support long after hospital discharge. Exactly what support they need will vary over time and some needs may not be obvious on discharge, initial community assessment and follow-up.

- Carer support is vital and different models work best for different people; a range of options and personal choice are important. Information requirements also vary over time as expectations are adjusted.

- These priority research questions closely align with the top 10 priorities in rehabilitation and long-term care identified in the Stroke JLA PSP.

5. Multiple long-term health conditions across the life course

Table 5: Summary of outputs from the demand signalling process related to 'multiple long-term health conditions across the life course': detailed research questions alongside their relevant evidence gap and NHS Long Term Plan commitment

NHS Long Term Plan ambition	Key evidence gaps	Detailed research question
Reduce the gaps in amenable deaths between the most and least deprived areas and **Increase the number of people receiving physical health checks by 110,000 per year**	Precise methods to predict trends in risk and outcome of stroke, and particularly to identify high risk groups and health inequalities. The best ways of managing risk factors in the context of multiple long-term health conditions.	Is the risk/benefit of acute treatments (eg tPA, thrombectomy) unfavourable for any groups of people with long-term conditions and/or are any not a cost-effective use of resources? What is the impact of multiple long-term health conditions on mortality risk and need for end-of-life care in acute stoke? How does having multiple long-term conditions influence response to and benefit from rehabilitation?

Detailed considerations

- Thrombectomy has the potential to deliver notable improvements for patients. However, 'grey areas' remain for patients at the margins of eligibility either because of (1) current poor clinical status (eg poor prognosis for surviving the stroke or thrombectomy procedure) or pre-existing co-morbidities, or (2) being outside the recommended time window for thrombectomy or this is unclear because the time of stroke onset is unknown. A RCT could address questions regarding patients at the margins of eligibility for thrombectomy. Thought should be given to the trial endpoints; these should reflect the outcomes that matter to patients and their carers.

- Owing to the incomplete understanding of conditions and complications that determine poor outcomes, and poor data flows, it is too early to introduce AI in this area. Instead, efforts should focus on improving the data flows and using data to develop predictive models.

- The insufficient amount of research and evidence in end-of-life care for stroke patients is disproportionate to the importance of this topic.

- Many studies have focused on small, highly selected groups of patients, and have measured improvements over a short time. Their results are not generalisable. This is a particular concern for the stroke population with multiple long-term conditions, who would likely have been excluded from these studies. Pragmatic and widely applicable research designs, potentially including the analysis of data from observational databases (registries), could begin to address information gaps for specific stroke populations. Analysis of data from routine, observational databases avoids the potential for bias in studies where patients drop-out before progressing to the rehabilitation package. Here, a consent model in which patients 'opt out' of follow-up (rather than the current 'opt in' to research) would help increase the representativeness of findings.

- Funding needs to be sufficient to allow measurement of outcomes for longer following stroke, specifically beyond the six-month follow-up time point.

- With increasing life expectancy more people will have multiple long-term conditions. It is therefore plausible that the majority of acute stroke patients and stroke survivors have multiple long-term conditions. As such, we need to commission research to inform how we provide acute and rehabilitation services for this patient demographic.

Next steps

15. This document has outlined the systematic approach to identification and prioritisation of research questions, and articulated the outputs for stroke services in England. The next stage is to undertake a signalling campaign, targeting and tailoring the signals according to audience; this work is being led by NHS England and NHS Improvement's Research Team.

16. There are three distinct communities for whom this work is relevant or of interest, namely those with a lived experience of stroke, those who are conducting research into stroke and those who fund studies related to stroke.

17. Working with the Stroke Policy Team, the Research Team will engage with these communities to raise awareness of this report, and with the Stroke Association to enhance the signal in areas that overlap with the JLA PSP.

18. Signalling to researchers will be targeted through special interest groups, eg the National Institute for Health Research (NIHR) CRN Stroke Specialty Group, and online portals, eg the Accelerated Access Collaborative (AAC) Innovation Service.

19. With regard to funders, for areas where relevant research is ongoing, the Research Team will work with the NIHR to establish a route for getting the latest evidence to policy-makers in a timely manner. Better use of existing and emerging evidence is often called for.

20. For funding calls that are in development but could potentially be aligned, the Research Team will encourage funders to tailor their calls accordingly, be that as a highlight note as part of the call, or as reference material to better inform decision-making at selection and funding committees.

21. For priority areas that are underserved and evidence is lacking, The Research Team will work closely with funders to design bespoke calls or programmes to address them.

22. Progress and impact will be tracked and monitored, with the aim of establishing a bi-directional feedback loop between the NHS England and NHS Improvement National Stroke Programme, the funders and the research community.

Annex 1: Methodology

Research generates new knowledge and guides best practice. Innovation explores different ways of doing things to improve the quality of care provided to patients.

Demand signalling is the process of characterising the research questions and making researchers and funders aware of them. A separate process will be developed to understand and signal the innovation challenges that link to the NHS Long Term Plan. The final stage of demand signalling is the use of commercial and policy levers to realise the benefits of research and innovation for the NHS (Figure 2).

Figure 2: Aims of research and innovation demand signalling
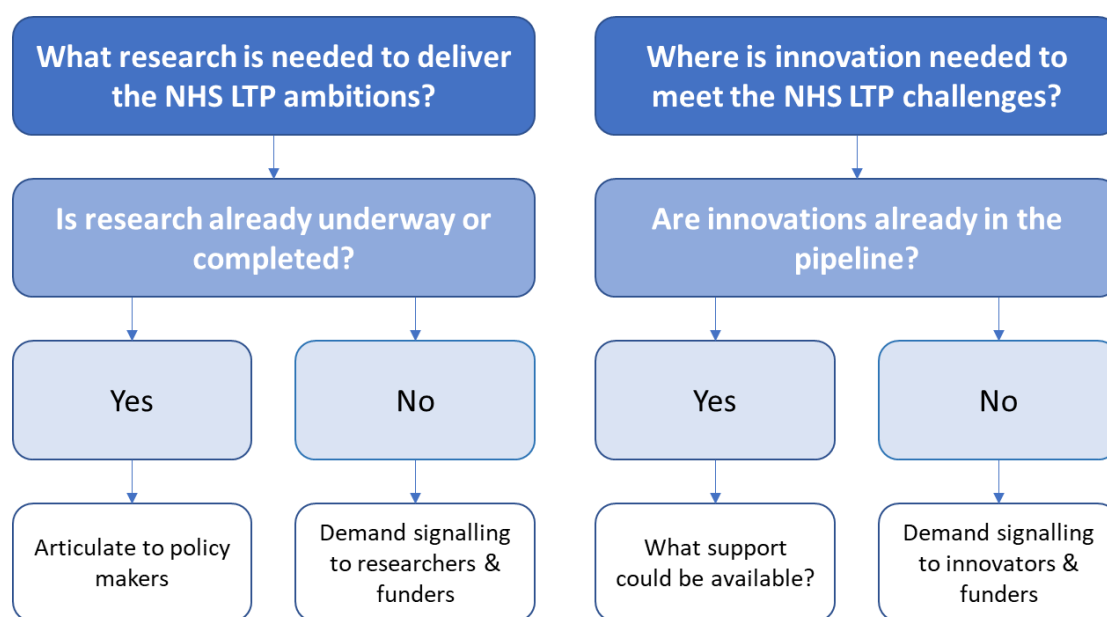
The research demand signalling process developed by the NHS England and NHS Improvement Research Team involves stakeholders from across the heath and care system including: the national clinical director, policy leads, clinical leads, allied health professionals, analysts, leading academics, charities and people with lived experience (Figure 3).

Figure 3: Overview of the systematic and iterative approach taken for demand signalling

National Priority Programmes derived from the Long Term Plan

Facilitated by NHS England and NHS Improvement: Policy experts, clinicians, academics, patients, people with lived experience, charity and advocacy groups (Identification Stage Stakeholders) meet to discuss and agree Research and Innovation priority areas

Analysis of evidence and identification of gaps related to the priority areas

Patient / Population, Intervention, Comparison, Outcome forms: Workshop invitees asked to submit PICOs.

Facilitated by NHS England and NHS Improvement: Led by priority area specialist. Identification Stage Stakeholders meet to discuss and refine Research Questions and Innovation Challenges from PICO submissions

Check the National Institute of Health Research Portfolio to ensure that these are unique questions which have not already received funding

Research questions and innovation challenges are signalled to academics, funders e.g. NIHR, innovators, charity and advocacy groups and others as appropriate

Long Term Plan

Workshop 1

Priority areas outlined

Horizon Scan NIHRIO

National Institute for Health Research Innovation Observatory conduct a horizon scan to see what current research and innovations align with these priority areas

Population Level Analysis

Literature review on identified gaps to determine the current state of evidence and what is outstanding

PICO development

Workshop 2

Refined research questions and innovation challenges agreed

Check against NIHR portfolio

National Research & Innovation needs signalled

Impact analysis and review

Phase 1: Identification
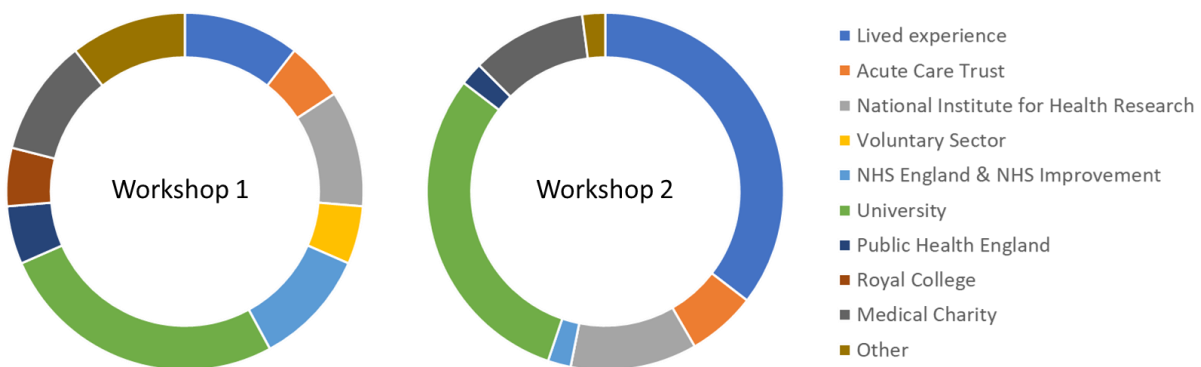
Phase 2: Signalling

Workshop 1

Through targeted engagement with senior strategic stakeholders from across a range of organisations, the objective of workshop 1 was to determine and agree the high-level priority areas where more research is needed to deliver against the ambitions for stroke services in England, as is outlined in the NHS Long Term Plan (Figure 1).
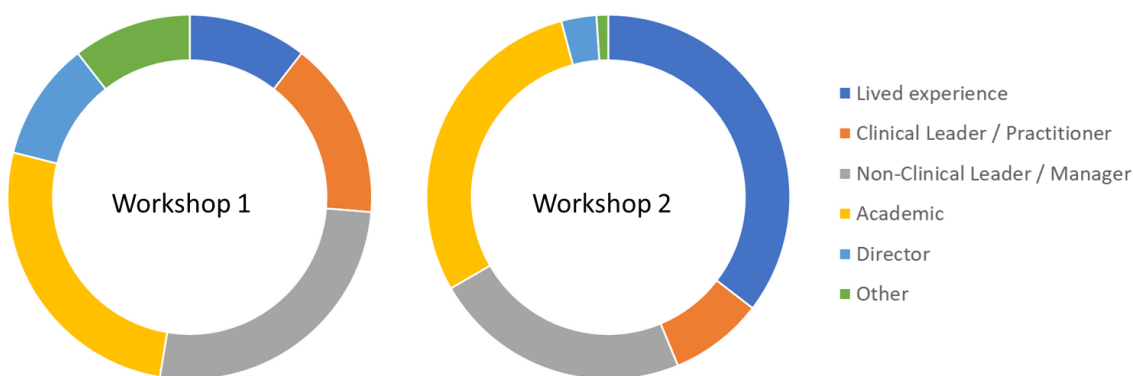
Facilitated by the Research Team, 19 senior stakeholders from a range of professional backgrounds and those with lived experience of stroke (see Figure 4) identified 15 high-level areas for research needed to meet NHS Long Term Plan objectives, and agreed the five highest priority among these.

Figure 4: Participants who attended workshop 1 (total 19) and workshop 2 (total 96)

By organisation

- Lived experience
- Acute Care Trust
- National Institute for Health Research
- Voluntary Sector
- NHS England & NHS Improvement
- University
- Public Health England
- Royal College
- Medical Charity
- Other

By job role

- Lived experience
- Clinical Leader / Practitioner
- Non-Clinical Leader / Manager
- Academic
- Director
- Other

Following workshop 1, King's College London was commissioned to lead an evidence review to help detail areas of unmet need associated with each of the five highest priority areas. The evidence gaps therein were cross-referenced and mapped against the outputs from workshop 1.

Clinical and policy leads from the National Stroke Programme worked with the authors of this evidence review to ensure that recent developments in policy and the stroke pathway were included and considered as part of the gap analysis.

The National Institute for Health Research Innovation Observatory (NIHR IO) has carried out a horizon scan to identify any innovations in the pipeline that may meet needs identified in workshop 1; the findings from this will also be useful to the National Stroke Programme as it considers wider stroke policy.

Workshop 2

Lead by the Research Team, the objective of workshop 2 was to bring clinicians, academics and those with lived experience together to discuss the evidence gaps identified in the evidence review, build consensus and further refine the short-list of population/problem/intervention/comparison/control/outcome (PICO) into researchable questions.

However, in contrast to workshop 1, many more people with lived experience of stroke participated (see Figure 4). This shift was intentional, to ensure that the final outputs reflected the needs of service users, survivors and their families, while still having relevance to the strategic objectives of NHS England and NHS Improvement.

In advance of workshop 2, delegates were given evidence summaries for each of the high-level priority areas and invited to submit detailed, PICO-style, research questions related to the evidence gaps therein.

Research questions were screened for duplicates, filtered against their relevance to the high-level priority areas, and prioritised against key cross-cutting themes in the NHS Long Term Plan and the Academic Health Science Network (AHSN) National Survey of Local Innovation and Research Needs of the NHS (see Annex 3).

In total 65 research questions were received; 49 were from people with lived experience of stroke. Where a research question concerned service delivery, we notified the relevant NHS England and NHS Improvement teams.

Annex 2: Evidence gaps that were not prioritised

Epidemiology/need and outcome

i. There is a need to better define long-term outcomes after stroke (and non-stroke population comparisons) using validated outcome measures, including patient reported outcomes and experience.

ii. An interactive dashboard of all relevant national data on stroke to inform policy and service and clinical decision-making would be invaluable.

Prevention

iii. There is a need to define what the most effective systems in the NHS are for managing stroke prevention.

iv. Understanding the effectiveness of alternative approaches to 'health checks' for prevention as these have not been shown to be universally effective.

Pre-hospital management

v. The optimal approach to improving stroke awareness and appropriate response in the population, particularly focusing on those at greatest risk, eg ethnic minorities, older patients and those with lower educational levels.

vi. Establishing whether mobile stroke units are clinically and cost effective, particularly in the context of identifying patients for thrombectomy.

vii. Better understanding of what treatments paramedics could give to improve outcomes.

Acute care

viii. The effectiveness of mechanical thrombectomy in patients presenting with basilar artery occlusion.

ix. The advantages of using alternative thrombolysis agents to alteplase in combination with mechanical thrombectomy.

x. The benefit of treatment with thrombectomy beyond six hours after onset of stroke.

xi. The utility, practicality and clinical and cost-effectiveness of using perfusion scanning to identify patients for treatment with IV thrombolysis and thrombectomy outside usual timeframes.

xii. How thrombectomy services should be configured to enable the best access to services with available resources.

xiii. How to accurately establish the degree of collateral blood supply with advanced imaging.

xiv. Establishing whether interventional radiologists, or other specialists who have a credential in interventional neuroradiology (stroke), provide similar outcomes, including safety profiles, to interventional neuro-radiologists in delivering mechanical thrombectomy.

After care in the hyperacute stroke unit

xv. The optimal blood pressure management after ischaemic stroke.

xvi. Although early consultant review and nurse staffing ratios above 3 per 10 beds is associated with decreased mortality on hyperacute units, optimal medical, nursing and therapy staffing ratios are not known for stroke units.

xvii. Understanding when mobilisation should start after stroke, including which patients benefit from early intensive rehabilitation and which benefit more from delaying treatment.

xviii. While psychological disturbance is common after stroke, there is insufficient evidence to draw conclusions about what psychological interventions are effective, when they should start after stroke, as well as what their intensity and duration should be.

Follow-up

xix. An evidence base is needed to determine the most effective way of performing systematic follow-up assessments of stroke survivors – what are the benefits, who should perform them, how and when?

xx.	What is the role of longer-term rehabilitation; when, where, how much and for whom?

xxi.	Models of health and social care with teams operating as a single unit have been shown to improve patient outcomes; however, a stroke-centric model needs to be established and evaluated.

xxii.	There is a necessity for validated patient-reported outcome measures specifically aimed at eliciting patient outcomes of post-stroke rehabilitation, primary care and secondary prevention interventions. Furthermore, nationally there is a need for stroke services to invest more time and effort in gaining insight into the lived experiences of stroke survivors.

Emerging technology and innovation in stroke care

xxiii.	Further research is required to ascertain real world usefulness and cost-effectiveness of emerging technologies, especially when considering overall population needs.

xxiv.	Implementation research is required to understand the challenges health organisations face in deploying and adopting technologies.

Effective system design

xxv.	How to improve public awareness of stroke and the need for urgent management.

xxvi.	Better understating of the best configuration, number and siting of stroke services in England. Does a hub and spoke model deliver benefits in rural areas, how many hyper-acute stroke units, thrombectomy centres and acute stroke units are required, as well as how many bed-based rehabilitation units?

xxvii.	How much of the inpatient care currently provided could be delivered more effectively at home.

Annex 3: Prioritisation criteria for PICOs

Table A3.1: Criteria used to assess PICO submissions during the initial sift

Criterion	Agree	Neither agree nor disagree	Disagree
The research question aligns with the high-level priority area identified in workshop 1			
There a well-articulated evidence gap and/or need for new original research			
The question is amenable to research			

The NHS Long Term Plan focuses on well-defined clinical pathways and priority programmes of work where changes are needed to ensure we have a health service that is fit for the future. This includes clear ambitions for improved stroke services, with specific commitments laid out. However, there are also cross-cutting ambitions relevant to all aspects of the NHS Long Term Plan: prevention, patient-centred care and reducing health inequalities.

Given the importance of these overarching themes to the delivery of the NHS Long Term Plan, and the inherent responsibility of all programmes of work to address them, they were chosen as prudent second-layer criteria to prioritise PICOs against (Table A3.2).

Table A3.2: Criteria used to prioritise PICO submissions following the initial sift, as part of a second-line assessment

Criterion	Yes	Somewhat	No
Does the research question address any of the cross-cutting priorities of the NHS Long Term Plan?			
Population health			
Prevention			

Personalised or person-centred care			
Health equality			
Does the research question align with any of the common priorities from the AHSN National Survey of Local Innovation and Research Needs of the NHS?			
Workforce			
Multi-morbidities			
Mental health			
Digital/AI			

In addition to the cross-cutting priorities of the NHS Long Term Plan, it was important to recognise and build on the hard work of other priority setting exercises. As is highlighted in the forward to this publication, the outputs of this research demand signalling overlap with those of the recent James Lind Alliance Priority Setting Partnership, led by the Stroke Association, suggesting there is consensus across the stroke community for where research should focus.

The other notable priority setting exercise that complements the demand signalling process is the AHSN National Survey of Local Innovation and Research Needs of the NHS. This survey explores the views of clinicians and managers in the NHS, focusing on the local research needs in each AHSN region. The priorities that common to each region included workforce, multi-morbidities, mental health and digital/AI.

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