NHS
National Institute for Health Research

NIHR Dissemination Centre

THEMED REVIEW

Care at the Scene

Research for ambulance services

April 2016

NIHR research on urgent and emergency care outside hospital

"More than nine million people contact the UK's ambulance services every year. NIHR-funded research is changing the way that 999 services are delivered, by identifying the best ways of treating urgent healthcare problems and providing better emergency care. This themed review brings together a range of studies, from clinical trials of new treatments to observational research on decision-making by ambulance staff.

"Twenty years ago, there was little evidence in the pre-hospital setting. Seeing this research makes me realise how far we have come, yet there are still many questions that remain unanswered. We have greater research engagement by ambulance staff than ever before, and this commitment will continue to drive forward research for better emergency care and improved patient outcomes."

Professor Jonathan Benger

National Clinical Director for Urgent Care, NHS England

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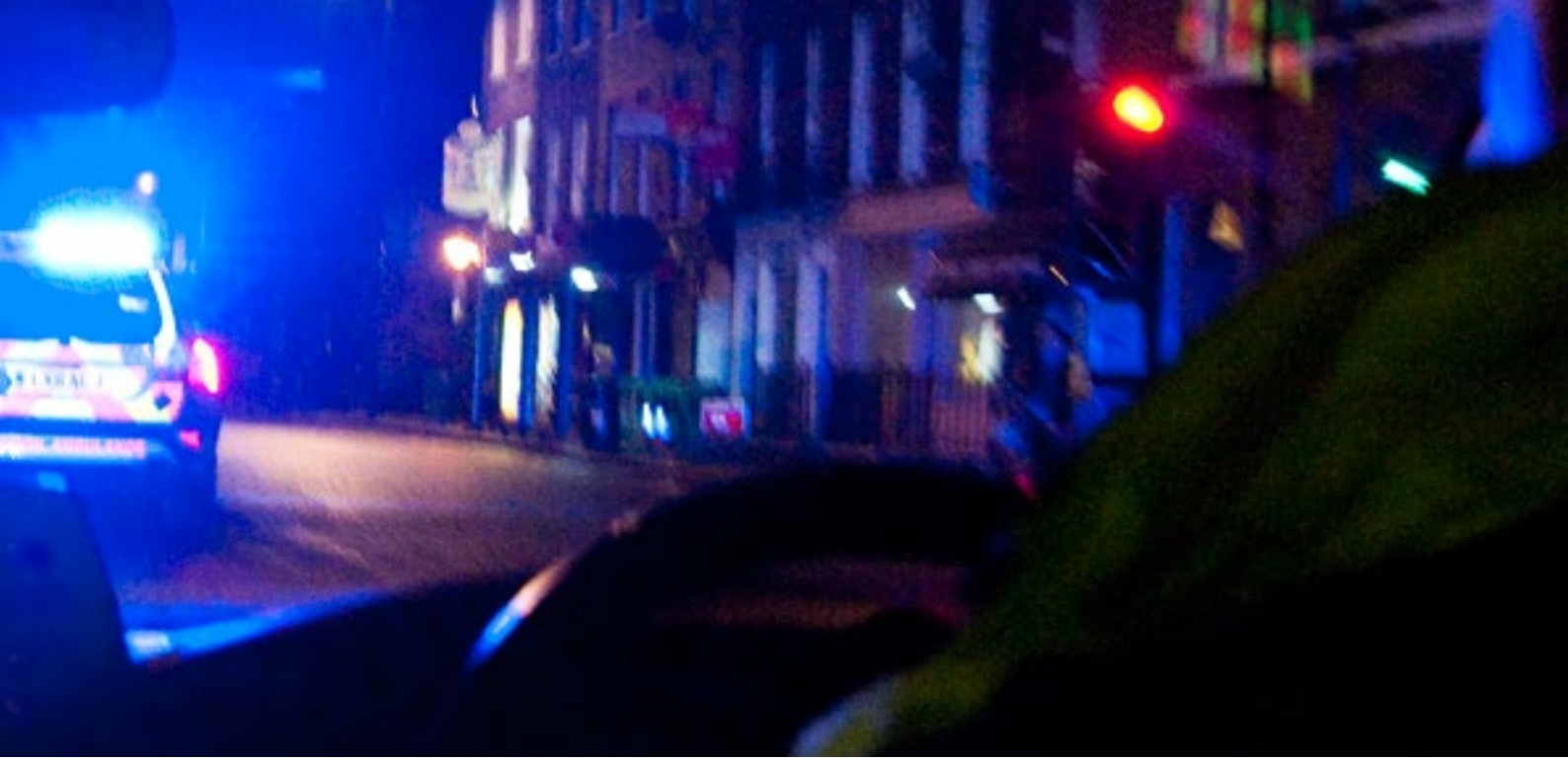
WHY ARE URGENT AND EMERGENCY CARE SERVICES SO IMPORTANT?

The ambulance service is one of the most visible parts of healthcare. From the flashing blue lights to popular television dramas, people think they understand what ambulance staff do. But their role and the scope of the care they provide has changed radically over the last few decades. The ambulance service is now expected to provide complete pre-hospital care. This includes critical interventions earlier in emergencies such as heart attack, stroke and injuries. But the majority of 999 calls are not traffic accidents and heart attacks. More typically, calls involve people with complex and ongoing health problems experiencing a crisis. This could be an elderly person with heart failure and diabetes having had a fall, someone with lung disease experiencing breathlessness or a person at risk of suicide ringing in distress.

Patient needs have become more complex, there is an ageing population and the number of 999 calls has risen. At the same time, there is also a greater range of services to which patients might be taken following assessment by ambulance staff. This might include urgent care centres, hospices, crisis houses or community mental health services as well as hospital. The configuration of services is different from area to area. And ambulance staff are working to exacting targets for assessing and responding to patient needs.

Increasingly, ambulances are seen as part of a wider system of urgent and emergency care services. The NHS strategic Five Year Forward View identified the need for networks of urgent and emergency care, with services working together in new ways (*NHS England 2014*). Eight vanguard sites were identified last year to develop and evaluate new approaches. This built on the Keogh national review of emergency and urgent care in 2013 (*NHS England 2013a*), with recent guidance for commissioners and providers in the 2015 report 'Safer Faster Better' (*NHS England 2015*). In Wales, a strategic review of ambulance services reported in 2013 with recommendations to address challenges, including a new system of clinical prioritisation and quality standards (*Welsh Government 2013*), which were implemented in 2015.

> ***Ambulance service call centres are increasingly becoming 'clinical coordination centres' with critical roles supporting the management of urgent and emergency care systems. The service response behind calls to 999 and 111 are beginning to be integrated – responding immediately when needed but also signposting and transferring people into a growing range of community-based services to meet their needs in real time.***
>
> Alastair Mitchell-Baker
> Non-Executive Director, NHS Ambulance Trust



WHAT DOES THIS REVIEW ADD?

This themed review brings together recent research evidence on urgent and emergency care, focused on the ambulance service. It should be useful to those commissioning and providing ambulance services, from medical directors to boards of ambulance trusts, as well as front-line staff. It should also be of interest to others, from general practitioners providing out of hours care to emergency doctors and nurses working in hospitals. We focus on studies which were funded by the NIHR in the last ten years. NIHR was set up in 2006 as the research arm of the NHS to provide a health research system focused on the needs of patients and the public. Over that time, NIHR has funded a number of programmes, projects, reviews and researchers working in and around pre-hospital emergency care.

This is not a systematic review of all evidence in the field. It should be read alongside useful overviews of the evidence, including a 2010 overview on pre-hospital urgent and emergency care (*Turner 2010*) and a round-up of evidence to support the NHS England review of services (*NHS England 2013b*). More recently, an NIHR rapid review has synthesised evidence on five aspects of service models for urgent care (*Turner 2015*, **NIHR published study one**). In addition, recent NICE service delivery guidelines on major trauma (*NICE 2016*) include useful supporting evidence on particular aspects of triage, clinical management and service delivery.

The scope of this review covers urgent and emergency care and does not include routine patient transport services, like ambulance staff taking patients to outpatient clinics. In this review, we have searched for the most relevant studies within the NIHR portfolio, but have not included clinical studies in other settings which could have implications for ambulance services. This review focuses mainly on adult patients, as the issues around the organisation and clinical management of children are distinct.

Almost 40 studies are featured in this report (22 completed, 17 ongoing) and summaries of these are provided in the appendices. Full reports and protocols of many of the NIHR funded studies featured in this report are available in the NIHR Journals Library .

This research has been organised into three main areas – understanding system and population factors that affect ambulance services; decision-making by patients, ambulance staff and services, workforce and patient experience; and clinical interventions in pre-hospital care. A final section looks at how ambulance services can make better use of evidence and support research to drive improvement.

Executive summary

AMBULANCES IN THE WIDER URGENT CARE LANDSCAPE

Demand for ambulance services has increased year on year. This is partly due to demographic changes such as an ageing population. But we do not understand all the reasons for changing demand. Ambulance services are part of a wider and complex system of unplanned care, including primary care, telephone helplines such as NHS 111 (which may sometimes be provided by ambulance services alongside 999 services), walk-in centres or minor injury units and hospital emergency departments. NIHR studies have explored how ambulance services are responding to some of these changes. Research showed variation in rates of hospital admission for conditions which could be treated out of hospital, with highest rates in deprived areas. This included patients arriving to hospital by emergency ambulance. System changes, such as centralising services for trauma or stroke, have implications for ambulance staff (as well as patients and their families) who will bypass local hospitals to reach specialist care. NIHR studies have looked at the impact of some of these reconfigurations on patients and services.

Ambulance services receive more calls but also patient needs are often more complex and uncertain. NIHR research has looked at some of these issues, including research on dementia and the very old. People with dementia can pose challenges for ambulance staff with difficulties in taking a history and understanding pain. Studies show variation in care home demand for ambulance services and scope for more use of paramedics with specialist skills in this area. People with mental health problems also pose particular challenges for ambulance staff and services. Recent NIHR research has examined evidence on the effectiveness of alternatives to hospital for people with mental health crises. These kinds of services will vary from locality to locality and may provide further options for ambulance staff to consider instead of hospitals.

DECISION-MAKING, WORKFORCE, PATIENT EXPERIENCE

NIHR research has thrown light on the complex and challenging decisions that need to be made by ambulance staff and services on the best management of patients in crisis. We do not know enough about why patients ring 999 when other services may be more appropriate for problems which are not life-threatening. And we do not know why patients sometimes do not ask for emergency help when needed, such as for acute stroke. Current research is exploring this. More ambulance services are now training staff to give advice on the telephone, treat patients at home or convey them to places other than hospital to relieve pressures on hospital emergency departments. The rates for non-conveyance to hospital vary widely among ambulance trusts and the reasons for this are being explored in current NIHR research.

Qualitative research has helped us to understand the complexity of these decisions for individual staff. This is particularly true for patients like frail elderly people, and one large NIHR trial is testing a new protocol for managing and referring older people who have fallen. Existing research has also shown the complexity of handover arrangements between ambulance and hospital staff. A small study showed how some information given by ambulance staff is lost at each handover as patients transfer to hospital. Another small study explored reasons for patient delays in stroke. Ambulance staff pre-alerting hospitals to patients with suspected stroke can speed up assessment at hospitals, but handover is not always straightforward. The service is changing fast and greater use of electronic patient records is helping to provide better continuity of care.

NIHR studies have also examined workforce issues, including a pragmatic trial indicating the effectiveness and acceptability of extended paramedic roles in the community (for instance, in 'see and treat' schemes). Other studies explored call handler roles and interaction between the computerised decision support, call operatives and clinical supervisors in new and emerging work cultures. Staff dispatching ambulances were also the subject of an NIHR study analysing words used by patients to describe stroke symptoms to enhance information available to call handlers.

All of these different ways of managing patients and providing care need to be evaluated in terms of impact on patients. But this is hard to measure. A current NIHR programme of work is developing new

ways of assessing ambulance performance and quality. Emerging findings suggest the importance of patient reassurance as a measure of outcome.

CLINICAL EFFECTIVENESS OF INTERVENTIONS

It can be difficult to carry out high quality clinical research in the pressurised ambulance setting. Some critical conditions are not encountered every day – regular paramedics may only see patients with cardiac arrest once or twice a year. Much care is driven by protocols using best available research evidence. Where none is available out of hospital, expert opinion often drives best practice, making use of research from hospital settings. But although the clinical problems are sometimes the same, the context is very different. NIHR research has addressed some of these gaps by funding UK-based clinical effectiveness studies out of hospital. Ambulance staff make use of high cost equipment and technology. But good quality evidence on the cost-effectiveness of different interventions is not always available.

The NIHR funded the largest trial in Europe on out of hospital cardiac arrests. It found no evidence that patients who were treated with mechanical compressions had better survival rates than those treated with manual chest compressions. This UK-based trial, which has achieved international recognition, provides useful evidence for ambulance leaders. In finding no benefit from mechanical devices, the study could save the NHS up to £40m in technology spend. The same team is now looking at the long term benefit and harms of using adrenaline for out of hospital cardiac arrests. Another important ongoing study in this area will compare devices to manage the patient's airway during cardiac arrest.

NIHR research has also been undertaken around treatment for respiratory problems. This includes completed studies on pre-hospital non-invasive ventilation. This was shown to have a positive effect, but cost-effectiveness was uncertain. As a result implementation is not recommended at present. Other ongoing work explored better ways for ambulances to respond to patients with breathlessness.

NIHR research has also looked at the effectiveness of treatments for trauma services. A trial of tranexamic acid showed that it was cost-effective in reducing deaths from bleeding for people who have suffered trauma. Its rapid introduction was helped by an implementation study in one part of the country to develop protocols and guidelines for ambulance staff to ensure consistency of treatment. Further work is being done to consider the use of tranexamic acid for people with head injuries.

PROMOTING RESEARCH WITHIN AMBULANCE SERVICES

There are exciting opportunities for developing research capacity and culture in ambulance services and pre-hospital care. The best value can be derived from NIHR research when a health economy is 'research ready': willing to define research questions, participate in and support research studies and take on board the findings. High-impact research needs ambulance services to work in collaboration with academic partners and bodies across the NHS and social care. Most of the studies featured in this review come from multidisciplinary teams, using mixed methods. Ambulance staff have an important part to play in contributing to an evidence-based health service and improving patient care when it is most needed.

What does this mean for me?

This evidence raises questions that you and your organisation may want to consider to identify areas for improvement.

- What is our non-conveyance rate and how does it compare with that of other trusts? What kinds of 'hear and treat' and 'see and treat' approaches do we use here?
- Given evidence on extended paramedic roles, do we use specialist paramedics (or similar roles) in the most effective way?
- What kinds of skills do our staff need – from emergency care assistant to paramedics with different skill sets?
- Do we offer our staff training in areas such as recognising and responding to mental health issues and dementia?
- How can we improve patient handover – for instance, have we considered schemes to pre-alert hospitals to patients with suspected stroke or better use of electronic information around resuscitation wishes?
- How does our dashboard of performance metrics address quality, including patient experience and satisfaction?
- Do we encourage staff to report safety incidents and learn from them?
- Have we considered the implications for our trust of latest research, like the results of the PARAMEDIC trial? How do we use evidence to make investment and planning decisions with our commissioners?
- Do we audit or evaluate any changes to how we work?
- Is research considered 'core business' here? For instance, do we have a research strategy? Is research activity and awareness part of our annual appraisal or the professional development of our staff?

> ***Ambulance commissioners in England invest well over a billion pounds each year for the provision of safe, effective, caring, responsive and well-led ambulance services. We have a responsibility to ensure that the money is invested in a way that maximises patient outcomes and research to identify what good or excellent looks like is a vital enabler. This summary document will, I am sure, stimulate further discussion between commissioners and ambulance providers.***
>
> Daniel Mason, National Ambulance Commissioners Network member
> 999 Lead, Yorkshire and Humber Clinical Commissioning Groups

Ambulance services within the wider urgent care system

WHY HAS DEMAND INCREASED?

It is well known that demand for emergency services is increasing. For ambulances, the volume of 999 calls has more than doubled in the last ten years and in 2014/2015 stood at a record high of 9 million calls in England (*HSCIC 2015*). At the same time, there have been parallel increases in other parts of the emergency care system with rising numbers of NHS 111 calls, A&E attendances and unplanned admissions to hospitals. We know some of the reasons for this increased demand, reflecting wider pressures on health and care services. This includes people living longer, with a greater number of serious health conditions. Indeed, the number of people over 75 attending emergency departments tripled in the last 20 years (*Turner 2010*). But we do not know all the reasons for this changing demand.

We also do not know enough about the relationship between different parts of the urgent care system. For instance, an early evaluation of NHS 111 – provided by ambulance services in some areas – found increased use of ambulance services, rather than the expected decrease in use after NHS 111 was introduced (*Turner 2013*).

Taking a broad look at what is known, a recent NIHR review (*Turner 2015*, **NIHR published study one**) reviewed published evidence on characteristics and trends in demands for emergency care. There were no UK-based studies, but four reviews and eight individual research studies (two with a particular focus on demand for ambulance services) were identified. This confirmed that consistent, year on year, increase in demand was common across many developed countries and was seen particularly in ambulance services. Some, but not all, of this could be explained by ageing populations. Other factors included health needs (chronic conditions, acute illness, drug and alcohol dependency), socioeconomic factors (isolation and loneliness, lack of social support, deprivation), patient factors and supply of local services. But there was little research overall in this area and the relationship between these factors and demand for services is not known.

WHAT ABOUT THE WIDER SYSTEM?

One NIHR study has attempted to explore just this issue of the underlying reasons for variation and increased demand (*O'Cathain 2014*, **NIHR published study two**). This two year mixed methods study looked at patterns of variation for emergency admission in relation to population and system characteristics. It should be noted that this study has wider reach than just ambulance services. This study looked at the wider question of unplanned hospital admission, of which ambulance services are only one factor. Experts identified fourteen tracer conditions for avoidable admission, such as blocked urinary catheters, which should not need treatment as a hospital inpatient if the urgent care system is working well. The study found that deprivation accounted for most (almost three quarters) of the variation in avoidable admission rates. Factors relating to emergency departments, hospitals, general practice and ambulance services together only explained another tenth of variation in avoidable admissions. Although the main finding of the study on the primacy of deprivation leaves little scope for action by health services alone, the study identified other useful insights. Differences in rates of non-conveyance (ambulances not taking patients to hospital) explained some of the variation in avoidable admissions. Emergency and urgent care systems with high non-conveyance rates had lower avoidable admission rates. Interviewees from ambulance services described barriers to appropriate non-conveyance, in particular the lack of responsiveness of services in primary care that would allow them to leave more patients at home safely.

In terms of what ambulance staff and services do and where they take patients, important clinical and policy initiatives have driven some profound changes in the system. These include centralising services at fewer specialist centres to improve outcomes for particular conditions. The benefits of specialised care need to offset potential harms from longer journeys and delays in treating patients. NIHR has funded a major five year evaluation of stroke service reconfiguration in London and Greater Manchester (**NIHR ongoing study one**). These service changes

arose from compelling clinical evidence of the benefits to patients with suspected stroke receiving rapid brain scans and thrombolysis at acute specialist stroke centres. A national strategy in 2007 (*DH 2007*) recommended hub and spoke models of care, with designated specialist stroke (hyperacute) centres.

The NIHR research programme has been evaluating these major service changes. The study is not yet complete, but has delivered important interim findings. In particular, key analysis (*Morris 2014*) found that both mortality and length of stay improved in the London area, with a fully centralised model of care. Manchester, which made less radical changes, saw length of stay fall, but outcomes did not improve significantly. The team also found that in Manchester only two thirds of patients who were eligible for hyperacute care were admitted to these centres (*Ramsay 2015*). Given that hyperacute care is associated with better health outcomes and processes of care, this has implications for access of patients to hyperacute stroke services and pre-hospital services. Related to this, Turner et al (*Turner 2015*) examined the evidence on different configuration models and underlined the importance of leadership in enabling change. The research included interviews with ambulance services. One of the main findings was that engaging with ambulance services when planning and implementing the new services was important for successful change. This research complements and builds on earlier NIHR work looking at the best ways of organising pre-hospital and acute stroke care. (*Ford 2012*, **NIHR published study three**).

Other NIHR research has looked at system and service configurations which may have an impact on ambulance services. One study (*Pickering 2014*, **NIHR published study four**) attempted a systematic review of international published evidence comparing local and specialised care for major trauma, head injury and stroke patients. It concluded that there was no significant difference for trauma and head injury patients, but benefits from specialised services for stroke (the review pre-dated the NIHR findings on stroke reconfiguration mentioned above). However, the authors noted the poor quality of evidence and wide variety of health systems and services in different countries which made it difficult to draw conclusive findings. In England and Wales, clinical audit data suggests an emerging picture of differences in processes of care, with patients nearly always receiving definitive care more quickly at specialist centres (www.tarn.ac.uk)

"It can be very stressful for our crews to bypass a local hospital to take a critically injured or unwell patient directly to a specialist centre. However ambulance staff are now better equipped with medicines, equipment and knowledge – and the outcome data shows that we are doing the right thing for our patients"

Mark Ainsworth-Smith, Consultant Pre-Hospital Care Practitioner, South Central Ambulance Trust

Another NIHR study of interest here (*Lecky 2016*, **NIHR published study five**) looked at the feasibility of carrying out a prospective trial in this country comparing outcomes for people with head injury at local and specialist centres. This feasibility study in two ambulance services concluded that although a trial was possible to compare such 'bypass' arrangements, the numbers needed to take part would be very large, given the relatively small volume of patients needing neurosurgery.

ADDRESSING PARTICULAR NEEDS

A persistent theme in recent policy and service guidance for ambulance services is the changing profile and complexity of patients needing care. Ambulance leaders noted increases in calls around complex chronic conditions (citing cancer, chronic obstructive pulmonary disease, heart failure and end of life care) and from patients

over 80 years and from care homes as notable factors in recent years (*AACE 2014-2015*).

NIHR funded work in one locality developed an interesting programme of work on interaction between older people and the ambulance services. This included a study of use of ambulance services by residents with dementia in care homes, tracking over a year residents at six care homes without on-site nursing (*Amador 2014*, **NIHR published study six**). It found that ambulance calls were made for more than half of all residents during that time. Around a quarter were treated on the spot. And of those conveyed to hospital, less than a half were admitted, suggesting scope for potential further reductions in demand on hospital services. This study confirmed wider literature on the variation in demand for emergency services from care homes. Further research could explore this in relation to factors such as presence or absence of on-site nursing, GP involvement, and access to residents' family, alongside residents' health characteristics.

In another study on use of emergency ambulance services by people with dementia, a review of published evidence highlighted the need for training of ambulance staff given challenges of understanding pain, taking history and locating appropriate services for these patients (*Buswell 2014*, **NIHR published study seven**). Other research highlighted problems in information available at emergency departments around care home residents and the need for better guidelines and handover (*Witt 2013*, **NIHR published study eight**). The question of avoidable admissions in the last few weeks and months of life and the role of ambulance staff is also being investigated by an ongoing NIHR study (**NIHR ongoing study two**).

"The service over the years has developed excellent pathways for onward referral of patients to avoid hospital admissions. However, we still struggle with patients experiencing mental health crises. Often we are the only service that can help and mostly out-of-hours and sadly our only option is emergency departments, which aren't necessarily the right setting for them."

Robert Lankford, Emergency Care Assistant, South Central Ambulance Service

Mental health is another challenging area for the ambulance services. It is estimated that around 6% of 999 calls are mental health-related, rising to 10% when combined with a physical problem (*Morrison-Rees 2015*). To deal with this, some ambulance services now routinely employ mental health practitioners in their control rooms to give advice to patients and carers and clinical expertise to crews. It is not always easy for ambulance staff to know what to do. While hospital may be the best place for some, alternatives have developed in recent years which may provide more appropriate care. A useful NIHR review provides an overview of evidence around some of these alternatives for people with mental health crises (*Paton 2016*, **NIHR published study nine**). Although evidence overall is of poor quality, there were indications of positive impact of services like crisis resolution teams offering home support and early intervention services for psychosis. A range of promising interventions needed further research, including street triage with mental health nurses working with police officers. This interaction with other services, such as the police, presents particular issues for ambulance staff. Another NIHR study looks at reasons behind increases in involuntary admissions over the years, with implications for ambulance staff as well as other health professionals (*Weich 2014*, **NIHR published study ten**).

SUMMARY

Demand for ambulance services has increased year on year. This is partly due to demographic changes such as an ageing population. But we do not understand all the reasons for changing demand. Ambulance services are part of a wider and complex system of unplanned care, including primary care, telephone helplines such as NHS 111 (which may sometimes be provided by ambulance services alongside 999 services), walk-in centres or minor injury units and hospital emergency departments. NIHR studies have explored how ambulance services are responding to some of these changes. Research showed variation in rates of hospital admission for conditions which could be treated out of hospital, with highest rates in deprived areas. This included patients arriving to hospital by emergency ambulance. System changes, such as centralising services for trauma or stroke, have implications for ambulance staff (as well as patients and their families) who will bypass local hospitals to reach specialist care. NIHR studies have looked at the impact of some of these reconfigurations on patients and services.

Ambulance services receive more calls but also patient needs are often more complex and uncertain. NIHR research has looked at some of these issues, including research on dementia and the very old. People with dementia can pose challenges for ambulance staff with difficulties in taking a history and understanding pain. Studies show variation in care home demand for ambulance services and scope for more use of paramedics with specialist skills in this area. People with mental health problems also pose particular challenges for ambulance staff and services. Recent NIHR research has examined evidence on the effectiveness of alternatives to hospital for people with mental health crises. These kinds of services will vary from locality to locality and may provide further options for ambulance staff to consider instead of hospitals.

Decision-making, workforce and patient experience

Recent policy and research has highlighted the complexity of the emergency and urgent care system. Each locality has a different pattern of services with different criteria for accepting patients. And patients calling 999 have a wide range of problems and conditions. This means that it is difficult to plan services. But it is also difficult for staff to make decisions and judge the risks associated with different courses of action. Decisions about where to go and what to do are complex for organisations and for individuals – staff and patients.

WHICH SERVICE SHOULD I USE?

For individuals with an acute health problem seeking immediate help, there is a sometimes bewildering set of options. These range from general practitioner same-day appointments or out of hours services, telephone helplines such as NHS 111, walk-in centres or minor injury units, hospital emergency departments, emergency ambulances and community nursing and social services. For people with ongoing health problems, such as respiratory disease or heart failure, there may also be specialist nurses and teams with 24/7 contact arrangements. It is sometimes difficult to know which option is best. And we need to understand what encourages people to choose one service over another.

The question of where patients go is addressed in part of an NIHR review looking at published research on drivers for increased demand for emergency care (*Turner 2015*, **NIHR published study one**). The reasons were complex and difficult to synthesise from the 38 relevant papers, but included issues such as access to, and confidence in, primary care.

An ongoing NIHR study will throw more light on this. It will examine how patients make sense of the different services on offer and their appropriateness for different kinds of need (**NIHR ongoing study three**). This should provide rich insights into how patients understand different services and make decisions around which to use. An interesting small study (**NIHR ongoing study four**) looked at the decisions made by patients with symptoms of

stroke about what service to contact and delays in getting hospital care (*Mellor 2015*). Amongst other findings, it highlighted the importance of bystanders in confirming symptoms and getting appropriate care.

Navigating complex systems of urgent care is difficult for patients and their families, but also for staff who might be the first point of contact. Knowing where to route patients depends on knowledge of local configurations of services and patient needs. For ambulance staff in particular, understanding the complex patchwork of services and their scope and criteria for accepting patients is crucial.

"I am currently working on a pilot scheme in our locality called the Early Bird GP Scheme where I have been working alongside a GP from 7:30-13:30 Tuesday to Friday. This has been going for 9 weeks with one to go. We have been to 120 jobs with only 21 going to hospital, a non-conveyance of over 80%. I've thoroughly enjoyed it and have learned so much."

Jacqui West, Paramedic,
South Central Ambulance Service

An important study on these complex systems (*O'Cathain 2014*, **NIHR published study two**) included a new finding around the variation between different ambulance services in the rate of non-conveyance to hospital. This is viewed with interest, given the need to reduce pressures on hospital emergency departments and admissions. Alternatives to conveying by ambulance include giving telephone advice rather than dispatching a vehicle ('hear and treat'), treatment at the scene by ambulance staff ('see and treat') and taking to other facilities such as a walk-in centre or primary care ('see and convey elsewhere'). These rates vary – at present, around 8% of calls are dealt with on a 'hear and treat' basis, but this varies from 4% to 13% in different ambulance trusts. Once dispatched, the non-conveyance rate is on average 37%, but this varies between 27% and 52% in different parts of the country (*NHS England 2015*). These comparisons are between the 11 ambulance services in England, which serve very large catchments. Within that, the variation between localities may be even greater. The exact nature of this variation in non-conveyance rates and patterns of services offered by ambulance services is being explored in a further study by the team. This will use mixed methods to explore different forms of non-conveyance and also rates of re-contact with the ambulance services within 24 hours to judge appropriateness of these diversionary services. (*O'Cathain 2017,* **NIHR ongoing study five**).

WHAT SHOULD I DO FOR THIS PATIENT?

These studies describe activity at a system or service level. But research has also thrown light on the decisions made by individual ambulance staff arriving at the scene. In particular, a qualitative study examined the way in which staff manage risks when making decisions about which patients to take to hospital or not (*O'Hara 2014*, **NIHR published study eleven**). Preliminary mapping showed just how complex the environment was in which staff make decisions, with new providers, new staff roles and new patient pathways within a context of demanding operational and performance standards. Staff increasingly need to make decisions around complex patients such as frail elderly people with multiple health problems or those with mental health problems. These are more difficult decisions than patient scenarios such as stroke, heart attack or trauma where the response is more protocol-driven. This study noted the challenges for ambulance staff in getting accurate information about availability and access to services which provided alternatives to hospitals. Staff also needed to assess the patient and their circumstances and be confident in referring patients on to other services, within the time constraints of response targets. Observational research showed the pressures on staff to be risk-averse when making decisions about whether it was safe to avoid hospital.

One new NIHR study examining just these complex scenarios facing ambulance staff is a trial of new protocols around managing older people with falls. These represent almost one in ten ambulance calls and the best course of action may be difficult to judge. This study, using experimental methods, will assess the impact of new training and guidance for ambulance staff to assess patients who have had a fall and refer to community falls services. This is a large trial of a complex intervention, with accompanying qualitative research to assess the appropriateness of care (**NIHR ongoing study six**). It builds on earlier work by the team to assess the impact of computerised clinical decision support for ambulance staff in managing older people with falls. This resulted in higher levels of referral to falls services, without any adverse effects, but rates of usage of the new equipment were low (*Snooks 2014*). There have been few ambitious service evaluations of this nature in emergency pre-hospital care.

Also addressing older people with falls is a new NIHR trial, currently at feasibility stage (**NIHR ongoing study seven**), testing a tool for ambulance staff to assess people who have fallen and are at risk of fracture. A key part of the study is how ambulance staff will share information with GPs so that they can target treatment for osteoporosis to prevent

> *"Much of my job is detective work – going to an elderly lady who has fallen, trying to find out not just what she needs clinically but what kind of support she has around her. That might mean ringing a relative, knowing what the local district nursing service is like, having a look around to see if she is coping alone. It's not always straightforward to make these decisions."*
>
> Scott Munro, Paramedic,
> South East Coast Ambulance Trust

further fractures. Another study tackling patients with complex symptoms is looking at better ways for ambulance staff to identify and respond to patients with breathlessness (**NIHR ongoing study eight**).

Ambulance staff arriving at a scene are dependent on the information given by the dispatcher receiving the call from the patient. The decisions and interpretations made by the call handler are the first and in some ways most important filters in the emergency care pathway. An interesting NIHR programme of research reported on one important aspect of this around stroke. This research was needed as the treatment of stroke is time-critical but can be difficult to diagnose correctly. Less than half of patients later identified as having a stroke are correctly predicted by dispatch staff. There has been little research into the interaction between patients making calls and the dispatchers in making sense of symptoms and signs. This four year programme of research included many strands of activity, including detailed analysis of calls and records looking at the words used by people with suspected and actual stroke during 999 calls compared with ambulance dispatch codes (*Watkins 2014*, **NIHR published study twelve**). This work was used to develop online training for dispatchers, using the words and emphasis given by patients to describe their stroke symptoms. Initial evaluation at one centre showed an improvement in the ability of dispatchers to correctly predict stroke cases.

Telephone triage and advice for non-emergency out of hours care is an important area of activity both within and around ambulance services. The recent wider NIHR review of published evidence relating to urgent care (*Turner 2015*) identified ten relevant systematic reviews and 44 individual studies in this area. From this evidence, it appeared that telephone triage and advice systems are appropriate, safe and liked by patients. However, there is little evidence on the efficiency of these services from a whole-system perspective.

WHO NEEDS TO KNOW?

Another area which has come into focus recently is the decision when to resuscitate patients who are poorly or frail. Policies stating patient and family wishes around resuscitation are not always consistently implemented. Information on the status of patients is not shared in a standard way. This makes it difficult for ambulance staff to take appropriate action when responding to a crisis. Current research, although based largely on practice in hospitals, has important lessons for ambulance staff and services in improving decision-making about when to attempt or not attempt resuscitation for those with cardiac or respiratory arrest (**NIHR ongoing study nine**). This work includes a series of systematic reviews and a consensus workshop to find ways of implementing these policies more consistently.

Many of the problems in patients not getting the right treatment come when they pass from one setting to another. One interesting NIHR study used ethnographic methods to shadow ambulance staff, especially at the point of handover with hospital emergency departments (*Sujan 2014*, **NIHR published study thirteen**). This showed some ambulance staff making extra effort to coordinate care in the interests of the patient, sometimes taking part in a 'secret second handover', waiting to brief the attending doctor rather than relying on the formal hand-off with the triage nurse. This study indicated the limits of reliance on the standardised structured handover summary which did not always allow for different professional perspectives and insights to be shared and reconciled. The authors also observed that organisational level pressures such as targets and management of patient flow are consistently under-recognised in safety interventions and solutions to improve handover. This was confirmed in a recent review of evidence on clinical handover between ambulance staff and hospitals (*Wood 2013*). It noted the challenges of handover in a busy or chaotic environment and found little evidence to support the use of standardised approaches, such as mnemonics, to improve consistency of handover. The authors called for more research on

handover, taking into account different contexts and professional cultures, rather than relying on standardised solutions on their own.

At an earlier stage, one NIHR study (**NIHR ongoing study four**) looked at hospital pre-alerting, where ambulance staff warn hospitals that a patient with suspected stroke is en route to hospital (*Sheppard 2013*). Evidence from the US suggests that hospital pre-alerting improves outcomes, but there has been little research in this country. This study examined this question in a cohort of patients in two hospitals in England. It found that patients received faster assessment at hospital when ambulance staff pre-alerted hospitals. In a related piece of work, the team looked in more detail at what happened after hospitals were pre-alerted (*Sheppard 2016*). They found that up to half of the recruited patients presenting with suspected stroke were pre-alerted by ambulance staff, in some cases against the instruction of locally agreed rapid transfer protocols. Where pre-alert protocols were not followed, there was sometimes disagreement between ambulance and hospital emergency department staff on the appropriate course of action at the point of handover. The authors suggested that aligning the expectations of ambulance and emergency department staff, perhaps through simplified pre-alert protocols, could be considered to facilitate more appropriate use of hospital pre-alerts in acute stroke.

A small audit (as part of another NIHR study on handover) provided useful information on the degradation of information as patients are transferred between settings (*Murray 2012*). This compared a hundred patient notes in a hospital resuscitation room with the notes provided by ambulance staff on arrival. The study showed that around a quarter of hospital resuscitation room notes either omitted information reported by the ambulance crews or transferred it with changes. This included important information, such as allergies to medication.

"It can be so difficult when our crews arrive at the scene. Often the patient is close to the point of death, with very little information available. This can lead to inappropriate transport to hospital or resuscitation even when the patient has made a request for this not to happen. In many cases we now receive a message on our information screens before we get to the patient which includes information such as the patient's resuscitation status."

Mark Ainsworth-Smith, Consultant Pre-Hospital Care Practitioner, South Central Ambulance Trust

Greater use of electronic patient information, like the summary care record in England (http://systems.hscic.gov.uk/scr), should make it easier to flag patient risks like these across settings. But there are also interesting differences in how electronic systems are used. For instance, one study suggested that decisions by ambulance staff not to convey elderly patients were more likely to be paper-based, with more detail and information than for those taken to hospital (*Buswell 2015*). Further research should throw light on the way in which electronic systems are used by ambulance staff and services and the impact on patient safety and care.

Wider concerns about quality and safety prompted a review of evidence on ambulance safety (*Fisher 2015*, **NIHR published study fourteen**). This was a scoping review which looked at the broad range of published literature but also evidence from safety incidents reported by NHS staff, coroners and litigation data. The review found very little high quality literature on safety and quality in ambulance services. This contrasted with the quantity and quality of safety evidence in hospital and other settings. Many were small-scale studies, often based on single centres, without controls. There were a few areas where some useful evidence was identified – for instance, noting more evidence to support 'hear and treat' (although focused more on operational effectiveness than clinical safety) than for 'see and treat' approaches at the time of the review. This work also included interviews with medical directors and senior staff who identified handover as their top concern. The scoping review concluded with an expert consensus group who considered the evidence and identified continuing uncertainties and priorities for further research.

WHO SHOULD PROVIDE THE CARE?

The last 30 years have seen huge changes in the scope and practice of ambulance staff, since paramedics were introduced into the NHS in the 1980s. In the past, ambulances transported all patients to hospital. Now some ambulance services treat up to half of all 999 cases at the scene. Change in the nature of work has been driven by rising demand and changes in technologies and remit, beyond immediate life-threatening conditions. At the same time, new specialist roles have developed requiring particular training and knowledge. This includes emergency care practitioners, who can assess and treat patients with minor injuries or conditions on the spot without necessarily referring them on to other staff or services. At a time when this role was quite new, NIHR funded a pragmatic trial to evaluate the impact of these staff (*Mason 2012*, **NIHR published study fifteen**). No research on this scale, involving over 5000 patients, had been undertaken before on an important workforce question in the ambulance service.

"Ambulance staff, like general practitioners, see a huge range and variety of conditions and sometimes require specialist advice. When specialist knowledge is required the ability to phone a specialist directly leads to a better patient experience and a reduction in inappropriate transport to an emergency department"

Mark Ainsworth-Smith, Consultant Pre-Hospital Care Practitioner, South Central Ambulance Trust

The evaluation found that emergency care practitioners could provide care for patients with minor injury or illness of at least an equivalent standard of safety and quality to that provided by usual clinical staff (such as doctors in hospital emergency departments). Indeed, patient satisfaction (*O'Keeffe 2014*), and quality of care measured by casenote review (*O'Hara 2011*) was judged higher for these new roles than for the usual caregivers. Overall, the study found that emergency care practitioners carried out fewer investigations, provided more treatments and were more likely to discharge patients home than the usual providers. This effect was most marked for those emergency care practitioners working in a mobile unit (as part of a 999 response), rather than being sited in urgent care centres, and cost savings were only achieved in that setting. Although the wider evidence base on skill mix and staff substitution (*Laurant 2005*) suggest mixed findings on cost-effectiveness, this study provided important new evidence to inform investment in new skills and roles. It confirmed earlier

findings on the potential benefits of extended roles for paramedics - in this case, for dealing with older people (*Mason 2007*). It also used an interesting range of methods, with a sophisticated study design pairing emergency care practitioners with similar staff in different settings, to assess the impact of this very complex intervention.

These studies were considered alongside other international evidence relating to extended paramedic roles in a broader NIHR review of urgent care (*Turner 2015,* **NIHR published study one**). This identified seven reviews and 12 individual studies, including the NIHR studies above. Existing evidence indicated that these extended paramedic roles were safe, effective and acceptable in managing patients outside hospital and potentially cost-effective. However, there were still uncertainties and more research would help in areas such as establishing the right mix between paramedics and paramedics with higher and specialist skills in the ambulance workforce.

Another ongoing NIHR programme of research is looking at the impact of deploying extended paramedic roles in more thorough and effective assessment of patients with suspected stroke (**NIHR ongoing study ten**). This includes a change of practice where paramedics assess patients, transport them to a suitable hospital, stay with them during the early part of their admission and accompany them into the scanner for diagnosis. This has the potential to improve continuity of care and to reduce the time to get to the scanner, which has been shown to be an important factor in improved recovery from stroke.

Of related interest is a suite of NIHR studies around the working arrangements and interaction between call handlers and clinical staff at 111 centres and other emergency providers. Case study research at five 111 centres noted considerable variation in how services were organised and delivered (*Turnbull 2014*, **NIHR published study sixteen**). Observational research showed reliance on local directories of available

services. Trust in the computerised decision support system appeared higher amongst call advisers than amongst clinical staff, with widespread belief that the algorithm was risk averse. This affected decisions on whether to dispatch ambulances. An important finding of the ethnographic research was that staff often develop workarounds to 'make the technology work'. This built on an earlier NIHR study (*Pope 2010*, **NIHR published study seventeen**) examining call handling in three settings, two of them ambulance services (an established service for emergencies and a new service for non-urgent 999 calls) and one in a GP out of hours centre. This study provided some rich description and analyses of differences in work activity, workforce, culture and context in these three settings. One important conclusion was the emergence of a new form of healthcare worker, in the form of call handler with their own professional identity. The roles and interactions with clinical supervisors were also emergent and formative at the point of study.

WHAT DOES GOOD CARE LOOK LIKE?

We need to measure the impact of changes in staffing, place of care or treatment on patients. But measuring quality in ambulance settings is very difficult. Ambulance staff do not usually have information about what happens to the patients they treat once they have left their care. This means that assessments of quality are often limited to measuring factors such as how quickly they respond, without knowing if their care has made a difference. An exciting NIHR programme of research is developing new ways of measuring how well ambulance services perform and the quality of care they provide (**NIHR ongoing study eleven**). To do this, the team will be linking ambulance records with routine patient data in hospitals.

They will also be getting input from patients, the public, providers and commissioners to identify outcome measures which are meaningful to them. This research programme is about to complete, but emerging results from qualitative research suggested that patient reassurance may be important for service users (**Togher, 2015**). This is an important finding, which could be useful for future assessments of ambulance services.

"In striving for research based improvements and training for better outcomes we must always ensure that the primary focus remains the patient"

Derek Prentice, Chair, Lay Group, Royal College of Emergency Medicine

SUMMARY

NIHR research has thrown light on the complex and challenging decisions that need to be made by ambulance staff and services on the best management of patients in crisis. We do not know enough about why patients ring 999 when other services may be more appropriate for problems which are not life-threatening. And we do not know why patients sometimes do not ask for emergency help when needed, such as for acute stroke. Current research is exploring this. More ambulance services are now training staff to give advice on the telephone, treat patients at home or convey them to places other than hospital to relieve pressures on hospital emergency departments. The rates for non-conveyance to hospital vary widely among ambulance trusts and the reasons for this are being explored in current NIHR research.

Qualitative research has helped us to understand the complexity of these decisions for individual staff. This is particularly true for patients like frail elderly people and one large NIHR trial is testing a new protocol for managing and referring older people who have fallen. Existing research has also shown the complexity of handover arrangements between ambulance and hospital staff. A small study showed how some information given by ambulance staff is lost at each handover as patients transfer to hospital. Another small study explored reasons for patient delays in stroke. Ambulance staff pre-alerting hospitals to patients with suspected stroke can speed up assessment at hospitals, but handover is not always straightforward. The service is changing fast and greater use of electronic patient records is helping to provide better continuity of care.

NIHR studies have also examined workforce issues, including a pragmatic trial indicating the effectiveness and acceptability of extended paramedic roles in the community (for instance, in 'see and treat' schemes). Other studies explored call handler roles and interaction between the computerised decision support, call operatives and clinical supervisors in new and emerging work cultures. Staff dispatching ambulances were also the subject of an NIHR study analysing words used by patients to describe stroke symptoms to enhance information available to call handlers.

All of these different ways of managing patients and providing care need to be evaluated in terms of impact on patients. But this is hard to measure. A current NIHR programme of work is developing new ways of assessing ambulance performance and quality. Emerging findings suggest the importance of patient reassurance as a measure of outcome.

Clinical interventions in and around ambulance services

WHAT IS GOOD ENOUGH EVIDENCE?

Making decisions about best care and treatment relies on good quality evidence. There are well recognised ways of translating research evidence comparing effectiveness of different medicines and procedures into practical guidelines for clinical staff. Much urgent treatment is guided by protocols to help ambulance staff, who are often in isolated and stressful situations. Protocols are developed using the best available current evidence. This may be from recent randomised trials but, where evidence is lacking, may be supported by a consensus of experts. This may be the case where there is evidence of effectiveness in the hospital setting, but not out of hospital.

There are also great difficulties in doing research in critically ill people out of hospital: ambulance crews and paramedics often have to make rapid treatment decisions and don't usually have time to weigh up whether a person may be eligible for a particular trial or to follow complex research protocols. Randomising people to different forms of treatment – the 'gold standard' for assessing whether one treatment is better than another - is therefore difficult in the ambulance setting. There are also important ethical considerations in performing research in critically ill people who cannot consider their options and give (or decline) their consent, although a recent framework provides practical guidance for researchers in this situation (*Davies 2014*).

The Cochrane collaboration has acknowledged the growing need for evidence-based practice in the pre-hospital and emergency health environment by setting up the Pre-hospital and Emergency Care field in Australia in 2004. This was re-established in France in 2014. Some relevant recent Cochrane reviews for people who are critically ill have covered the choice of intravenous fluid (*Perel 2012*), the timing and volume of intravenous fluid (*Kwan 2014*) and the impact of advanced life support training for ambulance crews on patient outcomes (*Jayaraman 2014*).

> ***When introducing a new treatment, whether a drug or device, into the ambulance service - or any other part of the NHS - it is important to base this on sound evidence , so that we are giving the best care available and not wasting resources that could be better spent on other aspects of care.***
>
> ***Only one per cent of recommendations in the 2015 guidelines for resuscitation are based on the highest level of evidence, so we have much to do to evaluate many of our existing treatments.***
>
> Tom Quinn, Professor of Nursing, University of Kingston and St Georges

TREATMENT OF CARDIAC ARREST

NIHR research has focused on some key areas, especially where life-threatening illness can strike quickly. One example of this is cardiac arrest outside the hospital setting, which affects over 30,000 people in the UK every year (*BHF 2015*). Outcomes are usually poor: in the UK fewer than 10% of all the people in whom a resuscitation attempt is made outside hospital survive (*Perkins 2015a*) and of these, up to 30% can have significant brain injury (*Stub 2015*). Improving these outcomes is a major priority for all involved in emergency care. The NIHR has funded research into some key aspects of the management of out of hospital cardiac arrest.

The gathering of accurate information underpins any work to improve outcomes, and the NIHR is funding the initial development of a comprehensive registry, the Cardiac Arrest Individual Registry and Outcomes (CAIRO) Programme (**NIHR ongoing study twelve**). This is being set up to collect accurate information on the management and the outcomes of each patient from initial cardiac arrest through to hospital discharge. Patients who consent are then followed up six and twelve months later. In the setup phase, decisions are being made on the choice of outcomes and also important ethical considerations regarding consent. This will help to find ways of ensuring that more people survive with the best possible quality of life. It should also help to address some key clinical uncertainties such as how much oxygen to give a patient once they have regained a heartbeat and ways of improving ambulance staff decisions on whether to start or stop resuscitation attempts. The CAIRO programme is working collaboratively with the Out of Hospital Cardiac Arrest Outcome (*OHCAO*) Project, an overlapping non-NIHR funded registry of out of hospital cardiac arrest, with a view to unifying the two initiatives over the next few years (*Perkins 2015b*).

One of the most important NIHR studies relevant to ambulance services is the PARAMEDIC trial, which was awarded 'Trial of the Year 2014' by the International Society of Clinical Trials. Physiological and animal testing suggested that mechanical devices may be more consistent and effective than manual chest compression, but there was no high quality evidence showing improved outcomes in humans. To discover whether the cost of this equipment is justified in ambulances the NIHR funded the PARAMEDIC study (**NIHR ongoing study thirteen**). This tested whether the introduction of the LUCAS-2 mechanical chest compression device into front-line emergency response vehicles would improve survival from cardiac arrest out of hospital. Four UK ambulance services (West Midlands, North East, Wales, and South Central) took part. Over 4000 patients were recruited over about three years. The trial results did not show improved outcomes (alive at 30 days) of mechanical compressions compared to standard manual compressions (*Perkins 2014*). On this basis (and with information from other recent randomised trials), the study authors concluded that the evidence did not support widespread adoption of mechanical chest compression devices for routine use by ambulance services.

Another randomised trial by the same group, PARAMEDIC-2 (**NIHR ongoing study fourteen**) began in 2014 to test the benefit (or harm) of using adrenaline for out of hospital cardiac arrest. Adrenaline has been one of the foundations of the management of cardiac arrest for over fifty years and it has been shown to increase the chance of the heart starting to pump again. However there is some evidence that there may be serious harms in the longer term, including brain injury and death. This study is by far the largest well-designed investigation to address this important question. It should give a definitive answer on whether using adrenaline during resuscitation improves long-term outcomes for people suffering a cardiac arrest. In an important reversal of the usual direction of information flow, the results of PARAMEDIC-2 may also influence directly the management of cardiac arrests occurring in hospitals.

Another aspect of the management of cardiac arrest is establishing a clear airway in the unconscious person and giving artificial breathing to help to supply

oxygen to the brain. Bag-mask ventilation is the first line when paramedics arrive. This is sometimes followed by the placing of a tube into the windpipe (trachea) which should give more reliable breaths and also protect the lungs from vomit and other secretions. Getting the tube accurately into the trachea can be difficult and if the tube is not in the trachea this may cause patient harm. Newer (supraglottic) devices which sit in the throat may be easier to insert and be more likely to be correctly positioned.

The NIHR REVIVE-Airways study (*Benger 2016*, **NIHR published study eighteen**) was a preliminary study designed to test whether a larger trial comparing the effectiveness of the laryngeal mask airway supreme (LMAS), i-gel and current practice would be possible in the early management of pre-hospital cardiac arrest. 184 ambulance paramedics took part and 615 patients were recruited to the study. The LMAS arm was suspended in the final two months following three adverse incidents. The authors found that a prospective trial of alternative airway management strategies in out of hospital cardiac arrest, cluster randomised by paramedic, was feasible and that there were no differences in patient outcomes. This has helped to define a further larger study, currently under way, which compares patient outcomes from tracheal intubation or the placement of a supraglottic airway device by paramedics – the AIRWAYS-2 trial (**NIHR ongoing study fifteen**).

"It can be difficult when there is only one clinician on an ambulance or just one person on a car. This in itself is underrated and causes challenges when decision-making. There's no one to consult with whereas in hospital several clinicians decide on a course of actions or treatment."

Clare Hindley, Paramedic practitioner,
South Central Ambulance Service

TREATMENT OF RESPIRATORY PROBLEMS

Another area in which the NIHR has funded research is in acute chest illnesses, particularly respiratory failure, which can result in the lungs being unable to get enough oxygen into the bloodstream. This results in severe breathlessness, an important symptom which triggers immediate dispatch of an ambulance and usually transfer and admission to hospital. Breathlessness may be a new problem or may be an exacerbation of an existing condition. The complexity of the transfer decision process in patients with breathlessness has been explored in a feasibility study with London Ambulance Service (**NIHR ongoing study eight**).

A large HTA study (*Pandor 2015*, **NIHR published study nineteen**) examined the clinical and cost effectiveness of pre-hospital use of assisted ventilation via a plastic mask over the nose or face. The researchers carefully reviewed published work and then combined the information from studies of CPAP (continuous positive airway pressure) or BiPAP (bilevel inspiratory positive airway pressure) with the endpoints of mortality or tracheal intubation. They were able to use the data in a complex analysis and concluded that pre-hospital CPAP (but not BiPAP) can reduce death and intubation rates for patients with acute respiratory failure in the UK. But given the high costs of establishing and running pre-hospital CPAP, the review concluded that stronger cost-effectiveness evidence was needed before implementation.

The researchers published an analysis of the potential costs and health outcomes when applied to a hypothetical cohort of patients with acute respiratory failure. They found that out-of-hospital CPAP was more effective than standard care but was also more expensive. To provide further robust evidence on cost-effectiveness, NIHR is now funding a feasibility study of pre-hospital CPAP in this country **NIHR ongoing study sixteen**).

Although the setting was different, of related interest is an NIHR study (*Gray 2009*, **NIHR published study twenty**) of patients with respiratory failure and distress in the hospital emergency department. This similarly found some benefits from use of non-invasive ventilation, but no impact on survival. It should be noted though that the settings are not comparable, given differences in the way ambulance staff assess patients and the lack of critical care and other clinical support if patients deteriorate. Caution is therefore needed in extrapolating results from clinical research in hospital emergency departments to the ambulance setting, although many studies will address the same clinical problems. In this review, we have not searched systematically for all clinical studies in the NIHR portfolio in hospital emergency departments and elsewhere which may be relevant to ambulance staff and services.

TREATMENT OF SERIOUS INJURY

Another focus of NIHR research has been in trauma and serious injury. This includes major trauma which describes people with serious and often multiple injuries with a high chance of death or disability. A typical cause of this is a road accident. This is a less common but important and difficult part of ambulance work.

The CRASH-2 study (*Roberts 2013*, **NIHR published study twenty-one**) was a landmark piece of research which looked at the use of a drug

to improve clotting - tranexamic acid. Over 20,000 patients who had suffered, or were at risk of, significant bleeding after a broad range of trauma were given the drug within eight hours of injury. Death rate, particularly death from bleeding, in the first four weeks was less in those who had received the drug. The drug is inexpensive and safe. As a result of this study tranexamic acid is now widely used in the UK and throughout the world for bleeding following trauma.

Further analysis of data collected in CRASH-2, correcting for risk of death according to the severity of injury (*Roberts 2012*), found that tranexamic acid reduces deaths whatever the severity of injury and the authors concluded that its use should not be restricted to the most severely injured.

While tranexamic acid was quickly brought into use in the military, implementation in the NHS was comparatively slow. One local NIHR organisation - PenCLAHRC - carried out a successful implementation project with South Western ambulance service to make this happen consistently and quickly (*Paudyal 2015*, **NIHR published study twenty two**). Local guidelines and protocols were agreed by emergency department physicians and the ambulance trust. Because of this, tranexamic acid was in regular use by ambulance crews across the south western counties less than 18 months after CRASH-2 was published. Building on this experience, recommendations were made for tranexamic acid to be introduced to all NHS ambulance services and hospitals in the UK during 2012.

The CRASH-3 study is under way (**NIHR ongoing study seventeen**), examining the use of tranexamic acid in people who have head injuries. Very small amounts of bleeding inside the head can cause great damage to the brain and small reductions in bleeding may give much better outcomes.

SUMMARY

It can be difficult to carry out high quality clinical research in the pressurised ambulance setting. Some critical conditions are not encountered every day – regular paramedics may only see patients with cardiac arrest once or twice a year. Much care is driven by protocols using best available research evidence. Where none is available out of hospital, expert opinion often drives best practice, making use of research from hospital settings. But although the clinical problems are sometimes the same, the context is very different. NIHR research has addressed some of these gaps by funding UK-based clinical effectiveness studies out of hospital. Ambulance staff make use of high cost equipment and technology. But good quality evidence on the cost-effectiveness of different interventions is not always available.

The NIHR funded the largest trial in Europe on out of hospital cardiac arrests. It found no evidence that patients who were treated with mechanical compressions had better survival rates than those treated with manual chest compressions. This UK-based trial, which has achieved international recognition, provides useful evidence for ambulance leaders. In finding no benefit from mechanical devices, the study could save the NHS up to £40m in technology spend. The same team is now looking at the long term benefit and harms of using adrenaline for out of hospital cardiac arrests. Another important ongoing study in this area will compare devices to manage the patient's airway during cardiac arrest.

NIHR research has also been undertaken around treatment for respiratory problems. This includes completed studies on pre-hospital non-invasive ventilation. This was shown to have a positive effect, but cost-effectiveness was uncertain. As a result, implementation is not recommended at present. Other ongoing work explored better ways for ambulances to respond to patients with breathlessness.

NIHR research has also looked at the effectiveness of treatments for trauma services. A trial of tranexamic acid showed that it was cost-effective in reducing deaths from bleeding for people who have suffered trauma. Its rapid introduction was helped by an implementation study in one part of the country to develop protocols and guidelines for ambulance staff to ensure consistency of treatment. Further work is being done to consider the use of tranexamic acid for people with head injuries.

Promoting research within ambulance services

This themed review has shown the benefits of research in improving ambulance care. This includes important evidence on clinical effectiveness, such as a large trial of mechanical chest compression devices during out of hospital cardiac arrest. But we also need insights from qualitative research to understand better the complexity of decisions made by staff and how different parts of the system work together.

Ambulance services and pre-hospital care have sometimes been underdeveloped as areas of research. One international study looking at trials in emergency medicine over ten years found that fewer than one in ten focused on pre-hospital care (*Jones 2013*). However, NIHR has funded a range of research relevant to ambulance staff through different national programmes, units and work streams. This includes local Collaborations for Leadership in Applied Health Research and Care (CLAHRCs) which encourage partnership between universities and service organisations, like ambulance trusts. Some of the work featured in this review has been funded by these collaborations, from pre-hospital care for stroke patients to how ambulances manage patients at end of life. There are local clinical research networks (https://www.crn.nihr.ac.uk/) and services to support those carrying out research. And NIHR funds training opportunities and fellowships for those carrying out research, including around emergency and pre-hospital care (http://www.nihr.ac.uk/funding/training-programmes.htm).

We have identified some of the challenges in carrying out research in the ambulance sector. This includes the nature of the work with very ill patients and challenges in conducting research in dispersed and pressurised settings. As part of an NIHR research programme, seven focus groups with more than 50 ambulance staff charted just these problems in carrying out research (*Watson 2012*). Some of the main barriers

> ***Paramedics are generating an increasing number of robust research studies, leading to continued improvement within clinical practice and better patient outcomes. It is exciting to be part of the emergence of this research-based culture, working with paramedic researchers who, in collaboration with other health care professionals, are shaping the future of out of hospital emergency, urgent and unscheduled care provision.***
>
> Professor Julia Williams
> Research Lead for the College of Paramedics

were time pressures and potential threats to professional autonomy and practice in following research protocols. The ambulance setting poses particular challenges for research. But good research has been undertaken and there are opportunities for more high quality research to tackle ongoing uncertainties.

There are interesting reflections from those who took part in the NIHR study, PARAMEDIC, the largest UK trial involving ambulance services to date (*Pocock 2016*). This used a human factors perspective to identify lessons for ambulance staff engaging in research. Findings from the workshop and survey suggested that good participation happens when staff value research, when this activity is normalised and when the research tasks are simple to complete.

As well as doing research, ambulance services have a responsibility to learn from best evidence. The National Audit Office report in 2011 noted that ambulance services should take more opportunities to learn from each other, including sharing good practice. It is encouraging to see a growing research culture in many ambulance trusts and services. This includes critical awareness of how research can inform decisions about new technologies and treatments. The example of the implementation of CRASH2 shows the power of sharing, where one service developed protocols and guidelines for the use of tranexamic acid by ambulance and hospital staff, which were then adopted by others. And the example of the PARAMEDIC trial showing no benefit of high cost mechanical chest compression devices illustrates the way in which research can support commissioning and investment decisions. Cash-strapped services need to be sure that money is only spent on new technologies where there is good evidence that they are better than standard care.

Ambulance services can also promote an evaluative culture. New services are rapidly developing in pre-hospital care, from staff with higher specialist skills to new approaches to managing patients at scene. These new ways of working need to be assessed to see if they deliver expected gains in terms of patient outcomes, cost savings and relieving pressure on other parts of the system.

There are exciting opportunities for developing research capacity and culture in ambulance services and pre-hospital care. The best value can be derived from NIHR research when a health economy is 'research ready': willing to define research questions, participate in and support research studies and take on board the findings. High-impact research needs ambulance services to work in collaboration with academic partners and bodies across the NHS and social care. Most of the studies featured in this review come from multidisciplinary teams, using mixed methods. Ambulance staff have an important part to play in contributing to an evidence-based health service and improving patient care when it is most needed.

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Photographs courtesy of the London Ambulance Service

Appendices

NIHR PUBLISHED STUDIES

NIHR PUBLISHED STUDY ONE: WHAT EVIDENCE IS THERE ON THE EFFECTIVENESS OF DIFFERENT MODELS OF DELIVERING URGENT CARE? A RAPID REVIEW

Published 2015, Turner

Five separate reviews were conducted, examining themes in the NHS England review of emergency and urgent care, using a rapid evidence synthesis approach, in order to inform future HS&DR programme calls for new research. The five topics were: factors affecting demand for care; telephone services for people with urgent health problems; training ambulance crews so they can treat more people at home; delivering care in emergency departments and developing emergency and urgent care networks. The review of demand for care found very little evidence to explain why demand has risen, with no published literature on whole-system demand. Evidence about telephone triage and advice services found these to be of generally high quality. Management of patients by extended role ambulance paramedic staff was found to be successful in reducing volumes of transport to hospital and making sound related decisions. There were substantial evidence gaps concerning models of ED service delivery and no evidence base on which to construct emergency and urgent care networks.

Source: http://www.journalslibrary.nihr.ac.uk/hsdr/volume-3/issue-43

NIHR PUBLISHED STUDY TWO: EXPLAINING VARIATION IN EMERGENCY ADMISSIONS: A MIXED-METHODS STUDY OF EMERGENCY AND URGENT CARE SYSTEMS

Published 2014, O'Cathain

This was a mixed-methods study with the aim of understanding variations in avoidable emergency admissions between different emergency and urgent care systems in England. It combined analysis of data to establish a standardised avoidable admission rate with an examination of variations on this rate in 150 health systems. Interviews with commissioners, service providers and patients explored these variations by examining strategies for avoiding admissions. The study found that deprivation explained most (72%) of the variation in avoidable admission rates and it was noted that systems serving populations with high levels of deprivation and in urban areas had high rates of avoidable admissions. Factors related to the configuration of services explained a further 10% of the variation. The study noted that some admissions would not be avoidable even in the best of systems and concluded that system interventions are needed, tailored to avoid admissions from deprived communities. It also noted that changes in coding of admissions would enable greater comparability in future admission rates.

Source: http://www.journalslibrary.nihr.ac.uk/hsdr/volume-2/issue-48

NIHR PUBLISHED STUDY THREE: DEVELOPING AND TESTING SERVICES FOR HYPERACUTE STROKE (DASH)

Completed 2012, Ford

This was an ambitious five year programme of research which included a number of work packages. This included components to develop information and awareness programmes on stroke symptoms for the general public and staff and to understand patient views around thrombolytic treatment and organisation of care. These findings were used to develop and test different designs of emergency stroke services and configurations in the north east of England. The programme included a strand looking particularly at the role of paramedics. This focused on a pre-hospital feasibility trial of a drug to reduce blood pressure with consent and drug administration by paramedics in one ambulance service. This showed that such research was possible and highlighted some challenges for ambulance staff, such as taking consent from patients.

Source: contact info@nihr-ccf.org.uk

NIHR PUBLISHED STUDY FOUR: COMPARISON OF DIRECT TRANSFER TO SPECIALIST CARE CENTRES WITH DELIVERY TO THE NEAREST HOSPITAL: A SYSTEMATIC REVIEW AND ECONOMIC EVALUATION

Published 2014, Pickering

This study looked at decisions to transport patients to regional specialist centres for major trauma and stroke compared with patients treated in non-specialist centres. It combined a systematic review of the evidence for a triage policy and transfer to specialist centres, a cost-effectiveness analysis of each decision-making strategy and a review of evidence on patient experience of and satisfaction with the regionalised care. For patients with major trauma, no significant difference in clinical outcomes for the two care pathways was measured. The quality and type of evidence about patients with head injury was more limited but the analysis showed no significant differences between the two triage methods. For stroke patients the picture varied according to the point at which they had received thrombolysis; outcomes were significantly better for patients transferred directly

to a specialist centre, if thrombolysis is only available at such a centre, than if transferred via a non-specialist centre. Pooled estimates indicated no significant benefit for either pathway, though these estimates were not considered robust because study designs and data were heterogeneous. No literature was available to evaluate patient experience or satisfaction in these three conditions.

Source: http://www.nets.nihr.ac.uk/projects/hsdr/10100909

NIHR PUBLISHED STUDY FIVE: THE HEAD INJURY TRANSPORTATION STRAIGHT TO NEUROSURGERY (HITS-NS) RANDOMISED TRIAL: A FEASIBILITY STUDY

Published 2016, Lecky

This study examined the feasibility of running a randomised controlled trial to compare two possible courses of action with patients with suspected severe head injury: transporting them either to the nearest hospital or directly to a specialist neurosurgical centre in order to establish which approach is superior. It found that taking a range of practical issues into consideration such a 'bypass' trial would be feasible but that the numbers of patients requiring early neurosurgery in specialist centres is small and so a trial to show the effect of early brain surgery in patients taken directly to the specialist centres would be infeasibly large. The triage data call into question the clinical effectiveness and cost-effectiveness of bypass for this study cohort group within the current NHS England trauma systems. It was noted that It may now be possible to conduct a further evaluation of early neurosurgery through bypass on early mortality in patients with traumatic brain injury using national trauma audit data.

Source: http://www.journalslibrary.nihr.ac.uk/hta/volume-20/issue-1

NIHR PUBLISHED STUDY SIX: EMERGENCY AMBULANCE SERVICE INVOLVEMENT WITH RESIDENTIAL CARE HOMES IN THE SUPPORT OF OLDER PEOPLE WITH DEMENTIA: AN OBSERVATIONAL STUDY

Published 2014, Amador

This longitudinal study tracked the involvement of emergency ambulance personnel in the support of 133 older people with dementia, resident in care homes. 56% of residents used the ambulance service. Less than half of the call-outs resulted in unscheduled admission to hospital. Gender, age and length of stay in the care home did not influence the use of emergency ambulance for these residents. Contact with primary care and the route of admission into the care home were significantly associated with the use of emergency ambulance service. In addition to the residents' own health characteristics, important contextual factors were: presence or absence of on-site nursing, GP involvement and access to the resident's family.

Source: http://bmcgeriatr.biomedcentral.com/articles/10.1186/1471-2318-14-95

NIHR PUBLISHED STUDY SEVEN: UNPLANNED, URGENT AND EMERGENCY CARE: WHAT ARE THE ROLES THAT EMS PLAYS IN PROVIDING FOR OLDER PEOPLE WITH DEMENTIA? AN INTEGRATIVE REVIEW OF POLICY, PROFESSIONAL RECOMMENDATIONS AND EVIDENCE

Published 2014, Buswell

The ambulance service plays an important part in assessing patients with dementia and deciding whether or not hospital is the most appropriate place for treatment. This study uses mixed methods to carry out Research into Older people with Dementia and their carers use of Emergency ambulance Services (RODES). The research includes an evidence review, audit of routinely collected data (patient care records and computer-aided dispatch records), critical incident review and a case study of a targeted service and stakeholder engagement. These analyses will identify current patterns of service use by older people with dementia and factors affecting decisions by ambulance staff to convey or not. The research should help to identify ways of using emergency ambulance services by older people with dementia more efficiently and designing better training for ambulance staff. It has also informed other funded work on reducing avoidable hospital admission for people with dementia.

Source: http://www.clahrc-eoe.nihr.ac.uk/2014/03/the-use-of-999-ambulance-services-by-people-with-dementia-living-at-home-and-in-care-homes-2/

NIHR PUBLISHED STUDY EIGHT: PATTERNS OF ATTENDANCE OF CARE HOME RESIDENTS TO AN EMERGENCY DEPARTMENT

Published 2013, Witt

This study investigated the information available to receiving teams when care home residents attended one Emergency Department in London by carrying out prospective data collection examining the circumstances of the patients' attendance. Care home residents accounted for a very small proportion of all ED attendances but the information gathered in the course of the study suggests that older individuals from care homes represent a discrete group with special needs. The study acknowledge that little is known about how to improve the liaison between care homes, Emergency Departments and primary care, noting that shared guidelines and documentation of cognitive impairment, previous history of care and overall frailty may lead to better outcomes for older people in this situation.

Source: http://www.ncbi.nlm.nih.gov/pubmed/23435335

NIHR PUBLISHED STUDY NINE: IMPROVING OUTCOMES FOR PEOPLE IN MENTAL HEALTH CRISIS: A RAPID SYNTHESIS OF THE EVIDENCE FOR AVAILABLE MODELS OF CARE

Published 2016, Paton

People with mental health crises, such as those experiencing psychotic episodes, do not always get the help they need. They represent an important source of 999 calls. This review looked at published evidence on different service models which offer alternatives to hospital for people experiencing mental health crises. The evidence was organised around four main areas of crisis response: support before crisis point; urgent and emergency access to crisis care; quality treatment and care when in crisis; and promoting recovery. This pragmatic review identified nine evidence-based guidelines, one review of reviews, six systematic reviews and fifteen individual studies. This was a very broad and complex review, comparing very different kinds of services from police street triage to telephone helplines. Evidence was generally of poor quality, with little cost-effectiveness data. However, some tentative findings emerged around potential effectiveness of interventions like crisis resolution teams and early intervention services for people with psychosis. More high quality evaluations are needed about safe and cost-effective alternatives to hospital to inform decisions by ambulance staff and others on where to convey patients with mental health crises.

Source: http://www.journalslibrary.nihr.ac.uk/hta/volume-20/issue-3

NIHR PUBLISHED STUDY TEN: VARIATION IN COMPULSORY PSYCHIATRIC INPATIENT ADMISSION IN ENGLAND: A CROSS-SECTIONAL, MULTILEVEL ANALYSIS

Published 2015, Weich

The rate of involuntary mental health admissions to hospital has been rising and the reasons remain unclear. This was the largest analysis of this kind in this country. Using routine information, the authors looked at different explanatory factors. They found that only around 10% of the risk of admission was explained by differences in people and places. This study also confirmed other findings for instance that black people were more likely to be compulsorily admitted than white people – this study found the rate was three times as much. There were also links between high rates of admission and areas of deprivation. Although this study concerns admission decisions made in hospital, it is relevant to ambulance staff who have to respond to people with mental health crises.

Source: http://www.journalslibrary.nihr.ac.uk/hsdr/volume-2/issue-49

NIHR PUBLISHED STUDY ELEVEN: A QUALITATIVE STUDY OF DECISION-MAKING AND SAFETY IN AMBULANCE SERVICE TRANSITIONS

Published 2014, O' Hara

This study looked at system factors affecting decisions made by ambulance staff, particularly on whether or not to take patients to hospital. The study was largely qualitative, using ethnographic methods (including observation of shifts, interviews, focus groups and use of digital diaries held by ambulance staff) at three ambulance services. The study found that ambulance staff have to work within a system which has become more complex, with the introduction of new services, staff roles and associated patient care pathways, along with increasing demands to meet operational standards and performance targets. The study identified nine types of decision and noted that the least complex in many ways were the traditional emergency cases such as patients with trauma, stroke or cardiac arrest which were more protocol-driven. Frail elderly people or those with multiple health problems posed more challenges in terms of risk and decision-making. The study included a range of rich and nuanced insights into the complexity and challenges of daily decision-making by ambulance staff.

Source: http://www.journalslibrary.nihr.ac.uk/hsdr/volume-2/issue-56

NIHR PUBLISHED STUDY TWELVE: EMERGENCY STROKE CALLS: OBTAINING RAPID TELEPHONE TRIAGE (ESCORTT)–A PROGRAMME OF RESEARCH TO FACILITATE RECOGNITION OF STROKE BY EMERGENCY MEDICAL DISPATCHERS

Published 2014, Watkins

Getting the right treatment at the right time is essential to improve stroke outcomes. But often people do not know they are having a stroke or may not describe their symptoms very clearly when making a 999 call. The correct triage decisions by emergency medical dispatchers receiving 999 calls is crucial. But little research has been done to describe and interpret the exchanges between patients with suspected stroke and dispatchers to understand how triage decisions can be improved.

This was a complex eight-study programme of research with one ambulance trusts and three hospitals. A range of hospital and ambulance data were collected and analysed. This included tracking a cohort of 735 patients with a dispatch and/or final diagnosis of stroke. A correct dispatch code was assigned in just under half of cases. Patients with facial weakness and speech problems were consistently associated with a dispatch diagnosis of stroke. Other parts of the research included qualitative research with patients and content analysis of calls, which found that the public used terms indirectly to describe loss of function, e.g. unable to grip, rather than general symptoms such

as limb weakness. Callers who reported a suspected stroke during the 999 call were usually correct. Research also showed uncertainties around understanding and use of current prompts around levels of consciousness. An online training package for dispatchers based on the programme's study findings was developed and evaluated. This was done by an interrupted time series design, with testing at 26 points over 18 months. This showed an increase in the proportion of patients correctly identified by dispatchers as having a stroke, although the study was limited to one ambulance service without controls, which could limit the generalisability of findings.

Source: http://www.journalslibrary.nihr.ac.uk/pgfar/volume-2/issue-1

NIHR PUBLISHED STUDY THIRTEEN: CLINICAL HANDOVER WITHIN THE EMERGENCY CARE PATHWAY AND THE POTENTIAL RISKS OF CLINICAL HANDOVER FAILURE (ECHO): PRIMARY RESEARCH

Published 2014,Sujan

This study looked at communication failures and threats to patient safety from handover in the emergency care pathway. The study carried out qualitative research in two ambulance services linked to three hospitals in England. Risks were explored in nine focus groups using patient safety techniques to map out risks and system weaknesses. A total of 270 handovers between ambulance and the emergency department and, within hospital, between the emergency department and acute medicine were audio-recorded, transcribed and analysed using conversation analysis.

Further organisational factors were explored in interviews with 39 staff across the three emergency care pathways. The authors concluded that handover can serve different functions, such as management of capacity and demand, transfer of responsibility and delegation of aspects of care, communication of different types of information, and the prioritisation of patients or highlighting of specific aspects of their care. Many of the handover risks were linked to capacity and patient flow issues. Findings suggested that practitioners needed flexibility to make trade-offs in order to resolve tensions inherent in handover.

Source: http://www.journalslibrary.nihr.ac.uk/hsdr/volume-2/issue-5

NIHR PUBLISHED STUDY FOURTEEN: PATIENT SAFETY IN AMBULANCE SERVICES: A SCOPING REVIEW

Published 2015, Fisher

This scoping study looked at the evidence on patient safety in ambulance services. It included a wide range of sources, from published literature to reported safety incidents, annual reports and quality accounts. Further issues and future research needs were identified through interviews with senior ambulance staff and through an iterative expert consensus exercise. This review identified few high quality studies and noted the lack of consistency in describing and analysing risks to patient safety in this sector. The research suggested that many guidelines for ambulance staff draw on clinical research in the hospital setting which may not always be directly applicable or are consensus-based. The review identified a number of areas for further research, including the effectiveness and safety of alternative pathways.

Source: http://www.journalslibrary.nihr.ac.uk/hsdr/volume-3/issue-21

NIHR PUBLISHED STUDY FIFTEEN: A PRAGMATIC QUASI-EXPERIMENTAL MULTI-SITE COMMUNITY INTERVENTION TRIAL EVALUATING THE IMPACT OF EMERGENCY CARE PRACTITIONERS IN DIFFERENT UK HEALTH SETTINGS ON PATIENT PATHWAYS (NEECAP TRIAL)

Published 2012, Mason

Emergency care practitioners were introduced in the 1990s as a new role. This extended paramedic role had become increasingly popular, with other 600 qualified professionals in 2007. However, there had been no national evaluation or impact of cost-effectiveness. This NIHR study was an ambitious pragmatic community trial to assess the clinical and cost-effectiveness of the emergency care practitioner compared with standard care. This covered 5790 patients in five pairs of matched control and intervention sites. The project also included qualitative research with staff and patients to understand the wider impact of new ways of working.

A key finding was that care delivered by ECPs appeared to be of comparable quality to the standard with which they were being compared. However, cost savings may be limited to certain settings and services. Impact varied according to setting, with the greatest effects (on subsequent visits to emergency departments and hospital admissions) apparent in mobile emergency settings. The study also unpacked the notion of substitution, given that ECPs work to protocols which require them to see a selected but limited range of presenting complaints and patient groups. Added value is being provided where the ECP is providing a higher level of care than previously existed, such as in the ambulance service, rather than substituting for doctors in other settings.

Source: http://www.nets.nihr.ac.uk/projects/hsdr/08151998

NIHR PUBLISHED STUDY SIXTEEN: THE WORK, WORKFORCE, TECHNOLOGY AND ORGANISATIONAL IMPLICATIONS OF THE '111'SINGLE POINT OF ACCESS TELEPHONE NUMBER FOR URGENT (NON-EMERGENCY) CARE: A MIXED-METHODS CASE STUDY

Published 2014, Turnbull

An important new development in the urgent care system is the 111 telephone line, featuring

computer-based decision support and non-clinical call handlers. This study combined ethnographic and survey methods to assess the impact on working practice and organisation. This included non-participant observation at five NHS 111 call centres and their linked urgent care centres and six focus groups with 47 call advisers, clinicians and organisational managers. An online survey was also administered to more than 700 call centre and urgent care centre staff, with around a third responding. Amongst other interesting findings, the study showed substantive differences in how NHS 111 is organised and delivered, depending on local configurations. Observational and other research showed that clinical assessment by call advisers is characterised by high levels of negotiation, communication and translation beyond the simple algorithm. This was supported by clinical staff, who played an important role in sanctioning emergency ambulance dispositions. There was great reliance on local directories of services around alternatives to hospital.

Source: http://www.journalslibrary.nihr.ac.uk/hsdr/volume-2/issue-3

NIHR PUBLISHED STUDY SEVENTEEN: ETHNOGRAPHY AND SURVEY ANALYSIS OF A COMPUTER DECISION SUPPORT SYSTEM IN URGENT OUT-OF-HOURS, SINGLE POINT OF ACCESS AND EMERGENCY (999) CARE

Published 2011, Pope

This mixed methods study assessed the work of non-clinical call handlers in three urgent care settings. Two of these case studies involved ambulance staff. Data consisted of nearly 500 hours of non-participant observation, 61 semi-structured interviews with health service staff, documentary analysis, and a survey of 106 call-handlers. This was informed by a theoretical approach to studying implementation and spread of a new technology or working practice. The research indicated that clinical assessment and triage by non-clinical staff, supported by computerised decision support, represented a substantial new way of working. The authors concluded that this activity more closely resembled clinical work and expertise than other call-centre work that it superficially resembled.

Source: http://www.nets.nihr.ac.uk/__data/assets/pdf_file/0010/64549/FR-08-1819-217.pdf

NIHR PUBLISHED STUDY EIGHTEEN: RANDOMISED COMPARISON OF THE EFFECTIVENESS OF THE LARYNGEAL MASK AIRWAY SUPREME, I-GEL AND CURRENT PRACTICE IN THE INITIAL AIRWAY MANAGEMENT OF PRE-HOSPITAL CARDIAC ARREST (REVIVE-AIRWAYS): A FEASIBILITY STUDY RESEARCH PROTOCOL

Published 2012, Benger

This was a feasibility study, with a randomised comparison of the effectiveness of the laryngeal mask airway supreme, i-gel and current practice in the initial airway management of pre-hospital cardiac arrest

Following out-of-hospital cardiac arrest (OHCA), tracheal intubation has been accepted as the optimal form of OHCA airway management in the UK but newer supraglottic airway devices (SADs) may be safe and effective devices in this situation. This study assessed whether it is feasible to use a cluster randomised design to compare SADs with current practice, and also to each other, during OHCA by ambulance paramedics.

184 paramedics consented to take part, just over a third of those approached, and 615 patients were recruited to the study. The LMAS arm was suspended in the final two months following three adverse incidents. The authors found that a prospective trial of alternative airway management strategies in OHCA, cluster randomized by paramedic, was feasible and that there were no differences in secondary outcomes.

Source: BMJ Open 2013;3:e002467 doi:10.1136/bmjopen-2012-002467

NIHR PUBLISHED STUDY NINETEEN: PRE-HOSPITAL NON-INVASIVE VENTILATION FOR ACUTE RESPIRATORY FAILURE: A SYSTEMATIC REVIEW AND COST-EFFECTIVENESS EVALUATION

Published 2015, Pandor

This HTA commissioned study was intended to examine the clinical and cost effectiveness of pre-hospital non-invasive ventilation. A systematic review was performed and then a network meta analysis.

Randomized or quasi-randomized studies of CPAP (continuous positive airway pressure) or BiPAP (bilevel inspiratory positive airway pressure) were included from 14 databases up to August 2013 with the endpoints of mortality or tracheal intubation. 10 studies met these criteria: the authors of seven of these provided data on individual patients (650 altogether) for meta analysis.

There was uncertainty associated with the effect of BiPAP on mortality or intubation relative to standard care.

The authors concluded that pre-hospital CPAP can reduce mortality and intubation rates for patients with acute respiratory failure, although the available evidence may not be generalizable to some pre-hospital systems. There was no evidence to support the use of BiPAP. They felt that the substantial cost of implementing pre-hospital continuous positive airway pressure meant that evidence of cost-effectiveness was required before implementation could be recommended.

Following further cost-effectiveness modelling, the authors concluded that the cost-effectiveness of out-of-hospital CPAP is uncertain. The incidence of patients eligible for out-of-hospital CPAP appears to be the key determinant of cost-effectiveness.

Source: http://www.journalslibrary.nihr.ac.uk/hta/volume-19/issue-42

NIHR PUBLISHED STUDY TWENTY: A MULTICENTRE RANDOMISED CONTROLLED TRIAL OF THE USE OF CONTINUOUS POSITIVE AIRWAY PRESSURE AND NON-INVASIVE POSITIVE PRESSURE VENTILATION IN THE EARLY TREATMENT OF PATIENTS PRESENTING TO THE EMERGENCY DEPARTMENT WITH SEVERE ACUTE CARDIOGENIC PULMONARY OEDEMA: THE 3CPO TRIAL

Published 2009, Gray

Non-invasive ventilation appeared to offer benefits to patients with respiratory failure or distress presenting to hospital emergency departments. But there hadn't been a large trial of its impact. This NIHR funded study tested the effectiveness of non-invasive ventilation in a randomised clinical trial involving over a thousand patients in 26 hospital emergency departments. This was the largest study of its kind. It found that non-invasive ventilation provided earlier improvement and resolution of breathlessness, respiratory distress and metabolic abnormality. However, this does not translate into improved short – or longer-term-survival. Cost-effectiveness data suggested improved quality at greater cost for non-invasive ventilation, but the authors emphasised uncertainties in these estimates.

Source: http://www.journalslibrary.nihr.ac.uk/hta/volume-13/issue-33

NIHR PUBLISHED STUDY TWENTY-ONE: THE CRASH-2 TRIAL: A RANDOMISED CONTROLLED TRIAL AND ECONOMIC EVALUATION OF THE EFFECTS OF TRANEXAMIC ACID ON DEATH, VASCULAR OCCLUSIVE EVENTS AND TRANSFUSION REQUIREMENT IN BLEEDING TRAUMA PATIENTS.

Published 2013, Roberts

Tranexamic acid is known to be effective in reducing blood loss for patients after surgery. This study tested its effectiveness when given early to patients suffering major trauma. This was a very large multi-centre trial of more than 20,000 patients in 274 hospitals in 40 countries. It was able to assess the impact of giving tranexamic acid in terms of mortality, vascular event or blood transfusion needed on arrival at hospital. The study showed that tranexamic acid safely reduced the risk of death in bleeding trauma patients in this study. It appeared most effective when given early after the trauma and within about three hours. The drug is relatively inexpensive and has potential application in a number of countries. This study benefited from cost-effectiveness analysis in different settings and concluded that its use is highly cost-effective in high, middle, and low-income countries. As a result of this trial, tranexamic acid has been incorporated into trauma treatment protocols in this country and worldwide and has been included on the WHO List of Essential Medicines.

Source: http://www.journalslibrary.nihr.ac.uk/hta/volume-17/issue-10

NIHR PUBLISHED STUDY TWENTY-TWO: TRANEXAMIC ACID IN MAJOR TRAUMA: IMPLEMENTATION AND EVALUATION ACROSS SOUTH WEST ENGLAND. EUROPEAN JOURNAL OF EMERGENCY MEDICINE

Published 2015, Paudyal

This collaborative project between NIHR PenCLAHRC and the South Western Ambulance Service NHS Foundation Trust was to carry out a prospective evaluation of tranexamic acid use in trauma patients following its introduction in emergency ambulances and emergency departments, implementing the findings from the CRASH-2 trial. The success of the process of establishing tranexamic acid as a standard treatment for specified trauma patients, administered by ambulance clinicians, lay in the adoption of a protocol closely aligned with local emergency departments. Liaison between the providers was crucial to ensure the correct follow-on care. Clear communication of the change of protocol to staff involved was crucial as were clear rules for the recording of TXA administration as part of the pre-alert and handover phases. The study was limited by the fact that the total number of eligible patients was not known, so the proportion receiving TXA could not be described. Limitations in TARN data gathering processes also limit the full picture as it excludes patients discharged from hospital within 72 hours.

Source: European Journal of Emergency Medicine 2015 00.000-000

NIHR ONGOING STUDIES

NIHR ONGOING STUDY ONE: INNOVATIONS IN MAJOR SYSTEM RECONFIGURATION IN ENGLAND: A STUDY OF THE EFFECTIVENESS, ACCEPTABILITY AND PROCESSES OF IMPLEMENTATION OF DIFFERENT MODELS OF STROKE CARE

Due to complete 2018, Fulop

This study is using patient level data from the HES database to investigate whether centralising acute stroke services in Greater Manchester and London is associated with changes in mortality and length of hospital stay. It is examining the records of a quarter of a million patients admitted to hospital after a stroke in the period January 2008 to March 2012. The initial findings are that since the centralisation of stroke services in these two areas, mortality and length of hospital stay fell across the country. In London there was an even greater reduction in mortality following stroke and a greater reduction in length of hospital stay. Greater Manchester also saw a significant reduction in length of hospital stay but centralisation of services had no impact on mortality over that in the country as a whole. Other interim findings point to differences in clinical processes and access, noting that only two thirds of eligible patients were admitted

to hyperacute units in Manchester. Another analysis noted the differences in systems and the importance of leadership in enabling change.

Source: http://www.nets.nihr.ac.uk/projects/hsdr/10100909

Morris BMJ article 2014

NIHR ONGOING STUDY TWO: UNDERSTANDING HOSPITAL ADMISSIONS CLOSE TO THE END OF LIFE (ACE) STUDY

Due to publish 2016, Barclay

This study is exploring the concept of what is meant by 'inappropriate' hospital admissions close to the end of life. The decision-making processes that lead to hospital admission shortly before death are often complex and challenging, occur at points of crisis and can involve multiple decision-makers, particularly when patients are elderly and have illnesses in which prognostication is difficult. Most of the limited research concerning such hospital admissions has been quantitative in nature. This study is a qualitative investigation of the decision-making processes of community, ambulance and hospital healthcare professionals and care home staff involved in such admissions, with the perspectives of next of kin after the death and health service commissioners.

The study seeks to add to the understanding of the end of life care decision-making – in context and around an actual critical event. It intends to arrive at an empirically-derived definition of 'inappropriate' admissions.

Source: http://www.phpc.cam.ac.uk/pcu/research/research-projects-list/other-projects/ace/

NIHR ONGOING STUDY THREE: A STUDY OF SENSE-MAKING STRATEGIES AND HELP-SEEKING BEHAVIOURS ASSOCIATED WITH THE USE AND PROVISION OF URGENT CARE SERVICES

Due to publish 2018, Turnbull

The urgent care landscape is complex – from walk-in centres to GP out of hours to 111 services. This study seeks to understand the way patients make sense of different parts of the urgent care landscape. Rather than identifying patterns of use as 'inappropriate', this exploratory research aims to understand why people might choose one service over another. This will be done by literature review, citizen jury groups with both the public and professionals to explore different concepts of urgent care and detailed qualitative repeat interviews with stratified sample of patients from one ambulance trust to explore trade-offs and drivers for accessing particular services.

Source: http://www.nets.nihr.ac.uk/projects/hsdr/141916

NIHR ONGOING STUDY FOUR: OBSERVATION AND IMPLEMENTATION STUDY INVESTIGATING OPTIMISATION OF THE MANAGEMENT OF STROKE AND TRANSIENT ISCHAEMIC ATTACK (TIA)

Due to complete 2017, Sheppard

This study aims to understand the barriers for patients receiving swift and appropriate treatment for stroke, with a strong focus on pre-hospital care. This five year programme is based in two acute trusts in the West Midlands region. It is a longitudinal observational study consisting of three phases: assessment of current practice, feedback of findings and evaluation of service change. Consecutive patients will be recruited from participating hospitals, and identifiable data will be collected to link records from primary care, secondary care and emergency services. Patients will be sent follow-up questionnaires examining quality of life at 3 and 12 months post-event. Qualitative interviews will examine the care pathway through the experiences of patients, their carers, healthcare personnel and commissioners. Collected data will be used in economic analyses. Using mixed methods, the study aims to address important questions such as how patients with stroke and transient ischaemic attack get to hospital and why they choose these routes, and to what extent the pre-hospital care impacts on timeliness of subsequent treatment, particularly thrombolysis. There have been a series of interim findings from this programme, reported in the body of the report.

Source: http://bmjopen.bmj.com/content/2/3/e001430.full

NIHR ONGOING STUDY FIVE: UNDERSTANDING VARIATION IN RATES OF AMBULANCE SERVICE NON-CONVEYANCE OF PATIENTS TO AN EMERGENCY DEPARTMENT

Due to publish 2017, O'Cathain

This study will use mixed methods to explore variation in non-conveyance rates by ambulance services. This includes analysis of approaches such as hear and treat (telephone advice by ambulance services) see and treat (patients managed by ambulance staff on the spot) and see and convey elsewhere (divert to non-hospital service, such as walk-in centre). The study will include qualitative interviews with ambulance trusts, paramedics and commissioners; analysis of routine dispatch data for all eleven ambulance services to identify variation between and within ambulance services; and factors affecting variation in appropriateness of services, by looking at re-contact rates for all services. This will be followed by more in-depth work, including observation research, at three study sites of hear and treat services, which have not been well researched, and investigation of a tracer condition, respiratory problems, which is a common reason for calling ambulance services.

Source: http://www.nets.nihr.ac.uk/projects/hsdr/135475

NIHR ONGOING STUDY SIX: CARE OF OLDER PEOPLE WHO FALL: EVALUATION OF THE CLINICAL AND COST EFFECTIVENESS OF NEW PROTOCOLS FOR EMERGENCY AMBULANCE PARAMEDICS TO ASSESS AND REFER TO APPROPRIATE COMMUNITY BASED CARE

Due to publish 2016, Snooks

Falls in older people is a common type of 999 call but it is often difficult for ambulance staff to judge when appropriate to leave at home rather than take to hospital. This team developed a complex intervention consisting of training for falls assessment, operational support and referral pathway to community falls services. The impact of this will be evaluated at three ambulance services in England and Wales through a cluster randomised trial. Twenty five participating ambulance stations will be allocated randomly to the intervention or control. The study will measure the impact in terms of repeated falls or related injuries and death in around 1450 patients. Qualitative research with a sample of patients will also assess the appropriateness and quality of care received.

Source: http://www.nets.nihr.ac.uk/projects/hta/070121

NIHR ONGOING STUDY SEVEN: TOOL FOR AMBULANCE STAFF TO ASSESS RISK OF FRACTURE

Due to publish 2016, Clarke

This study uses a computer-based tool to help ambulance staff assess the risk of fracture when attending a patient who has fallen. It addresses the problem of assessment and also communication between ambulance staff and general practitioners to share information about fracture risk and support the timely treatment of osteoporosis. This is a feasibility study for a cluster randomised trial, which aims to recruit around four hundred patients who have fallen from one ambulance station. Patients in the intervention arm will have information on their fracture risk sent to general practitioners. This study should show whether a larger trial is feasible and acceptable to link falls with fracture risk at the time a patient asks for help.

Source: http://bmjopen.bmj.com/content/4/9/e005744.full

NIHR ONGOING STUDY EIGHT: INNOVATIONS TO IMPROVE CARE FOR PEOPLE WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

NIHR CLAHRC North Thames

NIHR CLAHRC North Thames conducted a 3 phase retrospective study (the Year in the Life Programme) to evaluate initiatives in primary care on reducing admissions to hospital. This highlighted the importance of considering other parts of the system, one of which is the decision whether to transfer, which is an important, complex but poorly understood part of the emergency admission pathway. A better understanding of pre-hospital care for breathlessness can inform future strategies to improve community care and reduce avoidable admissions. This has been used to inform a feasibility study by London Ambulance Services (LAS) to examine the characteristics of patients transferred to hospital with symptoms of breathlessness, an important symptom which triggers immediate dispatch of an ambulance and usually transfer and admission to hospital.

Source: http://www.clahrc-norththames.nihr.ac.uk/innovations-to-improve-copd-care/

NIHR ONGOING STUDY NINE: DO NOT ATTEMPT CARDIOPULMONARY RESUSITATION (DNACPR) DECISIONS

Due to publish 2016, Perkins

Interventions to treat cardiac and respiratory arrests are highly invasive and have a poor success rate. For certain people who are very frail or poorly, it may not be appropriate and clinical staff try to agree with patients explicit statements in care treatment plans when resuscitation should not be attempted. But these policies are implemented inconsistently. This research consists of a programme of evidence reviews on current practice and barriers to implementing resuscitation orders. This research will be considered by experts, including ambulance staff, to develop better practice including standardised forms of decision-making across settings.

Source: http://www.nets.nihr.ac.uk/projects/hsdr/12500155

NIHR ONGOING STUDY TEN: THE PEARS STUDY: PROMOTING EFFECTIVE AND RAPID STROKE CARE

Due to publish 2019, Ford

This project is addressing two areas where early management of people with stroke could be improved through better working between ambulance and hospital services: (1) developing an enhanced paramedic role to transfer the patient directly to the scan room and stay with the patient to speed up scans & assessment by the stroke team and comparing the costs and benefits of this model of care to current practice (2) determining the likely effectiveness of the new technique of clot removal (thrombectomy) by analysing existing data sets and working out how many people across England could benefit from treatment.

Source: http://www.ncl.ac.uk/ion/research/neurodegenerative/ncpdproj6/

NIHR ONGOING STUDY ELEVEN:: PRE-HOSPITAL OUTCOMES FOR EVIDENCE-BASED EVALUATION (PHOEBE)

Due to publish 2017, Siriwardena

This five year programme of research will deliver useful information on how to measure the quality of ambulance services with a patient-centred focus. Much performance information in ambulance service is around response times, because of the difficulty in tracking outcomes after patients have left the care of

ambulance staff. There are few reliable and meaningful measures of quality including patient experience. To understand the outcomes of ambulance care, the team will link routine information from ambulance services with hospital data at the emergency department and for the inpatient episode. Further qualitative research with the public and other stakeholders will aim to identify wider perspectives on the most important issues and dimensions of ambulance care. The team will develop and test statistical models that can be used to measure quality, using the new information source, for the large population of patients who use ambulance services every year. This research will include as an output a set of measures that can be used on an ongoing basis, using information that is routinely collected on all patients. The measures will be used to support ongoing development of a suite of ambulance service quality indicators to regularly assess the quality of care they provide and will support audit and research by providing methods to measure the impact of any new changes and innovations in how ambulance services provide care to ensure continued improvements for patients.

Source: http://cahru.org.uk/research/peqo/phoebe/

NIHR ONGOING STUDY TWELVE: COLLECTING BETTER DATA ON OUT OF HOSPITAL CARDIAC ARREST

Due to publish 2016, Benger

This project scopes out the completeness and quality of information on the management and outcomes of patients with cardiac arrest outside hospital. The core of this development work is to build a comprehensive patient database called the Cardiac Arrest Individual Registry and Outcomes (CAIRO) programme. This will allow the team to confidentially track each cardiac arrest patient from initial collapse to hospital discharge. Those patients who consent will also be followed up six months later. Data from this registry will be used to address key questions, from decisions about when ambulance staff should stop and start resuscitation attempts to what is the right amount of oxygen to give patients who have regained a heartbeat. This programme sits alongside a non-NIHR funded registry of out of hospital cardiac arrest (OHCAO) and the two activities will be harmonised in the next few years.

Source: http://emj.bmj.com/content/32/6/e17.1.abstract

NIHR ONGOING STUDY THIRTEEN: PRE-HOSPITAL RANDOMIZED ASSESSMENT OF A MECHANICAL COMPRESSION DEVICE IN OUT OF HOSPITAL CARDIAC ARREST (PARAMEDIC): A PRAGMATIC CLUSTER RANDOMIZED TRIAL

Due to publish 2016, Gates

This study was designed to test whether the introduction of the LUCAS-2 mechanical chest compression device into front-line emergency response vehicles would improve survival from out-of-hospital cardiac arrest. Mechanical devices may be able to deliver more consistent compressions than manual CPR but there is poor evidence for their effectiveness in real-life situations.

Four UK Ambulance Services (West Midlands, North East England, Wales, and South Central) took part. This was a pragmatic "open label" controlled trial in adults with non-traumatic, out-of-hospital cardiac arrest. Clusters were ambulance service vehicles, which were randomly assigned (1:2) to LUCAS-2 or manual CPR. Patients received LUCAS-2 mechanical chest compression or manual chest compressions according to the first trial vehicle to arrive on scene. The primary outcome was survival at 30 days.

The authors concluded that there was no evidence of improvement in 30 day survival with LUCAS-2 compared with manual compressions. On the basis of this and other recent randomised trials, they did not recommend widespread adoption of mechanical CPR devices for routine use.

Source: http://www.nets.nihr.ac.uk/projects/hta/073769

NIHR ONGOING STUDY FOURTEEN: RANDOMISED PLACEBO CONTROLLED TRIAL OF ADRENALINE FOR OUT OF HOSPITAL CARDIAC ARREST (PARAMEDIC-2)

Due to publish 2019, Perkins

From the early 1960's Adrenaline has been one of the foundations of cardiopulmonary resuscitation (CPR). Randomised trials and observational studies show that adrenaline increases the rate of return of spontaneous circulation in out-of-hospital cardiac arrest but that longer-term outcomes (survival to hospital discharge and neurologically favourable survival) may be worse.

The PARAMEDIC-2 study may be the most important cardiac arrest research study ever to be undertaken in the United Kingdom. It should furnish a definitive answer to the question of whether giving one or more doses of adrenaline during CPR improves long-term outcome for people suffering an out of hospital cardiac arrest.

Source: http://www.nets.nihr.ac.uk/projects/hta/12127126

NIHR ONGOING STUDY FIFTEEN: CLUSTER RANDOMISED TRIAL OF THE CLINICAL AND COST EFFECTIVENESS OF THE I-GEL SUPRAGLOTTIC AIRWAY DEVICE VERSUS TRACHEAL INTUBATION IN THE INITIAL AIRWAY MANAGEMENT OF OUT OF HOSPITAL CARDIAC ARREST (AIRWAYS-2)

Benger 2019

The Airways2 trial is a large randomised controlled trial (RCT) in four English NHS ambulance services to compare the clinical and cost effectiveness of the i-gel airway device with tracheal intubation in the initial airway management of patients who have suffered an

out of hospital cardiac arrest (OHCA). Paramedics who agree to take part will be divided into two groups and given structured education on CPR and rescue breathing. One group will be required to use the i-gel and the other group to use intubation as the first method of rescue breathing in all cases of OHCA that they attend during the study. Survivors will be followed up in hospital, and three and six months later, to find out their quality of life of and the NHS resources used during their hospital stay and subsequently.

It is hoped that the results from this study will shape future OHCA guidelines and will yield real benefits to future OHCA patients in the UK and throughout the world.

Source: http://www.nets.nihr.ac.uk/projects/hta/12167102

NIHR ONGOING STUDY SIXTEEN: PILOT TRIAL TO TEST PRE-HOSPITAL NON-INVASIVE VENTILATION

Due to complete 2018, Fuller

A review of published evidence on pre-hospital non-invasive ventilation showed benefits but lacked robust cost-effectiveness data. This pilot study will test the feasibility of a definitive trial to address this question. This study lasting just over two years aims to recruit 120 patients from four ambulance hubs in one region. The study will assess questions of feasibility including problems of recruitment, retention, randomisation, data completeness and acceptability of the intervention.

Source: http://www.nets.nihr.ac.uk/projects?collection=netscc&meta_P_sand=Project (will be available here once contracted)

NIHR ONGOING STUDY SEVENTEEN: REDUCING BLOOD LOSS IN HEAD INJURY PATIENTS

Due to publish 2019, Roberts

Building on the evidence of effectiveness of giving tranexamic acid early to people with major trauma, this prospective study tests its impact in reducing bleeding and adverse outcomes in people with head injuries. Early findings from a nested study within the earlier CRASH-2 trial indicated potential benefits when analysing results for a subgroup of patients with head injuries. This definitive new randomised trial will test this extensively in a number of countries and aims to recruit around ten thousand patients with head injuries in total.

Source: http://www.nets.nihr.ac.uk/projects/hta/1419001

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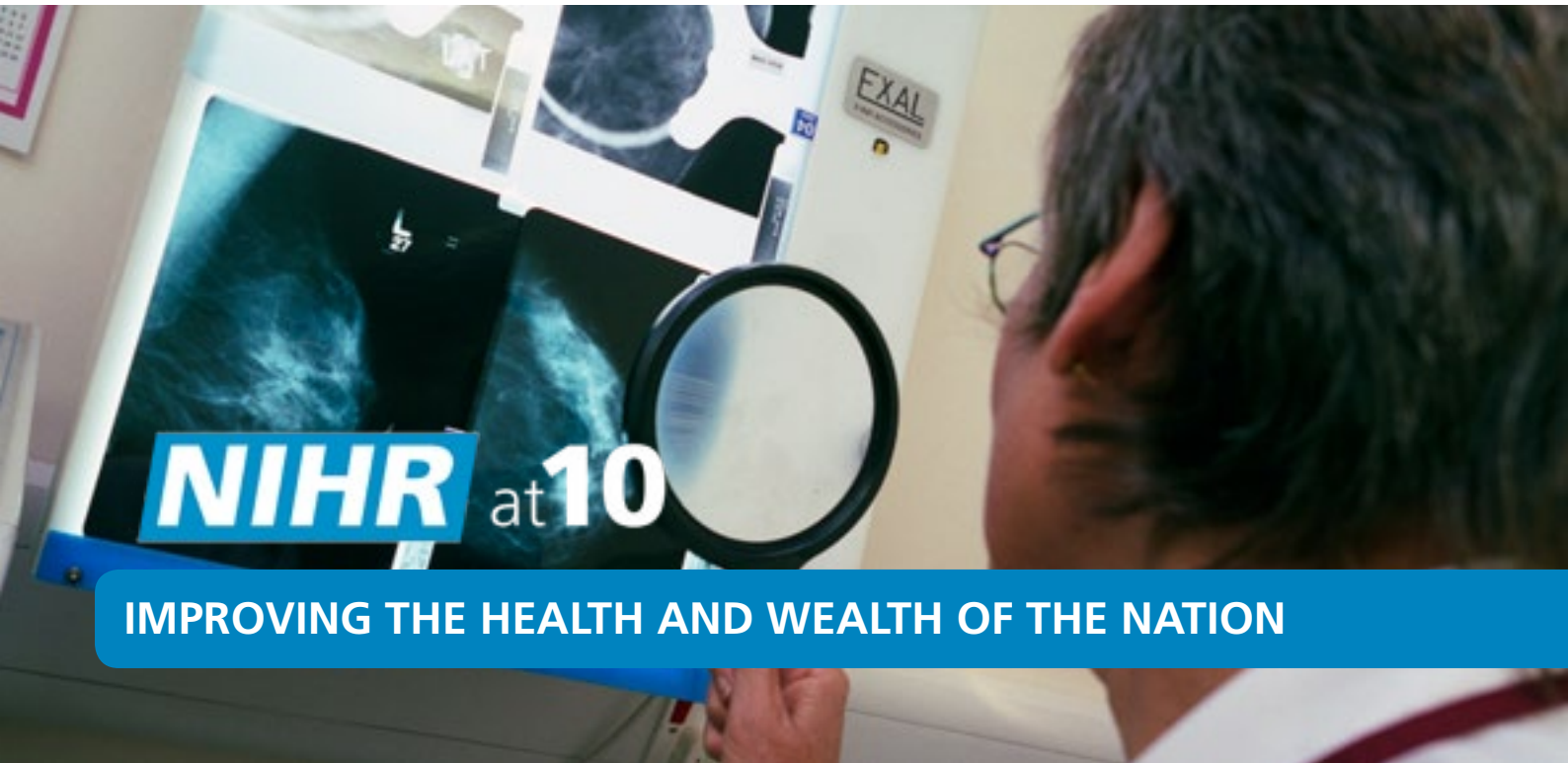

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