Full title of project

Understanding variation in rates of ambulance service 'non-conveyance of patients to an emergency department'

Short title: Variation in Ambulance Non-conveyance (VAN)

Summary of Research

Ambulance services are experiencing increasing demand for response to emergency calls. In response, they have increased the proportion of patients not conveyed to an emergency department (ED) in order to help manage demand, provide a clinically appropriate service for patients and contribute to reducing unnecessary use of EDs and emergency beds. Alternatives to transporting patients to an ED ('see and convey') include the provision of telephone advice and signposting rather than dispatching a vehicle ('hear and treat'), treatment at the scene ('see and treat') and transport to other facilities such as an urgent care centre or walk in centre ('see and convey elsewhere'). There is considerable variation in the rates of different types of non-conveyance, and in non-conveyance overall, between the 11 ambulance services in England. There is also variation in rates of re-contact with the ambulance service within 24 hours, possibly indicating differences in inappropriate non-conveyance. Understanding the reasons for variation between services can help to identify ways of improving service delivery across all ambulance services. We will explore variation in the three different types of non-conveyance to EDs in four ways. In Work Package 1 (WP1) we will identify determinants of non-conveyance rates and potentially inappropriate non-conveyance in the 11 ambulance services. We will undertake a qualitative interview study with 20-25 ambulance service managers, 22 paramedics and 11 health care commissioners to identify potential factors that may explain the variation at a patient, crew and organisational level. In WP2 we will undertake a multilevel analysis for each of the three types of non-conveyance using one month of routine ambulance data (approx. 560,000 calls) to test factors identified in WP1. In WP3 we will identify the determinants of potentially inappropriate non-conveyance. We will focus on re-contacts with the ambulance service within 24 hours for the 11 ambulance services for the three types of non-conveyance. We will also use a linked dataset constructed by the NIHR Applied Research Programme PHOEBE, which is developing ambulance service quality measures, to identify determinants of variation in mortality, hospitalisation and ED attendance rates for two ambulance services. In WP4 we will address two evidence gaps. First, little is known about variation in the provision of 'hear and treat' and we will explore this in depth in three services with highly varied 'hear and treat' rates and re-contact rates. We will use non-participant observation and interviews with between 21 and 30 ambulance staff delivering this service. Second, we will pay specific attention to respiratory problems within our study as this is the second largest indication for 'see and treat'. We will collect and analyse data specific to respiratory problems in WP1-3. The main benefits to the NHS will be guidance for policy makers, health care commissioners and ambulance services about the actions they can take to increase non-conveyance rates while minimising re-contact rates, that is, increasing non-conveyance rates safely and appropriately. This may have further impact for the emergency and urgent care system by reducing use of EDs and emergency beds.

Background and Rationale

Importance of non-conveyance

A considerable amount of NHS money is spent on emergency ambulance service provision. This amounted to £1.5 billion in 2009/10 for both emergency and urgent care provision (National Audit Office, 2011). The ambulance service is important not simply because it provides an essential service but because it is also central to the operation of the whole emergency and urgent care system (National Audit Office, 2011). Indeed our recently completed HS&DR funded study on avoidable emergency admissions identified that emergency and urgent care systems with higher rates of ambulance non-conveyance had lower rates of avoidable admissions, showing the potential impact of non-conveyance on emergency admissions (O'Cathain, 2013).

Increasing use of the emergency ambulance service has the potential to overload ambulance services and reduce the quality of service offered to life threatening emergencies. The task for services is to try and match their response to the clinical needs of callers. Alternative care such as advice over the telephone and referral to more appropriate providers ('hear and treat'), treatment at scene ('see and treat'), or transport to a lower level health care facility ('see and convey elsewhere') may offer better solutions for some calls. Non-conveyance is central to the recent Keogh review of urgent and emergency care because it is a way of offering patients care closer to home (NHS England, 2013). Recognising the complexity of decision-making around non-conveyance (Porter, 2007), and that many patients need and want to go to hospital, it is also the case that patients who call the ambulance service do not always want to go to hospital. They may dial 999 to seek advice about the most appropriate place to go or, if they have chronic conditions, because they think the service is more likely to treat them at home than a GP (Booker, 2012). In addition, patients can value the reassurance given by non-conveyance as well as conveyance to a hospital (Togher, submitted).

Levels of variation in non-conveyance

There is considerable variation in non-conveyance rates between the 11 ambulance services in England. Aggregated monthly data for six months of 2012/13 shows that telephone advice only rates ('hear and treat') varied between 3.4% and 10.5% for different ambulance services; and the percentage of patients who had an ambulance sent out but were not taken to an ED varied between 22% and 52% (source: KA34, AQI). There is also variation in potentially inappropriate non-conveyance: 13% of 'hear and treat' calls resulted in a re-contact with the ambulance service within 24 hours, varying between 3% and 31% for different services (source: AQI). It is important to understand what drives this variation and how it can be reduced appropriately.

International perspective

People being transported to hospital when there is no medical need is of concern internationally (Hjalte, 2007). Non-conveyance rates are 23% to 33% internationally (Snooks, 2004a). For example, 28% of children cared for by paramedics in Canada were not transported to hospital (Kahale, 2006).

Determinants of non-conveyance

We could find no research evidence about why different ambulance services have different rates of non-conveyance. However, there is evidence about the determinants of some types of

non-conveyance (Marks, 2002; Snooks, 2004a). This evidence covers international literature, with considerable differences in determinants between countries (Snooks, 2004a). Marks et al (2002) undertook an epidemiological study of non-transported patients in one ambulance service in the UK in 2000 at a time when 17% of patients were not conveyed and found that 34% were falls mainly in elderly people. Indeed the evidence base tends to focus on 'see and treat' where an ambulance is sent to the scene and the patient is treated at the scene (Marks, 2002; Snooks, 2004a). Within this type of non-conveyance the focus has tended to be on falls, which is the largest reason for 'see and treat'. A recent systematic review of non-transportation for falls in older people identified 12 studies showing that the rate of non-transportation varied between 11% and 56% in different studies and that re-contact with health care within 28 days was high (Mikolaizak, 2013).

Potentially problematic non-conveyance

Although some non-conveyance interventions have been found to be effective (Mason, 2007), with little risk for low acuity calls (Turner, 2010), evidence reviews have identified concerns about the safety of 'see and treat' (Snook, 2004a; Mikolaizak, 2013; Turner, 2010). Concerns about safety mean that it is imperative to consider potentially inappropriate non-conveyance rates. It is helpful to have the recently introduced quality indicator of re-contact rates with the ambulance service within 24 hours (Cooke, 2011) to allow exploration of variation in these rates in England.

The types of outcomes measured for non-conveyance in intervention studies have focused on further ambulance calls, ED attendance, primary care contacts, hospital admission and mortality (Mikolaizak, 2013; Snooks 2004b). Time periods of measurement of outcomes have been long, at 7 days, 14 days or 28 days (Mikolaizak, 2013; Snooks 2004a; Snooks 2004b). Other researchers have looked at shorter time periods: 15% (51/345 non-conveyed children were seen in an ED within 48 hours in Canada, with no deaths reported (Kahale 2006)). Variation in outcomes has been found, for example patients seen by emergency care practitioners had lower ED attendance and hospital admission rates than ordinary crews (Mikolaizak, 2013).

Limited evidence base on variation in 'hear and treat'

Most of the evidence base focuses on 'see and treat' rather than 'hear and treat' and 'see and convey elsewhere' (Turner, 2010). A randomised controlled trial of transfer from 999 to a nurse for telephone advice identified a high rate of transfer back to 999 and a slightly lower rate of satisfaction than for other calls (Turner, 2006). We could find no evidence base on variation in 'hear and treat'.

Limited evidence base on conditions other than falls

The evidence base has tended to focus on falls because this is the largest group of 'see and treat' non-conveyance. Indeed two recent/ongoing randomised controlled trials of non-conveyance focus on falls (Snooks, 2010; Snooks 2013). Although Marks found that respiratory conditions accounted for only 2% of non-transported calls in 2002 (Marks, 2002), a recent national audit within ambulance services in England identified that the top three 'see and treat' conditions were falls (28%), respiratory problems (12%) and mental health problems (6%). Given that excellent research has and is being undertaken on falls, we feel it is important to understand more about variation in non-conveyance for respiratory problems.

Need for further research

Our proposed study focuses on understanding the variation between ambulance services in the delivery of three types of non-conveyance with the aim of identifying facilitators and barriers to increasing non-conveyance appropriately. There is a need to understand more about variation in all three different types of non-conveyance. Given that research on non-conveyance has tended to focus on 'see and treat' for falls, there is a need to focus on 'hear and treat' and non-conveyance for other health problems. The National Audit Office concluded that ambulance services needed to take more opportunities to learn from each other (NAO, 2011). This study aims to identify learning for ambulance services and commissioners of ambulance services. Increasing non-conveyance rates is a key focus for policy makers, commissioners and ambulance services (NAO, 2011) and is likely to continue to be so in the future (Health Select Committee 2013). The recent Keogh review of urgent and emergency care identified care closer to home as a one of the five key principles for the future – something that non-conveyance can help to deliver (NHS England, 2013).

Evidence explaining why this research is needed now

Over the 5 years from 2007/8 to 2012/13 the numbers of calls to the emergency ambulance service in England have increased by 25% from 7.23 million to 9.08 million (http://www.hscic.gov.uk/catalogue/PUB11062). The increase is in non-life threatening conditions. Dealing with this increase without transporting patients to an emergency department (ED) can help to manage demand, provide a more clinically appropriate response for patients who do not need hospital care and may relieve pressures on EDs and emergency admissions.

Considerable variation exists in non-conveyance rates between the 11 ambulance services in England. Some variation may be warranted because of differences in population characteristics in geographical areas covered by ambulances services, some may be due to organisational differences between the services, and some may be the result of differences in the wider emergency and urgent care system and options available to manage care closer to home. There is a need to understand how to increase non-conveyance rates without compromising safety in terms of higher re-contact rates or other adverse consequences. We intend to explore the drivers of variation to help ambulance services to identify ways of increasing non-conveyance rates appropriately in the future.

Aims and objectives

1. To identify the determinants of variation between and within ambulance services for three different types of non-conveyance: 'hear and treat', 'see and treat' and 'see and convey elsewhere'.

2. To identify the determinants of variation between and within ambulance services in *potentially inappropriate* non-conveyance for three different types of non-conveyance.

3. To explore organisational variation in the provision of 'hear and treat' in three ambulance services.

4. To understand variation between and within ambulance services in three different types of non-conveyance rates for respiratory problems.

Research Plan / Methods

Conceptual framework

Our conceptual framework is 'unwarranted variation in health care' (Wennburg, 2002, 2011) where some variation is warranted due to patient need or preference and some is not. Wennberg identifies three types of unwarranted variation: effective care, preference-sensitive care and supply-sensitive care. Effective care is where there is evidence on effective care but variation in its use; this is unlikely to be relevant to ambulance non-conveyance because of the lack of robust evidence of effectiveness. Preference-sensitive care could be relevant to our study because some types of patients may have preferences about non-conveyance (warranted variation), but most of this type of variation in practice has been related to the preferences of clinicians and in our study it may relate to preferences of commissioners, services or paramedics. Supply-sensitive care may be highly relevant, whereby supply of types of resource such as trained paramedics could affect variation. Appleby et al (2011) use this framework in a discussion of variations in health care where they recommend the importance of publishing variation, identifying causes of variation and encouraging actions to deal with it. Our emphasis will be on understanding the causes of variation and actions that can be taken to deal with it. Appleby et al's map of causes of variation, displayed in their Figure 1, will shape our data collection and analysis in our qualitative and quantitative components. We will consider the range of issues potentially causing variation such as demand issues (e.g. population morbidity, commissioning practices) and supply issues (e.g. service configuration, clinical decision making), with attention to adjusting for warranted variation in order to identify unwarranted variation. Other theoretical frameworks may become relevant to our project as it progresses, for example patient safety and risk (Vincent, 1998). If variation in beliefs and practices around patient safety and risk emerge during data collection then we will identify a framework relevant to the emergent theme to facilitate and deepen analysis.

Setting

Originally we aimed to focus on the 11 ambulance services in England. Nine of these have already expressed interest in participating in this study if it is funded (see attachment). One ambulance service that has yet to agree to participate is very small and its difference in size makes inclusion in all aspects of this study challenging. We are likely to be able to obtain participation from 9 or 10 of the larger services in England.

Design

The design is a sequential mixed methods study with four components/work packages (WPs). See attached flow diagram of study design.

WP 1 Identifying factors affecting variation in rates of non-conveyance and potentially inappropriate non-conveyance

We will undertake a qualitative interview study with three key stakeholder groups – service providers, paramedics and commissioners. We will identify perceived determinants of each of the three different types of non-conveyance (hear and treat, see and treat, see and convey

elsewhere) and potentially inappropriate non-conveyance for each of the 11 ambulance services in England.

We will undertake face-to-face semi-structured interviews with managers in each ambulance service about their policies, non-conveyance models, organisational views, and facilitators and barriers to each type of non-conveyance and potentially inappropriate outcomes after non-conveyance. Providers of ambulance services can offer both a strategic and an operational view of non-conveyance, both of which are important to this study. Members of the National Ambulance Research Steering Group (NARSG), represented by all ambulances services in England, advised us that there is no consistency of roles between services and that we would need to interview between 1 and 3 managers per Trust to obtain both a strategic and operational view in each service. We expect to undertake around 20-25 interviews with ambulance service providers. The topic guide will be informed by a literature review so that determinants identified in the literature are addressed. In addition, we will ask each service to complete a proforma to identify relevant organisational responsibilities and resources, in particular whether they provide NHS 111, the type of prioritisation software used, and resources available for non-conveyance in terms of numbers of advanced practitioners and clinical supervisors. We will also request policy documents about non-conveyance and undertake documentary analysis on them.

We were asked at the outline stage of the application process to be clear how these interviews complement interviews with ambulance services which we undertook in a recently completed HS&DR funded study of avoidable emergency admissions (O'Cathain, submitted). In those interviews we interviewed a manager and paramedic from a single locality in six ambulance services (that is, we did not take an organisational view), asking about how the ambulance service and services in the wider emergency and urgent care system avoided emergency admissions (that is, the focus was on the health care system).

Although some managers in the service provider interviews may be paramedics, we will also interview two paramedics in each service about factors affecting the three types of non-conveyance, giving a total of 22 interviews.

Health care commissioners can shape the amount of non-conveyance undertaken. The National Ambulance Commissioning Group lists a lead commissioner for each ambulance service. The group has expressed interest in the study and agreed to participate in principle (see attached). We will request a face-to-face semi-structured interview with each commissioner to identify their approaches to commissioning the three different types of non-conveyance, and non-conveyance overall, and reasons for their approaches. We will undertake around 11 interviews with commissioners.

We will seek written informed consent for the interviews. We will use telephone interviews if face-to-face interviews are cancelled or difficult to arrange. We will digitally record interviews and transcribe them verbatim. We will analyse the data in two ways. First, we will use framework analysis which is appropriate for applied policy research (Ritchie, 1994). We will identify overarching factors affecting the three types of non-conveyance from the perspectives of providers, paramedics and commissioners, focusing on the underlying issues which drive approaches to non-conveyance. Where possible, we will test the effect of these factors in WP2 (see later). Second, we will identify how organisational factors are perceived to operate within each ambulance service, code this information, and then test these factors in the multi-level model described in WP2 (Sandelowski, 2000). For example, commissioners may identify 'historic financial investment' or 'historic financial constraint' around a type of

non-conveyance which would be coded as 1 and 2 respectively for each of the 11 ambulance services for testing in WP2. Two researchers will independently code the data for this part of the analysis and resolve disagreements with a third member of the team.

WP2 Testing factors affecting variation between and within ambulance services

WP2.1 Variation between ambulance services

We will obtain one month's routine Computer Aided Dispatch (CAD) call data from each of the 11 ambulance services to identify determinants of each type of non-conveyance. We will request the most recent month available at the start of the study (likely to be September 2014). The factors we will test will relate to three levels: patients, crews and ambulance services. ***Patient level characteristics*** available in CAD are age, sex, postal sector of incident, reason for the call, and time of call. We will use GeoConvert, an online mapping tool for UK academics, to link the postcode with the Index of Multiple Deprivation and rural/urban indicators. We will identify calls made in or out-of-hours (where in-hours is 8-6 Monday to Friday) as an indicator of the availability of other health services at the time of the call. Ambulance services in England use one of two software systems to prioritise 999 calls: AMPDS (6/11 services) and NHS Pathways (5/11 services). The reason for calling, known as the chief complaint, is recorded differently in each software system but can be identified using the AMPDS dispatch code or NHS Pathways symptom group discriminator. ***Crew level*** data will include type of response (e.g. solo responder in car or dual crewed ambulance), and skill mix attending the incident (e.g. paramedic qualification or emergency care assistant). Further skill mix data is available in another data set which can be linked using a pin number in CAD. We will test the feasibility of this linkage in one service before attempting to do it for all 11 services. We are not concerned with variation between individual crews or members, only the skill mix. ***Organisational characteristics*** will be identified from interviews in WP1 in terms of policies and attitudes towards the three types of non-conveyance.

We will write a specification of the data needed (taking differences in AMPDS and NHS Pathways into account) and visit each service to work with a data manager to provide the relevant data. All data will be anonymised. We will be unable to remove multiple calls by the same person because frequent callers are not consistently identified in CAD across all ambulance services.

There is no formal sample size calculation that can be undertaken. However, we have considered statistical power based on one month of CAD data. 566,000 calls received a telephone or face-to-face response in the month of December 2013 in England (source: AQI). One ambulance service is very small (Isle of Wight with 1,700 calls per month); the variation between the other 10 was 23,000 to 102,000. For these 10 services the range of numbers of calls resolved by telephone advice (hear and treat) was 1,129 to 9,559; for 'see and treat' and 'see and convey elsewhere' combined it was 15,000 to 30,000 (AQI reports combined numbers only). 'See and convey elsewhere' is a smaller group than 'see and treat' and is estimated to range from 450 to 7,400 per month for the 10 services (source: KA34).

The approach to analysis is described in WP2.2 below.

WP2.2 Variation within ambulance services

Ambulance services through national groups such as NARSG, the National Ambulance Services Clinical Quality Group (NASCQG), Association of Ambulance Chief Executives (AACE) and National Ambulance Medical Directors (NASMeD) members have expressed an interest in variation within ambulance services. Variation within an ambulance service may be larger than between ambulance services because of the urban/rural status of the locality or differences in the availability of primary, community and social services in different localities which allow non-conveyance e.g. 24 hour district nursing service or falls service. The ambulance services have formal localities, for example East Midlands Ambulance Service has five localities with very different urban/rural status. We will identify the variation in the three types of non-conveyance by locality within each service, explaining why rates vary at this level. 'Hear and treat' is likely to vary much less by locality than 'see and treat' and 'see and convey elsewhere' because crew skill mix associated with 'see and treat' and 'see and convey elsewhere' will vary in different localities.

For the 'see and treat' and 'see and convey elsewhere' analyses we will fit mixed effects logistic regression models with locality fitted as a random effect. All single patient level, crew level and organisational level characteristic variables that are significantly related to the outcome of '% not conveyed' at $p<0.15$ will be entered into the multivariable model building analysis. Using a backward elimination strategy with terms removed at $P>0.05$, the subset of variables that independently predict the outcome '% not conveyed' will be selected. We will also consider first order interactions between predictor variables. We will examine differences between the ambulance services by displaying the prediction intervals for the random effects of locality using caterpillar plots (Pinheiro, 2000). We will test for differences in the rankings of localities between different services using a Kruskal-Wallis test.

For the analysis of 'hear and treat', locality is not applicable so we will fit a logistic regression model with ambulance service as a fixed factor. Other variables included in the model will be selected using the strategy previously described. We will also consider interactions between ambulance service and the other predictor variables to allow for the possibility of non-constant risk (Nicholl, 2007).

The numbers available (see WP2.1) are adequate for use in a mixed effects or fixed effects logistic regression model. We will be able to test between ambulance service level variation using a fixed effects model only.

WP3 Factors affecting variation in potentially inappropriate non-conveyance rates

WP3.1 Re-contact rates for 11 ambulance services

All 11 ambulance services in England routinely collect two indicators of potentially inappropriate non-conveyance: re-contact with 999 within 24 hours of 'hear and treat' and within 24 hours of 'see and treat'. WP2 will be repeated to identify the determinants of re-contact rates for these two types of non-conveyance.

In December 2013, the re-contact rate for all 11 services in England was 8.6% for 'hear and treat' and 5.5% for 'see and treat'. Variation in re-contact rates for all 11 services in England for 'hear and treat' was 10-fold, from 2.5% to 20.2%. For 'see and treat' variation was 3-fold from 2.3% to 6.8%. We have considered statistical power in terms of the numbers available in one month of CAD data. The Isle of Wight service will yield small numbers of re-contacts (6 and 11 for the two types of re-contact collected) so we will focus on the 10 larger services

in England. Numerators of re-contact rates varied from 105 to 762 for ‘hear and treat’ and 279 to 1319 for ‘see and treat’ in one month of CAD.

WP3.2 Mortality, hospitalisation and attendance at an emergency department for two ambulance services

Other indicators of potentially inappropriate non-conveyance are not available routinely within ambulance service data. We will calculate other indicators using data from the ongoing NIHR Applied Research Programme PHOEBE which is linking 6 months of data from two ambulance services (Yorkshire Ambulance Service, East Midlands Ambulance Service) with mortality data from the Office of National Statistics, HES inpatient data and HES A&E data. We will identify the mortality rate, the hospitalisation rate, and the ED attendance rate of the three types of non-conveyance.

It is important to make clear that we are building on the PHOEBE programme of research and not repeating it. PHOEBE is doing this data linkage to measure a range of outcomes for ambulance services and to build predictive models. The outcomes are selected for measurement using a Delphi exercise; there is likely to be only one outcome for non-conveyance that needs linked data: use of any urgent service within 24 hours for ‘see and treat’. We intend to build on this by measuring three outcomes for each of three types of non-conveyance separately and focusing on variation in these outcomes. There is no consensus on the time period for measuring the three outcomes. The evidence base shows measurement of outcomes in a week or more (see earlier). We will seek the views of the ambulance services in WP1 about the most appropriate time period to measure. It is likely that we will consider outcomes within both 24 hours and 72 hours because these are likely to be related to the original non-conveyance decision. We have sought guidance from the Confidentiality Advisory Group of the Health Research Authority for the re-use of this data and have been informed that this is allowed if anonymised data is used (see attachment).

In November 2014 HES 2013/14 admissions and A&E attendances will be available for linkage with a six month period of 2013 ambulance data in PHOEBE. The dataset will be constructed for analysis by March 2015 when we would need it. The focus of our study is understanding variation in non-conveyance. We will consider patient, crew and locality level characteristics only because we will have this data for two ambulance services only. EMAS covers five localities and YAS linked data will only cover one locality.

Our analysis will be similar to that described in WP2.1. The size of the data set will be around 15,000 ‘hear and treat’, 120,000 ‘see and treat’, and 6,000 ‘see and convey elsewhere’. Mortality will be the outcome affecting the least number of people and will be negligible for ‘hear and treat’.

<u>WP4 In-depth exploration of variation in non-conveyance practices</u>

WP4.1 Exploring variation in ‘hear and treat’ in depth in three ambulance services

Given the lack of evidence about variation in ‘hear and treat’ we will focus on this type of non-conveyance in three ambulance services with varied practice.

Sampling of sites

'Hear and treat' is a two stage process provided within the ambulance service Emergency Operations Centre. Firstly non-clinical call takers (variously called call takers, Emergency Medical Dispatchers, Emergency Medical Advisors) assess 999 calls and identify calls potentially suitable for 'hear and treat'. These calls are passed to clinicians (known as Clinical Supervisors who may be nurses or paramedics) for enhanced clinical assessment. Callers dealt with by Clinical Supervisors may be given self care advice, referred to - or advised to contact- other providers, or an ambulance response dispatched. Using monthly national Ambulance Quality Indicators available in England, we will select three services with deviance from the average in terms of having a wide variation in the amount of 'hear and treat' and in the amount of re-contact in 24 hours. Note that this selection will depend on monthly national data and not on the analysis undertaken in WP2 and WP3. In December 2013, one ambulance service had the lowest 'hear and treat' rate yet one of the highest re-contact rates. One service had the highest 'hear and treat' rate yet one of the lowest re-contact rates. If these two services continue to be at extremes of variation at the start of our study we will seek their participation in this part of the study, with an additional service offering further contrast.

Observation

In each of three services we will undertake non-participant observation around two key processes: making the decision to offer 'hear and treat' and offering the 'hear and treat' advice. In an Emergency Operations Centre of each service we will observe the decision-making processes involved in both initial call assessment and enhanced clinical assessment. We will consider the interaction between the caller and the ambulance staff members, and the interactions between staff including where referrals are made which involve contact with other health and social care staff. The observation of staff in their 'natural' work environment combined with interviews (see below) to explore the observed behaviour will help to gain an understanding of staff actions and decisions in relation to 'hear and treat'. The actions of healthcare professionals have been assessed previously using observation, which derived insights that could not be obtained by other methods (Walshe, 2011). We will draw on learning from publications where observation has been used in similar settings (Pope, 2013; Turnbull, 2012; McCann, 2013).

We will need to listen in to, and observe, a variety of types of calls. We will spend 6 days in each site. The initial stage of this work will entail a day of familiarisation of the researcher with the Emergency Operations Centre setting, relevant staff roles and key documentation in relation to 'hear and treat'. This will help to identify a framework for the data collection. Observations of 8 hours per day for 5 days totalling 40 hours of observation per site will then occur. First, observation of Clinical Supervisors will occur. In an average sized ambulance service 20 hours of observation of Clinical Supervisors who offer 'hear and treat' will yield around 60 calls offered telephone advice only. There will be one or two Clinical Supervisors on duty at any time so a single researcher will observe between 30 and 60 'hear and treat' calls. After this is completed, observation of call takers will occur. Twenty hours of observation will yield a minimum of 60 calls referred to Clinical Supervisors for 'hear and treat' (recognising that not all calls referred for 'hear and treat' receive telephone advice only). However, there will be a number of call takers on duty at any one time so a single researcher will not be able to observe all these 60 calls. A call taker deals with around 5 calls

per hour so observing one call taker will only yield about four 'hear and treat' calls in an average site. However, the researcher will not simply be observing 'hear and treat' calls but the decision-making about which calls are categorised as suitable for telephone advice or an ambulance response. The researcher will observe this decision-making with the knowledge of at least 30 'hear and treat' calls from observing the Clinical Supervisors. Each 8 hour observation shift will include 3 hours in the day, 3 in the evening and 2 at night. Observation will not interfere with the normal activities of the staff being observed. We will balance observation days in each site to include winter and summer observations so that seasonal differences do not obstruct our ability to see differences between the three ambulance services. Members of our team have observed call handling and assessment previously for research (JT) and training (JW), as well as observing ambulance service staff on vehicles (ROH, JW).

Interviews

In addition to observation we will undertake face-to-face semi-structured interviews with call takers, clinical supervisors (some of whom will be paramedics) and their managers to examine how they manage 'hear and treat' calls, and how they minimise re-contact rates. This will include exploration of issues identified from the observations. The focus will be on variation in practice between the three ambulance services, attempting to understand why they have different rates of 'hear and treat' and re-contacts. We will undertake the observation and interviews in an iterative way so that learning from the observation can inform the interviews and vice versa.

In each site we will interview 1-2 managers, 3-4 call takers and 3-4 clinicians. This will total between 21 and 30 interviews. We will use telephone interviews if face-to-face interviews are cancelled or difficult to arrange. We will seek written informed consent from staff for the observations and interviews.

Data Analysis

Data from the observations will be recorded using handwritten notes, which will be transcribed into electronic format suitable for analysis. Interviews will be digitally recorded and transcribed verbatim. Data will be stored securely and in accordance with data protection guidelines. This work package will generate a large volume of data which will be managed through the use of the ATLAS.ti qualitative data analysis software. We will analyse the data using framework analysis (Ritchie, 1994).

This will complement the ongoing research of one of our team (JC) who is undertaking a systematic review of the appropriateness and safety of 'hear and treat' calls and is undertaking a survey of 'hear and treat' patients to explore its acceptability and the actions people take after receiving such advice.

WP4.2 Variation in non-conveyance of patients with respiratory problems

Respiratory problems are a common chief complaint of callers who are not conveyed to an ED. Respiratory or breathing problems includes chronic obstructive airways disease (COPD), asthma, respiratory tract infections and hyperventilation (Clawson, 2012). We will specifically ask in our interviews in WP1 about management of respiratory problems, repeat our statistical analyses in WP2 and WP3 for respiratory problems, and undertake a sub-analysis on respiratory problems in WP4.1 (if they appear in 'hear and treat').

Thinking about statistical power, in WP2, if 12% of 'see and treat' calls are for respiratory problems, a month of data from England will yield 25,000 cases for this type of non-conveyance. Numerators will vary between 1200 and 3500 for the 10 larger ambulance services in England. We do not know what proportion of the other two types of non-conveyance is for respiratory problems but the numbers will be considerably smaller and this may limit the analysis we can undertake. For WP3 numerators will vary between 33 and 160.

Integration of work packages

Attention to integration is important within mixed methods studies so that the whole is more than the sum of the parts. Interviews in WP1 will inform the quantitative analyses on determinants of variation in non-conveyance (WP2) and variation in potentially inappropriate non-conveyance (WP3). Findings from the depth understanding of variation between ambulance services in 'hear and treat' (WP4.1) may generate further hypotheses to test in WP2 and WP3, as well as expand our understanding of how factors operate. Findings from all components will be brought together at the end of the study using a matrix to identify overall learning about non-conveyance (O'Cathain, 2010).

Dissemination and projected outputs

We will anonymise ambulance services in any reporting of findings. The aim is not to benchmark services but to identify issues to help all ambulance services to undertake further appropriate non-conveyance. We recognise that the identities of some services can be worked out using publically available routine indicators but we will use anonymised reporting to keep the focus on learning.

We will undertake academic dissemination by publishing a full report in the NIHR Libraries Journal, publishing articles in academic journals, and presenting the research at relevant conferences e.g. international conferences in emergency care, the 999 EMS Research Forum, the College of Paramedics national conference, and the Health Services Research Network.

We will undertake impact activities by sending our report and a summary to, and offering attendance at meetings of, relevant colleges and associations such as the College of Paramedics and the Association of Ambulance Chief Executives. We will write summaries for commissioners and providers and disseminate the findings at the NHS Confederation emergency and urgent care forum. The focus will be on evidence-based guidance to commissioners and service providers on the critical factors which will enable services to increase the proportion of patients that are not conveyed to hospital in ways that are safe and appropriate.

We will work closely with the National Ambulance Research Steering Group (NARSG), and the College of Paramedics' Research and Advisory Committee, who have offered support for the research (see attached). We will give them ongoing feedback about the study and seek their views on emerging findings. Nine of the 11 ambulance services in England have already offered support for our study if funded (see attached). The Association of Ambulance Chief Executives have also offered support for the study (see attached).

Sir Bruce Keogh the Medical Director of the NHS in England continues to review emergency and urgent care with Professor Keith Willett and NHS England. We will inform them of our research and if they wish we will offer input to their endeavour.

To inform the general public we will press release our findings to promote the reporting of our findings in the media. We will use our Twitter account to disseminate our findings, establish a website which will report findings, and produce a lay summary for distribution to networks known by the PPI groups working with us. Our PPI applicant MM is interested in informing the general public about the range of outcomes that can occur when a patient calls 999 because she believes that patients currently do not know about the availability of non-conveyance options and too often expect to be taken to hospital.

Patient and Public Involvement

The School of Health & Related Research (ScHARR) at the University of Sheffield has a large portfolio of emergency and urgent care research projects. In order to support patient and public involvement (PPI) activities across these projects a PPI group, the Sheffield Emergency Care Forum (SECF), has been established. This group provides direct support to research teams within ScHARR and also provides wider links to related PPI groups within the South Yorkshire CLRN and Healthwatch. SECF and the PPI forums from two ambulance services (SECAMB and EMAS) will come together three times a year to obtain their views on planned data collection, emerging findings, interpretation and dissemination. All groups have members with experience of using an emergency ambulance and with long term conditions. The SECAMB PPI group includes people with chronic conditions due to their focus on primary care in the work of Paramedic Practitioners. The Healthier Ageing Patient and Public Involvement group from EMAS (and the University of Lincoln) is also fundamentally concerned about long term conditions.

Maggie Marsh is experienced at PPI, is a long standing member of SECF, and she is the PPI lead on other ambulance related research studies. She is a co-applicant and will attend management meetings where she will influence decisions being made about how to operationalise the research proposal and interpret findings. In particular she will help to write the lay summary for the ethics application as well as helping to ensure an ethical approach is being undertaken to the research, help to construct the topic guides for the interviews, help to write lay summaries of the findings for dissemination, and help to construct a wide reaching dissemination strategy. Enid Hirst is another experienced member of SECF and she will be a member of the Project Advisory Group where PPI will take a more strategic view of how the project is progressing and emerging findings.

Appropriate costs to support the PPI involvement in the project including fees, travelling expenses and consumables (telephone calls, email) have been included using the recommended costs set by INVOLVE.

References

Appleby J, Raleigh V, Frosini F, Bevan G, Gao H, Lyscom T. Variations in health care: The good, the bad and the inexplicable, The King's Fund Report, 2011.

Ḅooker MJ, Simmonds RL, Purdy S. Patients who call emergency ambulances for primary care problems: a qualitative study of the decision-making process. *Emerg Med J* Online First: doi:10.1136/emermed-2012-202124

Clawson J, Barron T, Scott G, Siriwardena AN, Patterson B, Olola C. Medical Priority Ḍispatch System breathing problems protocol key question combinations are associated with patient acuity. *Prehosp Disaster Med* 2012;27(4):1-6.

Cooke M. An introduction to the New Ambulance Clinical Quality Indicators. *Ambulance Today*, 2011;7(5):35-36.

Hjälte L, Suserud BO, Herlitz J, Karlberg I. Why are people without medical needs transported by ambulance? A study of indications for pre-hospital care. *Eur J Emerg Med*. 2007;14(3):151-6.

Kahalé J, Osmond MH, Nesbitt L, Stiell IG. What Are the Characteristics and Outcomes of Nontransported Pediatric Patients? *Prehosp Emerg Care* 2006;10(1):28-34.

McCann L, Granter E, Hyde P, Hassard J. Still Blue-Collar after all these Years? An Ethnography of the Professionalization of Emergency Ambulance Work. *Journal of Management Studies* 2013;50(5):750-776.

Marks PJ, Daniel TD, Afolabi O, Spiers G, Nguyen-Van-Tam JS. Emergency (999) calls to the ambulance service that do not result in the patient being transported to hospital: an epidemiological study. *Emerg Med J* 2002;19(5):449–52.

Mason S, Knowles E, Colwell B, Dixon S, Wardrope J, Gorringe R, et al. Effectiveness of paramedic practitioners in attending 999 calls from elderly people in the community: cluster randomised controlled trial. *BMJ* 2007;335(7626):919.

Mikolaizak AS, Simpson PM, Tiedemann A, Lord SR, Close JCT. Systematic review of non-transportation rates and outcomes for older people who have fallen after ambulance service call-out. *Australasian Journal on Ageing* 2013;32(3):147-157.

National Audit Office. Transforming NHS ambulance services. Department of Health. Report by the comptroller and auditor general. hc 1086session 2010–2012.10 June 2011.

NHS England. Transforming urgent and emergency care services in England. Emergency and Urgent Care Review. End of Phase 1 report. 2013.

Nicholl J. Case-mix adjustment in non-randomised observational evaluations: the constant risk fallacy. *J Epidemiol Community Health* 2007; 61(11):1010-1013.

O'Cathain A, Murphy E, Nicholl J. Three techniques for integrating qualitative and quantitative methods in health services research. *BMJ* 2010;341:1147-1150.

O'Cathain A, Knowles E, Maheswaran R, Pearson T, Turner J, Hirst E, et al. A system-wide approach to explaining variation in potentially avoidable emergency admissions: national ecological study. *BMJ Qual Saf* 2014;23(1):47-55.

O'Cathain A, Knowles E, Turner J, Maheswaran R, Goodacre S, Hirst E, et al. Explaining variation in emergency admissions: a mixed methods study of emergency and urgent care systems. *NIHR Journals Library* submitted.

Pinheiro J, Bates D. Mixed-Effects Models in S and S-PLUS. New York: Springer 2000.

Pope C, Halford S, Turnbull J, Prichard J, Calestani M, May C. Using computer decision support systems in NHS emergency and urgent care: ethnographic study using normalisation process theory. *BMC Health Services Research* 2013,13:111.

Porter A, Snooks H, Youren A, Gaze S, Whitfield R, Rapport F, et al. 'Should I stay or should I go?' Deciding whether to go to hospital after a 999 call. *J Health Serv Res Policy* 2007;12(suppl 1):S1 32-38.

Sandelowski, M. Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. *Research in Nursing & Health* 2000;23:246-255.

Ritchie J, Spencer L. Qualitative data analysis for applied policy research. In Bryman A, Burgess RG, editors. *Analysing qualitative data*. London: Routledge; 1994. pp.173-194.

Snooks HA, Dale J, Hartley-Sharpe C, Halter M. On-scene alternatives for emergency ambulance crews attending patients who do not need to travel to the accident and emergency department: a review of the literature. *Emerg Med J* 2004;21(2):212-5.

Snooks H, Kearsley N, Dale J, Halter M, Redhead J, Cheung W. Towards primary care for non-serious 999 callers: results of a controlled study of "Treat and Refer" protocols for ambulance crews. *Qual Saf Health Care* 2004;13(6):435–443.

Snooks H, Cheung WY, Close J, Dale J, Gaze S, Humphreys I, et al. Support and Assessment for Fall Emergency Referrals (SAFER 1) trial protocol. Computerised on-scene decision support for emergency ambulance staff to assess and plan care for older people who have fallen: evaluation of costs and benefits using a pragmatic cluster randomised trial. *BMC Emerg Med* 2010;10:2.

Snooks H, Anthony R, Chatters R, Cheung WY, Dale J, Donohoe R, et al. Support and assessment for fall emergency referrals (SAFER 2) research protocol: cluster randomised trial of the clinical and cost effectiveness of new protocols for emergency ambulance paramedics to assess and refer to appropriate community-based care. *BMJ Open* 2012;2(6): e002169. doi:10.1136/bmjopen-2012-002169.

Togher F, O'Cathain A, Phung VH, Turner J, Siriwardena N. What users' value about the emergency ambulance service: a qualitative interview study. Health Expectations, submitted.

Turnbull J, Prichard J, Pope C, Halford S, Salisbury C. Reconfiguring the emergency and urgent care workforce: mixed methods study of skills and the everyday work of non-clinical call-handlers in the NHS. *J Health Serv Res Policy* 2012;17(4):233–240.

Turner J, Snooks H, Youren A, Dixon S, Fall D, Gaze S, et al. The costs and benefits of managing some low-priority 999 ambulance calls by NHS Direct nurse advisers. *Report for the National Co-ordinating Centre for NHS Service Delivery and Organisation R & D (NCCSDO)*. April 2006.

Turner J. Building the evidence base in pre-hospital emergency and urgent care: A review of research evidence and priorities for future research. Department of Health, 2010. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_117194

Walshe C, Ewing G, Griffiths J. Using observation as a data collection method to help understand patient and professional roles and actions in palliative care settings. *Palliat Med* 2012;26(8):1048-54.

Wennburg JE. Time to tackle unwarranted variations in practice. *BMJ* 2011;342:d1429.

Wennberg JE. Unwarranted variations in healthcare delivery: implications for academic medical centres. BMJ 2002;325:961–4