BROADENING RESPONSIBILITIES: CONSIDERATION OF THE POTENTIAL TO BROADEN THE ROLE OF UNIFORMED FIRE SERVICE EMPLOYEES

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Summary

What is this report about?

This report, commissioned by the National Joint Council for Local Authority Fire and Rescue Services (NJC), aims to identify what impact, if any, firefighters can have on the delivery of emergency medical response and wider community health interventions in the UK.

What are the overall conclusions?

Appropriately trained and equipped firefighters co-responding[1] to targeted, specific time-critical medical events, such as cardiac arrest, can improve patient survival rates.

The data also indicate that there is support from fire service staff – and a potential need from members of the public, particularly the elderly, isolated or vulnerable – to expand 'wider work'. This includes winter warmth assessments, Safe and Well checks, community defibrillator training and client referrals when staff believe someone may have dementia, are vulnerable or even, for example, have substance dependencies such as an alcohol addiction. However, there is currently insufficient data to estimate the net benefit of this work.

How did the authors reach these conclusions?

Alongside an analysis of existing data and a rapid evidence review of published literature, the authors carried out extensive first-hand research. This included:

- **A survey** in which 42 of 50 fire and rescue services responded (32 were part of the NJC trial). The survey looked at the number and type of co-responding and wider work incidents that the fire and rescue services attended, as well as resources used, costs and equipment.
- **An economic evaluation** that shows firefighters co-responding to time-critical incidents are associated with a faster response to the scene and therefore, assuming an immediate implementation of appropriate actions, there is the potential for corresponding gains in survival probability and life expectancy, as well as favourable value for money. The economic evaluation concluded that the benefits of firefighters carrying out co-responding are substantially greater than the costs, with a return on investment of between £5.67 and £14.40 per £1 invested.
- **A detailed look at a single county fire and rescue service and ambulance service**. The national response time target for Red 1 and Red 2[2] calls for ambulance services is that 75% should be reached in eight minutes or less (DOH, 2015). However, due to increasing call demand, there has been a steady decline nationally in performance for several years

[1] Co-responding is a scheme whereby appropriately trained and equipped fire and rescue service staff are mobilised to medical emergencies (as agreed with an NHS ambulance service) as part of a joint fire and rescue service and NHS response.

[2] Red 1 calls are the most time critical and cover cardiac arrest patients who are not breathing and do not have a pulse, and other severe conditions. Red 2 calls are serious but less immediately time critical and cover conditions such as stroke and fits.

(Nuffield Trust, 2016). In this sub analysis of 100 cardiac arrests, firefighters achieved an eight-minute (or less) response in 66% of cases, while the ambulance service achieved an eight-minute (or less) response in 24% of cases.

- **An analysis of data from defibrillators** used by a fire and rescue service during cardiac arrests. This revealed the quality of chest compressions and the impact of early interventions, in this case, the delivery of an electric shock to patients in cardiac arrest. Although a small sample, the results showed good rates of return of spontaneous circulation (getting the return of a sustainable heart rhythm with a palpable pulse, and significant respiratory effort) that would match well with international best-in-class systems. A larger trial is needed, but it is likely that co-responding with the fire and rescue services will improve cardiac arrest outcomes.
- **Telephone interviews with 26 different fire and rescue services taking part in the NJC trial.** Participants unanimously agreed that co-responding should continue but that it must not impact (and within the interviewed services so far had not impacted) on 'core business', which was seen unconditionally as firefighting. The interviews revealed there was no standardisation of training, although agreed minimum levels appeared to have been achieved. The biggest concerns highlighted by staff were:
    - The difficulties experienced with relatives following fatalities. Staff sometimes felt unprepared and untrained for this aspect of the work, although some staff were able to respond very well in these circumstances.
    - Being dispatched to inappropriate incidents where they did not have the necessary skills to support the patient.
    - Waiting for an ambulance to arrive and having to provide care they were untrained for.
- Wider work in health was most frequently linked to preventive work, such as Safe and Well checks and prevention and management of slips, trips and falls.

Are there other specific findings?

- International examples demonstrate the effectiveness of using the fire and rescue service for medical response.
- When international cardiac arrest survival rates are compared, the UK ambulance service performs poorly.
- Given that firefighters generally are highly trained for rapid intervention, expanding their role (requiring some additional education and training) to include serious medical emergencies looks likely to be in the public interest.
- The fire and rescue services are able to reach incidents as a whole before ambulance services in 62% of cases based on the trial incident data.
- In time-critical incidents, such as cardiac arrests, they arrive sooner than ambulances in 93% of cases.[3]

[3] It is important to note that these results are not necessarily representative of all jurisdictions, but they are a good indicator of trends.

- In relation to responding to medical emergencies, clinically, at this stage, it is difficult to envisage the fire and rescue services as more than co-responders with a tightly defined boundary of interventions, unless there is considerable upskilling in terms of clinical examination, assessment and treatment provision. In the short term, this reinforces the argument for utilising firefighters to co-respond to specific, targeted patient presentations such as those in cardiac/respiratory arrest.
- Further work needs to be undertaken to establish what areas of wider health work is the most beneficial, both in humanitarian terms as well as cost efficacy.

What does the report recommend?

Recommendations include:

- Support for fire and rescue services to co-respond with ambulance services in targeted cases such as cardiac arrest and potentially other cases that are immediately life-threatening, such as respiratory arrest, convulsions, severe haemorrhage (both traumatic and medical cases) and other patients at high risk.
- Explore the potential to expand the work in Safe and Well checks including work in prevention such as slips, trips and falls; dementia awareness; and other activities.
- Change the fire and rescue service's incident recording system of data collection to use definitions and categories aligned with other databases, allowing more specific and sensitive analysis of patient presentations such as those used by the ambulance service. This would enhance any audit of responses to specific patient conditions, and would facilitate future collaborative research between ambulance services and fire and rescue services.
- Develop some 'exemplar' sites of best practice, where a strong commitment to research and evaluation can help drive the most effective models that positively influence patient care.
- Establish work streams to promote national standards in training and equipment.
- Explore how it might be feasible to speed up fire and rescue service activation.
- Carry out further research to understand the definitive impact on patient outcomes and cost efficacy.
- Collaborate with the NHS to ensure fire and rescue services are integrated with strategic health plans.
- Consider if direct commissioning of fire and rescue services for co-responding and involvement in wider health work is the most appropriate way forward to ensure these activities are fully funded and embedded in appropriate clinical governance structures.

Introduction

In recent years there has been consideration of encouraging a closer working relationship between the blue light services including, for example, the work of the Joint Emergency Services Interoperability Programme (JESIP). More strategically, Sir Ken Knight's 'Facing the Future' review (Knight, 2013) and non-policy related publications such as Ellwood & Phillips (2013) have also been published. Most recently, and since commencing this research, the government in England has implemented a duty for emergency services to collaborate through the Policing and Crime Act 2017. However, prior to this recent legislation, the National Joint Council for Local Authority Fire and Rescue Services (NJC) had already begun trials to develop an agreement on emergency medical response (EMR) as a viable form of collaboration, with substantial potential benefits across the UK. There is a growing consensus and a degree of logic to these ideas that provide for a more expansive role for the fire and rescue service (FRS) in the delivery of health care. There are however, many questions to be answered in any proposed extension of responsibilities, and this evaluation is one important element to aid further consideration of this topic.

It is notable that fire and rescue services have been particularly successful in applying preventive strategies to constrain demand; these approaches are urgently required in the context of ever increasing demand upon the National Health Service (NHS) generally and ambulance services in particular. The evaluation presented here starts what is likely to be part of a long-term effort to determine how fire and rescue services move to supporting the communities they serve through potential growth in their role and in the delivery of a range of health care activities. The potential spectrum of activities ranges from co-responding to cardiac arrest and other immediately life-threatening medical emergencies, where a very speedy response is likely to be an essential prerequisite for survival, through to involvement in preventative health actions, such as community risk assessments. As is often the case in early research, the available data is limited and must be treated with some caution but, as will be demonstrated, there are positive indications that this work is likely to be beneficial at a number of levels. Nevertheless further detailed evaluation will be necessary as the scope of activities increases.

The success of programmes developed by fire and rescue services, through prevention and other societal factors, have resulted, as recognised by a number of national reports, in some 'latent capacity'. To some extent this is likely to be inevitable, in that having a level of resources to meet their intrinsic requirement at a state of high readiness is logical and prudent. Given that fire and rescue services, and firefighters generally, are highly trained and designed for rapid intervention roles, expanding this to include serious medical emergencies would seem to be in the interest of all. Almost daily there are media reports indicating the immense pressure that health services are subject to generally and the Ambulance Service particularly. It is important to note that, while the data demonstrate a rapidly rising quantity of 999 calls to ambulance services, only a small proportion (in the order of 5%) are subsequently found actually to be immediately life-threatening, or serious from a medical point of view. Many others are 'emergent,' in that the patient may have subtle signs of deterioration that

may develop over time: this makes the quality of patient assessment, which would nearly always need to be conducted by a Paramedic or a Doctor, a key consideration. Given this dynamic it would seem sensible to suggest that the well differentiated, life-threatening calls would be a good fit for potential fire and rescue service involvement. Additionally there are many areas in preventive health, reflected in the Safe and Well checks, which appear to align with current fire prevention activities common within all fire and rescue services. It is therefore timely to consider what options may be available and what might be achieved through further 'blue light collaboration,' between fire and ambulance services in particular.

Most countries realised this some time ago and developed arrangements whereby fire service assets can be mobilised rapidly to respond to serious medical emergencies as, currently, they generally have more available capacity than healthcare services to do so. Modern computerised fail-safe technology enables firefighters, police officers and trained members of the public to provide some essential emergency treatment, such as defibrillation (providing a controlled electrical shock to some patients suffering cardiac arrest). Figure 1 demonstrates the impact of early defibrillation using a computerised automatic external defibrillator (AED) of a type generally available in many fire services throughout the world, but which is not yet common practice in the UK.

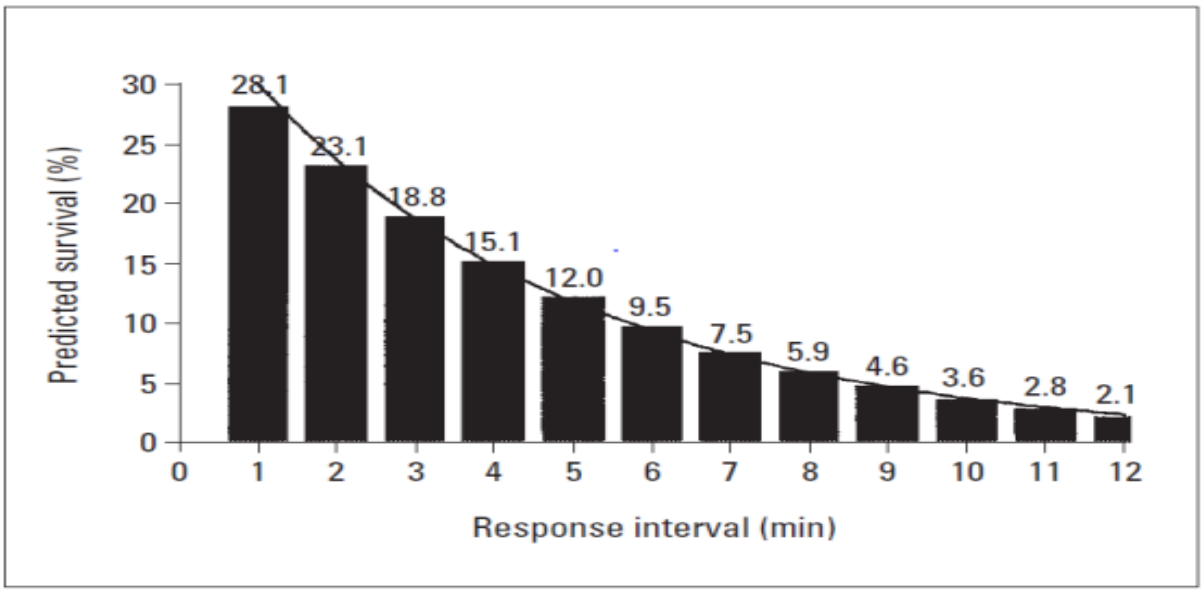

Figure 1: Cardiac arrest survival rates showing an increased probability of patient survival directly correlated in the speed that defibrillation can be effected, the implication being that co-opting fire resources to provide early defibrillation will save lives (De Maio et al., 2003)

When international survival rates are compared, the UK ambulance services perform poorly. This means that survival to hospital discharge from 28,000 out-of-hospital cardiac arrest cases in England has been reported at 8.6% (NHS England, 2014, the British Heart Foundation, NHS England and Resuscitation Council UK, 2014). This is much lower than in other parts of the world. One of the most successful examples worldwide is the Seattle Fire Department and the surrounding 'King County' systems, which demonstrate a survival rate of 20% for all cardiac

arrest rhythms and 50% for those presenting in ventricular fibrillation, for which defibrillation is the treatment of choice and where response times are a key factor in patient survival. This is approximately double the best performing ambulance services in the UK. If applied to the UK, then something in the order of 1,000-2,000 more lives would be saved annually. Indeed, the 1996 Review of Ambulance Performance Standards estimated a similar level of survival could be accomplished if the 8-minute standard was met (NHS Executive, 1996). In the event, a lower level of compliance (set not at a 90% but at a 75% level) for emergency "red" calls remains in force today for both Red 1 and Red 2 calls[4].

With minimal additional emergency care training (in the order of 4-5 days), firefighters can relatively easily be given selective additional skills. Typically, these revolve around emergency airway management, the administration of oxygen (with pertinent education around when it is not safe to use oxygen on a variety of acute medical patient presentations), and execution of other essential first aid actions including the control of external haemorrhage and the initial management of spinal injuries. With further training and governance there may also be the potential to include the administration of pain relieving gases, such as Entonox within their role.

Another example of this working in practice is in Melbourne, (Ambulance Services in Victoria, 2013, Smith & McNeil, 2002 and Bernard, 2009) where fire and ambulance services remain distinct organisations but work closely together with Paramedics receiving basic fire and rescue skills enabling them to support fire crews, and fire crews receiving basic emergency care skills on the pattern outlined above. Research has shown that Melbourne firefighters appreciate the relevance of emergency medical responding and find the work rewarding (Smith, et al 2001). Nevertheless, at present, in the UK these opportunities remain largely unrealised.

Collaboration and integration are likely to be a cornerstone of both fire and ambulance service modernisation in the future. Ambulance services have a budget of something in the order of 2% (£2.2 billion) of the NHS. Closer collaboration might be expected to improve efficiency in the medium to long term. Decisions taken by fire and ambulance Paramedic crews could have a major downstream effect that can influence spending in other parts of the NHS. This can best be appreciated if one considers the financial and, more importantly, the health and wellbeing benefit to patients of being treated effectively at home by a Paramedic with, perhaps, local primary care service support, rather than transport of patients to hospital emergency departments (Mason et al, 2007; Dixon et al, 2009; Snooks et al, 2014 and Bigham et al, 2013). Fire based community intervention programmes would make a contribution to this approach in time.

In summary, emerging data from this research project suggest that, while accepting the limitations of the information available, fire and rescue services have a useful role to play at a number of points across the spectrum of patient need. A key area is 'co-responding' or 'fire

[4] Red 1 calls are the most time critical and cover cardiac arrest patients who are not breathing and do not have a pulse, and other severe conditions. Red 2 calls are serious but less immediately time critical and cover conditions such as stroke and fits.

medical responding', in order to attend patients rapidly and apply early defibrillation where appropriate and to provide first aid. There are also a number of other patient groups where the early application of professional skills increasingly available to firefighters might make a difference to patient outcome, but this hypothesis would need to be tested in further research designed to determine if there is real benefit in this area.

As one moves further down the acuity range to those patients who have no immediate threat to life into the areas of community based care and public health, there are a number of wider work initiatives being promoted within the fire and rescue services, particularly in the guise of Safe and Well checks or assistance to people who have fallen at home or who are at risk of falling. This work also needs further investigation to look in greater detail at the impact upon patient/client outcome. There may well be potential improvements in patient satisfaction alongside improved health outcomes from community based and prevention orientated intervention projects. However, specific research, constructed for the purpose of measuring any effect is needed to resolve remaining ambiguities here. Ensuring that fire and rescue services are able to contribute to both local public health planning, through input to the local joint strategic needs assessments as well as to Strategic Transformation Plans is also likely to be beneficial. Collaboration and role expansion into the 'medical space' is an exciting proposal that will need further evaluation to guide the developments of projects in the future.

This is a time of change for public services. Fire and rescue services are well positioned to future proof their organisations and ensure they continue to make a professional and vital contribution to local communities in the 21st century through evolution and expansion of their roles with possible closer collaborative working with a variety of healthcare agencies.

Background to the evaluation

In 2015 the National Joint Council for Local Authority Fire and Rescue Services (NJC) began consideration of how the workforce's skills could best be utilised, exploring new and additional types of functions and activities. This included co-responding. Co-responding usually involves assistance to people potentially suffering cardiac problems. The ambulance service is mobilised at the same time and will attend the call, however response times have so far suggested that the fire service is more likely to arrive sooner.

The position at that time was that responding to incidents of a medical nature, such as co-responding, was carried out in a number of fire and rescue authorities (FRAs) by employees on a voluntary basis rather than as part of the core job. It was also recognised that not all ambulance trusts wished to take part.

Expressions of interest to undertake a trial under the auspices of the NJC in terms of co-responding were invited from fire and rescue authorities. This included co-responding but also work wider than co-responding that would be of value to the community and which, in some cases, would build upon collaborative working with other organisations. Some examples of wider work being carried out in the NJC trials are:

- Slips, trips and falls
- Bariatric assistance
- Winter warmth assessments
- Heartstart advice
- Dementia awareness
- Alcohol harm and reduction advice
- Smoking cessation advice
- Loneliness and isolation advice
- Safe and Well checks (including Winter Warmth Checks)
- Holistic safety visits in the home
- Fitting of risk reduction equipment
- Providing assistance to the elderly and frail
- Gaining entrance on behalf of ambulance services.

Research question

The research question identified at the outset of this project was: what impact, if any, can firefighters have on the delivery of emergency medical response (e.g. co-responding) and wider community interventions (e.g. dementia awareness) within communities across the UK?

Aim

The aim of this project was to examine the effect, if any, that the fire and rescue services are having on service provision and delivery within the NJC approved trials in the United Kingdom; plus, where feasible within the timescale and if data are available, the effects of any work that is being undertaken more widely within other fire and rescue services.

Definitions

For the purposes of this project, the following definitions were used, as operated by the NJC.

Co-responding: this is a scheme whereby appropriately trained and equipped fire and rescue service (FRS) staff are mobilised to medical emergencies (as agreed with an NHS ambulance service) as part of a joint fire and rescue service and national Health Service response. Co-responding is similar to first responders except the co-responders in this context are employed by a fire and rescue authority which has entered into an agreement with an NHS ambulance service to deliver basic life support until the arrival of the ambulance service who can provide advanced life support[5].

Wider work: this encompasses all new work broadly described as being of benefit to the community. Examples are: working with the elderly in respect of slips, trips and falls; assistance in the movement of bariatric patients; appropriate referrals as a consequence of dementia awareness training or alcohol addiction awareness training; provision of training to the community, for example, in the use of defibrillators and/or fitness training; winter warmth assessments; and Safe and Well checks.

Structure of the report

This report is structured into three main sections reflecting the core activities within this evaluation involving collection and analysis of primary data as well as utilisation of existing data and/or published literature in both policy and research.

1. Examination of results from five research-streams:
    a. Research-stream A: Aggregate survey
    b. Research-stream B: Health economic evaluation
    c. Research-stream C: Case study - interrogation of existing data from one single county fire and rescue service and its corresponding ambulance service
    d. Research-stream D: Cardiac arrest download data
    e. Research-stream E: Qualitative telephone interviews
2. Overall summary and conclusions

[5] For the avoidance of doubt first responding is the first person on scene who has been trained on an appropriate and approved course. First responders can be members of the public who volunteer for the role which in turn is organised, coordinated and managed by an NHS ambulance service.

3. Recommendations.

A summary of relevant published literature including both policy context and a rapid evidence review of health related research findings has been included in Appendix 1.

Research-stream A: Aggregate survey

This section represents the results of an aggregated survey in which 42 (84%) of 50 fire and rescue services took part. Results and discussion have been integrated in order to avoid unnecessary repetition.

Amongst the fire and rescue services who responded to the survey, 32 participated in the NJC trial. It is noted that one fire and rescue service did not co-respond to incidents but did conduct some wider work. Ten fire and rescue services did not take part in the official NJC trial, however eight of them did conduct some co-responding work and all of them participated in wider work. Furthermore, one non-trial fire and rescue service did not submit complete data, which is reflected in the results. The data presented below are for all the fire and rescue services that responded, whether or not they had taken part in the trial.

Fire and rescue services started their trials at different times and this is demonstrated in Figure 2 showing a steady increased participation throughout the duration of the trial.

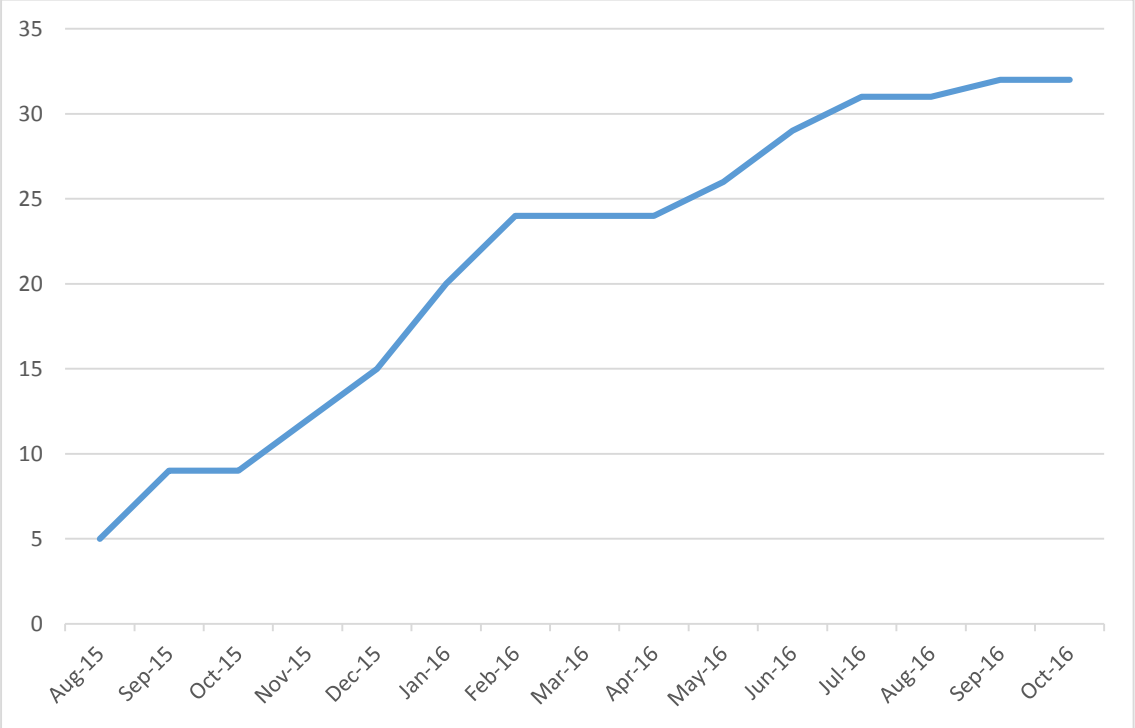

Figure 2: Number of fire and rescue services participating by date
Base: all trial fire and rescue services (32)

Number and responses to co-responding incidents

The number of incidents attended by NJC trial authorities and non-NJC trial authorities was recorded during the evaluation period. Table 1 represents 27 out of the 32 trial authorities and seven out of 10 non-trial authorities who provided data detailing the total number of incidents,

the total number of incidents recorded by those stations/crews available for co-responding, and the total number of co-responding incidents. Co-responding incidents added 28% to the volume of incidents attended by those stations/crews available for co-responding.

Table 1: Reported number of incidents by fire and rescue services including the number of co-responding incidents.

	Number of incidents reported by trial FRS	Number of incidents reported by non-trial FRS	Total
Total number of incidents recorded in the period for the whole FRS (include all incidents not just co-responding/wider work incidents)	487,797	54,718	542,515
Total number of incidents recorded by those stations/crews available for co-responding (include all incidents not just co-responding/wider work incidents)	177,991	20,001	197,992
Total number of co-responding incidents attended in the period by those stations/crews available for co-responding	29,723	13,022	42,745

Table 2 details the number of co-responding incidents attended by firefighters during the evaluation period. Only the data from the fire and rescue authorities providing information pertaining to all three elements have been included: 28 out of the 32 trial authorities, and five out of 10 non-trial authorities.

Table 2: Number of incidents attended by whole-time, retained duty system and mixed crew firefighters

	Number of incidents reported by trial FRS	Number of incidents reported by non-trial FRS	Total
Number of co-responding incidents attended by whole-time firefighters	12,311	337	12,648
Number of co-responding incidents attended by retained duty system firefighters	12,563	12,570	25,133
Number of co-responding incidents attended by mixed crews	480	220	700
Total	25,354	13,127	38,481

Overall, 65% of the co-responding incidents were attended by retained duty system firefighters. Whole-time firefighters and mixed crews accounted for 32% and 2% respectively. For trial authorities, the number of co-responding incidents were mainly attended by retained duty system firefighters and whole-time firefighters. However, 96% of incidents by non-trial authorities were attended by retained duty system firefighters.

Thirty-three per cent of the co-responding incidents were attended by whole-time firefighters, 65% were attended by retained duty system firefighters and 2% by mixed crews during the evaluation period.

For the first on scene data, analysis only includes complete reported cases in order to avoid distortion of results. Overall, the fire and rescue service were first on scene most of the time (62%) in contrast with the ambulance service (23%) (Figure 3).

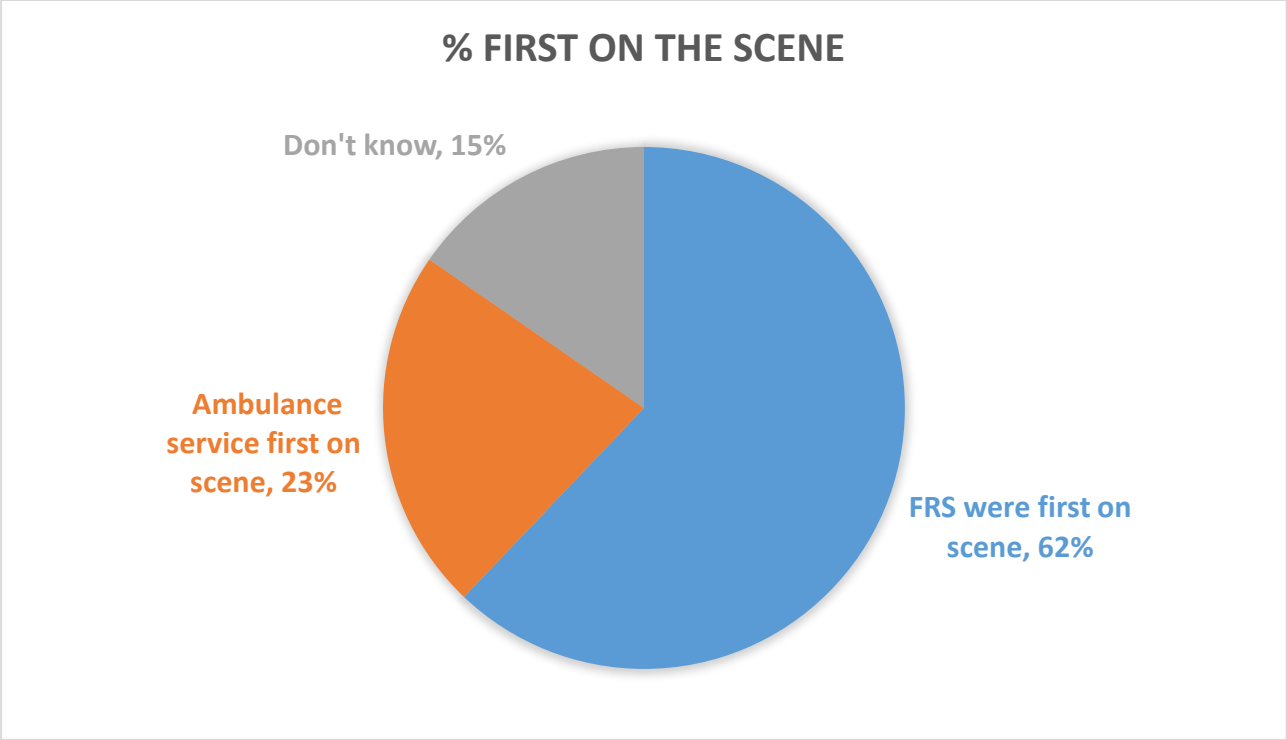

Figure 3: Arrival on scene: fire and rescue services and ambulance services
Base: fire and rescue services which provided complete responses (29)

However, as reported in the rapid evidence assessment (Lerner et al, 2009), being first on scene does not necessarily correlate with appropriate and effective interventions being delivered more quickly. It should be noted that the data from the defibrillator downloads (n=17), albeit a small number, indicates that appropriately trained firefighters are able to deliver effective interventions in terms of chest compressions and defibrillation when arriving first on scene at cardiac arrests (page 47).

Types of co-responding incidents

The types of co-responding incidents/activities among the fire and rescue service responded to as part of NJC trial are shown in Figure 4.

The reported categories are a subset of incidents taken from 'Incident Recording System' and for future research, consideration should be given to modifying this data collection tool to improve the nature of the collected information surrounding the specific triage categories.

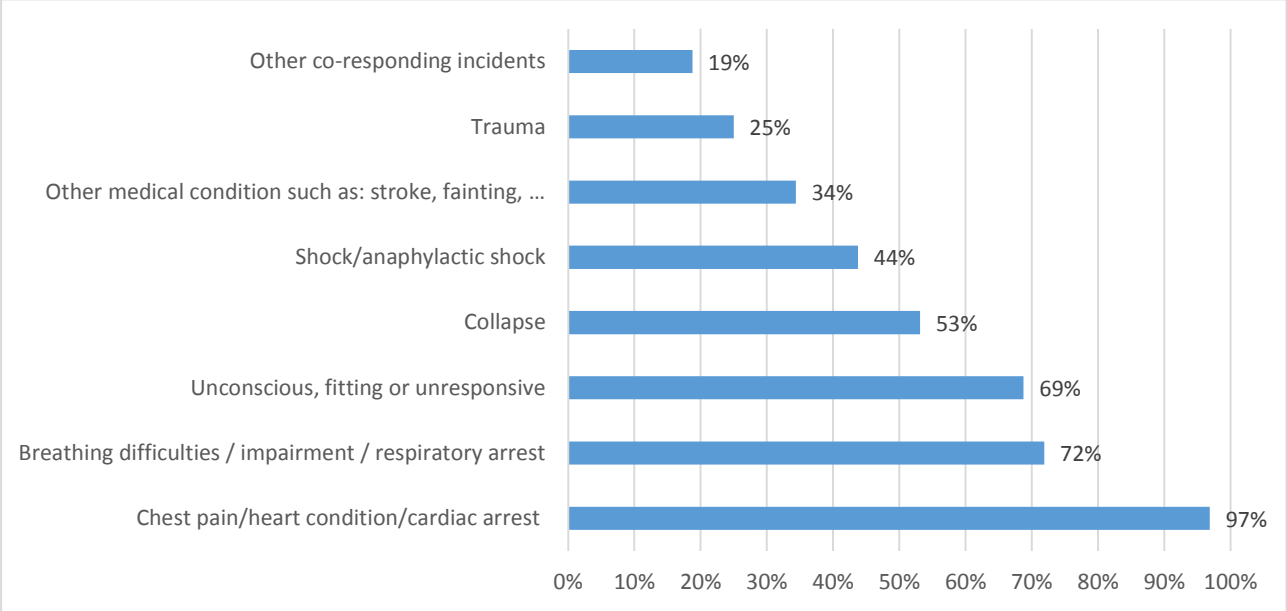

Figure 4: Type of co-responding incidents among the fire and rescue services participating in the NJC trial
Base: all responding fire and rescue services (32)

All except one (97%) fire and rescue service participating in the NJC trial did co-respond to chest pain, heart condition and cardiac arrest incidents. The majority of the trial fire and rescue service authorities participating responded to breathing, impairment and respiratory arrest incidents (72%), unconscious or fitting casualties (69%) and collapse incidents (53%).

Eight of the ten non-trial fire and rescue service authorities, and seven out of the 32 trial fire and rescue service authorities did co-respond outside of the NJC trial. The types of co-responding incidents/activities undertaken outside of the NJC trial are shown in Figure 5.

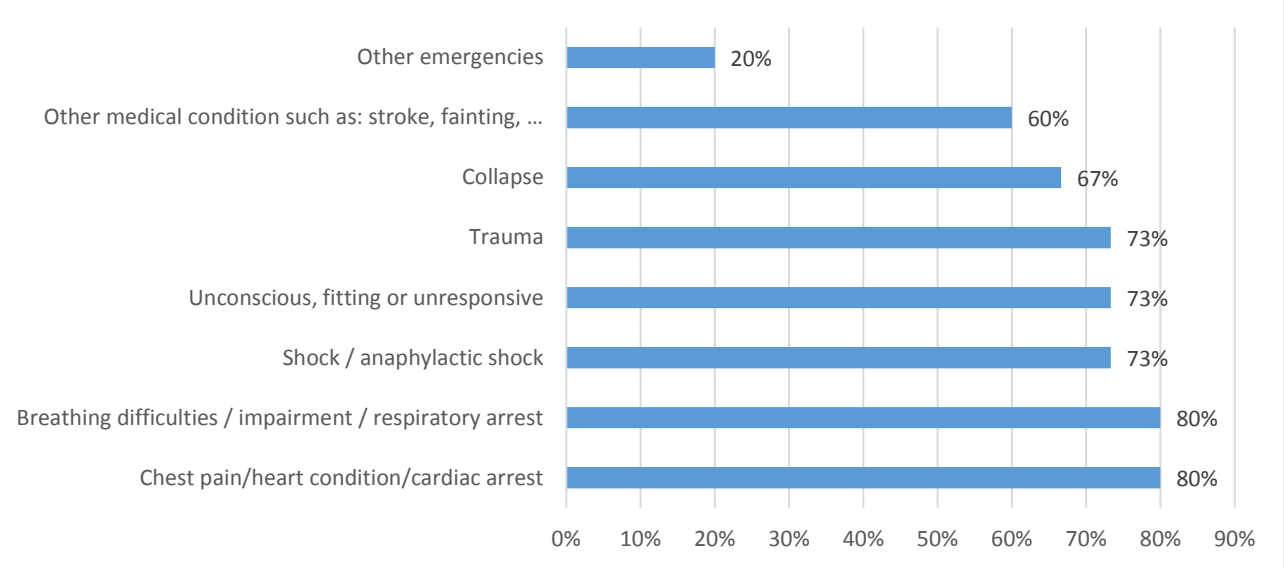

Figure 5: Types of co-responding incidents attended by fire and rescue services outside of the NJC trial
Base: all responding fire and rescue services outside the trial (15)

The two most common types of the co-responding incidents outside the trial are chest pain/heart condition/cardiac arrest and breathing difficulties / impairment / respiratory arrest for 80 % of the responding fire and rescue services.

Based on the feedback from the interim report, efforts were made by the fire and rescue service to provide more details about the incidents; however less than half were able to provide the specific triage categories used by the ambulance service. The numbers of co-responding incidents during the evaluation period for different categories of cause of death/nature of injury is presented in Table 3.

Table 3: Cause of death or nature of injury

Cause of death or nature of injury	Number of co-responding incidents	Number of fire and rescue services involved
Chest pain/heart condition/cardiac arrest	10,360	35
Not known	9,461	24
Breathing difficulties / impairment / respiratory arrest	4,631	34
Unconscious, fitting or unresponsive	3,159	35
No action required	2,761	29
Other medical condition such as: stroke, choking …	2,241	33
Collapse	921	32
Shock/anaphylactic shock	192	33

The main category of co-responding incidents (31%) was related to chest pain/heart condition/cardiac arrest. For 43% of those incidents, the triage was expanded into two categories where 93% corresponded specifically to 'Cardiac arrest' (n=4180) and 7% to 'Chest pain' (n=314).

The initial triage categories determined by the ambulance service were often not passed on or recorded in that format by the fire and rescue service, and so the available data mixes the 'perceived' nature of the emergency, for example 'chest pain or cardiac arrest,' with less well defined conditions and also with some assessment as to the actions required. Future research will need to explore the triage categories more comprehensively and, where possible, will also need to follow up patient outcomes, while considering the 'rules of engagement,' i.e.' the detailed criterion adopted for fire medical responding/co-responding in the difference schemes. It should be noted that no triage system can ever be 100% reliable, particularly at an early stage in the information gathering process, and as a result some level of 'over triage' to patients whose initial symptoms do not translate to a medical emergency will always be inevitable. There needs to be common understanding of what respondents meant by 'no action required' as it may simply be that there was no requirement for any action due to over triage; or possibly there was a very short period of time between the fire service arriving on scene and the ambulance service arriving and therefore the fire service did not need to take any action. Additional data would be required to investigate this further.

Wider work incidents

Thirteen out of 32 of the trial fire and rescue services were involved in wider work activities. Table 4 shows the types of wider work activities (that is, those over and above normal fire and rescue activities, but excluding co-responding) undertaken by fire and rescue services.

Table 4: Types of wider work activities undertaken by fire and rescue services participating in the trial

Wider work activities	**Number of trial FRS authorities**
Slips, trips and falls	7
Smoking cessation advice	5
Safe and Well Checks	5
Fitting of risk reduction equipment	5
Dementia Awareness	4
Alcohol harm and reduction advice	4
Winter warmth assessments	3
Heartstart advice	3
Loneliness and isolation advice	3
Holistic safety visits in the home	3
Providing assistance to the elderly and frail	3
Gaining entry on behalf of ambulance services	3
Bariatric assistance	2

Base: all fire and rescue services participating in the trial and performing wider work activities (13)

It is noted that 31 fire and rescue services carried out wider work activities outside the NJC trial: nine of the non-trial authorities, and 22 of the trial authorities.

Table 5 details the types of wider work activities undertaken by fire and rescue services responding outside the NJC trial.

Table 5: Types of wider work activities undertaken by the fire and rescue services responding outside the NJC trial

Wider work activities	Number of trial FRS authorities	Number of non-trial FRS authorities	Total
Bariatric assistance	19	6	25
Fitting of risk reduction equipment	15	6	21
Holistic safety visits in the home	14	4	18
Gaining entry on behalf of ambulance services	14	4	18
Safe and Well Checks	11	6	17
Dementia Awareness	9	4	13
Slips, trips and falls	7	3	10
Heartstart advice	6	4	10
Providing assistance to the elderly and frail	8	2	10
Winter warmth assessments	8	1	9
Alcohol harm and reduction advice	9	0	9
Smoking cessation advice	9	0	9
Loneliness and isolation advice	5	1	6

In comparison with the wider work activities undertaken as part of the NJC trial, there was a notably larger number of fire and rescue services undertaking wider work activities outside the trial (although some of those services were still operating co-responding within the trial). Table 6 illustrates the differences in volume of services participating in wider work.

Table 6: Number of fire and rescue services undertaking wider work 'as part of the trial' versus 'outside of the trial'

Wider work activities	Number of fire and rescue services undertaking wider work as part of the trial	Number of fire and rescue services undertaking wider work outside the trial
Bariatric assistance	2	19
Gaining entry on behalf of ambulance services	3	14
Holistic safety visits in the home	3	14
Fitting of risk reduction equipment	5	15
Safe and Well Checks	5	11
Alcohol harm and reduction advice	4	9
Dementia Awareness	4	9
Providing assistance to the elderly and frail	3	8
Winter warmth assessments	3	8
Smoking cessation advice	5	9
Heartstart advice	3	6
Loneliness and isolation advice	3	5
Slips, trips and falls	7	7

Notably bariatric assistance is the activity which varies the most, with 17 fewer authorities undertaking this wider work activity as part of the trial.

During the evaluation period, a total of 218,679 wider work incidents were covered by the fire and rescue services (Table 7). It was noted that over half (53%) of the wider work involved safety visits at home. This is in line with published research studies discussed in the rapid evidence assessment (Appendix 1), which identified an emphasis on falls prevention, safety assessment in homes for fire hazards and other health conditions including such diverse chronic conditions such as dementia (Laybourne, Martin, Whiting, & Lowton, 2011).

Table 7: Number of wider work activities undertaken by the fire and rescue services during the evaluation period

Wider work activities	Number of reported incidents
Holistic safety visits in the home	114,872
Safe and Well Checks	64,268
Home safety assessments	29,229
Gaining entry on behalf of the ambulance service	4,195
Slips, trips and falls	2,572
Heartstart advice	1,676
Other: assist other agencies	1,174
Bariatric assistance	368
Winter warmth assessments	220
Fitting of risk reduction equipment	75
Dementia Awareness	20
Smoking cessation advice	8
Loneliness and isolation advice	2
Alcohol harm and reduction advice	0
Providing assistance to the elderly and frail	0
Total	**218,679**

The second most frequently undertaken type of wider work activity was safe and well checks including winter warmth checks (29%).

Implications of wider role of fire and rescue services

Only thirteen out of 32 trial fire and rescue services were involved in wider work activities. And of these, seven (22%) took part in activities to prevent slips, trips and falls. Evidence suggests that hip fractures carry a substantial cost both personally and economically. As patients' age, decreasing bone mass, functional decline and drug interactions raise the potential for accidental slips, trips and falls (Carpintero et al., 2014). Ninety per cent of hip fractures occur in people over the age of 65: this represents 25% of all geriatric fractures. Despite improvements in care, subsequent mortality and morbidity is still high.

It is estimated that between 30-60% of community dwelling adults fall each year (Morrison, Chassin, & Siu, 1998). Moreover 90% of hip fractures occur from a simple fall from standing height. Poor lighting and other issues within the elderly person's environment compound the problem; an issue further exacerbated by low socioeconomic status, smoking, increased alcohol intake and dementia (Carpintero et al., 2014).

Studies suggest post-operative mortality from hip fractures at between 14 and 36% in patients 65 and older (Panula et al., 2011). One half of hip fracture patients will never fully regain independent living, requiring costly home care and support (NICE, 2011).

Currently there are approximately 70,000 hip fractures each year in the UK, costing £2 billion each year. The incidence is expected to rise to 101,000 by 2020 (NICE, 2011). Clearly a multi-

disciplinary approach to reducing the risk of falls is likely to impact in this area with considerable economic and individual benefit; the fire service has an important role to play here.

Involvement in wider works appears in line with published research studies that have been discussed in the literature review which identified an emphasis on falls prevention, safety assessment in homes for fire hazards and other health conditions including such diverse chronic conditions such as dementia.

There are clearly wider roles in health and well-being apart from the high acuity calls that the fire and rescue services could be further involved in. It is frequently more difficult in chronic conditions to assess efficacy or impact on patient outcome without using some qualitative assessments such as quality of life measures. The diversity of activities demonstrated in Table 7 leads to the conclusion that fire and rescue services should determine at a local level what roles to undertake, based on knowledge of local communities' health and social care needs.

Available resources

The fire and rescue services which were co-responding and who replied to the survey covered 511 whole-time fire stations, 843 retained duty system fire stations, and 192 mixed crew fire stations. However, not all of their stations and staff were actively involved in co-responding activities. Of their fire stations, 105 (21%) whole-time fire stations, 216 (26%) retained duty fire stations and 83 (43%) mixed fire stations were available for co-responding. This amounted to 26% of stations overall.

Similarly, not all of their operational appliances were involved: 368 out of 2,061 pumps (18%) and two of the 92 aerials were available (2%) for co-responding. Furthermore 50 out of the 569 special appliances (9%) and 165 of the 444 other operational appliances (37%) were also available. This equated to 19% of operational appliances being available for co-responding.

Finally, in terms of numbers of firefighters, 4,220 whole-time firefighters, 2,051 retained firefighters, and 250 control firefighters were assigned to co-responding representing 19%, 19% and 22% of the workforce respectively (and 19% of the workforce overall). Limitations in the data do not allow any clear comparison between the different models of service delivery adopted by whole-time and retained duty systems and this area would benefit from further clarification. For example, some fire and rescue services mobilise firefighters from their stations using their standard appliances, while others utilise 'solo' officer responders. Equally, models may differ when using retained duty personnel. Resolving which arrangements are more effective at reducing the interval between a unit being tasked and arriving at scene is of significant importance in helping to determine the potential contribution to improving patient outcomes; as is understanding whether the number of personnel being tasked affects the outcome.

Figure 6 represents the proportions of the different resources allocated to co-responding in fire and rescue services.

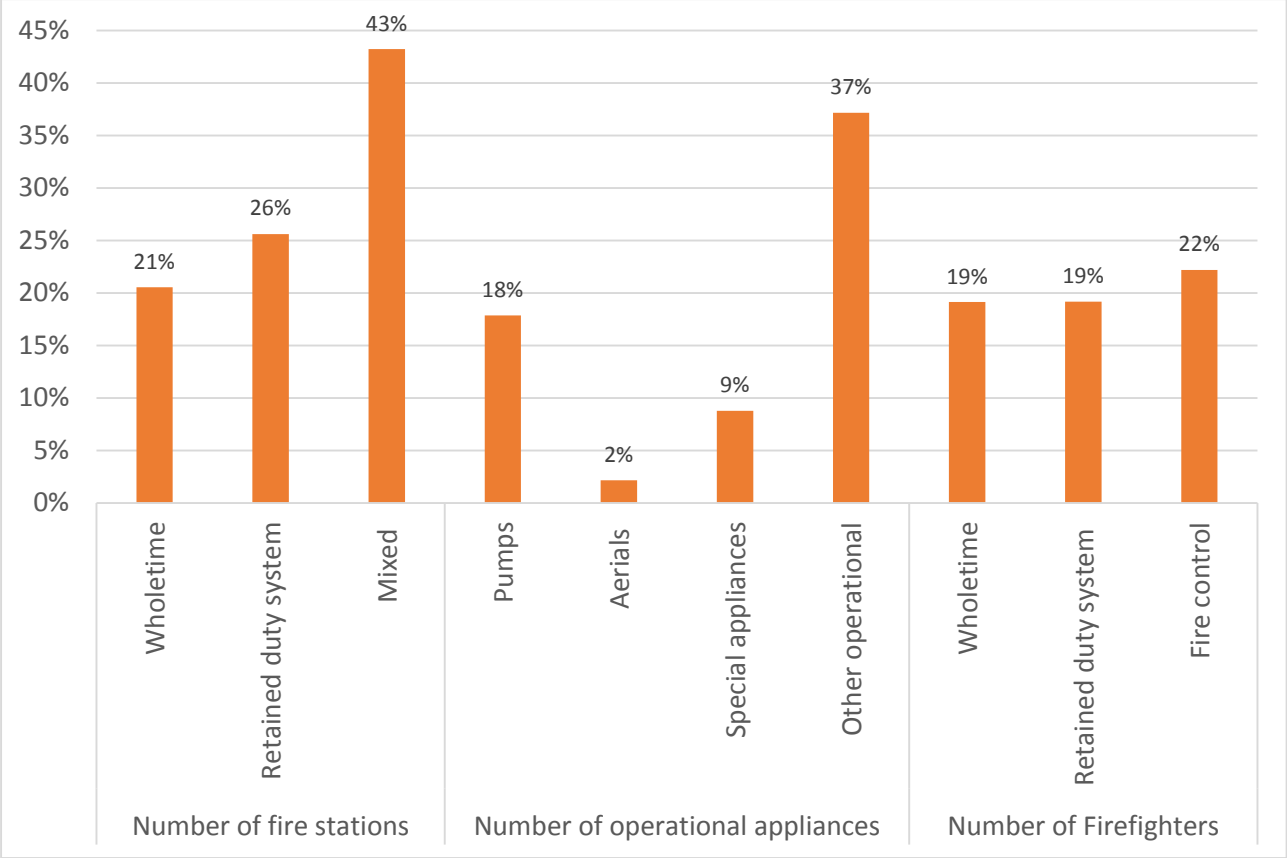

Figure 6: Allocation of resources in fire and rescue services to support co-responding activities

Call classification used between the fire service and the ambulance service

All except one fire and rescue service participating in the NJC trial responded to Red 1 calls (98%); 18 out of the 32 (56%) responded to Red 2 calls; and one of them responded to other calls during the NJC trial period. Outside the NJC trial, 13 out of 15 (87%) fire and rescue services responded to Red 1 calls, 11 (73%) responded to Red 2 calls and eight (53%) responded to other calls.

Equipment and personnel costs

The survey included questions on the costs associated with participating in co-responding, including equipment purchases, retained duty payments, overtime costs, and training. However, not all services reported costs, whilst others simply noted that their costs had been covered from other sources. It was not possible to determine whether the services not responding to this question had zero costs or simply chose not to respond. For the services that did report costs, it was not possible to determine the quantities of equipment or other items covered by the costs so there was no scope to standardize across services. Given the number of the non-reporting services, and the highly variable costs amongst those that did, Table 8 needs to be interpreted with caution. However, as the categories themselves may be informative in understanding the potential scope of costs we have included them below:

- Vehicle-associated cost (e.g. conversion, blue lights, maintenance, stickers, fuel)
- Vehicles
- Defibrillators (including pads)

- Handling equipment including lifting equipment
- Medical equipment including pulse oximeter, clinical bags, iGels, first aid kits
- Clothing (including protective clothing, uniforms)
- IT equipment
- Training equipment (including manikins)
- Communication equipment
- Other equipment
- Medical training including co-responder training, trauma course, FPOS course
- Backfill cost
- Driver training
- Radio communication training
- Trauma Risk Management training and Distress & Crisis management Training
- Catering
- Vaccinations
- DBS checks
- Medical consumables
- Cost of mileage and staffing time for all incidents
- Vehicle Costs
- Marketing cost
- Post-traumatic stress critical incident debriefing
- Travel

Five fire and rescue services reported that their equipment costs were covered by other sources. Nine fire and rescue services did not input any equipment costs. For the remaining 28 fire and rescue services Table 8 illustrates estimated costs incurred during the evaluation period.

Table 8: Estimated summary of costs and expenses incurred during the trial period

Cost	Amount	Number of FRS
Vehicle-associated cost (e.g. conversion, blue lights, maintenance, stickers, fuel)	£585,772	11
Vehicles	£423,000	4
Defibrillators (including pads)	£230,701	9
Handling equipment including lifting equipment	£145,145	3
Medical equipment including pulse oximeter, clinical bags, iGels, first aid kits	£64,984	19
Clothing (including protective clothing, uniforms)	£64,569	21
IT equipment	£48,038	6
Training equipment (including manikins)	£44,570	9
Communication equipment	£19,595	4
Other equipment	£2,649	6
Total	**£1,629,023**	

Average cost of attending incidents

Seventeen per cent of the fire and rescue services doing co-responding reported an average cost across all incident types (co-responding and usual fire and rescue incidents). For all incident types, the cost of all vehicles per co-responding incident including the employee costs was on average £181. The cost of the pumps per co-responding incident including the employee costs was on average £324. The cost of other vehicles per co-responding incident including the employee costs was on average £142.

Twenty-four per cent of the co-responding fire and rescue services reported an average specifically for co-responding incidents. The cost of all vehicles per co-responding incident including the employee costs was on average £169 and £100 excluding the employee costs. The cost of the pumps per co-responding incident including the employee costs was on average £264 and £40 excluding the employee costs. The cost of other vehicles per co-responding incident including the employee costs was on average £52.

Summary conclusion

The data from the aggregate survey have provided relevant stand-alone information about work and activities both within and outside the NJC trial, as well as informing development of the health economic analysis presented in the following section.

During the evaluation period firefighters co-responded to over 10,000 chest pain/heart condition/cardiac arrest incidents over this period representing 31% of all the co-responding incidents.

Overall, the fire and rescue services manage to get to 62% of all calls before the ambulance services which is notable in relation to the role of fire and rescue services in supporting ambulance services to manage time-critical high acuity calls.

Research-stream B: Health Economic Evaluation

The objective of the economic evaluation was to test whether fire and rescue service co-responding was associated with faster arrival at the scene for patients in cardiac arrest relative to ambulance response alone. Faster arrival on scene with appropriate action has been shown to improve the chance of patient survival and a normal life expectancy.

Data preparation

The analysis was based on two data sets: NJC incident data for services participating in co-responding (N=33,959, covering 25 fire and rescue services), and a paired sample of ambulance and fire and rescue service co-responding records from one county over the period October 2015 through October 2016 (N=1,293).

As detailed in Table 9 below there were a substantial number of missing records in the NJC dataset, most notably in the times the fire and rescue service and the ambulance arrived on-scene.

Table 9: Key fields in the NJC dataset

Field	**# valid**	**# invalid/missing**	**% invalid/missing**
Date/time of call	33,926	33	< 0.1%
Time at scene	22,165	11,794	34.7%
Incident stop time	26,509	7,450	21.9%
Incident closed time	27,669	6,290	18.5%
Time ambulance at scene	1,500	32,459	95.6%
Incident date ≥ 01/01/2015	33,089	35	< 0.1%
Call time < on-scene time	33,095	29	< 0.1%

Note that valid and invalid records in this table are calculated for the full dataset (N=33,959), before any exclusions are applied.

After excluding records that were missing the date/time of call, had an incident date prior to 2015, or an on-scene time prior to the call time (negative response time), we were left with 21,878 records covering 15 fire and rescue services. It was also discovered that one fire and rescue service's data system was incorrectly recording response times and so we had to exclude all their records. This reduced the number of records to 12,924 records and 14 services. We also found some extreme outliers in response times that were skewing the results so we excluded records that had a response time which was greater the 99.9th percentile of all response times (≥ 817.94 minutes, 13.6 hours). This left 12,911 records covering 14 fire and rescue services.

The time the ambulance arrived on scene was missing in 96% of NJC incident records. Where it was reported, the ambulance response times ranged from a minimum of -26 minutes to a maximum of 2,643 hours (110 days). Because of very extreme response times like this, the average ambulance response time was unrealistically large: 4,996 minutes or 83 hours. Ten per cent of the ambulance response times were greater 417 minutes (7 hours) and five per cent were greater than 134,446 minutes (93 days). Since none of these extreme times seemed realistic we made the decision to only compare ambulance response times of 60 minutes or less (N=1,371). Among these records, the average ambulance response time was 16.53 minutes.

The paired single county data was similar to the NJC incident dataset and included information on the date/time of call, the time the first responder arrived on-scene and the time the ambulance service arrived on-scene. The first service to arrive is not specified, but ambulance times greater than the first on-scene time indicate that the fire and rescue service arrived first. When the ambulance time is equal to the first service on-scene, it indicates that the ambulance arrived first. The absence of individual arrival times for the ambulance and the fire and rescue service does not limit the analysis, as the objective of the analysis was to test the value of faster fire and rescue service arrival on-scene; when the ambulance arrives on-scene first there was, by definition, no benefit in fire and rescue service co-responding.

The key fields in the paired single county co-responding dataset are detailed in Table 10.

Table 10: Key fields in the paired single county co-responding dataset

Field	**# valid**	**# invalid/missing**	**% invalid/missing**
Date/time of call	1,293	0	0
Time first responder at scene	1,293	0	0
Time ambulance at scene	1,288	5	0.3%
Call time ≤ on-scene time	1,293	0	0

The distribution of response times was tighter than observed in the NJC incident data. The first service on scene arrived within 8.95 minutes in half of all incidents and the mean response time was 9.88 minutes. Including cases where ambulance was first on scene, they arrived within 15.88 minutes in half of all incidents and the mean time was 19.40 minutes. As there were no extreme outliers in the data it was decided to include all records in the analysis.

Response times by service

The first step in the analysis was to test whether fire and rescue service co-responding was associated with faster times to scene than ambulance alone. This analysis was limited to 'time critical' calls, defined in the NJC incident dataset as calls with an NJC or IRS category code with "cardiac arrest" or "respiratory arrest", and in the paired single county dataset as "Red 1" calls. By definition, there is little or no survival advantage associated with co-responding to non-critical calls.

In absolute terms, the fire and rescue service was first on-scene in 93% of time-critical incidents (life threatening) in the NJC incident data. In the paired single county data, the fire and rescue service was first on-scene in all Red-1 incidents. The ambulance service was on-scene within 1 minute of the first on-scene in 17% of incidents. The distribution of time-critical response times from the NJC incident and the paired single county datasets are shown in Figure 7. The left-hand panel shows the distribution of fire and rescue service and ambulance response times up to 60 minutes from the NJC dataset. The average fire and rescue service response time was 8.67 minutes and the average ambulance response time (conditional on ≤ 60 minutes) was 17.54 minutes, a difference of 8.86 minutes.

The right-hand panel shows the distribution of response times of the first service on-scene (including the ambulance service) and the ambulance-only response times for Red 1 calls from the paired single county dataset. The average response times were 9.01 and 13.66 minutes, respectively, a difference of 4.65 minutes.

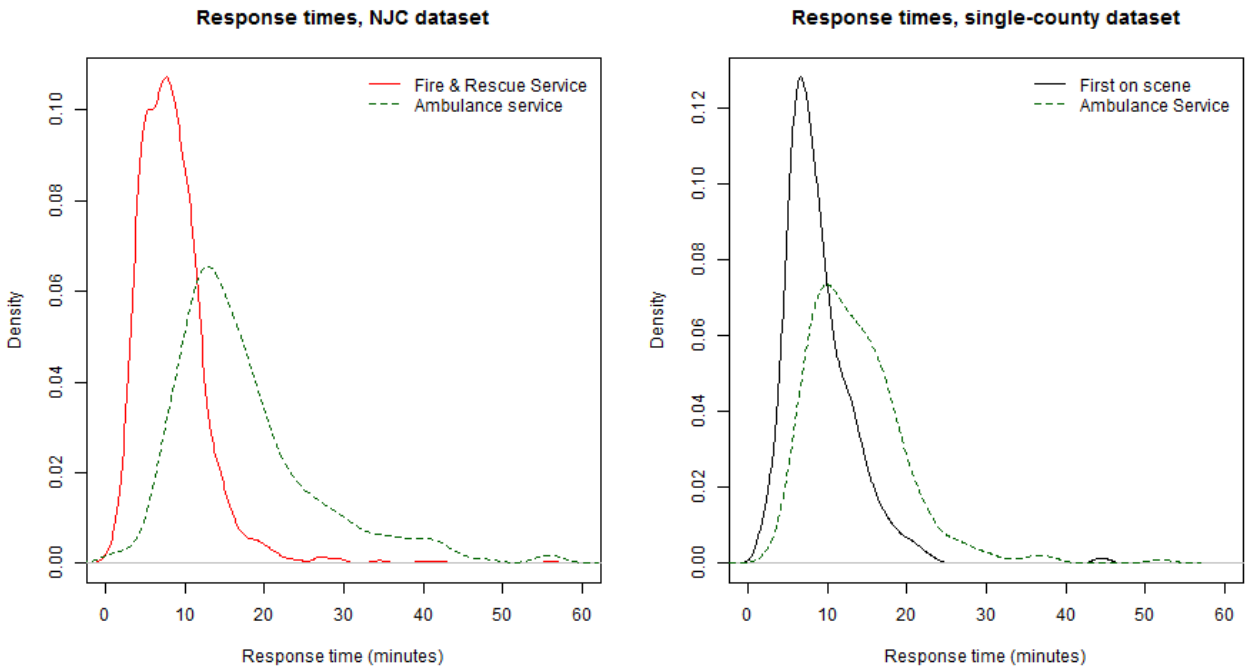

Figure 7: Response times to 'time critical' incidents, by service and data source

The scatterplots in Figure 8 show paired fire and rescue service and ambulance response times. Read across the bottom axis to see the fire and rescue service response time and then vertically to see the distribution of ambulance response times for that particular fire and rescue service time. There is no clear relationship between fire and rescue service and ambulance response times, but most ambulance response times lie above the diagonal line, indicating that ambulance response times were usually greater than fire and rescue service response times.

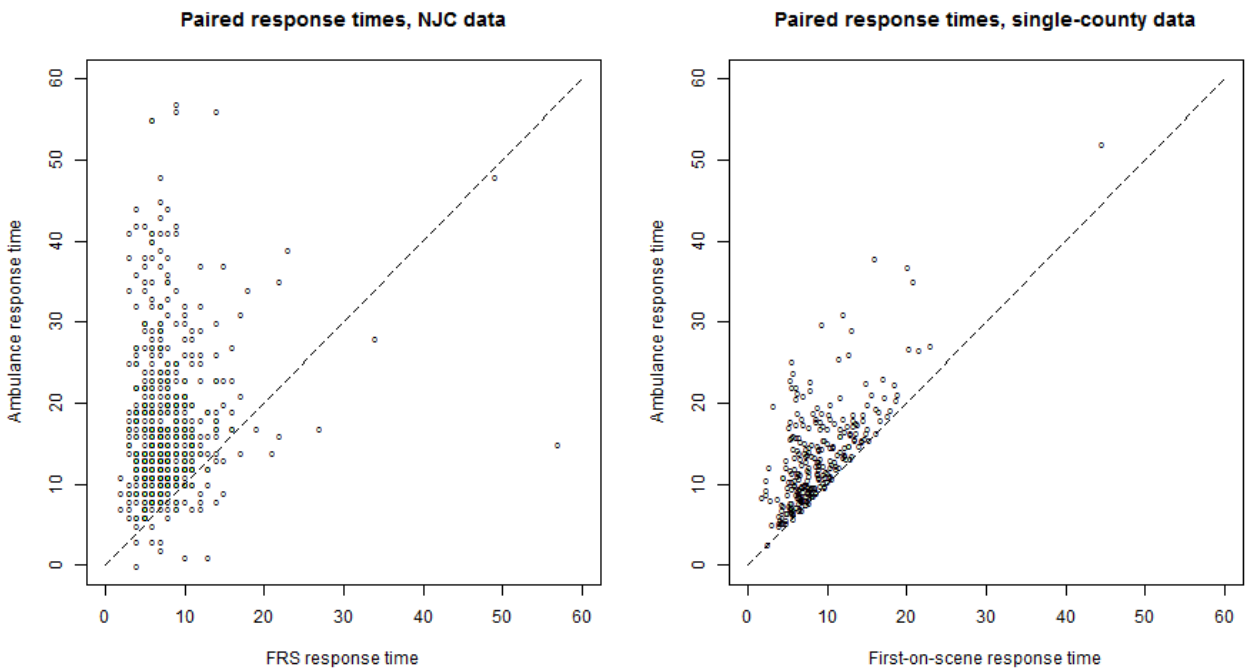

Figure 8: Paired response times to 'time critical' incidents, by data source

We further explored the NJC incident data by linking fire and rescue service response times from the NJC incident data with the proportion of retained duty stations from the aggregate survey. It was our expectation that services with a higher proportion of retained duty stations would have longer response times, but Figure 9 below shows little association between the proportion of whole-time stations and median response times. Note that not all services in the NJC incident data were represented in the aggregate survey, so not all services are presented in the figure.

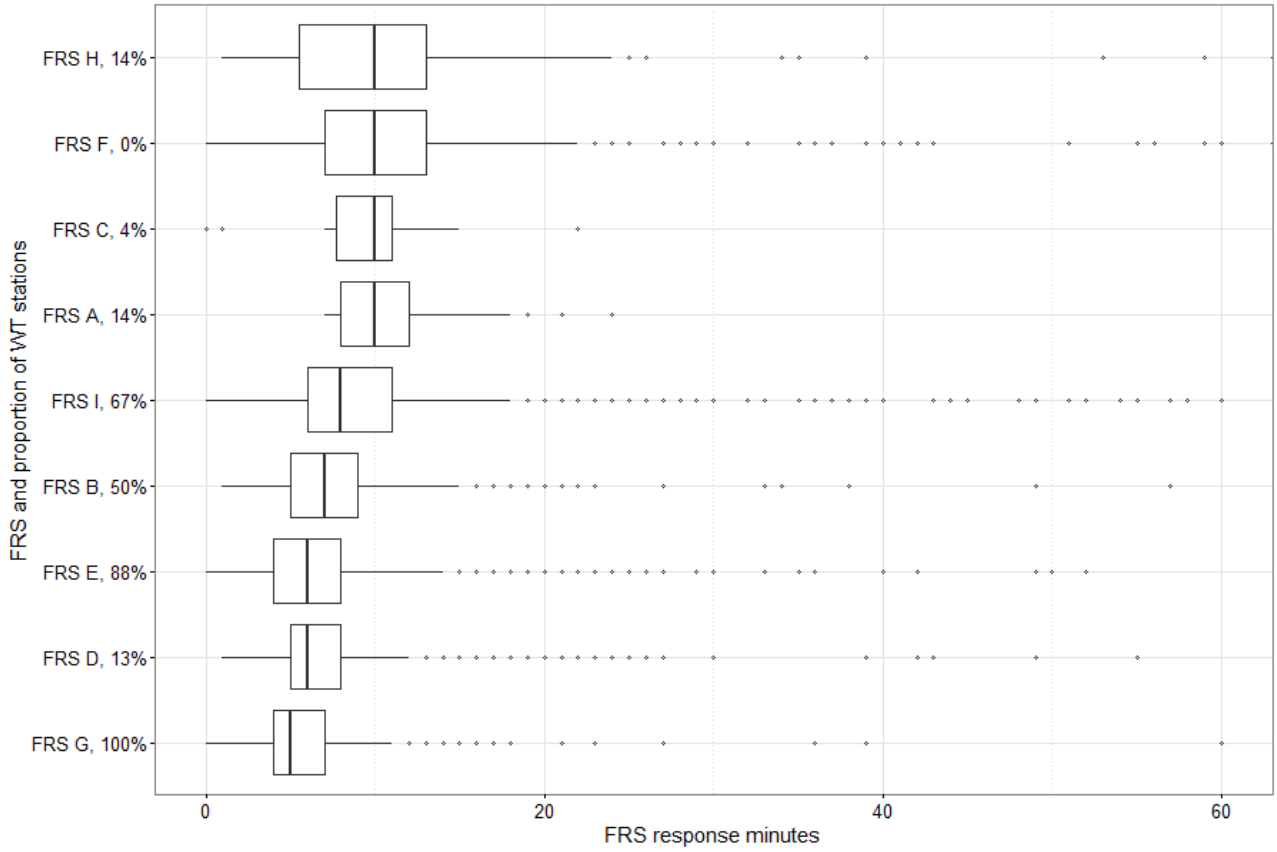

Figure 9: Fire and rescue service median response times by service and proportion of whole-time stations

Regression analysis found that the median fire and rescue service response time decreased by 8.4 seconds for every 10 per cent increase in the proportion of whole-time stations within a service. Interpreting this result is complicated by the fact that services with a lower proportion of whole-time stations are also likely to be more rural, with correspondingly greater distances between stations and the location of the incident. Therefore, it is not clear whether differences in response times are more related to duty systems or the rurality of the service. Also note that these are fire and rescue service response times only, as paired ambulance response times were not available for most incidents in the NJC data. It is possible that that we would see the difference in fire and rescue service and ambulance service response times more closely linked to the proportion of whole-time stations, as the impact of greater distances in more rural services would apply equally to both services, but this analysis was not possible with the data available.

Survival gains and societal value from co-responding

As mentioned in the introduction, there is a potential relationship between patient outcome and the speed of response in to cardiac arrest patients. The relationship between response time and predicted survival immediately following cardiac arrest is shown in Figure 10. It illustrates the potential benefit of even relatively small reductions in response time due to co-responding.

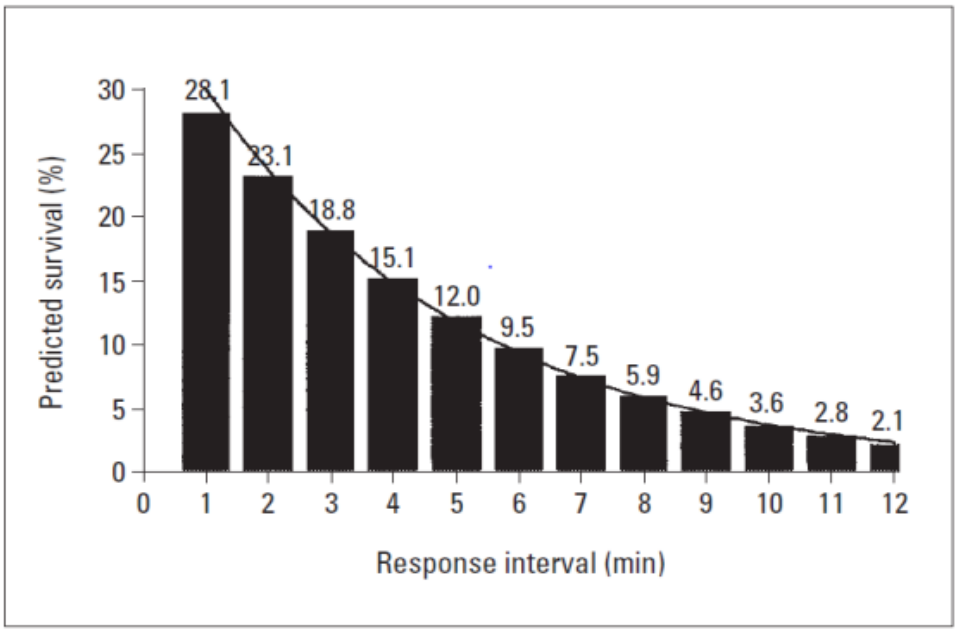

Figure 10: Predicted survival immediately following cardiac arrest (De Maio et al., 2003)

The predicted probability of survival for 'critical' calls was calculated for each service on the basis of the incident-level response times from the NJC incident and paired single county datasets. The gain in the probability of survival was calculated as the difference between the probability of survival given fire and rescue service response time and the probability given the ambulance response time. For example, if the fire and rescue service arrived in 5 minutes (a 12% probability of survival from Figure 10) and the ambulance arrived in 7 minutes (a 7.5% probability of survival from Figure 10), the net gain in the probability of survival was the difference between 12% and 7.5%, or 4.5%. When the ambulance arrived first, the direct survival advantage due to fire and rescue service co-responding was zero. The net survival advantage for all combinations of fire and rescue service and ambulance response times is shown in Appendix 2, and the mean survival advantages across all records by data source are shown in Table 11.

Table 11: Co-responding survival advantage by data source

Dataset	Critical incidents (%)	Mean survival advantage (95% confidence interval)
NJC	2,684/12,911 (20.8%)	+5.30% (4.90%, 5.70%)
Single county	266/1,293 (20.6%)	+2.74% (2.37%, 3.18%)

These expected survival gains were used to weight age-specific life expectancies derived from UK life tables (Office for National Statistics, 2015) to estimate the life years gained as a result of co-responding. Since these life years will not be lived in perfect health, they were further weighted by the expected health-related quality-of-life (HRQoL) of cardiac arrest survivors (Nichol at al., 1999) to estimate quality-adjusted life years (QALYs) gained by co-responding. To illustrate, a 65 year-old female has a remaining life expectancy of 20.9 years. Improving her likelihood of survival by 5.3% translates into an expected gain of 20.9 x 5.3% = 1.11 life years. These years would have a

quality of 78% of perfect health, so the quality-adjusted life years would be 1.11 x 0.78 = 0.87 QALYs.

Note that gains in survival were calculated on the basis of *expected*, not *actual* outcomes. If the fire and rescue service arrived on-scene sooner than the ambulance, this was counted as a gain in expected survival, *regardless of whether or not the specific patient survived*. The relevant measure in this context is whether co-responding improved the population-level likelihood of survival, not the outcome of specific patients.

The average age of patients in the incident data was 62 and, based on UK life tables, their estimated average remaining life expectancy was 22 years. After weighting by the co-responding survival advantage from Table 3, the average life years gained with co-responding was 1.35 and the average QALYs gained was 1.05. Based on a societal willingness-to-pay of £20,000 per QALY, as recommended by NICE (Rawlins and Culyer, 2004), the average fire and rescue service co-response to time-critical incidents generated a *gross* societal value of £21,047 per incident.

These figures are less favourable when considering the paired single county data, reflecting the smaller difference in response times and so the lower survival advantage associated with co-responding. Patient age was not reported in this dataset but, assuming the same age distribution as the NJC incident data, led to an average remaining life expectancy of 26 years. After weighting by co-responding survival advantage, the average life years gained through co-responding was 0.73 and the average QALYs gained was 0.56. At £20,000 per QALY gained, this implies a gross societal value of £11,352 per Red 1 incident.

It is important to note that, in both the datasets considered here, the proportion of critical incidents was only 21% of all co-responding incidents. This means that 4 out of every 5 of co-responding events generated *no* survival advantage. When this proportion is factored into the calculation, societal value falls to £4,420 based on the NJC incident data and £2,384 based on the paired single county data.

Costs of co-responding

The analysis above suggests that co-responding is associated with benefits in the form of gains in survival and QALYs, with a corresponding societal value, but it is also important to consider the costs of co-responding. These costs include training and additional human resource costs, specialised medical equipment, consumables, and vehicle operating expenses.

The NJC aggregate survey returns did not provide a specific cost per incident, so it was necessary to estimate costs on the basis of the information provided in this survey, other information available online, and some conservative assumptions. The estimates are based on an average crew of 3.8, derived from the NJC data. Retained duty firefighters are paid a £3.90 disturbance fee and then the same hourly wage as whole-time firefighters. Whole-time firefighters are paid for the entire time they are on duty, regardless of whether they responded to an event, and therefore do not represent an *additional* expense due to co-responding. Retained duty firefighters, though, are paid only if they respond to an incident, and then in hourly 'blocks': they receive a full hour's pay for incidents between 1-60 minutes, another full hour's pay for incidents between 61-120 minutes, and so on. Based on the NJC incident data the average co-responding incident was 47 minutes. This was rounded up to a full hour's pay for each retained duty firefighter, assumed to be £13.53. As a sensitivity analysis, we tested the impact of co-responding incidents taking

between 61 and 120 minutes, doubling the cost per incident of a retained duty firefighter to £27.06.

On the basis of these estimates and assumptions, the average cost per co-responding incident was estimated to be £284 with whole-time firefighters and £350 with retained duty firefighters. The inputs to this calculation are detailed in Appendix 2. Note, though, that these cost calculations are relatively simplistic. A more detailed accounting of the costs associated with co-responding would allow for better informed decision-making.

Net benefits and return on investment

Deducting the costs of co-responding from the monetised benefits of *all* co-responding incidents (critical and non-critical) in the two datasets results a conservative net benefit of between £1,985 and £4,091 per incident, or a return on investment of between £5.67 and £14.40 per £1 invested. The cost per QALY gained through co-responding is between £1,302 and £3,041; well within NICE's maximum willingness-to-pay threshold of £20,000 per QALY gained. Note that these are conservative estimates based on all co-responding incidents; net benefit and return on investment are more favourable when only considering time-critical events. The costs and benefits for time-critical and all co-responding incidents are summarised in Table 12, by data source and by whole-time (WT) and retained duty (RD) responders:

Table 12: Co-responding costs and benefits, by data source and responder status

	NJC data		Single-county data	
	Time-critical	**All incidents**	**Time-critical**	**All incidents**
QALYs gained per co-responding incident	1.05	0.22	0.56	0.12
Value per co-responding incident	£21,047	£4,375	£11,352	£2,335
Cost per co-responding incident (WT)	£284	£284	£284	£284
Cost per co-responding incident (RD)	£350	£350	£350	£350
Net monetary benefit (WT)	£20,763	£4,091	£11,068	£2,051
Net monetary benefit (RD)	£20,697	£4,025	£11,002	£1,985
Monetary return per £1 investment (WT)	£73.08	£14.40	£38.96	£7.22
Monetary return per £1 investment (RD)	£59.08	£11.49	£31.40	£5.67
Cost per QALY gained (WT)	£271	£1,302	£507	£2,466
Cost per QALY gained (RD)	£334	£1,605	£626	£3,041

QALYs=Quality-adjusted life years; WT = Whole-time; RD=Retained duty

A limitation to this analysis is that we assumed the cost of responding to non-critical events would be the same as responding to time-critical events. Given the uncertainty around the precise costs of co-responding, we tested a scenario where we doubled our cost estimates. Even under this less favourable scenario, all co-responding was still associated with positive net benefits of between £1,635 and £3,807 per incident, and a societal return on investment of between £2.33 and £6.70 per £1 invested. The cost per QALY gained was between £2,603 and £6,082, still well within the NICE £20,000 threshold.

It is difficult to estimate the total budget impact of co-responding as we did not have comprehensive data covering the entire UK. An estimate, though, may be drawn from the average number of co-responding incidents per station in the NJC incident data, including urban and rural

services. Individual stations responded to an average of (minimum 1 incident; maximum 1,805). At an estimated cost of between £284 and £350 per incident for whole-time or retained duty stations, respectively, this suggests the average annual cost of co-responding would be between £41,000 and £51,000 per station. Based on responses to the aggregate survey, each fire and rescue service had an average of 33 percent strictly whole-time stations. Using this proportion gives a weighted average cost of £47,560 per station. For the 257 unique stations in the NJC incident data, this suggests a total annual cost of £12.2 million. If this average cost per station is applied for example to all 704 stations in England, the total annual cost would be in the range of £33.5 million. It is important to highlight, though, that this estimate implicitly assumes that the stations that did not participate in the co-responding trial would respond to the same number of incidents, on average, as those stations that did participate. As above, it also assumes that the cost of non-critical events is the same as responding to a critical event.

Limitations

There were a number of limitations in the analysis. Most notably, there was a large number of missing values in the incident data provided by fire and rescue services, particularly around fire and rescue service time-at-scene and ambulance arrival times. After data cleaning, only 14 of the 25 fire and rescue services that participated in the trial were included in the analysis. This, and the narrow geographic focus of the paired single county data, means that the results reported here may not be generalisable across all services and jurisdictions. Other jurisdictions may see larger or smaller (or possibly even negative) advantages in fire and rescue service response times, with corresponding impacts on the benefit of co-responding. In particular, paired fire and rescue service/ambulance response times -- in both the NJC incident and the single county datasets – were only available for *urban* services. This means that the benefit of co-responding for rural areas cannot necessarily be assumed to be the same. Likewise, we were unable to estimate *differential* fire and rescue service response times for whole-time and retained duty systems. It seems plausible that whole-time responders, based at a station, will usually have faster response times than retained duty systems for a given level or rurality. Different models of co-responding – particularly where retained duty system responders have a vehicle at their home or workplace – may affect response times.

Finally, the analysis assumes that the fire and rescue service actions upon arrival at the scene of an incident will be identical to the ambulance service in terms of appropriateness and effectiveness. There is no direct data available to test this assumption as that is outside the scope of this evaluation. Further research is necessary to establish whether fire and rescue service co-responding is indeed equally effective in terms of health outcomes, not just response times.

Summary conclusion

On the basis of the NJC and single-county datasets, fire and rescue service co-responding appears to be associated with faster response times to scene and, assuming an immediate implementation of appropriate actions, corresponding gains in survival probability and life expectancy. When considered in the context of the costs, co-responding appears to be associated with very favourable value for money compared to common standards of value for money. The net benefit, or efficiency, of co-responding is maximised when responding to time-critical incidents such as cardiac arrest. Responding to less time-critical incidents is associated with smaller net benefits.

Research-stream C: Case study - interrogation of existing data from a single county fire and rescue service and the corresponding ambulance service

This section of the report looks in more detail at the paired single county data referred to in Research-stream B. It was compiled utilising data from a single county fire and rescue service and its corresponding ambulance service. Data comprised 1293 calls attended by both the fire and rescue service and the ambulance service (co-response); and the period covered by this data ran from the 21 October 2015 until the 21 October 2016. Figure 11 shows the calls broken down into Red 1 (immediately life-threatening) and Red 2 (serious but not the most life threatening) by percentage.

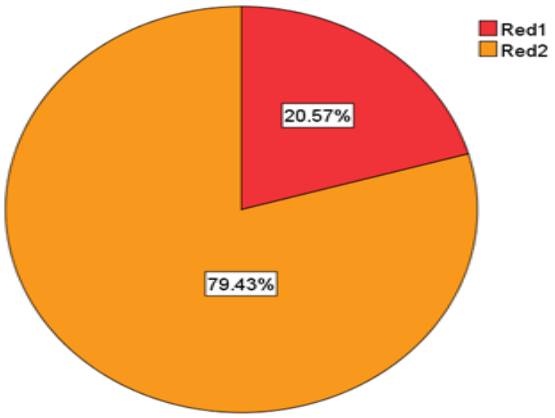

Figure 11: Red 1 and Red 2 calls by percentage between 21 October 2015 and 21 October 2016

The ambulance service national response time target for Red 1 and Red 2 calls is that 75% should be reached in eight minutes or less (DOH, 2015). There has however been a steady decline nationally in performance for several years (Nuffield Trust, 2016) as illustrated in Figure 12.

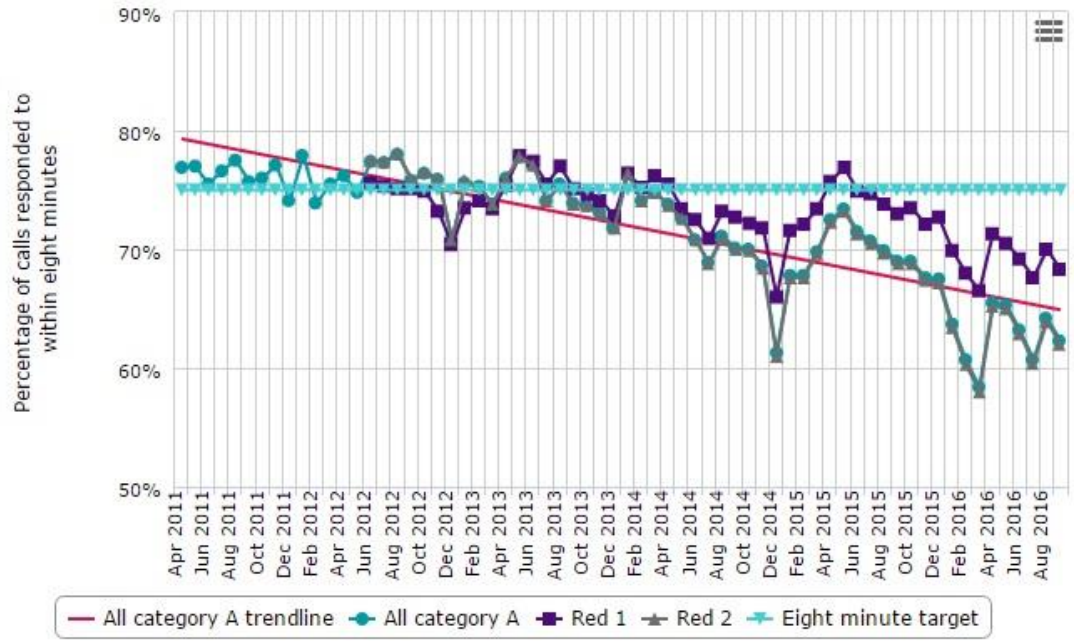

Figure 12: The proportion of Category A (Red 1 and 2) calls attended within 8 minutes over time

The single county fire and rescue service attended 100 calls per month, when averaged across the study period (Figure 13).

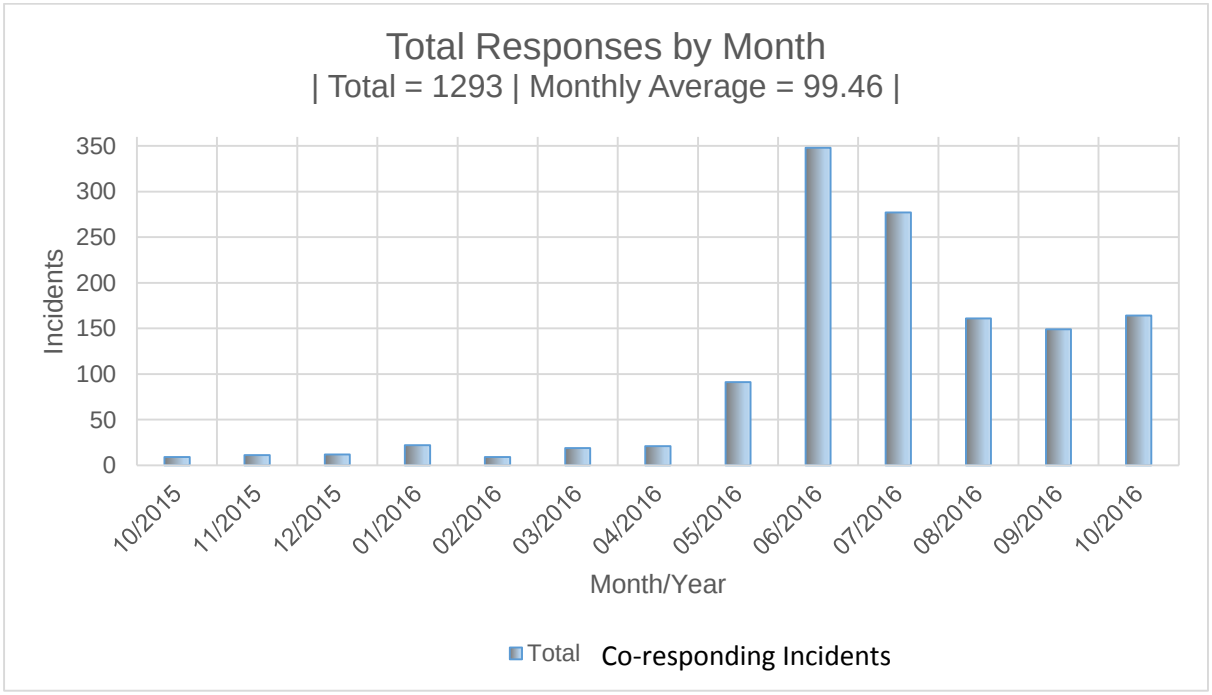

Figure 13: Total fire and rescue service co-responding incidents by month

The calls were identified against 36 categories, as shown in Figure 14.

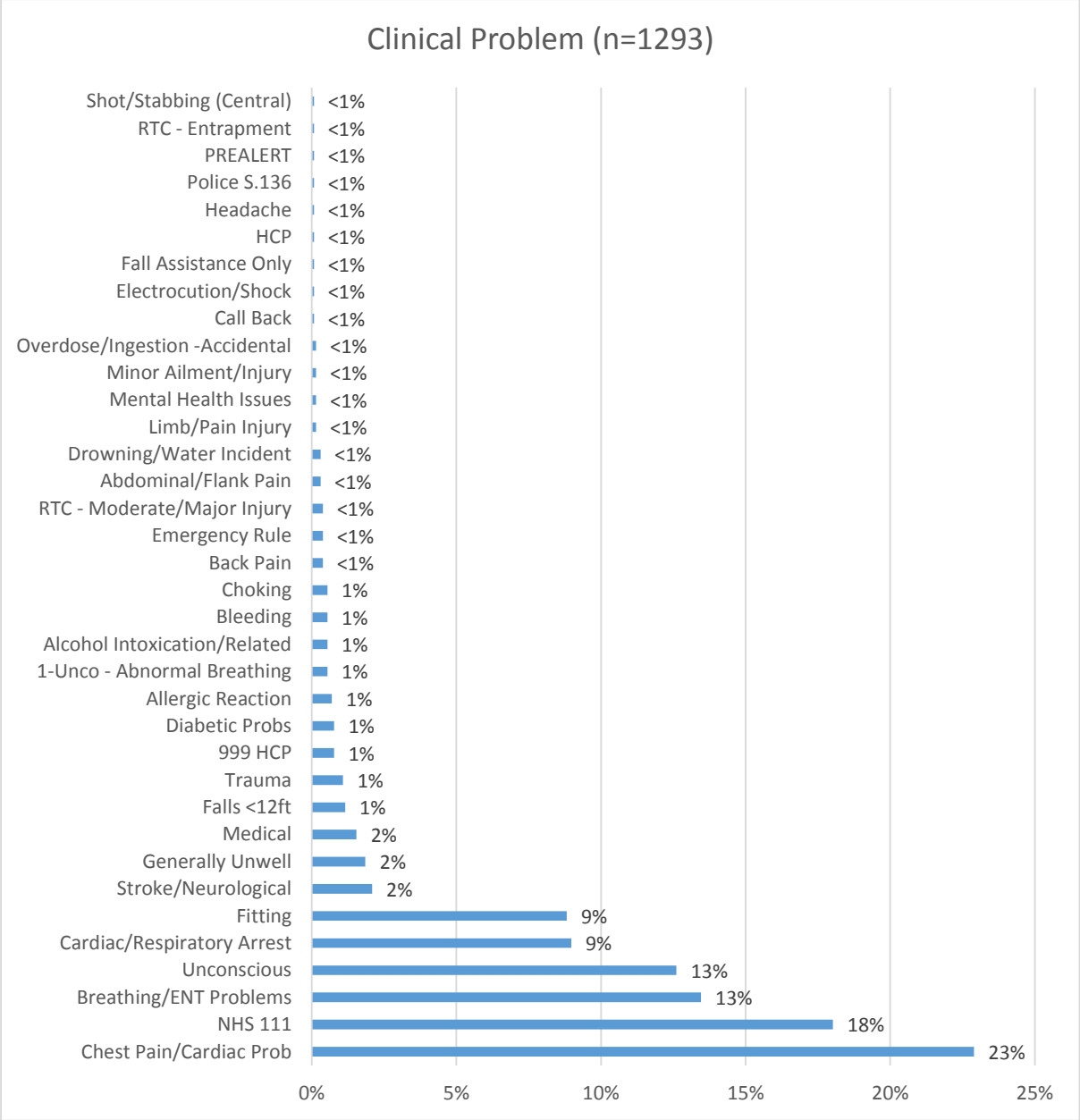

Figure 14: Nature of co-responding call and frequency

The bulk of this clinical problem data falls into six categories;

- Fitting - 9%
- Cardiac/Respiratory Arrest - 9%
- Unconscious - 13%
- Breathing/ENT Problems - 13%
- NHS 111 - 18%
- Chest Pain/Cardiac Problem - 23%

Broadening the Role

Broadening the role of the fire and rescue services to attend emergency operations centre directed calls has three considerations:

1) Does co-responding improve response times and, if so, are these improvements both statistically significant and clinically relevant?
2) Does co-responding lead to improvements in patient care in terms of outcomes (reduction in mortality and morbidity)?
3) Does co-responding lead to unintended consequences such as delays to definitive secondary care, or the withholding of additional resources as a response has already been achieved.

Since the introduction of Call Connect in 2006, it was, has been, and still is widely accepted that ambulance service call volume rises between 5-8% per year (DOH, 2005; HSCIC, 2014).

It would be entirely reasonable to expect that the availability of additional resources in the form of fire and rescue service vehicles and personnel would go some way to arresting the decline in response times. Understandably, an additional question lies in the sustainability of this as a long term solution.

The unintended consequences of this arrangement could see the fire and rescue services ending up with more than they initially bargained for, acting as a proxy ambulance service in the absence of supporting resources. Considerable evidence exists for target gaming in both the ambulance services and wider National Health Service (NHS). Gaming typically occurs when incentives are attached to targets in terms of success or failure and subsequent monetary funding or fines (Bevan & Hood, 2006; Heath and Radcliffe 2007).

One cannot overlook the potential by ambulances services to utilise this fire and rescue service response as a "clock stopper" thereby delaying subsequent supporting responses from the ambulance service.

Most of the current NHS drivers such as the Keogh Review (Keogh, 2013) are moving towards utilising Paramedics as part of a multi-disciplinary workforce, delivering care in the home. It is difficult, although not impossible, to see the fire and rescue services able to contribute in this area.

The provision of care for conditions such as myocardial infarction, stroke and trauma means they are now treated primarily in specialist secondary centres necessitating higher levels of skill in managing these patients in the prehospital setting (Ball, 2005; NCEPOD, 2007; Price, 2006).

The fire and rescue services would need to establish, in conjunction with ambulance services, a robust scope of practice with clear clinical governance in order to protect both patients and staff.

Cardiac Arrest

Analysing the data, it was noted that 9% of the 1,293 calls were 'Cardiac/respiratory arrest'. This is an area where fire and rescue service staff may have considerable utility. Since the OPALS study demonstrated that time to defibrillation is key in optimising survival following out of hospital cardiac arrest (OHCA) it is now widely accepted that a well-trained, motivated and equipped first

responder system is associated with improved survival in international best in class systems (De Maio, Stiell, Wells, & Spaite, 2003). Moreover the eight minute response time target was, and is, deemed to be a suboptimal strategy. The early provision of defibrillation has demonstrated efficacy, particularly in the electrical phase, which last approximately four minutes from point of circulatory arrest (Weisfeldt, 2004). Several studies have shown that defibrillation when performed by appropriately trained non-emergency medical service personnel improves survival, especially if aligned to high quality CPR (Caffrey, 2002; Hallstrom et al., 2004; Mosesso et al., 2002; Nichol et al., 2009; Valenzuela et al., 2000).

The OPALS study proposes that survival from OHCA declines by 23% each minute defibrillation is delayed; moreover a plateau was reached at five minutes beyond which the effectiveness of defibrillation declined markedly (De Maio et al., 2003). Reviewing the single county's paired ambulance/fire service data and performing sub analysis of the 100 calls indicated as 'Cardiac/respiratory arrest' showed a statistically significant improvement in response time performance for the single county fire and rescue service when compared with their corresponding ambulance service responses (Figure 15); this can be seen when analysing the median response time for both groups. If correct, this response time advantage could be exploited to initiate high quality CPR and early defibrillation in shockable rhythms; data from international studies would suggest this confers a survival advantage in populations supported by this infrastructure (Hallstrom et al., 2004; Herlitz et al., 2003).

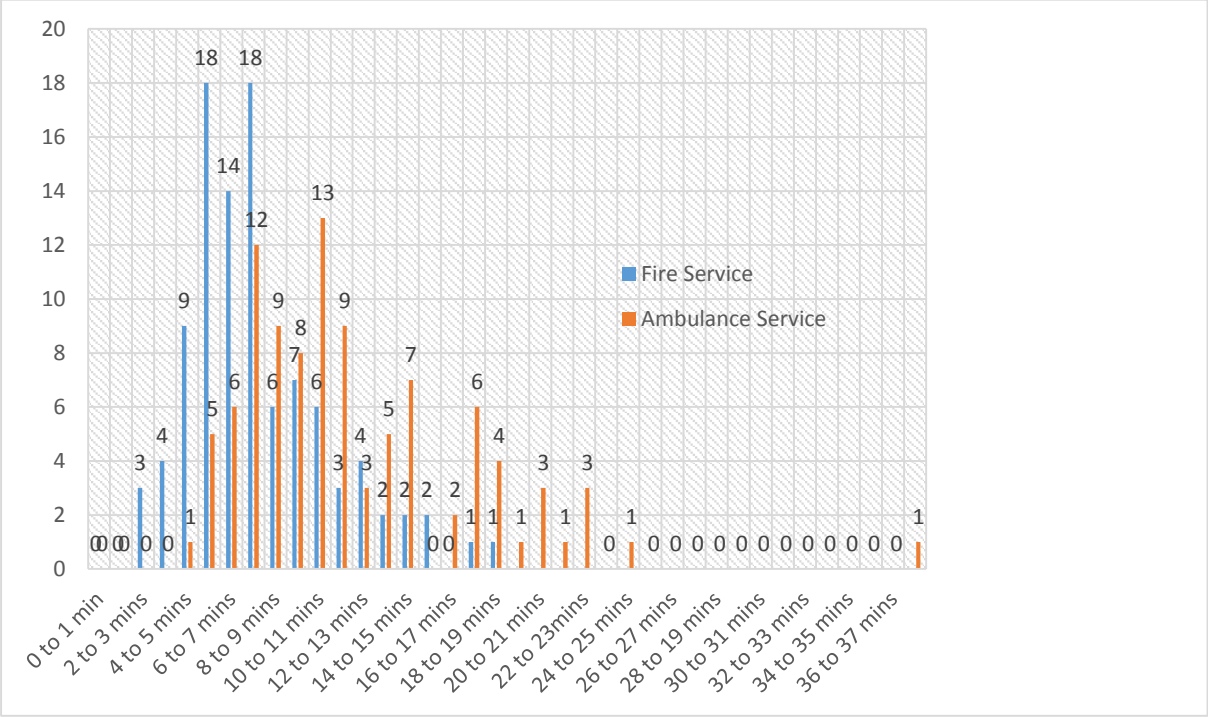

Figure 15: Fire and rescue service compared to ambulance service response times (n= 100)

The median response time for the single county fire and rescue service responding to cardiac arrest was 7 minutes 7 seconds; the median response time for their corresponding ambulance

service for the same calls was 10 minutes 46 seconds (a statistically significant difference of 2 minutes 23 seconds).

The single county fire and rescue service achieved an 8 minute response to cardiac arrest in 66% of the 100 cases included in the study. The ambulance service achieved an 8 minute response time in 24% of the 100 cases included in the study.

The ambulance service national response time targets for this call would be 75%. Best in class (international) would achieve an 8 minute response in 90% of cases.

In 2001 Pell, Sirel, Marsden, Ford, and Cobbe (2001) used Scottish Ambulance Service data for responses to cardiac arrest to propose an extended role for the fire and rescue service, whose response time targets to fires were 90% in 5 minutes; this would have brought defibrillation times to within the survival plateau, increasing survival from 8% to 11%.

Summary conclusion

A greater integration of fire and rescue services and ambulance services' resources co-responding as little as a decade ago would unlikely have found many caveats to its implementation. Large increases in prehospital research has driven significant clinical change in this arena.

The case for co-responding in cases of cardiopulmonary arrest are well founded on international literature; this would present the most compelling argument for broadening the role of the fire and rescue service in relation to higher acuity work.

The case for targeted responding to cardiac / respiratory arrests can be broadly made on the basis of the response time survival curve, where time to defibrillation is a key component of successful resuscitation.

In recent years, standards of care have changed markedly around the use of oxygen and other pharmacological interventions, whilst new direct admission pathways for myocardial infarction, stroke, arrhythmias and trauma necessitate greater complexity in assessment; this would require substantial and sustained investment in training and education for any staff involved in delivery of this care to these patients.

Clinically at this stage it is difficult to envisage the fire and rescue services as more than co-responders with a tightly defined boundary of interventions, unless there is considerable upskilling in terms of clinical examination, assessment and treatment provision.

Additional responding by the fire and rescue services is likely to have a beneficial effect in supporting ambulance service response time performance, especially in relation to cardiac arrest calls. In relation to the need not just to arrive on scene first but to take appropriate action, the next section illustrates in a very small sample the efficacy of CPR undertaken by fire and rescue service staff when co-responding to cardiac arrest calls.

Research-stream D: Cardiac arrest download data

A data download within this research-stream refers to a recording of a patient's clinical readings e.g. the echocardiogram (ECG) tracing of a heart rhythm, by a device: in this case an automated external defibrillator. In many medical devices, the tracing is not only printed onto the paper report, it is also recorded as a data file. This gives the user the option of either 'downloading' these data as computer files, or the file will be overwritten by continued use of the device. The point in time at which this 'deletion' occurs will depend on the data capacity of the device. After being overwritten, these patient data are usually not retrievable.

The majority of defibrillators have this recording capacity which, after connection to the patient via either defibrillator pads or ECG dots, records the patient's cardiac ECG continuously. In addition, some defibrillators use complex impedance technology which can measure chest wall movement, tissue density and even cardiac output in the major blood vessels. This allows a retrospective analysis of cardiac arrest download data files, to reveal both the quality of cardio pulmonary resuscitation (CPR) and also the impact of this physical intervention on the cardiac arrest patient.

Background

Evidence suggests that four features are associated with a decreased chance of successful resuscitation following cardiac arrest: lack of bystander CPR (bystander CPR is where a member of the public undertakes CPR before the arrival of medical assistance); unwitnessed arrest, non-shockable rhythm and out of hospital location. Survival from cardiac arrest is 8.7% with no bystander CPR compared to 11.3% with bystander CPR; 3.9% unwitnessed arrest compared to 15.9% witnessed arrest; and 4.2% with non-shockable rhythm compared to 27.1% for a shockable rhythm (McNally et al., 2011). Moreover the chance of successful defibrillation decreases by 23% for each minute that passes following collapse: a plateau is typically reached at approximately 5 minutes, beyond which successful resuscitation is challenging (De Maio, Stiell, Wells, & Spaite, 2003). This initial 5 minutes is thought to represent the "electrical phase" of cardiac arrest that is most amenable to defibrillation, beyond this the arrest enters a "circulatory phase" in which it is suggested advanced cardiac life support measures such as the provision of pharmacological agents are more commonly associated with achieving a perfusing rhythm; this is supported by best in class cardiac arrest systems that look to achieve a 4 minute response in 90% of cases (Weisfeldt, 2004).

The efficacy of early access defibrillation is widely supported by international studies (Caffrey, 2002; De Maio et al., 2003; Mosesso et al., 2002; Nichol et al., 2009). However increasing the availability of automated external defibrillators (AEDs) is typically only part of the overall metrics that contribute to successful resuscitation. Chest compression quality, in terms of rate and depth, aligned to rapid defibrillation that minimises the time not compressing the chest (pre-shock pause) have been evidenced as important components in the achieving return of spontaneous circulation (ROSC) (Edelson et al., 2006).

Cardiac arrest download data analysis

The following analysis is derived from 17 defibrillator downloads from AEDs. The data from cardiac arrest events from these AEDs is stored as an electronic file; this presents an option of analysing the data for the presenting rhythm, shocks delivered (DC cardioversion) and the quality of chest compressions by rate and the duration of any pauses (interruptions in chest compressions). The 17 cardiac arrests were attended by a single county fire and rescue service co-responding between the 22nd December 2015 until the 1st December 2016. Each cardiac arrest was supported by their local ambulance service as a secondary response.

Results

The initial data demonstrate a reasonably even split in terms of gender (Figure 16) and witnessed versus unwitnessed arrest (Figure 17).

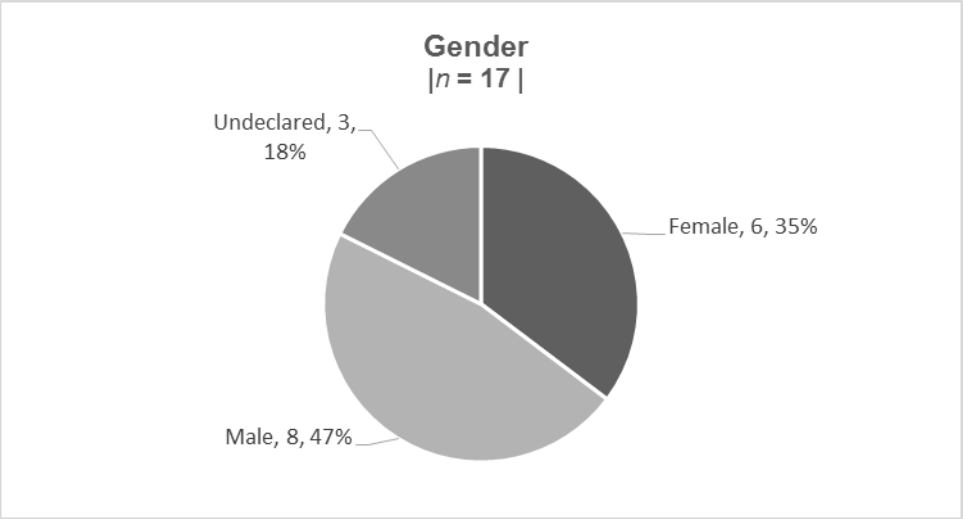

Figure 16: Breakdown of cardiac arrest recordings by gender (n=17)

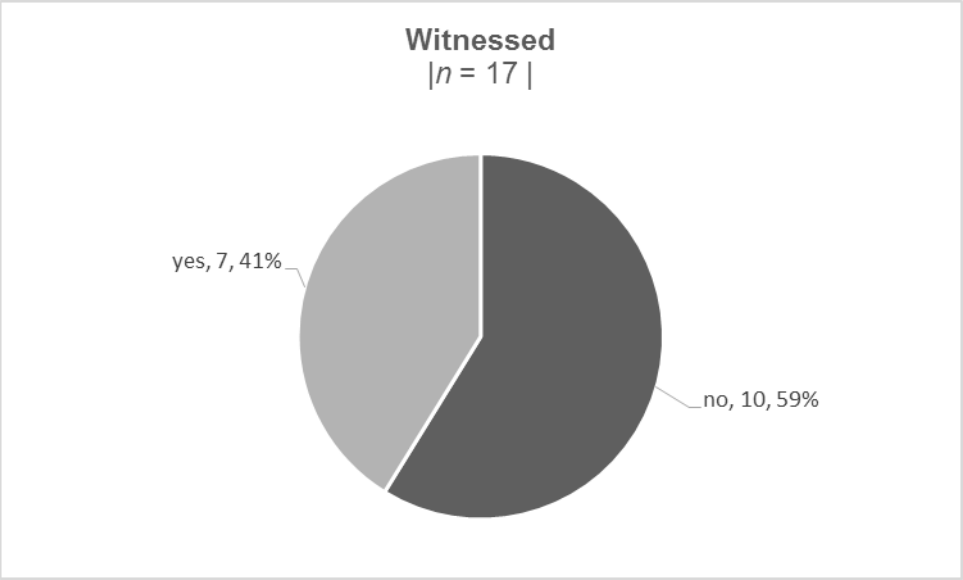

Figure 17: Breakdown of cardiac arrests by whether witnessed or unwitnessed (n=17)

Bystander CPR was confirmed in (*n*=10) 59% of cases as illustrated in Figure 18.

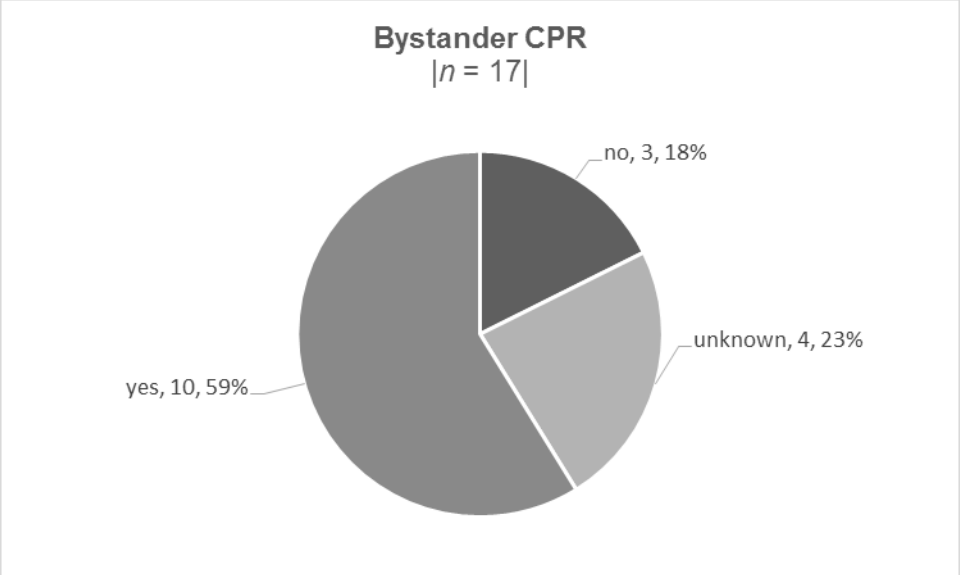

Figure 18: Breakdown of cardiac arrests receiving bystander CPR (n=17)

The breakdown of presenting rhythms (Figure 19) demonstrates asystole and pulseless electrical activity (PEA), both non-shockable rhythms, as the most common comprising (*n*=10) 59%.

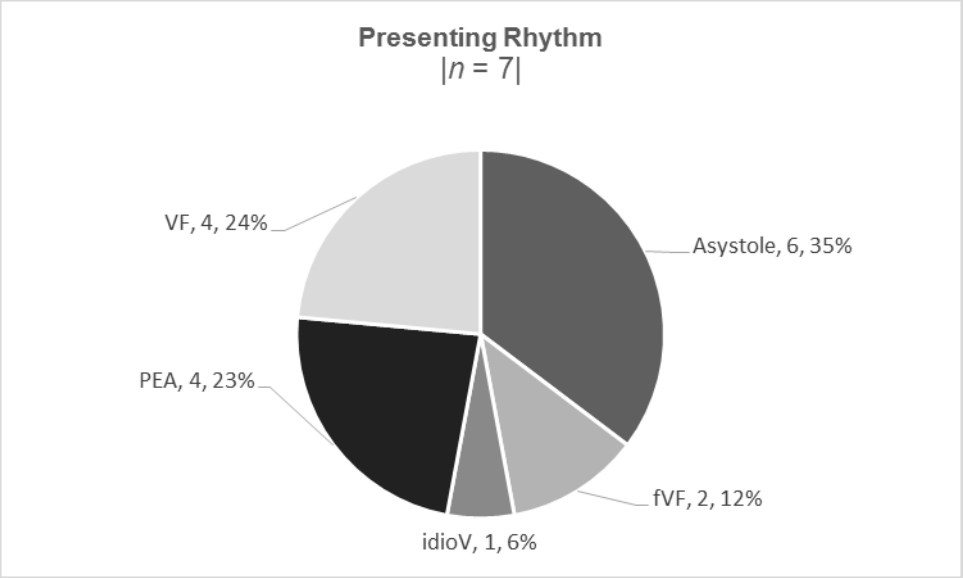

Figure 19: Breakdown of cardiac arrests by presenting rhythm (n=17)

Ventricular fibrillation (VF) and fine ventricular fibrillation (fVF) make up (*n*=6) 36% of the incidents; and both of these are shockable rhythms. Only one case (6%) is indicated as an idioventricular (idioV) non-shockable rhythm.

The rhythms prior to the first shock (Figure 20), which would have typically followed a period of two minutes of CPR, were shockable in 41% of the cases (n=7); the remainder (*n*=10) 59% were

indicated as unrecorded. This figure matches the initial presenting rhythms indicated as non-shockable and one might infer that those rhythms indicated as unrecorded were in fact non-shockable.

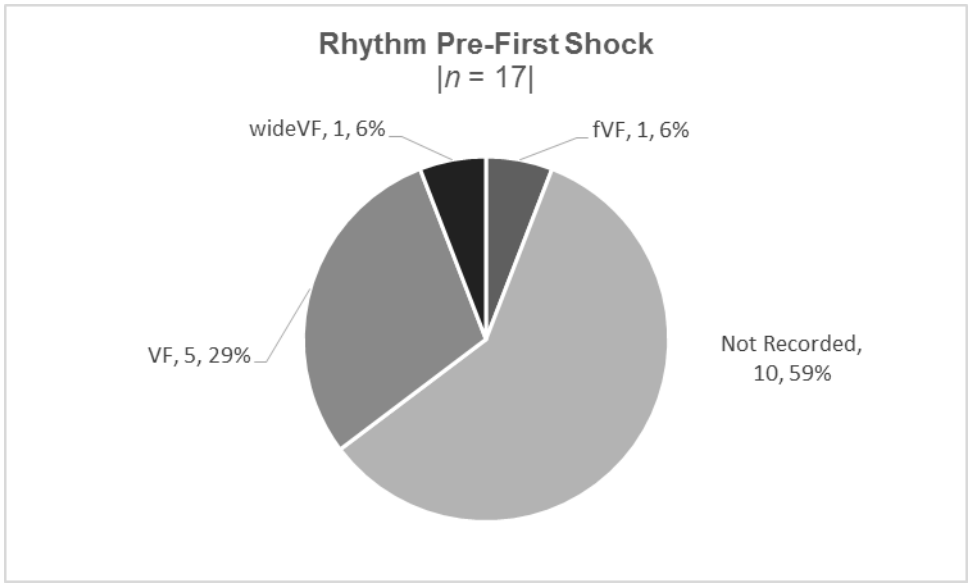

Figure 20: Presenting rhythms prior to first shock (n=17)

Analysis of the presenting rhythms post first (Figure 21) and second shock (Figure 22) are disappointing with (*n*=10) 59% and (*n*=12) 70% indicated as not recorded. Analysis of the non-shockable rhythms indicates (*n*=5) 29% and (*n*=3) 18% post first and second shock respectively, demonstrating a downward trend.

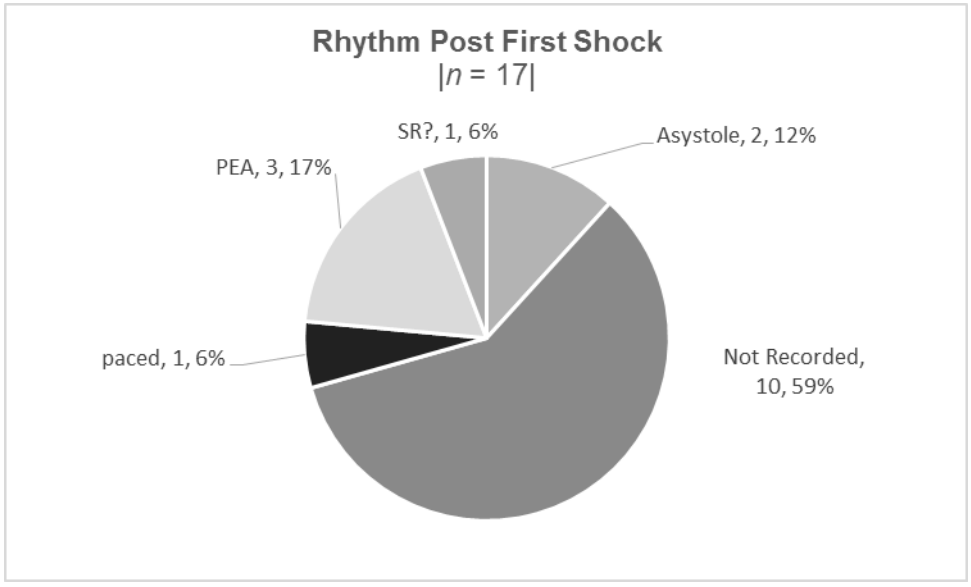

Figure 21: Presenting rhythms post first shock (n=17)

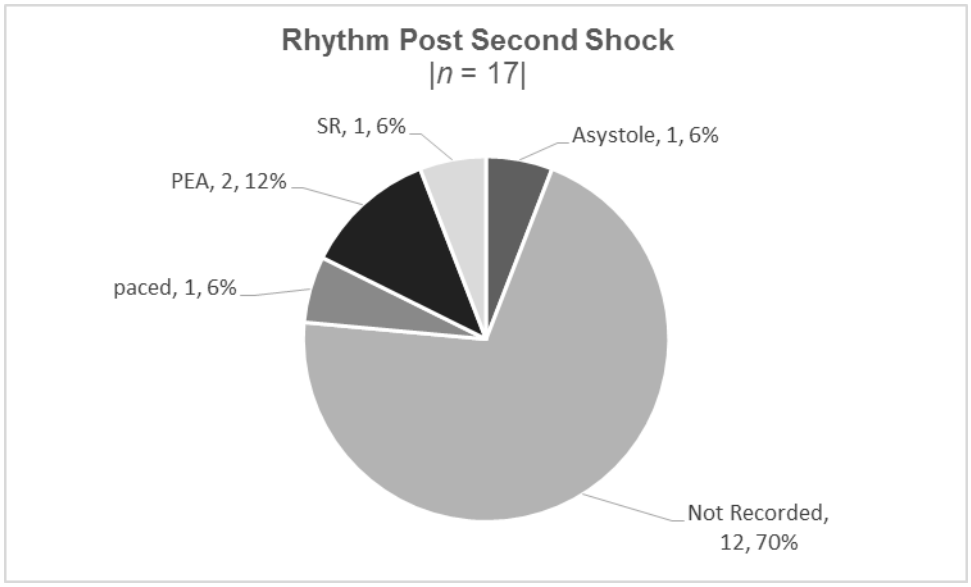

Figure 22: Presenting rhythms post second shock (n=17)

Analysis of the final rhythms (Figure 23) demonstrates that non-shockable rhythms have remained at (*n*=10) 59%, however (*n*=5) 29% are indicated as a sustained rhythm (SR); this demonstrates an upward trend from (*n*=1) 6% post first and second shock. Those rhythms showing as paced, indicate the presence of an internal pacemaker device that is picked up by the AED. The mean compression rate (Figure 24) is indicated as 122 compressions per minute (range 103-148).

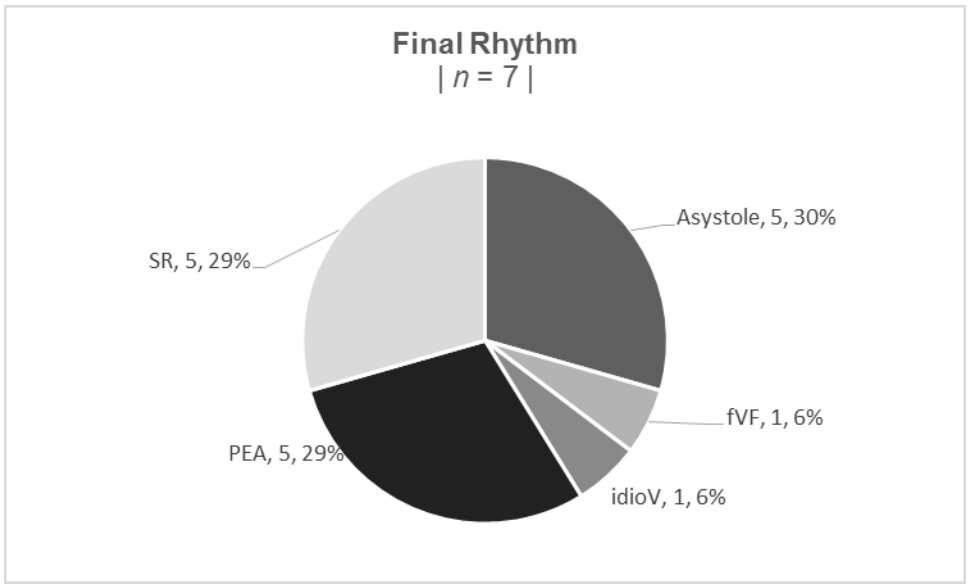

Figure 23: Final rhythms (n=17)

Final analysis was conducted using matched data from the ambulance service and the single county fire and rescue service to indicate the final outcomes at transfer of the patient to the emergency department. Not all records (*n*=3) could be matched, although it is known that the presenting rhythm was asystole (non-shockable). The analysis of (*n*=14) matched records between

the fire and rescue service and the ambulance service indicate that (*n*=4) 28% who presented in a shockable rhythm achieved return of spontaneous circulation (ROSC) at the emergency department; furthermore (*n*=3) 22% of those presenting in a non-shockable rhythm achieved ROSC. A total of (*n*=7) 50% achieved ROSC at the emergency department for both shockable and non-shockable rhythms.

The initial results from the AED downloads are promising, with a total of (*n*=7) 50% achieving ROSC at the emergency department. The results must however be viewed with caution as the sample data is very small; a much larger study is needed to indicate whether this trend would continue. Moreover ROSC, whilst essentially restoring blood supply to the central nervous system thereby preventing further sequelae, is only a proxy measure of survival to discharge. A large study of (*n*=4471) cardiac arrest victims randomised to either manual or mechanical chest compressions demonstrated that despite ROSC rates of 32% and 31% respectively, survival at 30 days had fallen to 6% and 7% in the same groups (Perkins et al., 2015).

However, the provision of early defibrillation in shockable rhythms is widely accepted as contributing towards cardiac arrest survival, even in the hands of non-medical personnel including the lay public (Capucci, Aschieri, & Piepoli, 2002; Capucci, Aschieri, Piepoli, et al., 2002). The success rates of implantable cardioversion defibrillators (ICD) in restoring perfusing rhythms following VF within 10 seconds of onset has been well documented (Connolly et al., 2000) thus the rationale for early intervention in the electrical phase of cardiac arrest.

The results indicate that 28% of those presenting in a shockable rhythm achieved ROSC, whilst this is to be welcomed (and as a percentage compares well with best in class performance) the sample remains small, making inferences speculative.

In this small sample, the mean chest compression rate (122) is still slightly higher (Figure 24) than that which is currently recommended by the Resuscitation Council of 100-120 compressions per minute (UK Resuscitation Council, 2016).

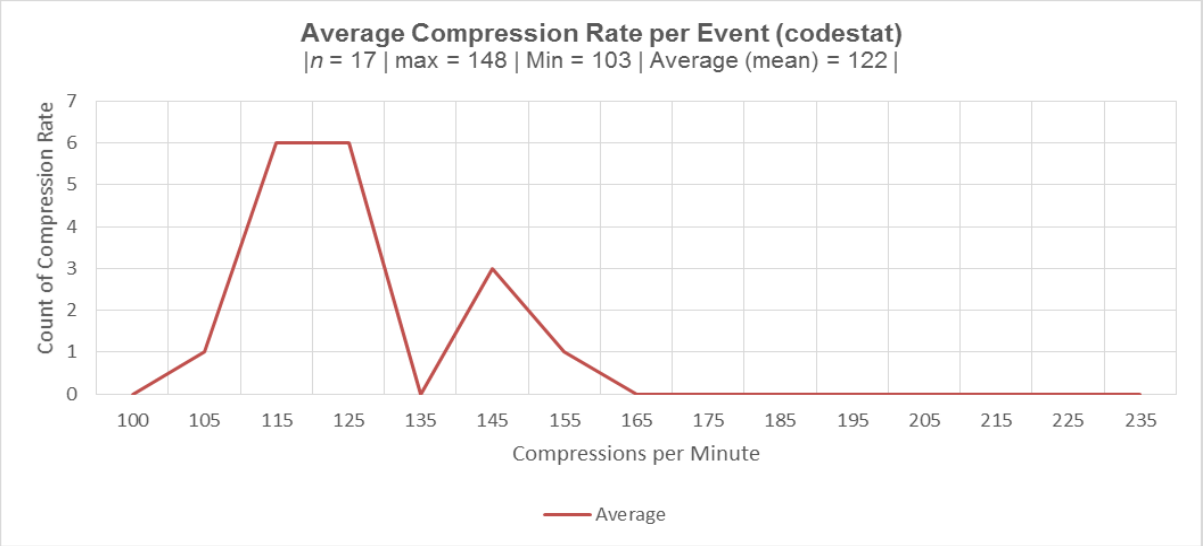

Figure 24: Average compression rate per event (n=17)

However, firefighters who are trained for the highly physical demands of their profession are unlikely to fatigue easily and with the addition of feedback devices could achieve correct compression rate at scene. The data did not allow for measurement of compression depth, this again is associated with defibrillation success and can be improved by the addition of feedback devices (Edelson et al., 2006). Studies of (*n*=3) European prehospital services (including the London Ambulance service) showed that chest compression depth was suboptimal (Wik et al., 2005); ensuring both correct rate and depth of compressions should be readily achievable by UK firefighters.

Summary conclusion

The data from such a small sample size limits the extent to which larger inferences can be made. The ROSC rates were good and would match well with other international best in class systems. The compression rate is a little high but could easily be corrected by additional training and the introduction of feedback devices. Compression depth was not measured but, as indicated, is likely to be improved by feedback devices and training. The use of ROSC can only be a proxy measure for survival to discharge and therefore must be viewed contextually. A larger multi-centre trial with agreed data metrics would answer the question as to whether this performance can be replicated nationally; if so, it seems likely that the fire and rescue service could improve cardiac arrest outcomes.

Research-stream E: Qualitative telephone interviews

This research-stream involved 26 interviews with staff from different fire and rescue services that took part in the NJC trial. The interviews were conducted over the telephone with between one and three participants, who were mainly managers and sometimes other staff, who were participating in co-responding or wider work throughout the United Kingdom.

Content of the responses from the semi-structured interviews have been analysed to identify the key issues identified by the participants. The semi-structured interviews allowed flexibility for the participant to raise the issues they considered important. The interviews were transcribed verbatim and processes of thematic analysis have been employed to develop categories and key themes.

Findings

Key activities

Firefighting was unconditionally identified as the key activity by the fire and rescue services. Their wider medical activities were identified as:

- Co-responding to high acuity calls, frequently referred to as Red 1 and Red 2 calls, although not all co-responders responded to Red 2 calls.
- Attending in medical emergencies to assist in forced entries and also for police emergencies.
- Assisting bariatric patients.
- Telecare service response.
- Non-emergency falls.
- Warmth assessments.
- Reducing injury from slips, trips and falls; installing aids to minimise risk.
- Home safety checks to reduce the risk of fire in the home.
- Signposting individuals to other agencies and providing equipment and assisting in the reduction of safety or security as and when required.
- Safety work: training and inspection of premises for risk purposes.
- Partnership with British Heart Foundation to improve public education around management of cardiac arrest.
- Promotion of fire station events for CPR training for members of the public: Heartstart, Out of Hospital Cardiac Arrest strategy.
- Safe and Well visits incorporating dementia awareness, alcohol harm and reduction, smoking cessation advice, dealing with loneliness and isolation.
- First Contact, constructed from Exeter Data targeting the over 65s.
- All Risk Protect – boarding up or via welfare warrants.

The biggest key activity for most stations was co-responding although it was evident that preventative work was expanding and being viewed by several participants as a growth area for future development to include a variety of activities such as administration of flu vaccinations to elderly people who were not able to easily get to their GP; or generic health screening activities involving routine measurement of blood pressure, blood glucose etc. Clearly participants acknowledged the need for education and training for fire and rescue staff around these activities to ensure knowledge and skill competency. However, these areas would benefit from further examination in the future to establish whether there is scope to utilise fire and rescue staff in the successful delivery of these screening and prevention programmes.

It was interesting to note that whilst some fire and rescue services had been co-responding for some time, most areas had commenced co-responding relatively recently, many within the last year as a result of the NJC trials. Some stations were developing wider participation schemes and were in the process of negotiating partnerships with other agencies including social care agencies and local councils.

The key themes and issues raised by fire and rescue services are outlined below.

Communication

(a) Triage

Problems occurred on some occasions with the initial call to the fire station. Calls were not always appropriate for fire crew to respond to as, in the main, they were expecting Red 1 or Red 2 calls. The calls were sometimes outside of the scope of the trial. It was not apparent whether these inappropriate calls were triaged incorrectly by the call-taker or whether the caller misrepresented the nature of the incident in the first place. The Memorandum of Understanding (MOU) agreed at the start of the trial between the fire and rescue services and the ambulance services should have made clear to the organisations involved the criteria for emergency responding and there appeared to be a deviation from this MOU at times. Overall, it appeared that as the trial progressed, the number of inappropriate calls declined for some areas and the quality of communication improved over time.

(b) Dispatch systems

Different systems were in use to mobilise firefighters to incidents. In a majority of cases, after an initial call was received, usually via a 999 or 111 call, it was passed to the ambulance services' dispatch centre where the decision is taken as to what resources to deploy including contacting the fire and rescue services if appropriate. From this point, a variety of systems were used to mobilise crews such as pagers, airwave radios, or mobile phones. How fire and rescue service resources were alerted depended on models used in the stations and arrangements with local ambulance services. It also depended on whether co-responders were whole-time or retained staff and whether the co-responder was a lone responder, lived near the station, or the station was in a rural or urban area. A number of different models of response were evident. The following issues were identified in relation to the systems used for mobilisation. Not all areas raised the same issues:

- There were technical problems with the fire and rescue service and ambulance service systems as, despite being relatively modern, there were no easy ways to talk to each other

directly which restricted the sharing of information directly. Some managers felt that the technology needed to be improved.

- If the mobilising system was on the fire appliance and a call was received whilst attending a fire incident, or the vehicle was out of range, this results in a refusal to accept the call. One area reported only three stations were involved in the trial and they were thus less flexible; but if the crew were unable to attend and had to decline this was acceptable practice.
- Cardiac arrest calls were not always identified/triaged accurately resulting in some frustration when initially arriving on scene as the fire and rescue staff may have prepared themselves en route for a full cardiac arrest only to be stood down on arrival; or alternatively arriving on scene to find that the patient is in cardiac arrest when the firefighters were not expecting this clinical presentation.
- As well as inhibitory factors to direct communication, there were some problems in control room to control room communication, especially in the early stages of the trials when staff seemed less certain as to who should be mobilised to which calls. Initially a high number of incidents were not being passed on to the fire service; this was resolved over time through discussion and consultation with the ambulance services.
- In one area the co-responding mobilising system was '*really clunky'* so the crews changed to being mobilised directly by the fire and rescue service's own control centre. As ambulance services work in different ways to the fire and rescue services, there is a need to establish the most effective ways of communication.
- Monthly meetings for volunteers, key stakeholders and control to review system efficiency was deemed to be a really useful activity in one fire and rescue service.
- The importance of maintaining control of their own staff was expressed by managers, as they do not want a third party directly mobilising fire and rescue service staff.

Experience of participation in the trial

(a) Response

'The intention is to 'give them [the patient] the best chance of survival'

A common view from participants was that involvement in the trial would help and improve a person's chances of recovery as expressed in the above quote. The staff response to participating in the trial, was mainly viewed as very positive, and described by one manager as *'overwhelmingly positive – all volunteered'*. Another manager described the crews as being keen to respond as they were *'…skilled and capable and acknowledge a public need*'. Some participants felt that a few staff had less positive perspectives about the extended scope of practice for example: some people viewed the trial as encroaching on the work of the NHS; some staff struggled with the *'softer skill elements',* and *'didn't join the fire service to do this';* there were reports of political aspects to the reluctance especially a fear of being seen as taking work away from Paramedics, and concern over any financial remuneration for the extra responsibility; and some staff were apprehensive at the responsibility of the task. However, these experiences were perceived by the interview participants to be in the minority.

There was no particular consensus in the interviews as to which category of calls the fire and rescue services should respond to. Predominantly Red 1 calls were viewed as appropriate but, additionally responding to Red 2 calls was seen as enabling fire and rescue service staff to have more opportunities to use their skills recognising that it might benefit them in the longer term as

staff would maintain skill competence through having consistent levels of exposure to patient care and management.

Responding to patients who had fallen (with or without injury) was seen as another area that had benefit to a large group of patients. Providing a falls service was seen as possibly verging on the social care domain but participants frequently referred to the potential for preventive work to be seen as an opportunity to counteract the latent capacity claim often directed at the fire and rescue services.

Participants reported the majority of the workforce were happy to co-respond if the terms and conditions were right and cost effective. Some managers perceived there were specific benefits to the retained staff as *'otherwise they would have been lost due to inactivity in the area'*.

Overall participants felt staff were positive about the impact co-responding can have in their own communities, through potentially improving patient experience and outcomes. Some participants considered that many firefighters already possessed the skills necessary for co-responding, such as responding to cardiac arrests and using a defibrillator, as this was already part of their work. In some instances teams had been co-responding for a number of years before becoming involved in the trial, whereas in the most part the trial had opened up a number of opportunities for fire and rescue service staff to be involved in new and emerging areas supporting health and social care providers.

(b) Mobilisation

'…everything from a fully-equipped, fully staffed engine to a service Vauxhall Corsa with one or two people in it….. could be a minibus, estate car, a Galaxy, Corsa but what they'll all have with them is in the boot of those vehicles, and on the fire engines is the kit necessary to undertake the safe and well checks.'

The example above illustrates the different models utilised for responding in different stations.

No matter which model of mobilisation was used, one area that was clear was that fire and rescue staff always remained under the control of the fire and rescue services and, at no time, was the primary commitment of the fire and rescue services to responding to fires compromised. A '*breakaway clause' , (*otherwise known as a redirection policy), was reported by some participants where it was made very clear that '*fire will be a priority and a fire engine will be re-directed'* if there is a fire requiring the appliance and firefighters. This was embedded in the MOU and issues of clinical governance were discussed prior to the commencement of the trial to ensure that both services were happy that patients and the public would be well served in the event there were competing priorities for the firefighters' time. Clinical governance was an issue that was frequently discussed in the interviews seemingly being the responsibility of the ambulance services, and it did cause some challenges in relation to training and timescales (discussed later).

(c) Factors impacting on level of participation

Starting in the trial was delayed for some crews/individuals because of a problem with the timing of the delivery of the ambulance service safeguarding training and Disclosure and Barring Security (DBS) checks. Delays in the DBS checks also affected firefighters in some stations being unable to participate along with their colleagues so there was a 'staggered' start in some areas.

Changes in the ambulance service categorisation process, due to participation in a national ambulance trial, affected participation in some areas. This was seen as a point of frustration as fire and rescue staff in these locations noted a drop in demand when their ambulance services changed from one system to the new system (red, amber, green) as essentially this reduced the number of calls being categorised as red. Participants reported that once firefighters were comfortable in their new roles there was an appetite to be continuously involved and to have their involvement reduced was not welcomed.

Another ambulance service changed protocols in terms of location and also changed the control team who were not familiar with the Emergency Medical Response. Some stations co-responded to Red 1 or similar calls only and therefore had a limited experience, whilst other stations responded to a variety of emergency calls with multi-role vehicles, and lone responders.

There was no standardisation in the trial as to what type of calls the fire and rescue services would respond to for example some did not cover paediatrics, suicides or threatened violence. Participants suggested that in the post-trial evaluation that there should be consideration of whether there should be a national recommendation in relation to this.

Some fire and rescue services were prescriptive in determining which calls they responded to. This was to ensure a sustainable workload on top of the other skills the firefighter has to maintain. For example, one participant described that their service responded to four call types only: cardiac arrest/at risk of cardiac arrest, unconscious, catastrophic haemorrhage and choking. These were agreed by the fire and rescue service and their local ambulance service as targeted areas of response for that fire and rescue service.

(d) Response models

Whole-time and retained stations participated in the trial. There were different models of response in evidence: in some areas the co-responder was in a car, in others a fire engine was mobilised. Most responded in crews or in twos but in some stations there were single responders. Single responders doubled up in the early days of the trial in one station for the purposes of sharing experiences and building up confidence. Teamwork has a long-standing culture in the fire service and moving to a solo responder model was considered a real obstacle. Because single responders are counter to active team maintenance, several fire and rescue services using this model provided another firefighter. In some cases the fire service paid for the second firefighter to attend which was seen as unsustainable in the long-term.

(e) Co-responding

'…effectively our personnel have taken over the basics of the resuscitation enabling the Paramedic to use their more advanced skills to administer drugs and not having to be doing compressions or managing the basics.'

The above description illustrating the expectation of the work of co-responding was reflected in similar contributions from other managers. People described different levels of involvement during co-responding in cardiac arrest situations. Crews have sometimes stood by depending on the number of resources dispatched to the event, but most frequently they have actively participated in scene management: moving the patient, assisting in resuscitation, assisting Paramedics with equipment. There was a general feeling that Paramedics are relieved to get the help in a cardiac arrest– the firefighters support them by taking over core activities such as chest

compressions enabling the Paramedics to focus on advanced airway management, drug administration, fluid management etc.

Some interviewees mentioned that there had been an impact on staff motivation when call volume reduced as they had been expecting consistent regular responding and it was not always clear why there was a reduction in call volume. For most services there was a point when the demand reduced and frequently there did not seem to be a recurrent pattern as to why these quieter periods manifested themselves.

(f) Inappropriate calls

It was noted that sometimes firefighters had been mobilised to inappropriate incidents. Some of the incidents that firefighters had responded to had placed them in difficult positions as it seemed that participants believed that firefighters prefer to be able to do something tangible. It was reportedly more stressful to be in situations where they felt they could not do anything practical to improve the situation. Firefighters can find it frustrating *'dealing with complex medical conditions which they can't fix and [they] struggle to understand the fact that all we're asking them to do is to ensure their condition doesn't worsen …. until the correct health professional is in attendance.'*

The contributor continued to describe the responses by the firefighter may involve basic observations and '*handholding'* which makes some staff feel awkward. He also raised staff concerns regarding their inability to respond to distressed family members during resuscitations and how some find supporting the family awkward, issues that were of concern to several interviewees. Categories of incidents that crews/individuals attended included: unconscious, stroke, breathing difficulties, chest pain, overdose, intoxicated persons who have 'passed out' and needed their airway maintained, suicide (hangings), broken leg, drownings, pub fights (with police in attendance) and, in one instance, delivering a baby. However, despite feeling somewhat inadequate in these types of cases, access to clinical support was available during incidents through telephone or radio contact to the ambulance service's clinical hub.

In another area, the fire and rescue service had been mobilised even if the ambulance service did not have an ambulance available. This was not part of the MOU but nonetheless, although infrequent, it reportedly did happen. Consequently fire and rescue service staff were sometimes mobilised to inappropriate incidents, which was not seen by interviewees as best practice especially if the calls were to patients where fire service staff felt they were unable to do anything meaningful to support the patient.

Another problem raised regarding inappropriate calls was the experience of having to wait for the ambulance to arrive, which on occasions was a long time. Some crews have used the time to talk to the patient and on occasions even fitted a smoke alarm. There was a feeling from several participants that staff prefer cardiac arrest calls as they can get in and do something useful like chest compressions, and then leave the scene as soon as they are no longer required – there was some attraction for some firefighters to jobs that were short in duration but high in intensity of activity; these were seen as more interesting than being involved in lower acuity activities such as safe and well checks. Although conversely there were examples given of staff preferring to be involved in some of the wider activities in terms of providing a variety of experience in role expansion.

(g) Non-emergency experiences

Attending lower acuity calls on behalf of the ambulance service involved carrying out certain clinical observations in order to help clinicians at the end of the telephone determine whether additional resources are needed to send to those patients. These observations included blood pressure, blood glucose and respiratory rates and were reported to the clinician in the emergency operations centre, who advised on further action. In one example, the patient was then referred to the local authority falls team. Repeat callers in some of the non-emergency calls are often older people, who are frail, lonely and socially isolated and interviewees frequently commented on the potential for the fire and rescue services to make a big difference from a humanitarian perspective to the quality of life for these individuals.

Training and development

'We use the ambulance service [for] clinical governance as they are the experts, and there is no statutory responsibility placed on us to respond to incidents.'

Because activities to ensure clinical governance were the responsibility of the ambulance services, stipulations were made on the appropriate training. A variety of training programmes existed for co-responding firefighters: some were delivered in conjunction with ambulance services, others independent of ambulance services, but these had nevertheless sanctioned by individual ambulance services. Minimum levels of training were required as part of the trial principles. Whilst that level was always in place, the extent to which co-responders had undergone further training was inconsistent across the different fire and rescue services.

Examples of training courses provided prior to co-responding and wider work:

- 2-day course for medical life threatening calls. Ambulance service 3-day course for immediate emergency care.
- Ambulance service familiarisation training, fire and rescue service base training and refresher training.
- First aid course plus additional regional training from ambulance services.
- Ambulance service course for clinical governance trainers to the prescribed level for competence in respiratory and cardiac arrests and life-threatening conditions.
- Defibrillator training with ambulance service input.
- Training to Intermediate Emergency Care level appropriate for community first responders. The ambulance service require a minimum of 2 day training for community first responders dealing with Red 1 and Red 2 calls on trauma incidents that are based on cardiac arrests and breathing difficulties.
- In one fire and rescue service, all staff receive medical training for emergency medical response. Extra training for the urban search and rescues teams was also given, which required specific training to a pre-defined medical standard.
- A 16-hour bespoke course that focuses on high quality CPR and defibrillation in addition to ICAT first person or senior casualty care award.
- Initial local training was provided by the ambulance service.
- Safeguarding Level 2 training.
- A local university provided training and on-going work with local nurse teams for follow-ups in non-emergency falls. (RSPH Understanding Health Level 2.)

- A 5-day course with a combination of immediate emergency care combined with community first responders' course that was clinically governed by ambulance service.
- 5 days training then 1 or 2 days of 'uplift' training (core principles of ambulance service, clinical governance, infectious disease control, moving and handling, patient record keeping, and CPR).
- Single day first aid course for all staff with extra defibrillator and oxygen training validated by ambulance service.
- 4 days training with experienced Paramedic.
- RNLI model of casualty care.

'I do think we need to look at our training for longer term.'

Training needs were seen to be a long-term issue, which was being addressed by the managers. Some areas provided on-going/refresher training, some in response to staff requests, which were also varied. New training courses were necessary to fit in with ambulance service changes and this could be problematic in that it might take a while before the firefighters could be updated to new policies or procedures. Working groups dealing with training were also in operation, as were feedback groups and training resources and it was through this system that additional training needs were identified such as managing grieving relatives; breaking bad news etc.

It was recognised that education and training was important to ensure firefighters felt comfortable and competent in their expanding roles but that there would be a significant cost attributed to delivery of on-going education and training and this needs consideration if the trial is to be incorporated into daily work expectations within fire and rescue services.

Preparation for staff

'…when their feet hit the ground, doing emergency medical response ….they've identified that we could have trained them better for different things.'

Participants' views on staff preparation were varied, as illustrated in the above quote. Training was considered adequate before going live, but once staff had engaged in the trial these experiences led to the identification of more specific training and education needs – in particular the need to be trained in dealing with relatives, Do Not Resuscitate orders and using 'softer skills'.

Confronting patients and relatives during inappropriate calls (those that firefighters were not trained to deal with) was flagged as problematic, as highlighted in previous section. Prior to the trial some staff went out on observation with ambulance crews to alleviate their trepidation. Dealing so frequently with non-traumatic death had not been fully considered and although staff were more familiar with dealing with traumatic death (fires and road traffic collisions), managing what was termed as '*benign'* death and the frequency with which staff were exposed to this was unanticipated. In the main there was a feeling amongst the participants that there was adequate post incident debrief support provided, which they reported was in contrast to their ambulance staff colleagues who, in the firefighters' opinions, appeared to be relatively unsupported in comparison. There was positive feedback from firefighters about the level of support they received in relation to managing traumatic situations, but a demand for more education surrounding the management of non-traumatic death and bereaved relatives.

Confidence levels amongst staff were said to have 'massively increased' since expanding the role of firefighters into gaining entry and co-responding, with a feeling that this work had also improved their confidence and skills when attending 'core business' calls such as road traffic collisions.

Relationship with ambulance service

'…not replacing the ambulance service, we respond alongside them.'

The above quote was a common theme reflected amongst participants in relation to co-responding. Co-responding provided an opportunity to break down professional barriers on the ground and understand more about the demands of each agency.

For some co-responders there was a mixed relationship with the ambulance service as, on occasions, the ambulance crews were unaware the fire and rescue service had been dispatched to the incident. Generally it was reported that, as the trial progressed, better relationships developed which was welcomed by both groups of staff.

A survey carried out in one area found the relationship with the ambulance staff was very positive and reported feedback from the ambulance service that the trial helped *'to realise how professional the crews are.'*

Similar praise from an ambulance service was echoed in another area where they had a positive patient outcome from a cardiac arrest: '*The net result of this superb display of teamwork, involving 10 people, each person with a specific role to play, was a return of spontaneous circulation on arrival at hospital.'*

There were few issues raised at front-line level but in some cases problems in communication at management levels affected teams on the ground. One ambulance service was seen as rigid and bureaucratic as they were more concerned with safeguarding training than appropriate medical training. This was considered frustrating as the start of the trial was delayed due to this. Tension was apparent with another ambulance trust as there was no effective internal communication, resulting in managerial information not getting to the shop floor. In this case, during the early days of the trial, ambulance crews were not informed of the fire and rescue service participation which did not aid relationships or collaborative working. Mistrust was noted with senior managers and there was tension over funding issues. However with time and considerable work from both agencies it appeared that these issues become less problematic as the trial progressed.

In several cases delays from the ambulance service clarifying the necessary level of medical care that affected equipment, training and skillsets hindered starting time for the trial. As mentioned earlier, problems also arose when some ambulance services participated in a national ambulance trial which re-categorised calls to red, amber, green and this impacted on the volume of calls to those fire and rescue services working with them. In one case, despite regular joint meetings, this was not communicated to the fire and rescue service and so was frustrating.

However, senior managers had regular joint meetings in some areas and were able to discuss and address the challenges for the trial. Meetings were held more regularly for some when compiling the Memorandum of Understanding and one area had established a committee to oversee the Memorandum of Understanding.

The fire and rescue services and ambulance services shared the same buildings in some areas, which was beneficial in developing relationships and appeared to facilitate quicker communication and developments within the trial. Sharing buildings was seen to have economic benefits as well as developing professional relationships.

Impact on core business

'Statutory responsibilities were not impacted on by provision of response to medical emergency'.

There were no reports of any statutory work directly affected by the trial. A priority to attend fire calls was paramount and protected. Processes were in place to ensure that the capacity of the fire and rescue service to attend fires was never compromised due to participating in the wider work and co-responding. Managers were aware of the product of their own success in firefighting: *'…fastest fire and rescue service to life-risk fires in the country, and obviously, we seek to maintain that, and that's why we've got some low fire deaths.*'

This success enabled the fire and rescue services to branch out into other areas of work such as co-responding, viewing this work as an asset to increasing firefighters' skills. The need to keep the identity of the fire and rescue service within the political climate and balance that with the need to embrace change in the firefighting rolemap was expressed. Also, based on experiences of some of the new work undertaken, operational management of the co-responding call outs will have to be considered carefully, otherwise there could be professional compromises as described by one manager in the following quote: *'[We] cannot get into a position where fire engines are 'babysitting' until ambulance turns up. We cannot get into moral dilemmas of having to leave vulnerable patients if called to [an] inappropriate call.'*

Protocols were in place which were followed rigidly and were essential to ensure staffing levels were able to respond to a fire incident. Primacy was reserved for the appliance and measures were in place if there was a problem.

Finance

'…should have had a commitment to the level of resources that was going to be required to actually make this happen right from the outset, from both sides.'

'Finance' was a section in the interview schedule, but clearly in conversation people were making a best guess rather than having specific detail so whilst this gives an overall idea of what things needed to be costed, caution should be given to the actual numbers per se.

Estimates of cost and financial arrangements were not standardised across the trial and they were varied and decided between the individual ambulance service and the local fire and rescue service. Not all participants gave full details and most of the expenditure is related to emergency responding. The following areas were identified as incurring costs and just give a general flavour of the differences:

<u>Training</u>

The different fire and rescue services approached funding differently. Examples were given where the ambulance service paid for training of the firefighters to ensure they had the appropriate skills to manage the agreed level of calls and patient presentations.

The scope of training, and how it was costed, varied between fire and rescue authorities. Managers gave a range of examples:

- £13,600 was the cost of training to one fire and rescue service.
- Driver training was an issue especially for the single responder.
- One fire and rescue service paid for all training including driver training.
- One fire and rescue service provided only driver training.
- One fire and rescue service spent £300,000 on training and still has 250 crew to be trained.

Additional call outs for staff/retention

Depending on which staff were involved in the co-responding (whole-time or retained) the costs of staffing also varied:

- Crews were salaried therefore no additional staffing costs.
- Wage costs were incurred with additional call outs.
- The fire and rescue service pays for the attendance of a second person at a co-responding incident, while the ambulance service pays for first person.

Hepatitis B vaccinations

Because it was a trial, the costs incurred for inoculations varied:

- Paid for by the fire and rescue service, £2900.
- Inoculation was not enforced during the trial.

Consumables

The ambulance service often reimbursed fire and rescue services for the disposable medical equipment, or just replaced them at scene.

Vehicles and fuel

Costs for vehicles and fuel depended on the model of co-responding:

- The single responder uses their own car, and mileage is reimbursed by the ambulance service.
- Ambulance service bought and insured two cars.
- The fire and rescue service provided a separate vehicle.
- Vehicles provided by both fire and rescue service and ambulance service.
- Ambulance service funded vehicle.

Equipment

Costs varied between fire and rescue services for equipment, for example:

- Blue lights and overalls cost one fire and rescue service £4350, although other areas had these provided by the ambulance services.
- Bag mask and valve provided for first responders by the ambulance service; the fire and rescue service provided defibrillator.
- The ambulance service paid for all equipment.
- The fire and rescue service provided all equipment.

Disclosure and Barring checks

Costs varied between fire and rescue services for Disclosure and Barring Services (DBS) checks, for example:

- Fire and rescue service paid £1549 for the checks.
- Ambulance service paid for DBS checks.
- DBS checks were already carried out before the trial.

Replacement staff costs

Managers were able to provide examples for a range of other costs that were also incurred, that were perhaps less obvious.

Examples of additional staffing costs incurred included:

- The project manager for the trial was not replaced in his current position. Applying for a replacement would have incurred more costs.
- Ten people were taken off operational duties for a week's training but there was no financial recompense.

Administration

Some additional administrative costs were identified, including the need for some staff compiling data for the trial.

Having an additional administration team for IRS (Incident Recording System) incurred extra costs.

General comments on costs

'What does a life cost?'

A powerful comment, and one which for decades has been impossible to answer. However what is clear is that health and social care agencies have limited budgets and services are constrained by costs. The same applies to fire and rescue services and the message was clear from the interviewees as illustrated in the following quote: '*If this is to become firefighting work in the future the NJC will need to address funding issues.*'

A number of interviewees made general comments about costs for the future, particularly if the trial is to become business as usual. For several fire and rescue services a cost recovery scheme with the ambulance services was in effect and funded as the co-responder scheme. Additionally some fire and rescue services are negotiating costs with other social care agencies in relation to wider work activities. Concerns were expressed regarding the financial implications of the scheme, particularly a need to be aware that if the service becomes free to ambulance services there will be implications with regard to responses: it was felt that it may not be sustainable if healthcare related call volume increases and the fire service has to absorb the costs of delivering this service.

Challenges

The challenges posed by co-responding and wider work were explored with participants.

(a) Staff terms and conditions

Because the trial has been extended, after a year in some areas the staff wanted remuneration for carrying out extra responsibilities. Some firefighters expressed their concern at their increased

responsibilities and pressure the trial had incurred, but at the same time there were more frequently reports that participating in this type of work increased staff enthusiasm and was seen as an attractive proposition in relation to professional development.

Disclosure checks were a problem, as some staff had not disclosed appropriately, and enhanced checks necessary for the trial delayed the start date. In some cases there were delays in DBS checks administered by the ambulance services that meant staff could not participate in the trial. This led to a staggered implementation amongst staff groups which was not viewed positively and so fire and rescue service managers invested time and energy in getting these elements resolved as quickly as possible so as to sustain their staff group's interest in participating in the trial.

There was mention in one fire and rescue service that retained staff with other responsibilities had difficulties with the volume of medical calls on top of fire calls, as they were unable to find time to rest. Despite being given flexibility to switch off the pager, some of these staff felt they had a moral obligation to their community and they did not want to do this. The notion of responsibility to their local community was clearly represented throughout the interviews as it appeared that fire and rescue service staff identify strongly with their local communities as frequently they live and work in the same area.

There was some confusion about the health risks to firefighters working more closely with the general public and there appeared to be no consensus about the need for innoculations/vaccinations such as Hepatitis B. It was felt by some participants that there should be a national standard for healthcare prerequisites just as there is within ambulance services.

(b) Inter-professional attitudes and barriers

At times it was felt that the ambulance services could have contributed more to the implementation of the co-responding, although equally there were reports of excellent collaboration.

The number of coordinators overseeing the trial in the ambulance service may not have been adequate in some cases which participants felt impacted on trial commencement dates or delayed resolution of issues that cropped up during the trial. In particular, areas of clinical governance were problematic at times especially if fire and rescue service staff were trying to seek advice and/or clarification of situations whilst on scene with the patient(s) and they could not access the support services in place (such as telephone clinical support because the lines were busy). On occasion this led to firefighter dissatisfaction with the support mechanisms as they were left not knowing what to do for their patient at that time.

One participant in one area spoke about how a *'collective concept of operations'* has helped to engage the ambulance staff, but mentioned that there are still cultural differences between the two services that are '*really hard to crack'*. There is work to be done as to how to blend the two services whilst maintaining distinct and unique elements present within the two professional groups.

(c) Political influences

Several interviewees raised the impact of local and national politics on the development of the trial. These were sometimes seen as obstacles in relation to whether or not the trial will be continued and ultimately become day-to-day business for fire and rescue services.

Some participants identified that some firefighters were reluctant to engage in the trial over concerns that the fire and rescue service might be seen as taking over ambulance service jobs, and some firefighters are apprehensive at the new responsibilities and fears around changes in the fire and rescue services. It had been challenging to engage some of these individuals in positive dialogue and action in relation to the development and implementation of the trial.

Some people reported that long standing opposition to co-responding has impacted upon the national negotiations, which has manifested in some local resistance to participation.

It appeared interviewees welcomed the initiative to produce this independent evaluation of the trial as participants unanimously agreed that the trial should become usual practice for fire and rescue services and they were interested to see whether other fire and rescue services were having similar experiences.

It was also apparent that in the early stages of the trial many ambulance service staff were unsure of the political influences on the implementation of this trial and expressed concerns to firefighters about fearing a 'takeover' of their professional roles. As time passed in the trial it appears that this fear subsided as it was clear that firefighters were working in support roles in healthcare and as reported earlier ambulance service staff welcomed this assistance identifying the positive contribution that the fire and rescue service staff were making to healthcare provision.

(d) Co-responding

I've seen more deaths in the last 6 months than I have in 15 years.'

Co-responding, compared to some of the other wider work fire and rescue services were conducting, had some specific challenges. As noted earlier, crews have been sent to inappropriate incidents. Conversely there have been missed calls to incidents. One fire and rescue service was concerned about the effectiveness of the mobilising system to triage incidents initially to the highest call category: these calls should then be downgraded as further information is gathered, but this was not happening which contributed to attending inappropriate calls.

There have been some incidents when crews were confused over 'Do not resuscitate' instructions. The guidance to firefighters was, if in doubt, proceed with CPR and contact the clinical advice line. In addition, participants reported that some firefighters had difficulty in recognising life extinct placing them in awkward situations. These situations have been traumatic for a few individuals, as is dealing with grieving relatives and delivering bad news. Although firefighters attend traumatic scenes in their own work these incidents are new and traumatic in a different way. *'We've not sent them before to people's houses to deal with mums, dads, brothers, sisters who are actively dying in front of their relatives'*.

Being dispatched to cardiac arrest calls and finding that actually the patient is alive and possibly not even meeting the criteria of a high acuity clinical presentation can be frustrating. At times firefighters were sceptical about whether they were just sent to random calls just to stop the clock. One fire and rescue service sent their staff to spend time with call-takers to see how patients are triaged. This demonstrated that, on occasions, telephone triage is difficult and is not always an exact science especially if the caller is giving less than accurate information which can result in an inappropriate call priority being allocated to both ambulance and fire service staff.

A separate issue arises for firefighters attending Red 2 incidents. There can be a longer waiting time for ambulances to reach Red 2 incidents depending on how busy the service is at the time, and this can mean crews/individuals staying longer at the scene sometimes in situations which the firefighters perceive as uncomfortable as they do not know what they can do to assist that patient. One crew waited with a patient for three and a half hours for an ambulance, although this is the exception rather than the rule. In another fire and rescue service there was a case where the firefighters were left waiting with a patient and were unable to get through to the ambulance service's clinical support desk as it was busy. The firefighters decided to transport the patient to hospital despite that being against the advice and guidance they were given. It must be said that in the serious adverse event investigation that followed this decision, it was identified that this action probably saved that patient's life, however the manager was clear that they needed to make sure systems are in place to prevent that happening again - *'it was a positive outcome, but it's something that we want to avoid at all costs.'*

Finally, mobilisation caused problems with time delays as some retained firefighters had to collect the vehicle from the fire station after they had been contacted to provide an emergency medical response. This meant that the response time to the call was unnecessarily protracted. Again there are different models in different fire and rescue services as some retained staff take the vehicle home with them as they are 'on-call', which subsequently reduces their response times to on scene. Looking at models across the UK to establish best practice is essential to ascertain a best fit mode of response to improve on scene times, which subsequently may impact on patient outcome.

(d) Personnel issues

Responding to forced entry calls and co-responding has exposed crews to far greater levels of death than previously. Various welfare assistance programmes and strategies have been established by fire and rescue services to deal with the effect. These include referrals to the occupational health service, debriefing services and raising management awareness of such issues. In addition, in one fire and rescue service operational decisions have been made, following a run of traumatic incidents, not to send crews out until they had sufficient periods of recovery both physically and mentally.

Safeguarding issues have also been noted in co-responding, and in one fire and rescue service led to a review of training and an airwave radio for co-responding crew.

One fire and rescue service reported that crews would rather work in pairs, possibly reflecting the impact of the fire and rescue service 'watch culture'. That said, it helps to have one person deal with the relatives at the scene, whilst the other deals with the patient as they can support each other. Watch culture was clearly viewed as beneficial and supportive by the interviewees with people expressing that working closely in a team can result in confidence building.

Staff confidence was reported to have improved for those participating in the trial and anxiety dissipated as the trial progressed. Some fire and rescue services also noted that co-responding helped to retain and recruit staff as it was reported that staff wanted to be more involved and active during a shift.

As alluded to earlier, one area of concern is that, through expanding the role of firefighters, they have been exposed to more death than in their standard work but in a different context, leading

to concerns around their psychological welfare. Many of the cardiac arrest calls are to elderly people, frequently in their late 80s and 90s who have multi pathology and often reduced chance of survival. Equally, firefighters reported struggling with the decision of having to resuscitate these patients especially if they were frail – the notion of 'futile resuscitation' is a concept that ambulance staff are well acquainted with but firefighters less so. Strategies and services have been expanded to address and support staff with some of these more sensitive issues that they are being faced with.

Value to the community

Some areas had media publicity to launch the trial, while some felt the public have not had enough information about the trial and are still surprised when a fire engine turns up to an incident.

Fire and rescue services did not report any negative feedback from the public, and felt that people did not care as long as they were getting a medical intervention. One fire and rescue service had conducted some consultation with the public, and found that although people were comfortable with co-responding, they did not want the service to compromise on its statutory duties. However, another fire and rescue service reported instances when the public have been confused about fire crews attending, particularly when the incident is dealing with something like a stroke and the crew are unable to do anything other than 'handholding'.

Small, close communities, which are more isolated, rely on the co-responding service more than larger communities with a good infrastructure for health and social care. Participants report that many service users have recognised that firefighters are saving lives through the co-responding scheme and frequently participants identified that the public state they do not mind who turns up as long as someone helps their friend and/or family member – especially if they are in cardiac arrest. Firefighters often live in the area they are co-responding in so are known to the local public, which is beneficial but can also be stressful especially if the patient's outcome is poor.

Moving forward with the scheme

All participants saw a future for expanding the roles of firefighters but many expressed some demands in order to ensure it is sustainable. The future of the scheme is complex and dependent on a national agreement. Other factors are influential such as the review of the ambulance response times. There is an acceptance amongst participants that there will be some medical response in the future, and all can see a role for such a scheme because of the massive demand on ambulance services and their call volumes; but there was recognition that there has to be a balance so fire and rescue service priorities are not compromised.

It was suggested that skillsets may not have to be developed further than 'first person on the scene intermediate level' as Paramedics will arrive to provide clinical care; and one respondent suggested it might be helpful to contract an occupational doctor to provide the fire and rescue service with its own clinical governance.

There was a suggestion that relationships with ambulance services will have to be more closely aligned should co-responding become business as usual. Also there would be a need to develop relationships with other agencies such as clinical commissioning groups, local health services, local authorities and health and well-being boards to advise the fire and rescue service on the wider

work they could usefully undertake. Some stations already offer a range of services such as telecare and falls recovery services that could be commissioned. Fire and rescue services already respond to miscellaneous incidents, so the view of some respondents was that adding emergency and medical response would not be a 'great leap' and should not impact on the budget. Working with representative bodies to identify longer-term ambitions for the fire and rescue service was suggested as a step forward.

There is a drive by fire and rescue services to work more closely with a variety of other health and social care agencies apart from ambulance services, as the role of firefighters has changed. A number of participants felt the new work should be part of a contractual agreement, and that clarity is needed from a national level on the rolemap of firefighters.

Finally there was a view from some that funding for the expanding work will have to be guaranteed and adequate.

Overview

Interviewees felt that participation in the trial became easier as staff became more confident and gained more experience. Working in teams was helpful as this is part of the fire and rescue service culture. Responding to traumatic situations within a different environment to usual fire incidents raised different stresses, as there was more exposure to death. Some areas had problems with mobilisation for three reasons: system problems related to misunderstanding for call handlers; teams were mobilised to inappropriate calls; and, some ambulance trusts participated in a national trial which affected categorisation of calls and reduced the demand for responding from fire and rescue services.

Generally speaking managers thought staff felt positive about participating in the activities. Training courses had provided opportunities to develop new skills that they were keen to utilise. Retained staff were usually located in their communities and were positive about their contribution to the community in which they live. Following changes in ambulance service categorisation of calls, staff in some areas were disappointed that they were not utilised as much in the latter stages of the trial. The biggest concerns highlighted by staff were:

(a) The difficulties experienced with relatives following fatalities. Staff sometimes felt unprepared and untrained for this aspect of the work, although some staff were able to respond very well in these circumstances.

(b) Being dispatched to inappropriate incidents where they did not have the necessary skills to support the patient.

(c) Waiting for an ambulance to arrive and having to provide care they were untrained for.

Managers provided support for staff in respect of the exposure to more 'benign' death and in some instances provided training courses on how to deal with grieving and bereaved relatives. Liaison meetings with the ambulance service raised the issues regarding inappropriate calls in some areas. Waiting times for ambulances to collect patients reflected the demand on ambulance services.

Ambulance services and the fire and rescue services were the major funders for the activities. Often both of these services jointly financed the activities. Protocols and standards for training

were mainly established by the ambulance service, which caused delays in some instances. In a minority of cases other streams of funding such as clinical commissioning groups and the Fire Transformation Fund had made contributions. Responding to emergency incidents was reported to be a cost mutual arrangement for some areas with a proviso the crew arrived at the scene within a specified time. Each area had different experiences, needs and expenditure. Hidden costs, particularly relating to staff who were managing the projects were identified. Overall there was a general view the activities were benefitting patients and assisting ambulance services without encroaching on the 'core business' of the fire and rescue services. Other activities such as Safe and Well checks were being expanded and in some cases verging into the domain of other health and social care services. Future plans were being made to provide commissioning services with new partners.

National agreements, political pressure and the cooperation of other professional bodies are most influential in the way forward for these activities. Participants acknowledged the scheme has been welcome but felt that if it is to continue it will need support from the Fire Brigades Union and the ambulance services' trade unions. Crucially, participants also recognised it would need adequate funding and political support. Alongside this there was an acknowledgement that fire and rescue services have to move forward and embrace change without compromising their statutory duties or identity and whilst retaining autonomy.

Summary conclusion

- Overall the participants unanimously agreed that this type of work should continue for fire and rescue services.
- There was clear recognition that this work must not impact (and has not impacted) on fire and rescue services' 'core business'.
- Different areas participated in the trial in different ways depending on their location and local agreements.
- There was no standardisation of training, although agreed minimum levels appeared to have been achieved.
- Models of dispatch varied between fire and rescue services, and there was no consensus on an ideal model for response to calls.
- There was no consensus as to which calls fire and rescue services should attend, although there were indications that staff were more interested in Cat A Red 1.
- Funding arrangements varied between different co-responding and wider work agreements.
- Some fire and rescue services expressed concerns over the management of clinical governance.
- There was a general perception of improved relationships with the ambulance service and inter-professional working which spread beyond the trial activities.
- Participants noted co-responding had also led to the improved confidence of fire and rescue service staff at fire service incidents, such as patient management at road traffic collisions.

- There was some recognition that firefighters understandably lacked knowledge about the complexities of patient assessment and that targeting staff to a narrower focus of patients might enhance clinical competence and confidence rather than spreading staff across a much wider range of patients with complex clinical presentations.
- Fire and rescue services were mainly involved in co-responding incidents; some fire and rescue services reported wider work in the interviews, but those who did identified that activities were verging into clinical preventive work such as Safe and Well checks and prevention and management of slips, trips and falls.

Vignettes of wider work activities

There were many different examples of participation in wider work beyond co-responding to high acuity calls. Some examples are presented here and several more excellent examples can be found in the Local Government Association's (2015b) publications '*Beyond fighting fires: the role of the fire and rescue service in improving the public 's health*' and the 2016 publication '*Beyond fighting fires 2: fire and rescue service transformation'.*

Vignette 1

Support for non-emergency falls and wider health and wellbeing checks.

Safe and Well Checks

Safe and Well visits had been in place for 12 months in this fire and rescue service targeting the most vulnerable people in the community who were identified in a referral pathway by social housing groups, local councils, the ambulance service or the police. A visit is booked and the person is visited by the crew on duty. The checks are a standard safe and well visit and now include some road safety advice which will include tyre tread depths. This fire and rescue service works with Age UK and is exploring new areas to expand this work. They are considering doing safe and well plus checks which will be a commissioned service.

Non-emergency falls

This commissioned scheme had been running for 44 weeks in two geographical areas covered by this fire and rescue service. In one area there have been 470 incidents; the other has been operating for 30 weeks and has had over 1,300 incidents. The 'patient' wears a telecare pendant that is activated by the individual if they fall. They are then connected to a local handling centre who alert the local fire and rescue service. The fire and rescue service will respond within 40 minutes. Clients tend to be elderly, frail people who have social care packages. Some firefighters have found dealing with this aspect of work difficult because it is dealing with people at end of life as opposed to an emergency. In order to address this, training sessions have been organised by the local university's Faculty of Health, with additional work with local care nurse teams. If there is any indication of a medical condition causing the fall, then an ambulance is called.

Working with the ambulance service the fire and rescue service identified specific kit necessary for this work. Equipment for lifting has been acquired and new techniques have been developed. Three fire and rescue service crew members will attend the call. Staff are mostly positive about participating in this work, as they believe that rescuing someone within 45 minutes gives a better recovery outcome than if a person lies unattended for 3 hours or more – and certainly with some clinical presentations that is the case. There has been *'no detrimental effect on our responses to fires*.' A number of callers did not have a fall and were elderly frail, lonely and isolated people who knew that someone would come and have a talk to them, and several of these were repeat callers.

Vignette 2

Multi-agency vulnerability assessments.

The multiagency vulnerability team, a relatively new project, involves health, fire and police representatives who carry out multi-agency vulnerability assessments in respect of prevention and protection with a view to identifying vulnerable people before the emergency services are contacted.

Another similar project, running for 18 months in a deprived area that is jointly resourced with health, is focussed on improving the safety in houses. The aim of this project is to reduce the demand on the public services as there is a high level of crime, fire activity and ambulance activity in this geographical area. Managers felt that staff enjoy this work in a multi-agency context as they are making a home safer, healthier and more secure. Links with health centres have also been made, where staff can refer patients for a check. These principles will be incorporated within the traditional home fire safety checks in the future.

Vignette 3

Safe and Well Checks.

The content of this fire and rescue service's Safe and Well visit, and the subsequent referral pathways and training package that underpin the delivery, was devised by a working party that included local NHS Trusts, local authority public health and social care teams and Age UK.

This is seen as beneficial as it is a collaborative venture which has informed service provision based on expert opinion and guidance – both in relation to the equipment used and the advice given by fire and rescue service staff during Safe and Well visits. These subject specialists have also provided staff with appropriate education and professional development to ensure the effective implementation of these visits.

This fire and rescue service is developing an evaluation programme in conjunction with their health and social care partners to assess cost efficacy and effectiveness of the services that are being provided.

Safe and Well checks also include warmth assessments and provision of risk reduction equipment. Fall at rest equipment can be provided, such as non-slip mats, non-slip adhesive pads to go under chair/bed castors, and touch lights to make a person safer particularly at night. Also included in the Safe and Well checks are dementia awareness, alongside alcohol harm and reduction, smoking cessation and general wellbeing.

The area served by this part of the fire and rescue service is deprived and targeted for supportive education for this reason, as incidents of fire are linked to alcohol misuse, heavy smoking, drug use and social deprivation. They aim to do around 11,000 safe and well visits per year in areas with individuals who are known to be vulnerable. In addition to their firefighters they have access to staff who are expert in disability issues and are experienced working with individuals from ethnic minority groups who may have additional needs. Referral criteria are clear, as is the criteria for

intervention in relation to the provision of risk reduction equipment. An assessment is made and then, if needed, a referral is made to an appropriate agency. Staff are participating in this work *'providing we've got the training*'. Anecdotes of the help provided has been given by the crews for example in one instance a lady was *'absolutely freezing to death'* as she couldn't afford to fix her boiler. Firefighters examined her boiler and discovered she had turned the thermostat down and had been living in the cold for several months. They now call in every two weeks to check on her.

The director of a health service provider recognised the benefits of these checks, which are estimated to cost £10 per household, and agreed '*right, you are going to do 10,000 at £10 … that's £100,000, so that equates roughly to about three broken legs…this makes complete economic sense that we actually fund this.*'

Vignette 4

Out of Hospital Cardiac Arrest Strategy (Scotland).

'It is much wider than co-responding'

The Out of Hospital Cardiac Arrest (OCHA) strategy produced by a broad range of stakeholders, arose out of a report by Her Majesty's Fire Service Inspectorate who investigated arrangements in the (Scottish) Fire and Rescue Service and involvement for medical emergencies and partnership with the (Scottish) Ambulance Service. The purpose of the report was to consider *'maximising opportunities to contribute to community safety, by the acquisition and use of defibrillators and other medical equipment, in collaboration with the (Scottish) Ambulance Service*.' The (Scottish) Fire and Rescue Service pledged its commitment to the OCHA strategy and commenced working in partnership with the (Scottish) Ambulance Service in co-responding trials to out of hospital cardiac arrests. The trials were launched in November 2015 and coincided with European Restart the Heart Day.

Another aspect of the (Scottish) government strategy was to 'reduce the inequalities' in relation to health and social care. As a consequence the (Scottish) fire and rescue service is including the provision of CPR training as part of the home fire safety programme. This has been rolled out in three towns that have been evidenced based from the (Scottish) Ambulance Service in a partnership with the British Heart Foundation and there are rescue kits in every fire station. Members of the public are encouraged to come to the fire stations to receive CPR training from the staff. A launch in November 2015 at a local school was used to promote this service and there are plans to introduce CPR training into the school curriculum across Scotland.

Vignette 5

Attending non-injury falls on behalf of the ambulance service.

'A bespoke team' '

'…. putting a smile back on people's faces'

Calls for people who have fallen, without injury who cannot get up come through either 111 or the 999 service and are triaged at source. Once identified as a non-clinical fall with no injuries the fire

service are mobilised to attend. When the firefighter(s) get on scene, they undertake clinical observations such as blood pressure, blood glucose, and respiratory rates. These are relayed to the clinician over the phone at the clinical hub, who asks further clinical questions if required. Once given authorisation by the clinician, the firefighter is then able to move the person to a place of safety and if appropriate refer them to the local authority falls team's urgent care practitioners. If there are any doubts about the clinical presentation of the patient, an ambulance is dispatched.

Besides being able to refer to the local authority falls team, facilities are available to put resources in place as firefighters are being trained to fit support rails and other falls prevention equipment as required.

Another route for referring people who have fallen without an injury falls is through a social enterprise such as City Health Care Partnership. Calls generally come from clinicians, nurses, or domiciliary care nurses. On average there are one and half calls a day, but recent arrangements with Telecare have increased the numbers slightly.

Training is given to the crew who volunteered for this work that they '*hugely enjoy*', particularly because they make a difference to people's lives. It is harder with these types of calls to provide accurate evidence for cost effectiveness, but as discussed earlier (page 25) there is significant evidence that preventing falls in the elderly and avoiding fractures such as neck of femur could improve both mortality and morbidity in the over 65 age group.

Calls are responded to, on average, within 17 minutes from when there call is received. It is a bespoke team for falls and co-responding.

Overall summary and conclusions

This evaluation has collected and/or analysed a vast amount of information and generated substantive primary data from the various research-streams.

Overall, the potential for impact on patient outcomes is greatest in two key areas:

> ***Cardiac arrest*** – fire and rescue services co-responding to time-critical events like cardiac arrest can provide meaningful improvements in patient survival, provided staff are trained and are taking the appropriate action; getting on scene first is not enough by itself.
>
> ***Wider work*** - the qualitative data indicates strongly that there is support from staff to expand this work, and that there is potential need from members of the public especially those who may be elderly, isolated and/or vulnerable. However, there is insufficient data from this evaluation to estimate the net benefit.

These findings support co-responding but we were not able to identify a single model of co-responding which is most effective. This report shows that co-responding to time critical events is associated with substantial net benefit, and it is likely that focusing on these types of incidents will offer the greatest *value-per-incident*, or cost efficiency. Responding to a broader range of incidents may increase *aggregate* benefits, but it is not clear that the benefits of responding to less urgent incidents will always outweigh the costs.

There are international examples demonstrating the effectiveness of utilising a proportion of the capacity within the fire and rescue services for medical response enabling earlier response to serious medical cases such as cardiac arrest. This option could be expected to have the greatest positive impact on response time performance, an important factor for patients with serious illness or injuries. It would, therefore, be likely to increase the number of lives saved (NHS Executive, 1996), per year; a more precise estimate may well be possible with additional research. There are also a number of other potential benefits, such as drawing upon the fire and rescue services' success with prevention and other aspects of collaboration (Mansfield, 2015).

Based on the NJC incident data and the paired response single-county dataset, the fire and rescue services are able to reach overall incidents before ambulance services in 62% of cases, and in the time-critical incidents such as cardiac arrests they appear to be arriving on scene sooner than the ambulance services in around 93% of cases as seen in the single county paired responses. It is important to note, however, that these results are not necessarily representative of all jurisdictions but it is a good indicator of trends.

As noted in Research-stream A, we were unable to estimate the aggregate costs of co-responding due to non-reporting from many services, but Research-strand B demonstrates that the benefits of co-responding are substantially greater than the costs, with a return on investment of £5.67 and £14.40 per £1 invested. Co-responding also appears to be highly cost-effective in terms of generating health gains, with a cost of £1,302 and £3,041 per quality-adjusted life year (QALY) gained. This is far below NICE's threshold willingness-to-pay of £20,000 per QALY gained. Net benefits were greatest for 'time critical' incidents, but benefits were positive and favourable even

when all co-responding events – including those that were not associated with survival gains – were considered, and in a sensitivity analysis where we doubled the costs of co-responding to allow for uncertainty. In this respect, the economic justification for co-responding appears conclusive.

This study has identified key areas for future evaluation which need to be considered when making decisions about the way forward.

Recommendations

- Support co-responding with ambulance services to targeted cases such as cardiac arrest and potentially other cases that are immediately life-threatening, such as respiratory arrest, convulsions, severe haemorrhage (both traumatic and medical cases) and other patients at high risk.
- Explore the potential to expand the work in Safe and Well checks including work in prevention such as slips, trips and falls; dementia awareness; and other activities.
- Change the fire and rescue service's incident recording system of data collection to use definitions and categories aligned with other databases, allowing more specific and sensitive analysis of patient presentations such as those used by the ambulance service. This would enhance any audit of responses to specific patient conditions, and would facilitate future collaborative research between ambulance services and fire and rescue services.
- There is an argument for developing some 'exemplar' sites of best practice, where a strong commitment to research and evaluation can help drive the most effective models that positively influence patient care.
- Establish work streams that can help to promote national standards in training and equipment, in order to reduce the danger of wasteful duplication.
- Consider how, through mapping the mobilising arrangements, it might be feasible to reduce the time to fire and rescue service activation.
- Undertake further research to include examination of definitive impact on patient outcomes of interventions by the fire and rescue services so as to accurately identify cost efficacy, as well as humanitarian benefits of the expansion of roles of fire service employees.
- Collaborate with the NHS nationally and local authority public health teams to ensure that fire and rescue services are integrated with strategic health plans and also contribute to regional and local public health needs assessments and wellbeing initiatives (including Joint Strategic Needs Assessments).
- Ensure that individual fire and rescue services work with local NHS Strategic Transformation Plans and consider if direct commissioning of fire and rescue services for co-responding and involvement in wider health work is the most appropriate way forward to ensure these activities are fully funded and embedded in appropriate clinical governance structures.

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Appendix 1:

Literature Review: Policy Context

Introduction

The purpose of this section is to provide a policy context for current developments, including in broadening the role of uniformed fire service employees.

Policy context

Key messages arising from the policy literature

- General consensus that further blue light collaboration amongst the emergency services is both possible and highly desirable.
- There are already many examples of collaboration.
- There is no consensus on a national model for inter-service collaboration.
- The lack of "fit" between the number and boundaries of emergency services could be a practical barrier to effective collaboration.
- The LGA in particular is opposed to a statutory duty to collaborate which specifies only other emergency services, stating that this could stifle innovation.

There are currently 45 fire and rescue authorities in England, consisting of six metropolitan authorities; 23 combined authorities; 15 county authorities; and the London Fire and Emergency Planning Authority (LFEPA), a body of the Greater London Authority. This compares with ten NHS ambulance trusts in England, and 39 territorial police forces. In Scotland there is one fire authority, the Scottish Fire and Rescue Service Board; alongside the single Scottish Ambulance Service and a single police force. In Wales responsibility of the three fire services lies with the Welsh Government, and there is one ambulance trust and four police forces; whilst in Northern Ireland the single fire service is responsibility of the Northern Ireland Government, and there is one ambulance service and one police force.

The current legal responsibilities of fire and rescue services are set out in the relevant Acts:

- Fire and Rescue Services Act 2004 (for England and Wales)
- Fire (Scotland) Act 2005
- The Fire and Rescue Services (Northern Ireland) Order 2006.

But they can be summarised as follows:

- Responding to fires, road traffic accidents, and other emergencies
- Contributing to national resilience (collectively being able to respond to up to four simultaneous national-level emergencies)
- Undertaking preventative activities to reduce the risk of fire
- Carrying out safety inspections of business premises.

Fire Statistics

The number of fires has been falling steadily for at least the last 15 years. Fire Statistics for England 2014/15 (Home Office Statistical Bulletin 08/16) show that there were about 496,000 incidents attended by fire and rescue services in 2014/15, compared with 1,016,000 incidents attended in 2003/04. Similarly, in Wales between 2005/06 and 2014/15 incidents dropped from 53,000 to 36,000; and in Scotland they dropped from 104,000 in 2009/10 (the earliest for which this equivalent data is available) to 85,000 in 2014/15.

This fall can be attributed to a variety of causes, including better building standards, foam filled furniture regulations[6], greater safety of electrical and gas devices used in the home, and effective work by fire and rescue services to improve public knowledge of fire and related risks and to help vulnerable people manage their risks more effectively.

However, there are some reasons to think that in future this trend could stop or go into reverse. Among the reasons why this might happen are: climate change, and a consequent increased frequency of natural disasters including flooding; and increasing poor safety standards as a result of overcrowding in domestic premises (frequently in Houses of Multiple Occupation (HMOs) in the private rented sector).

Funding of Fire and Rescue Services

In common with all local authorities, fire authorities have recently faced large reductions in funding. In England the National Audit Office (NAO) estimates that between 2010-11 and 2015-16, funding for stand-alone fire authorities fell on average by 28% (National Audit Office 2015). Once council tax and other income is taken into account, stand-alone authorities received an average reduction in total income ('spending power') of 17% in real terms. Similarly, in Scotland, the Scottish Fire and Rescue Services budget has been reduced by 31 per cent in real terms against the 2012/13 budget of its predecessor eight regional brigades (Audit Scotland, 2015); and Wales and Northern Ireland Fire Services have also seen reductions.

As a result, UK fire authorities are working to reconfigure their services to make efficiencies with minimum impacts, particularly on emergency response configuration and on response times. In general, when making budget reduction decisions, fire authorities have tended to protect appliances, but reduced numbers of firefighters and other staff and, recently, reduced the number of fire stations. The NAO reports that, in England , *"Fire control, non-uniform and senior firefighter managerial posts have seen the largest reductions in numbers, but numbers of non-managerial whole-time firefighters have reduced by around 14% from 2010-11 to 2014-15".* Scottish Fire and Rescue Service (2016) statistics also demonstrate reductions in numbers of staff and stations in recent years; while the Welsh Government (2016) statistics show the number of stations has remained roughly similar to the early 2000s, but the number of operational staff has reduced.

Impact on Fire Prevention Activities

The NAO reports that fire and rescue services in England have reduced their prevention and protection activities, but that there is little evidence on how this might affect the future number of fires and other emergencies. The NAO estimated that audits and inspections fell by 30% from

[6] http://www.legislation.gov.uk/uksi/1988/1324/contents/made

2010-11 to 2014-15, and personnel hours spent on home fire safety visits and other fire risk checks fell by 27%. Figures from Wales show that hours spent on community fire safety activity has also reduced since the late 2000s, although it is still much higher than in the early 2000s. In Scotland, however, the personnel hours spent on home fire safety visits since 2010-11 has increased by 36%, according to Scottish Fire and Rescue Service (2016) statistics.

Collaboration between Emergency Services

Sir Ken Knight (then the Government's Chief Fire Adviser) was commissioned by the previous Government to report on the future of the fire service in England. His report, "Facing the Future" (2013), considered reducing the number of fire services through merger and co-working with ambulance services. It also suggested further major change options, including merging fire and rescue services with other blue light services; sharing governance structures with other blue light services; and improving co-ordination between Government departments with an interest in fire and rescue functions.

The Emergency Services Collaboration Working Group published a report (2014) "*Emergency Services Collaboration – the current picture*". The working group included senior members of the Association of Ambulance Chief Executives (AACE), Association of Chief Police Officers (ACPO), Association of Police and Crime Commissioners (APCC), College of Policing, Chief Fire Officers Association (CFOA) and the Local Government Association (LGA) on behalf of fire authorities. The report identified a number of examples of collaborative working already in existence, including combined fire and police stations in Norfolk and Suffolk; and a new combined police and fire training facility in County Durham.

In September 2015, DCLG, the Department of Health and the Home Office issued a consultation document on closer working between the emergency services in England. The document discussed the potential for further *"blue light collaboration"* and proposed a new duty on all three emergency services actively to consider collaboration opportunities with one another to improve efficiency and effectiveness. Similarly, in spring 2016 the Scottish Government consulted on the Fire and Rescue Framework for Scotland 2016, in which they outlined their expectations that "The Scottish fire and rescue service should continue to investigate options for sharing premises, assets and services with partners, including Police Scotland and the Scottish Ambulance Service where it could help protect public service provision within a community or contribute to better local or national outcomes." The Northern Ireland Fire and Rescue Service are currently consulting on a proposal to "explore opportunities for collaborative working with Health & Social Care (HSC) Services".

On 1 October 2015, NHS England, Public Health England, the Fire and Rescue Service, Age UK and the Local Government Association published a "Consensus" document (NHS England et al 2015) setting out how the organisations would work together to encourage local action to prevent or minimise service demand and improve the quality of life of people with long term conditions. Firefighters across the country will aim to carry out more 'Safe and Well Checks' in people's homes when they visit, extending the existing home safety checks (which number about 670,000 a year) into a 'Safe and Well' visit to support vulnerable people and those with complex conditions, by reducing fire risks and aiming to minimise health risks such as falls, loneliness and isolation. This is

intended to reduce visits to Accident and Emergency departments, and the incidence of broken hips and depression.

In 2015-16 the DCLG distributed £75 million to English fire authorities through a Fire Transformation Fund[7], which could be used to set up fire stations to be jointly used with other "blue light" services.

An example of current collaboration between emergency services is a joint project of Surrey Fire and Rescue (Surrey fire and rescue service), East Sussex fire and rescue service, West Sussex fire and rescue service, and South East Coast Ambulance Service (Surrey County Council, 2015). Early deliverable projects between emergency services in Surrey have gained national recognition, with Surrey partners being presented the Gold Award for 'Working Together' at the Improvement and Efficiency Social Enterprise (iESE) in March 2016.

In September 2015, through the auspices of the NJC, Surrey Fire and Rescue Service launched a county-wide trial co-responder scheme under which South East Coast Ambulance Service NHS Foundation Trust (SECAmb) can request deployment of the fire service personnel to particular health emergencies in the community, such as cardiac arrests. The co-responding trial has provided over 300 Surrey fire and rescue service personnel with training in emergency and trauma care skills. Additional medical equipment, including defibrillators, has been provided on all fire engines, managers' cars and four wheel drive vehicles.

Under the separate 'wider work trial', Surrey fire and rescue service has taken on responsibility from Surrey Police to respond to calls from SECAmb to gain entry to properties where there is a concern for the safety of the occupant. Surrey fire and rescue service is able to respond within 10 minutes on average, can usually gain access with less damage to property and can free police resources for other urgent calls. The missing person's pilot scheme allows Surrey fire and rescue service and SECAmb to help the police search for high risk missing people, who are often the very young, very old or those with a potential mental capacity issue.

Mergers of Fire and Rescue Services

From 1st April 2013, a single national Scottish fire and rescue service was formed as the result of an amalgamation of eight fire services in Scotland. There have been two recent mergers of fire and rescue services in England: between Devon and Somerset fire and rescue services in April 2007, and Dorset and Wiltshire in 2016. Some fire and rescue services have combined control centres: West Midlands and Staffordshire; Cambridge and Suffolk; East and West Sussex and the North West Fire Control which covers Greater Manchester, Lancashire, Cumbria and Cheshire.

[7] https://www.gov.uk/government/publications/fire-and-rescue-authority-transformation-funds-for-2015-to-2016-bids

Conclusions

The following conclusions are supported by the evidence cited in this section:

- The number of fires and other emergencies has been falling, but could start to rise again in future.
- The number of other emergencies for which the fire and rescue service have at least partial responsibility is likely to rise, particularly those associated with climate change such as flooding.
- Collaboration between fire and rescue services and other blue light services has wide support inside the fire community, in other emergency services and in Governments, and there are some important examples of collaborative working at both leadership and service delivery level.

What key players are saying

Current Blue Light Collaboration

AACE, ACPO and CFOA produced a joint statement on blue light collaboration in the United Kingdom (February 2014). They agreed that:

- All three organisations are keen to support innovative approaches to service delivery.
- They welcomed the Government's commitment to 'improved integration of local emergency services' and the debate this opens regarding a more coordinated approach to the delivery of blue light services.
- They supported the Government's commitment to a local approach in public service provision, and said that emergency services should have the freedom to integrate and collaborate in a way that meets local needs. *"Any attempt to integrate services without a sound evidence base may meet with fierce local opposition"*.
- The emergency services would work to remove barriers to change and help ensure that all emergency services are informed of the costs and benefits of various models.
- They would encourage the sharing of estate wherever this is practical.
- They would explore how fire and rescue services and police might contribute further in terms of co-responding with the ambulance service.
- They would build on the existing levels of joint emergency service training and exercising which takes place on a local, regional and national level.
- Both ACPO and CFOA recognised *"the paramount need for the Ambulance service to remain an integral part of the NHS where it will play an increasing role in the provision of Urgent and Emergency care"*.

Importantly, at the Fire Brigades Union Conference in the following May 2015, the union members themselves voted to change their previous policy position, which was to oppose co-responder and first-responder schemes being introduced in an ad hoc manner at local level. Instead, they agreed to continue the discussion at national level on emergency medical response, and engage in trials subject to NJC approval (Fire Brigades Union, 2015a).

Then AACE produced a report in September 2015 titled *"A vision for the ambulance service: '2020 and beyond' and the steps to its realisation"*. The document did not include any specific reference to collaboration with other emergency services. However, it did provide a relevant description of different broad categories of ambulance service work into the future, including: navigation and coordination (single 999 and 111 clinical hub); diagnostics; and, where required treatment and transport.

The document also states that: *"Delivery of care within the home environment will increasingly become the norm for the ambulance service with a vast reduction in hospital conveyances; transport will cease to be the default option for clinicians. The advancement in Paramedic training and enhanced skills sets will ensure this can be achieved safely and competently and to the benefit of patients and their families"*.

Individual ambulance services have produced more detailed summaries of the extent and future of collaboration between emergency services. For example, Adrian Healey, Head of Tri Service Development for the South Western Ambulance Service NHS Foundation Trust, presented to the LGA Fire Service Conference on 9 March 2016 (Healey, 2016). He reported 45 volunteer-based co-responder schemes across the region (with five more schemes in development); joint service estate sites, including dispatch points and fleet workshops and a tri-service station. He predicted future estate strategy alignment between services; expansion of tri-service response; Paramedic integration; regional Emergency Service forums; and joint community support and prevention schemes. However, he also pointed out practical issues that might affect collaborative efforts. For example, his Trust is required to deal with six fire and rescue services, five police services and 12 Clinical Commissioning Groups.

Government Consultation on Emergency Services Collaboration (England) and Subsequent Proposals

The Government in England's September 2015 consultation document generated 318 responses. The largest group responding to the consultation were representatives from the fire and rescue service, who contributed over a third of responses, followed by representatives from the police who contributed over a fifth of all responses. Ambulance services contributed 3% of responses. These proportions at least partly reflect the relative numbers of discrete organisations in each emergency service. On 26 January 2016, the Government published its response to the consultation *"Enabling closer working between the Emergency Services - Summary of consultation responses and next steps"*.

Some key responses to the consultation and next steps document are summarised below.

The LGA consultation response (2015a) stated that fire and rescue servicess have already been at the forefront of developing collaborative arrangements between emergency services, both in relation to co-responding and joint work on prevention, and the provision of back office services and the co-location of crews and vehicles at shared sites. The LGA also stated that: *"increasingly FRAs are collaborating with wider health partners than just the ambulance service. A growing number of fire and rescue services like Kent and Humberside are supporting health and social care interventions by providing, for example, comprehensive checks in the home to identify, in particular, elderly or vulnerable people. Fire and rescue service teams working in this way are installing cold alarms alongside smoke alarms in the homes of elderly people living alone so they*

can be supported if the temperature dips below a certain level. This work saves lives, helps to keep people healthy, tackles growing levels of obesity and reduces hospital admissions."

The LGA concluded that: *"putting in place a duty to collaborate on fire and rescue services with just the other emergency services is likely to provide a constraint that stifles innovation and broader collaboration. In the LGA's view the provision of incentives, like transformation funding, is more likely to produce greater collaboration between the emergency services…"*.

The Fire Brigade's Union response to the Government consultation (Fire Brigades Union, 2015b) listed five key areas for the development of fire and rescue services' future work (suggesting that none fit with the proposed transfer of responsibility to Police and Crime Commissioners). These are already being progressed by the NJC: emergency medical response; multi agency emergency response to terrorism; environmental challenges; youth and other social engagement work; and inspections and enforcement.

The response also stated that: *"Emergency medical response is probably the greatest contribution firefighters might make to promoting innovation and greater collaboration in public services at present… The FBU believes that the integration of firefighters into the health agenda potentially represents a win-win outcome for both services and more importantly, a qualitative improvement in services to the public. The union has seen examples internationally, such as in some cities in the United States, where this system works well for both those who need medical services and the workforce who provide it."*

CFOA (2016) stated that: "*Fire and rescue services already work closely with colleagues from the emergency services – for example over a third of UK fire and rescue services are already co-responding with ambulance colleagues – and we will take steps to ensure this best practice is recognised, shared and replicated where possible….*

"CFOA is pleased that the government will be maintaining the principle of local determination over governance changes, and we are keen that fire and rescue services do not lose their important links to local government, the NHS and other organisations which enable services to make an important wider social contribution…."

Conclusions

- There appears to be a consensus among the senior management and national representatives of the three emergency services that further blue light collaboration is both possible and highly desirable. This includes: joint delivery of preventative programmes; co-location; and specific service developments such as the provision of some emergency medical services by firefighters.
- There are already existing successful local examples of collaboration.
- There is no consensus on a national model for inter-service collaboration. The preference is for local solutions based on detailed examination of local circumstances.
- The lack of "fit" between the number and boundaries of emergency services could be a practical barrier to effective collaboration; there is a general expectation that further mergers of fire and rescue services will take place.
- The LGA in particular is opposed to a statutory duty to collaborate which specifies only other emergency services, stating that this could stifle innovation.

- The Government has not ensured that collaboration is pursued in any systematic way, and proposed changes in governance arrangements (which require a local case to be made in each instance) combined with budget reductions could make effective collaboration more difficult to achieve.

Literature Review: Research Evidence

Introduction

The purpose of this section is to examine the existing research and evaluations which may offer potential evidence of the effectiveness of activities to broaden the role of uniformed fire service employees.

A Note on Cost Benefit Analyses and Incentives for Change

The concept of cost benefit analysis in relation to public service reform is not straightforward. In particular, the questions of where the benefits of a particular reform may accrue and how they can be properly quantified are important when considering what incentives there are on individual actors to fund or implement the reform.

In some cases, "benefits" from a specific service change or development may accrue directly to the organisation that carries out the relevant actions or service. For example, a local authority will typically keep the proceeds of fines from relevant parking and traffic offences to cover the cost of providing the service and, if a surplus, other transport-related issues. Therefore the authority may benefit financially, even if it faces additional costs from funding enforcement activity.

In other cases, the local authority will not directly benefit, for example if it increases enforcement activity against retailers selling illicit tobacco. The government may benefit from increased tobacco tax receipts, and society as a whole may benefit if consumption of illicit tobacco falls. However, there is no direct financial incentive for the local authority to increase its enforcement activity in this area.

There is good evidence (included in the next section of this report) to show that the fitting of smoke alarms as part of a home fire safety programme reduces the financial impact of damage from domestic fires (as well as reducing deaths and serious injuries). The financial benefits accrue to victims of fire, to the NHS and social care system. Home fire safety visits can be seen to support independent living, and to some degree benefit wider society, because, for example, of a consequent reduction in insurance premiums and a reduction in work absence. This does not necessarily create an incentive for fire and rescue services to devote additional resources to such visits. The same consideration might apply to home safety visits that extend beyond fire safety to include issues like falls.

In some cases, for example the promotion of public health, the benefits of a particular policy or service development may be hard to quantify in financial terms. Health economists use various techniques to attempt this – typically the concept of Quality Adjusted Life Years – but all are subject to significant methodological objections. In addition, while a successful public health

intervention such as an effective falls programme may save specific costs (for example, the costs to the NHS of treating injuries), it may also increase other social costs (for example, from treating chronic diseases associated with greater longevity). Even where there is a direct benefit, it may take the form of slowing the rate of increase of demand for a service rather than in directly reduced costs, and this may be hard to quantify.

It is therefore necessary to consider where the costs and benefits of proposed developments in services offered by fire and rescue service would fall, and how net benefits can be quantified.

Research evidence

The research review yielded articles describing and evaluating projects in the following areas:

- Home safety/fire safety/risk management/falls prevention
- First responding/co-responding/collaboration between fire and ambulance/emergency medical services
- Studies of implementation issues such as training, protocols, culture and staff attitudes.

The key findings from the studies cited in this section are:

- Very few studies address cost effectiveness.
- There is good evidence for clinical effectiveness of co-responding schemes, where fire service staff assist with basic life support skills such as defibrillation and improve response times.
- Other studies show no improvement to clinical effectiveness. The reasons for this were various and included
    - skills such as chest compressions not being applied optimally
    - failure to use automated external defibrillation (AED) even when first on scene
    - no extra benefit from an additional first responder scheme where an effective one was already in place
- Building on good evidence of fire and rescue services' existing role in fire prevention, there has been discussion and some study of involvement in falls prevention, although no previous studies, as yet, of effectiveness of such schemes; and of fire service involvement in heart attack education and in dementia awareness.
- Several studies throw some light on the issues faced in implementing these schemes and cover several aspects of service organisation:
    - Choosing which calls are appropriate for first responders
    - Organisation of emergency dispatch functions
    - Staff training and education
    - Communication and leadership
    - Collaboration across organisations.

Cost effectiveness studies

Two studies outside the UK assess the cost benefit and cost effectiveness of dual responding and first responding. One from Sweden (Sund et al, 2012) and another from Canada (Jermyn, 2009) found that extra lives were saved and estimated the cost of achieving that. Sund found the cost

per quality-adjusted life year (QALY) was estimated at €13,000 and the cost per saved life was €60,000. Jermyn calculated a cost per life saved in an urban area was CAD 7,000 and the cost per life saved in the rural area was CAD 49,000.

Clinical effectiveness

Positive findings of clinical effectiveness of first responder schemes

Several studies have found improved outcomes for patients attended by first responders, including fire department first responders (Nordberg et al, 2015; Hansen et al, 2015);

Positive findings of clinical effectiveness is associated with the Fire Service assisting the emergency medical services crew with cardiopulmonary resuscitation (CPR) efforts (Hollenberg et al, 2009) and the fire crew arriving first (MacDonald et al, 2009; Hoyer and Christensen, 2009). White et al (2005), set in Minnesota, USA and Van Alem et al (2003) found no difference in survival rates for patients attended by different professional groups, reflecting that it is the time to definitive treatment that is crucial, rather than the profession of the individuals providing it.

Speed of response

Speed of response can make a crucial difference to outcome in cases of serious and life threatening illness and injury. It can therefore be regarded as a proxy for better outcomes. Several studies that do not address clinical effectiveness do identify better response times as a benefit of first responder schemes (Lerner et al, 2003a; Smith et al, 2001a; Boyle et al, 2010; and Saner et al, 2013).

Neutral or negative findings on clinical effectiveness of first responding

There are also several studies that found no positive effect on clinical outcomes.

Boland et al (2015) assess the value of the dispatch of advanced life support (ALS) firefighters in Minneapolis, Minnesota, USA. Firefighters used one or more of their advanced skills in just 7.6% of the cases where they arrived first. The clinical value of the interventions remained unknown and there was some evidence of suboptimal chest compressions and AED use. The authors concluded that the emphasis should be on consistent application of basic life support skills in the responders who arrive first on scene. Confirming the importance of early defibrillation, Lerner et al (2009) describe failure of first responders to deploy AEDs in 42% of cases.

Sayre et al (2005) assessed a scheme in which police vehicles were equipped with AEDs, but where survival to discharge was similar in both the intervention and control groups, leading to the conclusion that where there was already a fire department first responder scheme in place the addition of police first responders did not make a difference.

Other health interventions

The Fire Service's role in fire prevention is well established and addressed widely in the literature (Ta et al, 2006; Diekman et al, 2010; Arch et al, 2012; Clare et al, 2012; Gielen et al, 2013; Istre et al, 2013; Lehna et al, 2015). Pirrallo et al (2004), Diamond-Smith et al (2014) and Craig et al (2015), are the only economic evaluations revealed in the searches, which found savings in terms of less damage to property, lives saved and fires prevented respectively.

There are many cases of this approach being extended into other areas of safety and health.

Laybourne et al (2011) argue that an effective community partnership model for falls prevention could lead to shared costs, increased participation by a range of people and organisations, cross-fertilisation of ideas, (for example combining the fire service's risk prevention approach with the health promotion focus of the NHS) and enhanced co-ordination and co-operation between agencies. But there have been few studies that actually test the effectiveness of such schemes. Our search revealed just one, Weiss et al (2003), which confirms that emergency medical services can collect data to predict older people's risk of falls and identify people for whom intervention would be helpful.

We found two examples of other interventions.

Meischke et al (2004, 2006) describe a randomized trial in which heart attack survival kits, including advice on calling 911 and use of aspirin in cases of chest pain, were provided in a door-to-door home intervention in King County, Washington, USA. The seniors who had received the advice were more likely to call for chest pain and to have taken aspirin.

Harfleet (2014) in a news article, describes a community outreach initiative in Kent UK in which firefighters were trained as dementia friends[8] in order to be more responsive to individuals with dementia when undertaking community safety activities.

Implementation Issues

Dispatch criteria

A small number of international studies have attempted to determine which calls are appropriate for attendance by fire crews. Craig et al (2010) describe the selection of a sub-set of Medical Priority Dispatch (MPDS)[9] determinants. Funk et al (2002) found that 93% of fire department responses to motor vehicle crashes in Albany, New York did not require a complex extrication, suggesting that fire vehicles should not automatically be dispatched to such calls. Key et al (2003) concluded that firefighters could go to certain 911 calls *in place of ambulances* with no adverse outcomes.

Training and education

Walker et al (2005) examined the training and protocols for management of burn injuries by the UK fire service. UK Chief Fire Officers were surveyed for Lee and Porter (2007) and for Quinn et al (2009) in order to establish what levels of medical skills were taught to firefighters. All three studies found considerable variation and a lack of standardisation.

Cone et al (2001) found that basic life support crews in a US emergency medical services system cancelled advanced life support crews inappropriately in 77% of cases, underlining the importance of developing operational protocols appropriate to the level of training of those attending calls.

Williams et al (2011) reviewed emergency medical services provision in nine US states in order to identify differences in scope of practice and any factors that might be influencing those. Services surveyed included combined fire and emergency medical services as well as emergency medical

[8] https://www.dementiafriends.org.uk/

[9] The Advanced Medical Priority Dispatch System (AMPDS) was until recently the standard system used by UK Ambulance Services although several now use NHS Pathways as their clinical triage system

services-only. The study found that rural services were more likely to authorise interventions than urban services. The presence of a medical director was associated with a higher likelihood of authorising some types of interventions.

Smith et al (2001b and 2002) looked at the personal and professional impact on firefighters of participating in Melbourne's first responder scheme and the first twelve months of operation of the service. It found a number of positive messages and also some pointers to implementing similar projects elsewhere in terms of communication and support from managers within the fire service. The need to maintain firefighters' knowledge and confidence is also identified, given that the skills were used rarely.

Success factors in developing new initiatives

Henderson et al (2010) described an arson prevention programme, and identified the importance of sharing knowledge across/between services through education and consultation, including deliberate approaches to breaking down cultural barriers between very different groups of professionals with different cultures.

Elmqvist et al (2010) asked fire and police personnel to describe their experiences of being first on scene at traumatic incidents, which include experiencing strong emotions while needing to be calm in response to others' expectations. These are experiences that it is important to help people prepare for and deal with.

Lerner et al (2003b) reported on a survey of US and Canadian firefighters' attitudes to involvement in an AED programme. Reportedly two-thirds of respondents were "*very comfortable"* using AEDs and only 3% felt *"very uncomfortable"*.

Conclusions

- Provision of basic life support, including defibrillation, by first/co-responders is associated with quicker response times and if response times improve, so potentially can outcomes for patients experiencing out of hospital cardiac arrest if they are appropriate for defibrillation.
- Evidence for training fire crews in advanced life support skills is sparse and suggest it may not be the best way forward.
- Evidence for cost-benefit or cost effectiveness of first and/or co-responders is limited and based in other countries with different emergency system design which may create issues of transferability.
- There is good evidence for the effectiveness of fire prevention schemes, including examples of cost-effectiveness studies.
- There is some evidence for potential impact of firefighter interventions in other areas of safety and health.

Evidence on implementation issues also suggests a number of conclusions:

- Clarity on treatment protocols is important and there may be value in considering a consistent standard between services, although geographical differences may be logical because of different travel times to hospital in urban and rural areas.
- Care should be taken not to over-estimate the knowledge or skills of personnel.

- In the small number of studies that have examined staff attitudes to new roles, most found that staff responded positively to the opportunities, seeing them as valuable professional development.
- In implementation, attention must be given to good communication with staff and provision of appropriate support, particularly where staff will be responding to traumatic incidents.
- Where schemes involve cooperation between professionals in different organisations with different cultures, time must be set aside to help staff develop knowledge of and trust in each other's contributions.

Appendix 2: Survival advantage by fire and rescue services' and ambulance services' response times

	+ Additional ambulance response minutes												
fire and rescue service Response minutes	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12+**
1	0.0%	5.0%	9.3%	13.0%	16.1%	18.6%	20.6%	22.2%	23.5%	24.5%	25.3%	26.0%	26.0%
2	0.0%	4.3%	8.0%	11.1%	13.6%	15.6%	17.2%	18.5%	19.5%	20.3%	21.0%	21.0%	21.0%
3	0.0%	3.7%	6.8%	9.3%	11.3%	12.9%	14.2%	15.2%	16.0%	16.7%	16.7%	16.7%	16.7%
4	0.0%	3.1%	5.6%	7.6%	9.2%	10.5%	11.5%	12.3%	13.0%	13.0%	13.0%	13.0%	13.0%
5	0.0%	2.5%	4.5%	6.1%	7.4%	8.4%	9.2%	9.9%	9.9%	9.9%	9.9%	9.9%	9.9%
6	0.0%	2.0%	3.6%	4.9%	5.9%	6.7%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%
7	0.0%	1.6%	2.9%	3.9%	4.7%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%
8	0.0%	1.3%	2.3%	3.1%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%
9	0.0%	1.0%	1.8%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
10	0.0%	0.8%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
11	0.0%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
12+	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Adapted from De Maio et al. Annals of Emergency Medicine. 2003; 42(2): 242-250.

Appendix 3: Cost calculations

Crew	**Avg crew**	**Unit cost** [1]	**Disturbance fee**	**Cost per incident**	**Source**
Retained duty crew	3.8	£13.53	£3.90	**£14.88**	A
Medical supplies	**Cost**	**Qty**		**Cost per incident**	
Philips Heartstart FR3 semi automatic defibrillator	£1,975.00	145	events/year x 5yrs	£2.73	B
Primary battery for Philips HeartStart FR3	£203.00	300	shocks/battery	£0.68	C
Philips Heartstart FR3 smart pads x5	£162.00	5	pads	£32.40	D
Fast response kit	£51.00	1	per incident	£51.00	E
				£86.80	
Call-out costs	**%**	**Cost/hr**	**Hours/call**	**Cost per incident**	
Hire - Aerial Rescue Pump	0%	£285.00	1.00	£285.00	F
Hire - Aerial Ladder Platform	51%	£274.00	1.00	£274.00	F
Hire - Pumping Appliance (incl. Rescue Pumps)	32%	£262.00	1.00	£262.00	F
Hire – Light Vehicles	17%	£47.00	1.00	£47.00	F
AVERAGE	**100%**	**£232.18**	**1.00**	**£232.18**	
Training	**Cost/FF**	**FF/incident**	**Events/6mons/FF**	**Cost per incident**	
Initial training [2]	£368.00				G
6-month requalification	£115.00				G
Annual cost	**£280.60**	**3.8**	**72**	**£14.72**	

TOTAL COST PER INCIDENT

Retained duty crew	**£350.34**
Whole time crew	**£284.11**

Assumptions

1 Assumes whole time salary costs are independent of co-responding

2 Assumes an initially trained FF continues to co-respond for 5 years

Sources

A https://www.fbu.org.uk/pay-rates/pay-settlement-2016

B http://www.stjohnsupplies.co.uk/products/Defibrillators/Defibrillators/Philips-Heartstart-FR3-semi-automatic-defibrillator-with-text-display

C http://www.stjohnsupplies.co.uk/products/Defibrillators/Accessories/Primary-battery-for-Philips-HeartStart-FR3-defibrillator

D http://www.stjohnsupplies.co.uk/products/Defibrillators/Accessories/FR3-Smart-Pads-5-Sets

E http://www.stjohnsupplies.co.uk/products/Defibrillators/Accessories/Fast-response-kit-for-Philips-HeartStart-FR3-defibrillator

F http://www.firescotland.gov.uk/media/542248/140130_charging_policy.pdf

G NJC Fire Evaluation Survey