Clinical Innovation in pre-hospital care: An introduction to Critical Care Paramedics in the United Kingdom

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Research placement fellowship

This research report is part of a research fellowship jointly funded by the Economic & Social Research Council (ESRC), the National Institute for Health Research (NIHR) Service Delivery & Organisation (SDO) programme and South East Coast Ambulance Service NHS Trust.

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The South East Coast Ambulance Service (SECAmb) is a forward looking ambulance trust with a vision to be clinically focussed to patient need, innovative, team based, high performing and matching or exceeding international excellence. The critical care paramedic programme is a new thread of activity to achieve this vision.

The general fellowship aims are:

1. To improve the quality and relevance of research
2. To develop capacity at SECAmb for accessing, appraising and using research evidence
3. To encourage greater engagement, linkage and exchange between research and practice communities.

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ISBN: 978-1-905846-54-2

2011

Forward by Professor Andy Newton (Director of Professional Standards & Innovation) at South East Coast Ambulance Service NHS Trust

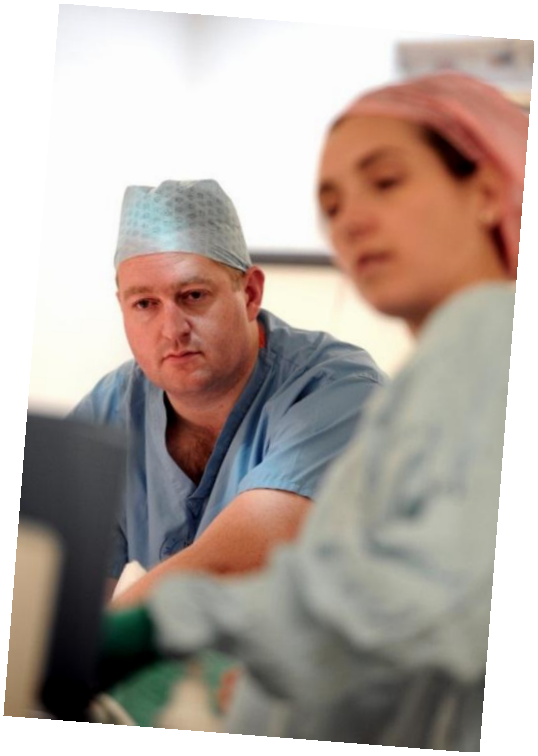
It is sometimes difficult to believe that Paramedics have been registered as Allied Health Professions (AHPs) for only 10 years and that in comparison to other health care providers their numbers are small – 15, 000 compared to 230,000 doctors and 600,000 nurses. Despite these modest numbers Paramedics are now an integral part of the NHS, as indeed they are in most developed countries. They deal with nearly 8 million 999 calls each year in the UK alone. They have strong approval rating from the public, and are very visible, given their role at the 'front of the front line'; yet their full potential to provide clinical and cost effective health care is only now starting to be fully realised.

The first 'paramedic' training programme to be developed in the UK occurred in 1971 and was initiated by Dr Douglas, (now Professor) Chamberlain, who remains highly active in both the development of the profession and in resuscitation science research today. Other schemes followed, but although these local pioneering early schemes were successful, largely due to the energy and enthusiasm of both medical innovators and receptive ambulance crews, there were also many detractors who were less convinced.

The issue of the cost effectiveness and value of paramedics was finally resolved by a Department of Health initiated study in 1984 (undertaken by the University of York) which showed conclusively that in comparison to many other potential health related ventures, paramedics represented an unusually cost effective investment opportunity for the NHS. This official recognition has enabled the UK to produce a nationally available paramedic led ambulance service, which in clinical terms compares favourably with many international systems and which is significantly cheaper than the Franco-German models that substitute doctors in the paramedic role. Dr Jashapara's work, with its emphasis upon clinical and cost effectiveness provides insights that are essential to planning future service delivery in an age where costs must be justified and constrained, with every available penny of tax payers money must be converted into efficient and effective service delivery for patients.

However, this fact in no way reduces the key role that medicine has to play in delivery high quality ambulance services; it simply changes the emphasis of medical involvement from routine 'hands on' service delivery to more high level functions that lead and facilitate service effectiveness, a model common in North America and the Commonwealth. These key roles include oversight, planning, clinical governance teaching, research and audit, but also some 'in field coaching' to ensure that the service 'on the ground' is delivering the necessary levels of safety, effectiveness and quality. It is now possible to

'project forward' to the accident site a consultant level of advice, using modern technology in a way that has hardly been tapped in the UK, but which avoids the logistic and economic challenge of physically delivering a consultant medical practitioner to the scene of an incident. It is also important to note that the Critical Care Paramedic programme would not have been possible without this close collaboration with the many medical leaders and indeed nursing and educational leaders too, because without this commitment and support it is impossible to create a service that can meet patient need and retain the confidence of patients, professionals and commissioners.



The critical care paramedic role represents an evolutionary development that follows a similar path of enhancing the knowledge and skills of paramedics in much the same way as has been practice for other more established professional groups, such as medicine, nursing and many allied health professionals. This development also follows similar initiatives that have occurred in Canada, Australia, South Africa, the United States, and elsewhere that have been designed to improve the clinical effectiveness of ambulance services.

The initiative recognises that clinical practice must flex and change in response to new challenges and ever changing patterns of patient demand and epidemiology, as well as the wider social changes and the perceived risks that the ambulance service is designed to respond to. It also recognises that as these requirements become ever more sophisticated and difficult, and it is therefore simply not impossible to expect every paramedic to embrace every new challenge and skill, hence the need to start to provide more specialised services and consequent post registration opportunities to enable them to function as safe and effective practitioners. This trend has been happening for a number of years and despite some errors, misunderstanding and false starts, specialist paramedic practice in primary care is now reasonably well established.

This area of clinical practice is finally coming of age with a new national examination for paramedics working in primary care, jointly endorsed by the Royal College of General Practitioners (RCGP) and the College of Paramedics. CCP developments lag slightly behind this work, but with a new emphasis upon the needs of the seriously injured through the work of Professor Willett, the advocating regional trauma networks should stimulate developments in this area.

The skills that are imparted during CCP training are not solely clinical ones. Pre-hospital care is increasingly a team-oriented endeavour and there is a need to ensure that 'human factors' and structured teamwork oriented

exercises are included in the preparation of these staff. Equally, not all the challenges are purely clinical or related to single patient events and it is likely that the CCP will play a wider role in supporting the emergency preparedness, very probably via providing part of the proposed Medical Emergency Response Incident Team, MERIT, indeed delivering much of this service in a ‘Paramedic Incident Response Team,’ ‘P-MEIRT’ or ‘Enhanced Care Team,’ ECT, and supporting Hazardous Area Response Team, HART Development too.

Whatever the complexion of future challenges, having a well developed, cost effective more highly trained workforce, with specific skills and capabilities directed to the care of the seriously ill and injured is an investment that is expected to play an important role in future patient care.

Professor Andy Newton
Consultant Paramedic
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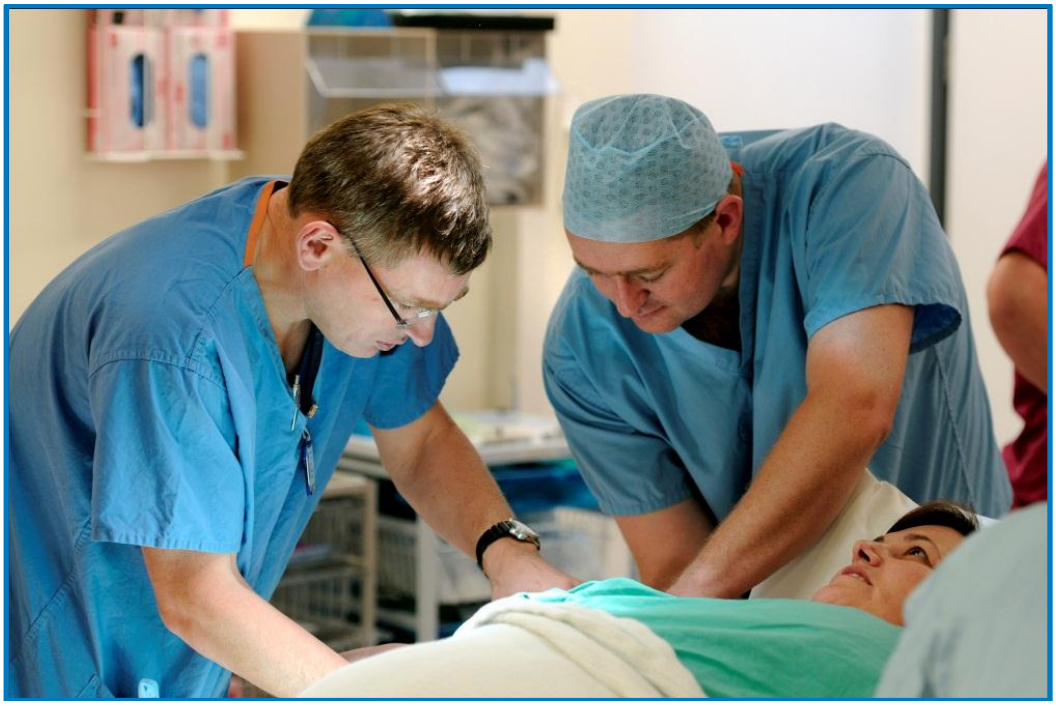

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Executive Summary

The aim of the project was to evaluate the development of 'Critical Care Paramedics' (CCPs) at South East Coast Ambulance NHS Trust (SECAmb) in the UK.

Background

SECAmb has developed a new CCP role in response to numerous national reports critical of sub-standard pre-hospital care for seriously ill and injured patients, and the need to save more lives.

There is an ongoing debate on the use of doctors and paramedics in pre-hospital care and the evidence is mixed whether one is more effective than the other in reducing mortality rates. There are examples in other countries of increasing the involvement of paramedic staff, and of improved survival and treatment rates. Evidence from the US showed that every additional year of paramedic experience was associated with a 2% increase in the survival rate of the patient. The use of advanced paramedics is the norm within the "Anglo-American" system of paramedics such as the US and Canada, where they have achieved 20% lower mortality rates than the UK. The Mobile Intensive Care Ambulance (MICA) paramedic system in Melbourne, Australia, is a particularly useful comparator for the South East Coast region as the population, epidemiology, language, culture and health care systems are similar. The German system of pre-hospital care based on doctors is 42% more expensive than the UK and there is no clinical evidence that it is more effective.

The CCP part-time development programme includes:

- Four modules taught at the University of Hertfordshire, The 'critical thinking' module is noteworthy as it helped CCPs new to academia with their mental reasoning and academic writing skills.
- A preceptorship programme to develop clinical competences based at an Intensive care unit, operating theatre and Accident and Emergency environment. The preceptorship programme was enhanced by the enthusiasm and commitment of the Consultant Anaethetists acting as preceptorship supervisors.

Through the training, the paramedics enhanced their patient assessment skills, gained a wider knowledge of drugs, improved their diagnostic abilities, advanced their management of pain and become better at clinical decision making. Many CCPs felt that they act more calmly and confidently in complex situations.

Approach

This evaluation study used a financial and qualitative methodology to unravel the cost effectiveness of CCPs. Using this methodology rather than just a randomised population study, helped uncover the rich processes underlying the new capabilities rather than simply reporting statistically significant differences. In any case, the small CCP sample at the start of this evaluation would have made any statistical comparisons meaningless.

The study is based on an extensive literature analysis, 60 interviews with key stakeholders, observations of CCPs in the field, attendance at meetings including developmental activities, and review of internal documentation.

Results

The cost-benefit analysis demonstrated that a CCP Enhanced Care team in each eight NHS Primary Care Trusts (PCTs) in the SECAmb region would cost £272,475 and the cost of a life saved was £8,515. The same provision provided by doctor based Enhanced Care team would cost £3,030,412 and the cost of life saved would be £63,134. The National Institute for Health & Clinical Excellence (NICE) threshold for the introduction of a new drug is £30,000. If one compared the introduction of advanced pre-hospital care in the UK to a new drug, a CCP based approach for improving patient survival rates would fall well within these limits. In contrast, a doctor based approach would be deemed too expensive and not necessarily more effective.

SECAMB has managed to develop the CCP training programme through prudent financial management and funding from two PCTs. The PCTs have provided seed corn funding to cover non-recurrent CCP training and development costs in their region. In addition, they have provided funding for recurrent costs such as CCP salary uplift costs to Band 6 positions.

Only 4% of CCP workload has been involved with transfers and not all of them as secondary escorts. This has resulted in certain levels of skills fade among CCPs.

There are a finite number of preventable deaths each year and it is as much about the effectiveness of the overall trauma system and network as it is about improvements in pre-hospital care. Improvements of 2% preventable deaths are likely to accrue from the introduction of highly trained CCP Enhanced Care teams especially in advancing patient pathways.

Implications for the future

If SECAmb is to continue to use CPPs in the role of critical care transfers, it needs to work more closely with PCTs, hospitals and critical care networks to increase demand for critical care transfers.

To ensure that CCPs maintain their clinical skills at the highest level regular post-training placements are required in hospitals.

As the new role demands clinical leadership in the field, SECAmb needs to consider some form of CCP leadership training in the future

Operational issues could be improved:

- Clinical supervision of CCPs post training has been limited off-line to the Medical Director and Consultant Paramedic/Clinical Director. Medical governance and clinical supervision could be enhanced by the investment in two full time equivalent (FTE) Consultant positions. They could provide online medical advice and support via telemedicine, intermittent infield supervision and coaching, generation of procedures, and research and audit functions.
- Tasking has been seen as a problem by CCPs as they are not always tasked appropriately to high acuity incidents. Even though measures have been taken to address the problem, a special action group may help improve current processes.

Knowledge sharing among CCPs could be enhanced through providing them time to develop informal networks and supplementing the networks with online discussion forums, wikis, blogs and some form of social networking.

Other ambulance services could follow SECAmb's lead to develop their own 'hybrid' or 'advanced' paramedics to meet national concerns. This will help save lives of seriously ill and injured patients and contribute to lower mortality rates in the UK.

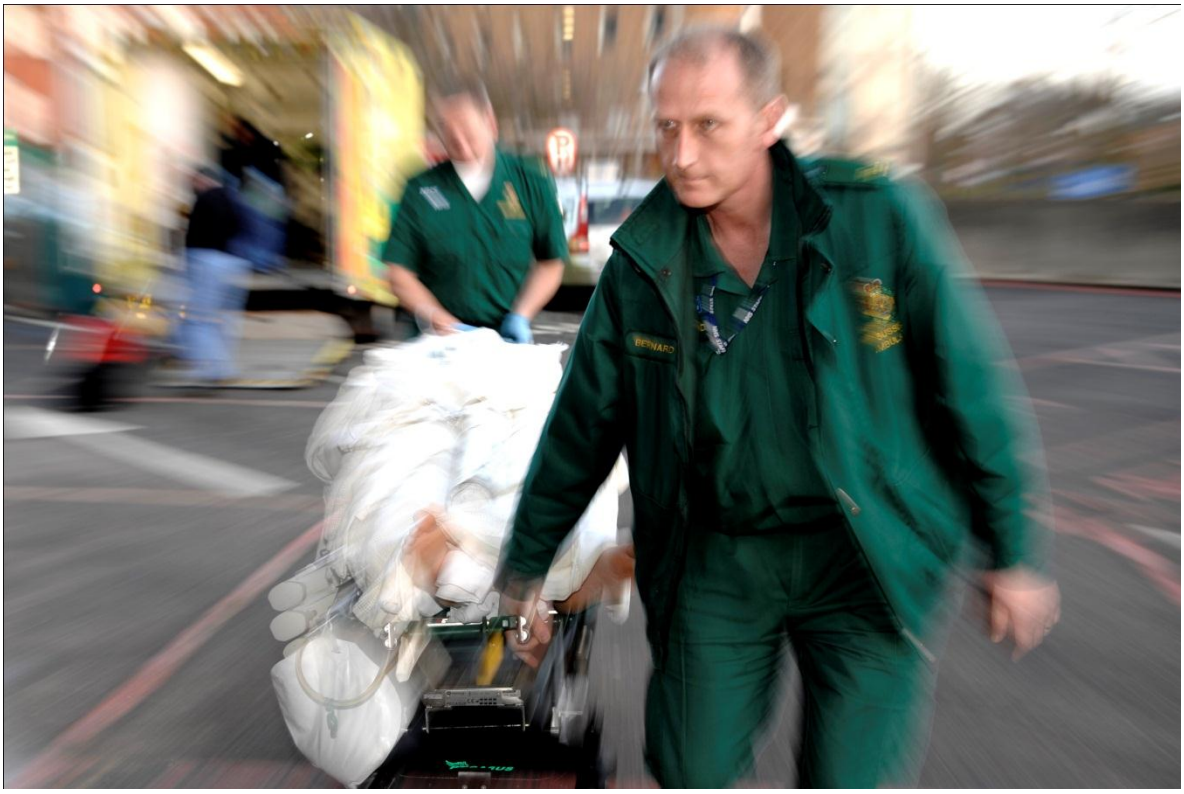
The evaluation was carried out by Dr Ashok Jashapara of Royal Holloway, University of London, as an ESRC Research Fellow and received financial support from

- the UK Economic and Social Research Council (ESRC)
- National Institute for Health Research - Service Delivery & Organisation (NIHR SDO) and
- the South East Coast Ambulance NHS Trust (SECAmb)

Dr Jashapara acknowledges the helpful involvement of SECAmb staff in participating in this evaluation project.

Lessons from the Purley and Cannon Street rail crashes show that paramedics could conduct many advanced capabilities of doctors in the pre-hospital environment (New 1992, p.32):

"Paramedics may be able to fulfill many of the immediate care procedures currently undertaken by medical teams. The potential for reducing the administratively complicating factor of hospital-based personnel working at the scene is considerable."



Acknowledgements

Dr Ashok Jashapara appointed an advisory group for this evaluation study and would like to thank members of this group for both challenging and encouraging him on his research fellowship – Professor Andy Newton, Dr Jane Pateman, Dr Julia Williams and Dr Sarah Poole.

The author is grateful to Tom Barker and Sangeeta Sooriah at the NHS Confederation and Lesley Lilley at the ESRC for actively engaging in the research described in this report. He would like to thank the critical care paramedics who gave up their time graciously for this study in between their duties and, on occasion, took Dr Jashapara out on live calls to see the nature of their work. This has included Mark Stobbart, Stuart Plumbley, Jez Harwood, Shaun Barron, Keith Foord, Richard Brandon, Michael Carter, Jez Loseby, Simon Rosenberg, David Priest, Mark Durham, Neil Painter, and Bernard Robinson. In particular, he would like to highlight Gordon Clark, Allan McHenry and Andy Collen who helped set up many interviews. He appreciated validation of the study's findings by CCPs on their development day. Dr Jashapara is grateful for the numerous conversations with paramedics and technicians in relation to this study. He is grateful to staff who helped provide financial information on CCP costing and funding including Greg Timmins, Andy Cashman, Jonathan Rowe and Geraint Davies. Among the directors at SECAmb, he is indebted to Professor Andy Newton, Dr Jane Pateman and Sue Harris for their support. He welcomed feedback from Helen Medlock and others on a draft copy of this report.

Dr Jashapara would like to thank Jackie Huddlestone and Catherine Plowright for providing their different perspectives on transfers associated with critical care networks. He is grateful to the CCP development team at the University of Hertfordshire for their time and insights; Dr Julia Williams, John Donaghy and Dr Mark Nash. Dr Jashapara was impressed with the commitment and enthusiasm of the preceptorship supervisors and would like to thank Dr Mike Margarson, Dr Owen Boyd, Dr Richard Venn and Dr Amanda Wellesley from A&E for their time in this study. To understand more fully about MICA paramedics, Dr Jashapara is grateful to Dr Mark Bloch, Scott Stewart and Shaun Whitmore for their involvement in this study. He was grateful to Professor Malcolm Woollard who provided an external perspective on CCPs and advanced paramedics around the world.

Dr Jashapara is most grateful to Hazel Wilks for the report's artwork and typesetting as well as Dawn Unsal for proofreading it.

Finally, Dr Jashapara would like to thank the ESRC, NHS Confederation and SECAmb for funding this research fellowship without which this evaluation would not have been possible.

Introduction

Performance of ambulance services is still measured in terms of time. It is the speed at which ambulances arrive at a Category A (life threatening) incident within eight minutes or 19 minute standards. Annual statistics are collected and comparisons are made between ambulance trusts based on these response times. League tables or 'star ratings' have emerged in England and each ambulance trust makes comparisons with others on their Category A performance. Time is critical and a connection exists between delay in treatment and mortality rates. This has been termed the 'golden hour' where a lack of clinical intervention can make the difference between life or death of critically ill patients. However, there is debate on whether the most appropriate intervention is to take the critically ill patient to the nearest hospital for stabilization or to travel longer distances to a specialist trauma centre (Little 2010). A certain amount of tactical maneuvering has been observed among ambulance trusts to improve their ratings (Commission for Health Improvement 2003). Ambulances have often concentrated in densely populated areas to achieve response times at the expense of rural areas. Some flexibility has been observed in the classification of Category A calls. Incidents have been classified as Category A only if control rooms believe they can achieve the eight minute target (Audit Commission 2007; Bevan and Hamblin 2009).

This fixation on time as the primary performance indicator has had its own implications. Ambulance trust boards become preoccupied with developing strategies to use their limited resources optimally in order to improve their standings in national statistics. The emphasis becomes one of operational efficiency rather than innovation. Time becomes the holy grail and strongly influences the culture of ambulance services. This can be at the expense of other quality indicators and an inherent criticism arises from treating the clock rather than the patient (Price 2006). Recent evidence from over 11,000 patients shows that a four minute response time has a positive survival benefit for critically ill patients rather than the current eight minute UK standard which has no survival benefit (Pons, Haukoos et al. 2005). This raises questions about the adequacy of the current benchmarks used in the UK. The eight minute target was selected by the Healthcare Commission (2005) based on clinical evidence that suggested around 1800 lives could be saved each year from people suffering acute heart attacks.

There is a shift among many ambulance trusts to move beyond response times to other performance indicators. The difficulty is measuring what matters as the most important aspects of performance in ambulance services cannot easily be measured; namely clinical outcomes. An ambulance crew can arrive at a scene in 8.01 minutes and have saved a life and, yet, be deemed as a failure. In recognition of the limitations of response times, a number of ambulance trusts are moving towards a balanced scorecard (Kaplan and Norton 1992) approach to performance measurement. The focus is on quality improvements through providing alternative performance indicators to response times. Originally the Healthcare Commission had provided three

alternative measures for ambulance trusts; clinical focus, patient focus and capacity and capability focus. The National Welsh Ambulance Service Trust has adapted this approach and developed its own performance indicators:

- Delivering services to stakeholders – predominantly around response times
- Resource utilization – effective financial and human resource management
- Management processes – change management and effective clinical and corporate governance
- Innovation and learning – this section is surprisingly brief in detail

The Care Quality Commission (regulators in health and social care) has established eight priority indicators against which it will assess the performance of ambulance trusts:

- Management of stroke and transient ischaemic attack
- Management of hypoglycaemic attacks
- Management of asthma
- Management of patients with cardiac arrest
- Management of acute myocardial infarction
- Repair and safe environment of ambulances – indicator withdrawn
- Experience of patients
- NHS staff satisfaction

A major mind shift occurring in ambulance trusts is the importance of clinical outcomes as well as response times. It is not about focusing on one or the other but both. This is very opportune given the number of major reports relating to the high numbers of preventable deaths and evidence of suboptimal care among critically ill patients. Trauma relates to serious injuries

where there is a strong possibility of death or disability. The National Audit Office report (2010) on '*Major trauma care in England*' highlighted the need for ambulance services to improve their clinical governance in terms of quality and safety and to share these arrangements between hospitals and air ambulance services. The NCEPOD report (2007) on '*Trauma: Who cares?*' found that 60% of patients received standards of care which were below good practice. Effective airway management was identified as an important skill among ambulance services to ensure a successful outcome.

In response to these significant challenges, the South East Coast Ambulance NHS Trust (SECAmb) (2008) has developed the role of a 'Critical Care Paramedic' (CCP) to improve levels of experience and develop skills sets to ensure positive outcomes for seriously ill and injured patients. This includes severe, complex and multiple injuries arising from trauma. The Department of Health (2005) estimates that around 10% of all emergency calls are life threatening and critically ill patients account for 5-8% of ambulance staff's workload. Based on various sources, there are likely to be 600-700 cases of major trauma in the South East coast region and SECAmb has predicted 293 preventable deaths in their region each year. This equates to 1-2 cases of trauma per PCT per week. SECAmb has recognized the need for specialized paramedics to manage these situations rather than relying on other paramedics who may only see major trauma cases once or twice a year. The premise is that highly skilled paramedics with regular exposure to critically ill patients will be best placed to provide the most effective pre-hospital treatment.

Apart from the primary retrieval of seriously ill and injured patients, CCPs have been developed to assist in the transfer of critically ill patients. The intention is to develop high level CCP transfer skills to enable CCPs to transfer critically ill patients as secondary escorts and to enable skilled nurses to remain in ITU units. The intention is to develop positive cost savings for hospitals as ITU nurses wouldn't need to be deployed for the transfer of critically ill patients between hospitals.

An additional innovation at SECAmb has been the introduction and development of a 'paramedic practitioner' in primary care. Similar to CCPs, they have undergone university education and developed advanced diagnostic and treatment skills to treat patients suffering from less serious conditions. With this initiative, SECAmb has aimed at treating less serious patients at home and helped save undue costs and pressures on hospitals and their A&E departments. Paramedic practitioners have acted as gatekeepers and directed patients with less serious conditions to the most appropriate treatment; their GP, their pharmacist or no treatment at all. As part of their training, paramedic practitioners have been co-located at GP surgeries to develop the necessary competences.

The aim of this report is to evaluate the development of 'critical care paramedics' (CCPs) at SECAmb. The evaluation design is based on four

objectives that arose using ‘oval mapping’ techniques with the core evaluation team. These objectives were:

1. To assess improvements in clinical outcomes by critical care paramedics
2. To evaluate operational efficiency of critical care paramedics
3. To assess differences in education, training and competence of critical care paramedics
4. To evaluate the interface of critical care paramedics with other professions

This report is aimed at NHS clinicians, service managers and commissioners responsible for planning and implementing improvements in the care of seriously ill and injured patients.

Critical Care Paramedics: Improving quality of care of seriously ill and injured patients

The strategic vision of South East Coast Ambulance NHS Trust is to develop a quality focused clinical service operating to international best practice. Arising from this vision, one of their primary goals is to improve the quality of their response to life threatening (Category A) calls. There are a number of strategies SECAmb could adopt to meet this goal. The most obvious is to have medical doctors attending the most acute and life threatening incidents. This would observe historic conventions and practices in France and Germany where there has been an oversupply of doctors. The Franco-German model of advanced care relies on doctors conducting medical interventions with ambulance personnel taking on primarily medical transport roles. They are not expected to perform advanced skills such as intravenous cannulation or defibrillation. Fire personnel are also used in transport roles and may act as first responders in hard to reach areas even though they do not have the necessary advanced skills (Banks 1999). Doctors, predominantly anaethetists, are specially trained for emergency medical assistance and advanced medical support (Barrier 2001).

There is considerable international debate on the most effective ambulance service models between the “scoop and run” Anglo-American approach and the “stay and play” Franco-German system. The death of Princess Diana has become a celebrated cause at the heart of this contested area. The argument is that she would have survived had her car crash occurred in America (Sancton and MacLeod 1998). Proponents of this view argue that stabilizing patients in the field is a mistake and evidence supports the need to transport critically ill patients swiftly to hospitals where there is recourse to the best medical facilities. Doctors stopped working on ambulances at the outbreak of World War II and focused on facilitating and developing paramedics to take over the pre-hospital role. They acted as facilitators, mentors and coaches to paramedics. In the early 1980s, the American College of Surgeons (ACS) approved a medical protocol to improve the nature of trauma care. This was known as the Advanced Trauma Life Support (ATLS) and became the standard for trauma care in many countries adopting the Anglo-American approach (Collicott 1992). It provided a new philosophy of care for severely injured patients around well considered processes and medical teams who were taught in them.

The use of research evidence to support the two sides of the polemic has been misleading (Spaite, Criss et al. 1996). There are serious methodological flaws where no control groups have been used and no actual association between on-scene intervals and mortality has been confirmed. Association need not imply causal effect. There may be an effective middle way between the extremes of these two schools of thought. For instance, Japan has essentially been a “scoop and run”, defibrillation system. However, it is now expanding its paramedic service to more complex advanced life support (ALS) and trauma protocols (Lewin, Hori et al. 2005).

The development of CCPs at SECAmb has been influenced by the role of MICA (Mobile Intensive Care Ambulance) paramedics founded in Ambulance Victoria in Australia. MICA paramedics were established in 1971 to provide a higher clinical skill set and to perform more advanced medical procedures. Many of these advanced procedures have been ground breaking and MICA paramedics have developed skills in advanced airway management such as endotracheal intubation and rapid sequence intubation. They can treat life threatening chest injuries including pneumothoraxes (collapsed lung) by inserting a chest tube. MICA paramedics can insert intra osseous (into bone) cannula for advanced drug and fluid administration in paediatric patients and, most importantly, make complex medical decisions without medical consultation. They provide the clinical leadership for other paramedics. The physical geography of the SECAmb region is similar to Victoria with a 5m population and relatively sparse population outside the main city, Melbourne.

Recent evidence supports the use of MICA paramedics with advanced cardiac life support skills and shows a significant effect on patient survival in the Queensland Ambulance Service (Woodall, McCarthy et al. 2007). Logistic regression techniques found that the survival benefit was multifactorial and linked to greater skills levels as well as more informed use of a range of pre-hospital interventions. MICA paramedics are also involved with inter-hospital transfers of critically ill patients. A major recent study of 451 transfers in Victoria found that the mortality of MICA escorted patients (6.0%) was significantly lower than medically escorted patients. The highest mortality rates (26.7%) occurred among hospital medical officers who were mostly junior doctors (Zalstein, Danne et al. 2010). Ireland developed its own MICA paramedics in 1996 to provide a ground transfer service for critically ill patients. An evaluation of the service found that there were no patient deaths among 484 transfers. This study showed that 93% of transfers required airway interventions and 32% needed inotropic (muscle contraction) support during the transfer (Rohan, Dwyer et al. 2006).

National drivers in CCP development

There have been a number of national reports that have driven the development of the CCP role. SECAmb have recognized that preventable deaths and sub-optimal care of seriously ill and injured patients have featured as an underlying thread in these reports. The key messages for ambulance services in each major national report can be summarized as follows:

"Better Care for the Severely Injured" - Joint Report from the Royal College of Surgeons of England & the British Orthopaedic Association (2000)

- One third of all deaths after major injury were preventable. 770 deaths were preventable in England (p.16)
- Treatment of 12% of patients was sub optimal (p.16)
- Advanced airway management using rapid sequence intubation (RSI) must only be provided by doctors (p.36)
- Paramedic applies resuscitations interventions to life threatening problems after rapid survey of airway, breathing, circulation and level of consciousness. Target of no more than 10 minutes on-scene time (p.47)
- Greater need for greater patient assessment training rather than acquisition of intervention skills (p.54)

"Meeting the Challenge: A strategy for allied health professions" – Department of Health (2000)

- Government committed to expand roles of allied health professionals to ensure they use their skills flexibly and creatively to benefit patients
- Improving education and training
- Investment of £2m in leadership development
- Consultant therapists to start by 2004

"Taking Healthcare to the Patient" - The Bradley Report (2005)

- Ambulance services tend to over-categorize 30% of their calls as Category A when only 10% are life threatening (p.11)
- Ambulance services need to provide a range of mobile healthcare services for patients who need urgent care as well as improving their quality of service (p.14)
- Improvements are needed in the treatment of major trauma including closer collaboration with critical care networks (p.23)
- Need for better assessment of pain and administration of pain relief (p.23)
- Improvements in emergency inter-hospital transfer arrangements between ambulance and acute hospital trusts (p.23)
- Use of doctors to respond to Category A calls should be better supported (p.23)

“Mending Hearts and Brains” - Professor Roger Boyle (2006)

- Paramedics to play greater role in assessing where patient should be treated (p.2)
- More effective to take heart and stroke patients to specialist treatment centres (p. 6)
- Paramedics to assess whether patient is in 3-hours treatment window for clot-busting drugs at a specialist stroke centre

“Trauma Who Cares” - NCEPOD (2007)

- 60% of patients received a standard of care below good practice (p.10)
- Need to integrate clinical governance of all agencies into a regional trauma service (p.12)
- No evidence to support association of response times with better outcomes (p.38)
- High incidence of failed intubations (16%) (p.43). Pre-hospital intubation needs to be part of a pre-hospital doctor based care system (p.44). Need to provide airway management skills including rapid sequence intubation to secure clear airway and maintain ventilation (p.12). 19.8% of patients transported by ambulance had noisy or blocked airways (p.43)
- Need to standardize Patient Report Form (PRF). The ambulance PRF was unavailable in a third of cases
- 7% of patients transported by ambulance were taken to the inappropriate first hospital (p.42)

“High Quality Care for All” (Lord Darzi – Next Stage Review) (2008)

- Change that is locally-led, patient centred and clinically driven (p.17)
- Saving lives by creating specialized trauma centres supported by skilled ambulance services (p. 18)
- Make ambulance trusts into NHS Foundation Trusts (p.61)
- Allow NHS Foundation Trusts the freedom to innovate and invest in improved care of patients (p.61)

“Major trauma care in England” – National Audit Office (2010)

- The need for development of trauma networks where ambulance services and specialist centres coordinate protocols to deliver the most serious cases to the best equipped hospitals (p.6). Need to develop and implement triage protocols between ambulance trusts and primary care trusts (p. 8)
- Ambulance trusts have no systematic way of monitoring the standards of care provided to trauma patients and clinical governance arrangements between pre-hospital and hospital care are weak (p.7). Need for dialogue between ambulance services and doctors about pre-hospital care (p.17)

- The low incidence and high complexity of trauma patients stresses the need for trauma systems with recognized standards and protocols. In-hospital mortality has reduced by 15-20% where trauma systems have been introduced (Mann, Mullins et al. 1999; Celso, Tepas et al. 2006). Implementation of trauma systems may result in savings of additional 450-600 lives in England each year (p. 8)
- Major trauma in England is not currently being delivered efficiently or effectively (p.8). Need for formal evaluation of effectiveness of pre-hospital care.
- Ambulance trusts need to develop quality assurance procedures to ensure that defined clinical standards by the Joint Royal Colleges Ambulance Liaison Committee are met (p.9). There is a lack of integration of clinical governance (quality and safety) mechanisms between ambulance trusts (p. 20)

"Implementing trauma systems: Key issues for the NHS" – Ambulance Service Network (NHS Confederation) (2010)

- Critical care transfers likely to increase as more patients are taken to specialist centres (p.4)
- Mortality from major trauma is 20% higher in England than the US (p.7)
- Ambulance on-scene times much higher than recommended '10 minutes' (p.10)
- Risk of death increased by 1.5-5.0 times when patient transferred to local hospital rather than major trauma unit (p.11)
- Accuracy of triage systems needs significant improvements (p.12)
- Adopting alternative trauma systems in urban, suburban and rural settings rather than single model (p.18)
- Impact of volume on trauma outcomes is complex and skills, facilities, seniority and reputation are more likely to have an impact

The critical factors for ambulance services arising from these national reports are summarised in Figure 1. The local drivers for SECAmb introducing 'critical care paramedics' have included the following documents:

- The Department of Health's (2005) MERIT Programme (Mobile Emergency Response Incident Teams) with the onus on ambulance services to conduct health service assessments, instigate triage processes, treat and transport casualties and, ultimately, to save lives. It was suggested that CCPs may take on this role
- SECAmb's (2007) Fit for the Future Programme proposing the development of 12 CCPs in the West Sussex LHC
- SECAmb's (2008) vision as an "innovative, clinically focused, high performing team based organisation that matches and exceeds international best practice". This has included development of specialist role of a 'critical care paramedic' and rollout of innovative clinical practices and equipment

- SECAmb's (2008) Commissioning Strategy which included the development of 60 CCPs and 300 Paramedic Practitioners (PPs) over five years
- Healthcare for London's Trauma Review (ongoing) which aims to set up trauma networks across London with specialist major trauma centres
- NHS South East Coast's (2010) 10 year vision of innovation through 'Healthier People, Excellent Care'. SECAmb's pledge to take major trauma patients to specialist units. Established a trauma network for brain injured and polytrauma patients in an effort to improve models of care.

"Regional Networks for Major Trauma" – NHS Clinical Advisory Groups Report (2010)

- Severely injured patients are 15-20% less likely to die if admitted to a Trauma Centre rather than other hospitals (p.7)
- Current over-focus on response times means patients are at risk of receiving sub-optimal care (p.12)
- Military evidence shows that advanced resuscitation skills are crucial in improving mortality (p.19)
- Paramedic to be present in Ambulance Control room 24/7 to make appropriate tasking decisions in major trauma (p.20)
- Enhanced Care teams should be available 24/7 to provide pre-hospital care for the major trauma patient (p.20)
- Need for advanced airway techniques including Rapid Sequence Induction (RSI) to be performed competently to secure airway (p.24)
- Enhanced Care team skills to include advanced analgesia, thoracotomy, resuscitative thoracotomy, amputation, regional nerve blocks and procedural sedation (p.24)
- Enhanced Care team to comprise 8 No. Level 6/7 practitioners 24/7 with extended training (p.24)
- Enhanced Care team to gain experience of major trauma through regular exposure (rather than once every 18 months) as well as advanced training (p.28)

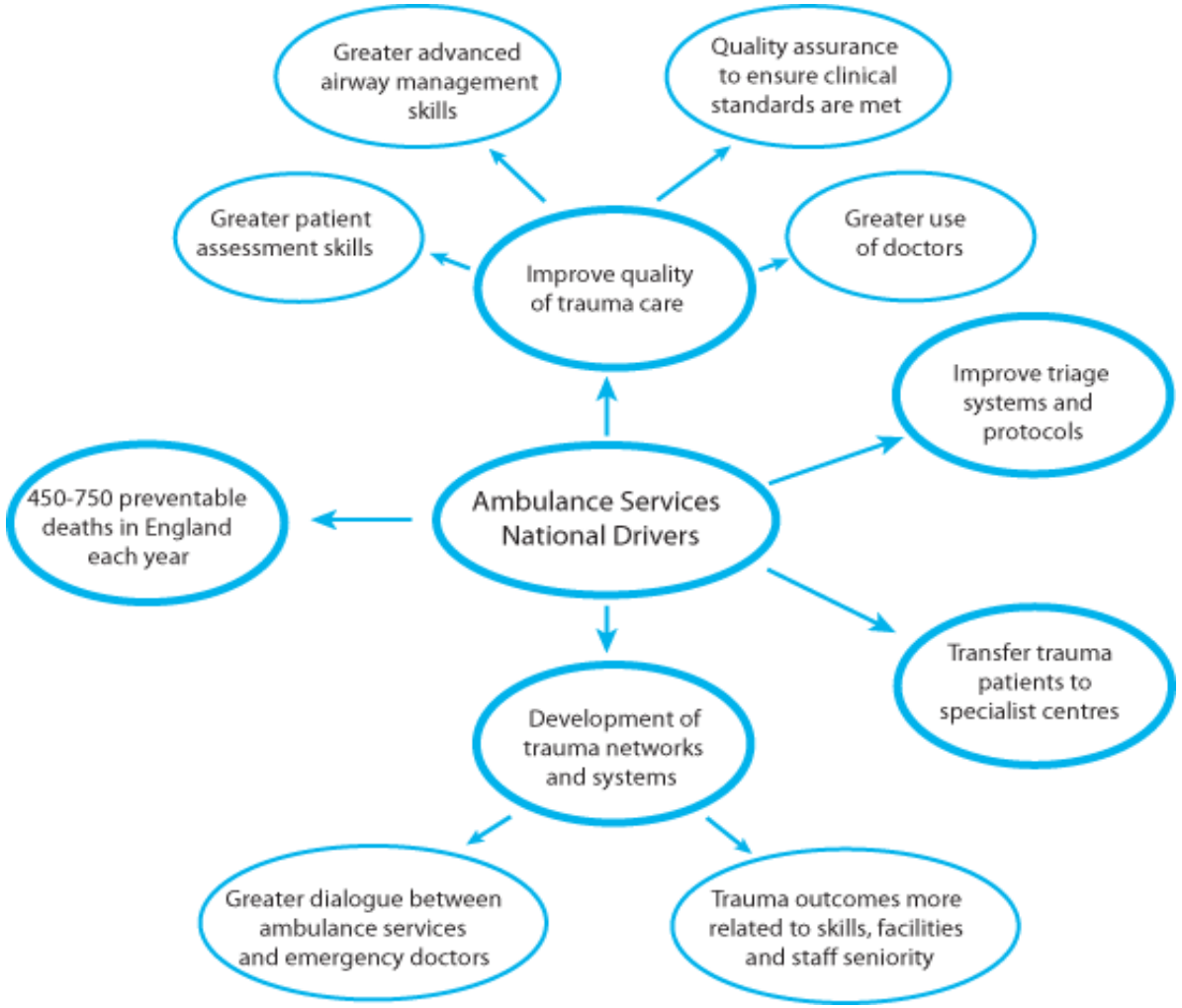


Figure 1: Critical national drivers for ambulance services

The role of Critical Care Paramedics (CCPs)

The development of critical care paramedics (CCPs) at South East Coast Ambulance Service is modelled closely on the highly successful mobile intensive care ambulance (MICA) paramedic in the state of Victoria in Australia. Like MICA paramedics, CCPs have a higher clinical skill set and can perform advanced medical procedures. In 1971, MICA paramedics were trialed in Victoria to address avoidable deaths from road traffic accidents and heart attacks. This is not dissimilar to current national preoccupations of reducing mortality rates among ambulance services in England. MICA paramedics trained for some months at Royal Melbourne Hospital and, having gained an advanced clinical skill set, were able to replace medical registrars on MICA ambulances. Table 1 provides the type of skill sets found among advanced paramedics equivalent to CCPs in Canada, US and Australia.

Treatment issue	Comparable grades of advanced paramedic in other countries, for example Canadian Advanced Care Paramedic (ACP) Skills / US Emergency Medical Technician-Paramedic (EMT-P) Skills / Australian Mobile Intensive Care Ambulance (MICA) Paramedic Skills
Airway management	Drug assisted intubation including rapid sequence induction and intubation - cricothyrotomy and others
Breathing	Use of mechanical transport ventilators, active oxygen administration by surgical airway, decompression of chest cavity using needle/valve device (needle thoracotomy)
Circulation	Intravenous plasma volume expanders, blood transfusion, intraosseous (IO) cannulation (placement of needle into marrow space of a large bone), central venous access (central venous cathether by way of external jugular or subclavian)
Cardiac arrest	Expanded drug therapy options, ECG interpretation (12 lead), manual defibrillator, synchronized mechanical or chemical cardioversion, external pacing of the heart
Cardiac monitoring	18-lead ECG monitoring and interpretation
Drug types permitted	Dramatically expanded (up to 60) drug list. Note: in some jurisdictions, advanced paramedics are permitted to administer any drug as long as they are familiar with it
Patient assessment	Interpretation of lab results, interpretation of chest x-rays, interpretation of cranial CT scan, limited diagnosis (e.g. rule out fracture using Ottawa ankle rules), and now ultrasonography
Wound management	Wound cleansing, wound closure with Steri-strips, suturing

Table 1: Advanced paramedic skills comparable to CCPs in Canada, US and Australia

As shown in Figure 2, there are two primary roles for critical care paramedics; one of enhanced response to seriously ill or injured patients and the other to transfer critically ill patients between hospitals. To enable this to be done effectively in the initial rollout, there is a secondary role of assisting with specialist tasking to substantiate that CCPs are primarily dispatched to the 10% high acuity 999 calls and the most acute hospital transfers. This ensures that their advanced clinical skills are utilised most effectively by the ambulance service. CCPs may operate as ground based critical care ambulance units or act as part of the physician/paramedic team staffing air Helicopter Emergency Medical Service (HEMS) units.

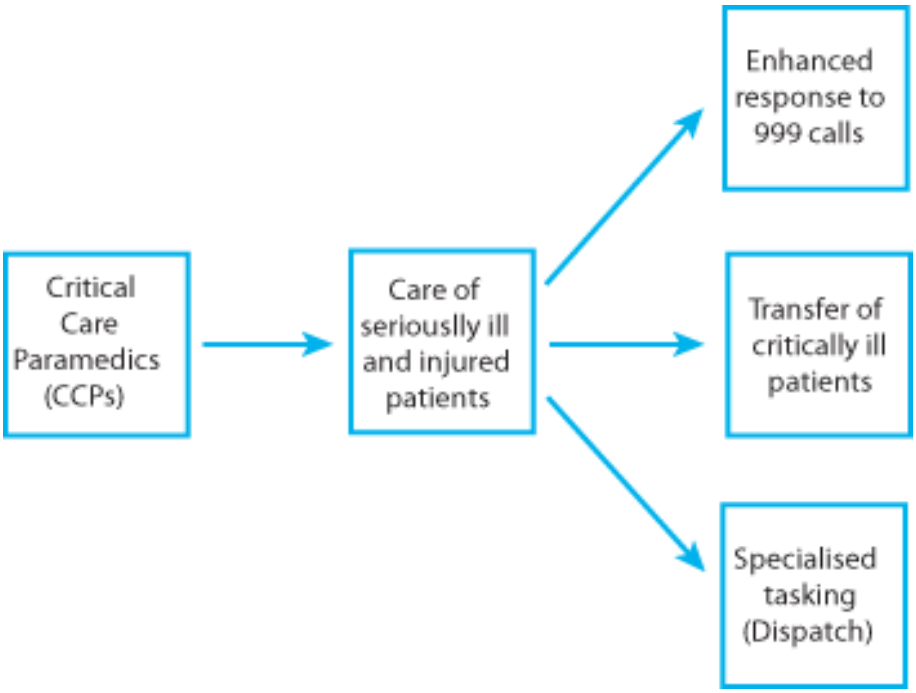


Figure 2: Roles of critical care paramedics (CCPs)

The intention is to have CCPs embedded in critical care networks and the emerging trauma networks working closely with doctors and nurses involved in emergency care and, especially, critical care transfers. They would provide a support role to ambulance crews working in communities where necessary. Critically ill and injured patients account for 5-8% of staff workload. SECAmb have recognised a gap in the clinical skills mix of most ambulance personnel to differentiate between clinical conditions safely and effectively. This gap of new and complex clinical pathways was addressed by the development of CCPs with greater clinical knowledge, skills and decision making abilities.

There was a pilot course, ‘Cohort 0’, to test the training packages for CCP development and numerous programme changes were made following student feedback. This cohort was composed of paramedics from East of England, West of England as well as SECAmb. The first critical care

paramedic course commenced in September 2007 and was provided by the University of Hertfordshire. The course comprised four modules:

- Patient assessment
- Foundations of Critical care: Adult and Child
- Advanced Airway Management, Ventilation and Resuscitation: Adult and Child
- Critical care transport: Adult and Child

The first group of students qualified in December 2008 and began their new role as 'critical care paramedics' in the West Sussex area on 5 January 2009. This early adopter site included CCPs working from Worthing and Arundel to maximise their effectiveness. The successful CCP students were awarded a Postgraduate Certificate in Patient Assessment & Management. The university phase takes a 10 months period with 16 weeks directly in training. A number of CCPs have continued their studies (self-funded) at University of Hertfordshire with the goal of gaining a Master's degree. Initially, CCPs worked in pairs for six weeks followed by a preceptorship period which included hospital placements, working with high acuity patients and under the supervision of consultant doctors (anaethetists) in acute trusts. They developed a portfolio of evidence to support their clinical abilities which were approved by their preceptorship supervisors (consultant anaethetists) based at a number of hospitals in the region. Their competencies were more oriented towards critical care transfers as shown in Table 2 but can be applied equally to primary retrieval in the pre-hospital environment. The preceptorship period takes between 6-12 months depending on speed of competency acquisition by the CCP.

CCPs have worked predominantly from ambulances with a technician crew and at times used rapid response cars to allow enhanced response to distant incidents. At the time of writing, one CCP cohort based in Kent had completed their educational phase at University of Hertfordshire and another cohort had begun their studies. At a recent CCP development day, there were around 45 CCPs in attendance at various stages of their development. SECAmb has a goal to develop 60 CCPs by 2013. The different uses of pre-hospital clinicians with critical patients are illustrated in Figure 3.

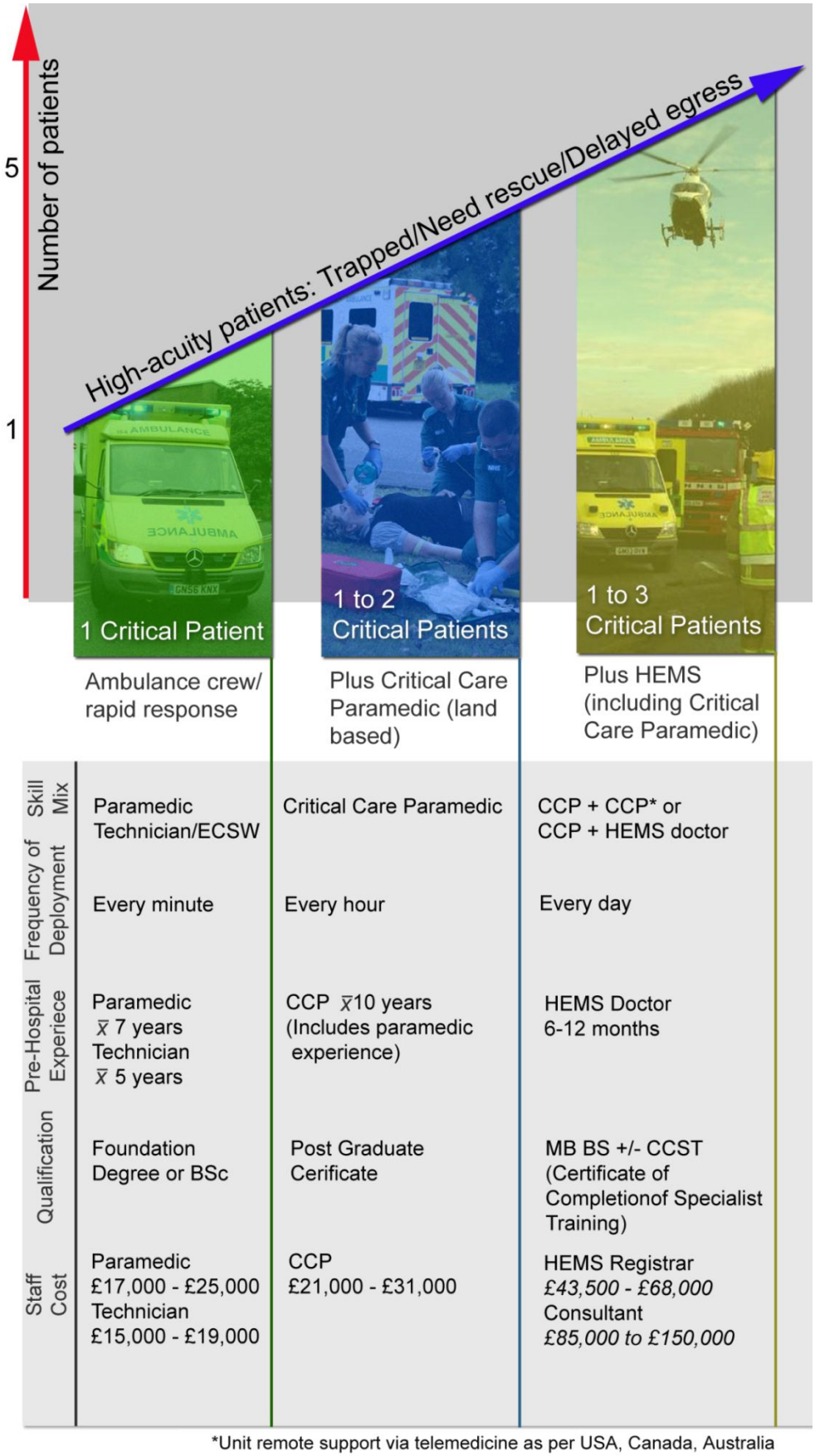


Figure 3: The use of pre-hospital technicians in treating critical patients

CCP competencies
Use of Midazolam*
Use of Ketamine*
Preparing for insertion of a CVP Line
Preparing for insertion of arterial cannula
Blood sampling from an arterial cannula
Interpretation of blood gases
Interpretation of blood results
Blood transfusion set up and checking
Cricoid pressure competency
Endotracheal Intubation +/- Bougie
Endotracheal intubation with adjuncts
Preparation for rapid sequence induction
Failed intubation drill
Surgical Cricothyroidotomy
Ventilatory assessment
Failed ventilation management
Sedation
Connection of vaso-active agents
Titration of vaso-active agents

Table 2: CCP preceptorship competencies

*Midazolam and Ketamines are available for use by paramedics on a Patient Group Directive (PGD) basis. Current legal anomalies prevent paramedics being in possession of these dugs. This situation is under review by the Home Office.

Evaluation design

The study began by discussing the evaluation design with the core evaluation team at SECAmb. This comprised Professor Andy Newton (Director of Professional Standards & Innovation SECAmb), Dr Jane Pateman (Medical Director SECAmb), Dr Sarah Poole (SECAmb), Dr Julia Williams (University of Hertfordshire) and Dr Ashok Jashapara (University of London). The evaluation team discussed the use of a randomised control trial to explore whether a positive relationship existed between critical care paramedics (CCPs) and clinical outcomes. This was laden with difficulties for a number of reasons. There were no CCPs who had completed their preceptorship at the start of the study to show that they had developed their full complement of clinical skills. At that stage, the sample size would have been 12 CCPs based in West Sussex. This would make any statistical analysis almost impossible to show statistically significant relationships and comparisons. Even if this could be done by waiting for more CCP cohorts, the study faced the problem of establishing a reliable control group. Any control group drawn from SECAmb would be biased as CCPs were tasked with a higher volume of high acuity calls. For effective comparison, a control group would be needed from another ambulance trust with a similar geographic spread. A randomised control trial would need ethical approval from the appropriate NHS Research Ethics Committee which would further delay the study. There was limited time on this research fellowship and the core evaluation deemed that a randomised control study would be inappropriate at this stage. Such a study would be more suitable once the target of 60 CCPs had been reached and successfully passed through their education and preceptorship programmes.

In the circumstances, the evaluation team decided to conduct a qualitative study to better understand different aspects of the CCP role and their impact on clinical outcomes. At the beginning of this study, an oval mapping exercise was conducted by the evaluation team to bring out the different aspects that would be valuable in an evaluation study. Such an approach allowed joint diagnosis, mutual control and joint action. The outcomes of the oval mapping exercise can be seen in Figure 3. Four key objectives emerged from the oval mapping techniques. These were:

1. To assess improvements in clinical outcomes by critical care paramedics
2. To evaluate operational efficiency of critical care paramedics
3. To assess differences in education, training and competence of critical care paramedics
4. To evaluate the interface of critical care paramedics with other professions

The advantages of a qualitative approach are that they can help explain causal links in real-life interventions that are too complex for the survey strategies; describe the ‘real-life’ context in which an intervention has occurred; provide an illustrative description of the intervention itself and

explore those situations in which the intervention being evaluated has no clear, single set of outcomes (Dopson 2003). For the researcher based at SECAmb as part of a fellowship, a continuous balance was negotiated between acting as an everyday participant and as a scientific enquirer. The evolution of the CCP programme was tracked through interviews, observations of CCPs in their daily duties and a review of internal documentation. Fieldwork included around 60 semi-structured interviews with many different stakeholders:

- Critical care paramedics involved in West Sussex and Kent
- Critical care paramedics involved with the air ambulance – Helicopter Emergency Medical Service (HEMS)
- Preceptorship supervisors involved with the clinical skills training and assessments of CCPs
- Academics at University of Hertfordshire involved with the educational training of CCPs
- Critical care network managers involved with critical care transfers in their region
- Dispatch personnel involved with tasking CCPs
- Directors at SECAmb involved with the development and operational management of CCPs
- A&E Consultants involved with CCPs
- Mobile Intensive Care Ambulance (MICA) Paramedics in Victoria, Australia who provided the model for the CCP programme
- International experts involved with paramedics and trauma care

Most interviews were conducted face-to-face and all interviews were recorded and transcribed. In some cases, telephone interviews were conducted due to physical or geographic constraints. The study reviewed extensive internal documentation that traced the evolution and implementation of the CCP programme. Figure 4 shows the evaluation design that emerged. All interviews were coded in Nvivo, qualitative data analysis software, and initial interpretations of data were discussed between the evaluation team. Notes were kept of all meetings which were included as part of the analysis. The fact that this evaluation was part of a live study enabled the researcher to observe how things evolved over time especially interactions and causal relations. The researcher had access to most of the main players to enable a reasonably complete picture of CCPs to emerge, acknowledging the everyday complexities of working in a large ambulance trust. Fieldwork also included accompanying critical care paramedics and observing their work treating seriously ill and injured patients. Often, this was the only way to conduct an interview with CCPs. It was catching moments in the day when CCPs were free from the demands of emergency calls from the dispatch centre. This made the research process very dynamic but there were days of fieldwork when interviews were not possible due to CCP work pressures.

A small quantitative study was conducted by Dr Jane Pateman and Dr Sarah Poole in 2009 to examine CCP activity in West Sussex. This showed that CCPs were predominantly tasked to high acuity incidents; though there was some lower acuity activity. Pre-hospital times were predominantly higher for CCPs as they dealt with high acuity patients such as road traffic collisions (RTCs) with a trapped patient. This was the same with on-scene stabilisation times. A 'Daily Skills Log' was developed by the researcher to ascertain the frequency and confidence levels CCPs had in using skills based on their 20 new competences. This was rejected by CCPs as the competences were oriented towards critical care transfers which only accounted for around 5% of their workload. As such, this evidence could not be used as part of the study.

Validity of the evaluation study occurred in two ways. The initial findings were presented to critical care paramedics on a professional development day and there was general agreement with the findings. A draft report of the study was also reviewed by key staff at SECAmb.

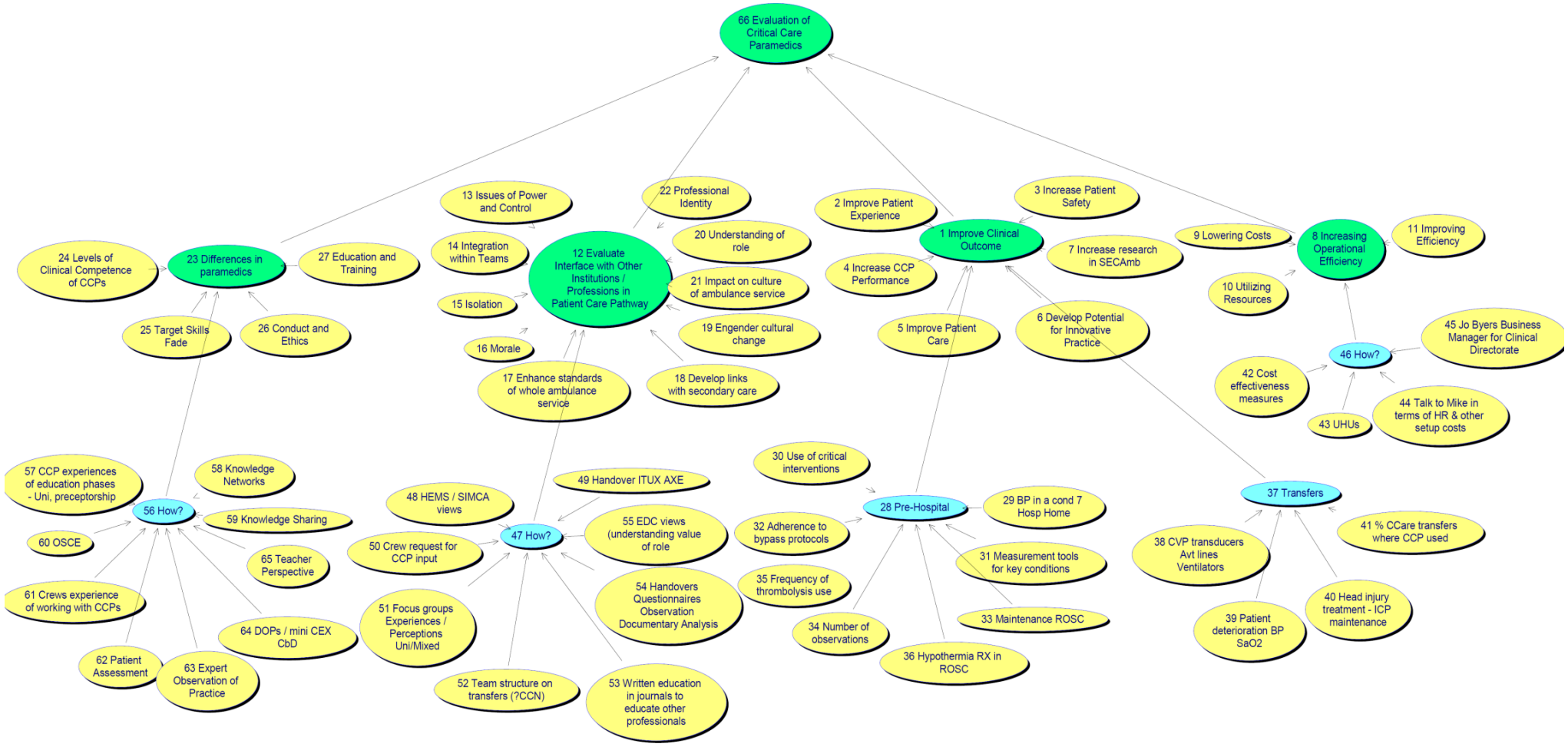


Figure 4: Oval mapping of evaluation design

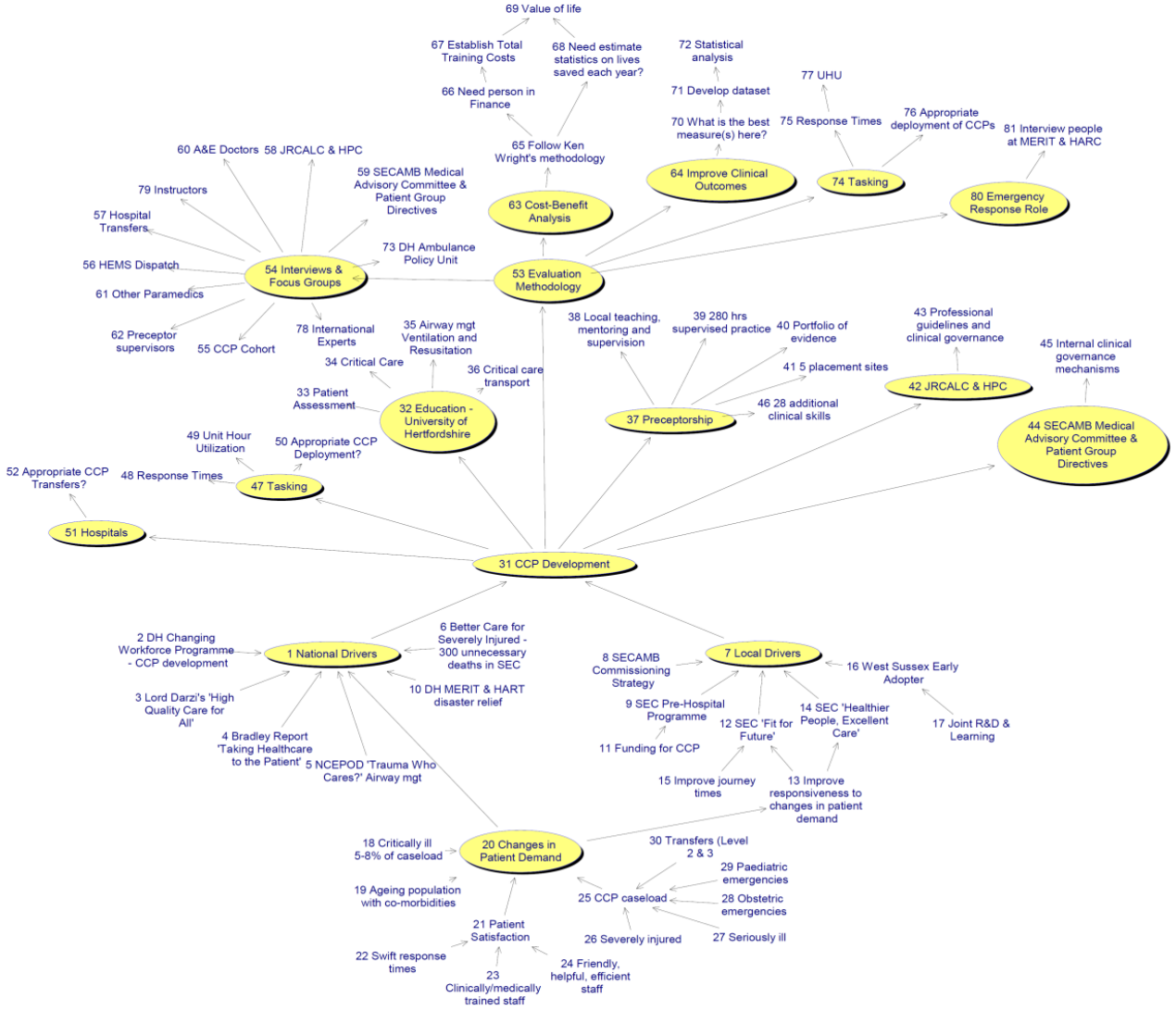


Figure 5: CCP evaluation design

The financial case for Critical Care Paramedics

The costs of CCP training

Ken Wright (1984) conducted a cost benefit analysis of ambulance services to assess the 'value of life' from extended training of ambulance staff. In the 1980s, the extended training included endotracheal intubation to establish and maintain an airway, ventricular defibrillation to assist with cardio pulmonary arrest and intravenous infusion following severe blood loss. A similar type of analysis can be conducted for critical care paramedics following their advanced education and training at university and hospital. This education and training has included completion of four taught modules at the University of Hertfordshire and a preceptorship period:

- Patient assessment
- Foundations of critical care: adult and child
- Advanced airway management, ventilation and resuscitation: adult and child
- Critical care transport: adult and child
- Preceptorship at a hospital developing competencies in critical care

The costs of training one CCP are shown in Table 3 below. These costs are based on wages and prices at August 2010.

	Initial	Recurrent
Band 6 uplift	£0.00	£3,971.00
Module fees	£2,620	£0.00
Travel & subsistence	£1,000.00	£0.00
Training backfill	£4,725.00	£0.00
Placement costs	£1,300.00	£0.00
Placement backfill	£5,040.00	£0.00
Continuing professional development	£0.00	£250.00
Drugs, equipment and medical supplies	£0.00	£250.00
Turnover maintenance	£0.00	£778.25
Initial equipment set up costs	£1,000.00	£0.00
Total Costs	**£15,565.00**	**£4,721.00**

Table 3: Costs of training Critical Care Paramedics

The costs include the backfill costs while CCPs are being trained and are based on 788 hours 'lost' to the CCP education pathway per student. The

additional ambulance equipment costs have not yet been quantified due to the emerging scope of practice. An estimate of £10K capital per team of six CCPs has been made, plus ongoing revenue costs of £3-5K per annum. The cost of university and hospital premises have been factored into the module fees and placement costs. No allowance has been made for the high levels of leisure time sacrificed by CCPs as considerable amounts of private study are required during their development. Many CCPs have continued to follow the Masters pathway in their own time. The picture of future ongoing training costs is still emerging in terms of CCP involvement in ITU units to prevent skills fade. This could equate to several £k per CCP per year under current arrangements and is currently being negotiated with acute hospital trusts.

Many of the CCPs undertaking the training and development are under forty years of age. As this a new programme, there is currently no information available on retention rates of CCPs. It is clear that they are a highly motivated group of paramedics. If one adopts the Ken Wright (1984) analysis, the assumption is that CCPs would serve for another 20-25 years in this capacity. If one adopts a more conservative assumption, it is likely that CCPs would serve at least 10 years of service. Using these assumptions, the net present value of annual training costs can be calculated using the equation:

$$\text{Net Present Value (NPV)} = R_t / (1 + i)^t$$

where R_t = net cash flow
i = discount rate
t = time (in years)

A reasonable discount rate of 5% has been used to calculate the NPV for the training investment for three different periods as shown in Table 3. The main post-qualification cost is the wage supplement paid to CCPs on successful completion of their training.

CCP Years of Service	Initial Costs	Recurrent Costs	Total Costs
10 years	£955.56	£4,721.00	£5,676.56
20 years	£293.31	£4,721.00	£5,307.63
25 years	£183.86	£4,721.00	£4,904.86

Table 4: CCP Training costs discounted over years of service

The training and development costs at SECAmb come from multi-professional education and training (MPET) or non-medical education and training (NMET) budgets. These are one-off non-recurrent costs which have been met through seed corn funding from two PCTs as shown in Table 5; £109K from West Sussex PCT and a lump sum (figure unavailable) from East Kent PCT. The recurrent costs come primarily from CCP uplift in salary costs from Band 5 to Band 6.

PCT Funding		2008/09	2009/10	2010/11
West Sussex	Non-recurrent	£88K	£21K	£0
	Recurrent	£184K	£184K	£184K
	Total	£272K	£205K	£184K
East Kent	Non-recurrent	Lump sum (unavailable)	£0	£0
	Recurrent	£0	£92K	£92K
	Total	Unavailable	£92K	£92K

Table 5: Current PCT funding for CCPs

The benefits of CCP training

The training and development of CCPs has been modelled on intensive care paramedics (ICPs) in Queensland, Australia. Advanced treatments such as intubation and administration of cardio-active drugs are provided by ICPs. A recent study (Woodall, McCarthy et al. 2007) adopted logistic regression techniques to see if there was a relationship between skill levels and survival to hospital discharge of patients suffering from out of hospital cardiac arrest. Intensive care paramedics (ICPs) had initial three years of paramedic training followed by two years in the field and one year full time intensive care training. The study (n=1687) showed that survival rates were higher (6.70%) and statistically significant with ICPs compared to non-ICPs (4.66%). The study also showed lower rates of patients (33.5%) were transported to hospital by ICPs compared to non-ICPs (50.9%). This implies that ICPs are better placed to select patients for whom resuscitation is viable. The study didn't examine whether the increased survival rates were due to ACLS (advanced cardiac life support) interventions or ICP advanced skills set. Mann and Guly (1997) found that experience did matter in 15% of patients involved in out of hospital cardiac arrests presenting non- ventricular fibrillation (VF). There was a significantly increased rate of return of spontaneous circulation (ROSC) in those patients attended by paramedics rather than technicians. This result was supported by another study (Kriegsman and Mace 1998) that showed that paramedics significantly improved ROSC and survival to ICU admissions in rural settings compared to emergency medical technicians. Increased survival to hospital discharge was noted among paramedics but this was not shown to be statistically significant.

A recent study in King County in America (Gold and Eisenberg 2009) showed that paramedic experience did lead to positive outcomes. In a retrospective cohort study (n=699) of out of hospital VF cardiac arrests, the study found that every additional year of paramedic experience was associated with a 2% increase in the survival rate of the patient. Paramedic experience included intravenous line insertions, intubations, and provision of medications in VF cardiac arrest. In a British study (Soo, Gray et al. 1999) based in Nottinghamshire of out-of-hospital cardiac arrests (n=1547), patients

resuscitated by paramedics were more likely to survive to hospital discharge than technicians. In the CCP context, it is noteworthy that resuscitation by a paramedic assisted by a medical practitioner (with a higher skill set) provided the best chances of the patient surviving the event.

As there are no current studies examining survival outcome measures of CCPs, another source of evidence is to explore HEMS (Helicopter Emergency Medical Service) teams as having advanced skill sets and higher levels of clinical judgement comparable to CCPs. A Rotterdam study (n=346) (Frankema, Ringburgh et al. 2004) found that mortality was higher for HEMS medical teams but when patients were controlled for acuity of trauma, mortality rates were lower for HEMS teams compared to ground emergency medical support. Response by the HEMS medical team resulted in improved outcomes for blunt trauma and severe head injuries. This can be explained by the extended scope of airway management and the crew expertise and experience especially with multiple trauma patients. A Dresden study (n=403) (Biewener, Aschenbrenner et al. 2004) found that that there was clear evidence for marked survival outcomes when HEMS medical teams or ground ambulances transferred a patient to a specialist trauma centre. There was no clear evidence of preclinical superiority of HEMS medical teams over ground ambulance support. However, an earlier randomised control study (n=574) (Baxt and Moody 1987) showed that a doctor/nurse service in a pre-hospital setting does influence blunt trauma patient outcome compared to a paramedic/nurse service. Both crews were trained to conduct the same level of interventions. The doctor led crew had a statistically significant mortality rate of 35% lower than predicted whereas the paramedic led crew had a mortality rate the same as predicted. In contrast, Hamann, Cue et al (1991) found that there was no difference in patient outcome when a doctor was part of HEMS and when they were not.

The evidence on whether a doctor provides additional benefit compared to a paramedic is mixed. Liberman, Muller and Sampalis (2000) conducted a meta-analysis of the literature in urban settings. They found that the mortality rate (n=174 articles) was highest in the doctor group and lowest in the emergency medical technician group providing basic life support (BLS). There was no attempt to control for severity of injuries which was highest in the doctor group. In rural settings, paramedics who had undergone advanced life support (ALS) training were found to have significant improvements in mortality (Messick, Rutledge et al. 1990). The literature suggests that doctors have a greater impact on survival rates in rural rather than urban settings (Butler, Anwar et al. 2010). Nicholl, Brazier and Snooks (1995) found that there was no significant difference between ground medical transport (GMT) and HEMS once the nature and severity of injury had been controlled. Patients were transported to one of 19 hospitals rather than a specialist trauma centre. In a study of patients with blunt injuries (n=632), Younge, Coats et al. (1997) found that 2-6 extra trauma patients were likely to survive out of 100 patients when transported by HEMS rather than ground ambulance. The literature is unclear on whether improvement in outcome is as a result of an experienced trauma team or transport to a specialist trauma centre.

Endotracheal intubation (ETI) is an advanced airway management skill performed by CCPs and has been shown to lead to improved patient outcome. In a study of 10,314 patients, Davis, Peay et al. (2005) found that pre-hospital endotracheal intubation resulted in statistically significant positive patient outcome (Odds Ratio (OR) = 1.4) compared to emergency department intubation. Evidence from Ontario of critical care transfers (MacDonald and Farquhar 2005) shows that critical care paramedics successfully transferred and managed all complications without any deaths of intra-aortic balloon pump (IABP) – dependent patients (n=29) without additional medical escorts.

Even though none of the studies are looking directly at survival benefits of the advanced clinical skills set of critical care paramedics, it is important to examine studies that show no difference in patient outcomes particularly from cardiac arrest. In a major Ontario study (n=5639), Stiell, Wells et al (2004) examined the impact of increased training of paramedics in advanced cardiac life support (ACLS) which included endotracheal intubation and the administration of intravenous drugs. A program of rapid defibrillation was included in the training. The study found that the extra training in advanced life support interventions did not improve patient survival rates from out-of-hospital cardiac arrest. Another study (Nguyen-Van-Tam, Dove et al. 1997) also found that extended training of paramedics in the management of out-of-hospital cardiac arrest resulted in short term survival advantages after cardiac arrest compared to technicians.

The mixed nature of supporting evidence shows that positive survival outcome for critical care paramedics is likely to be affected by the whole trauma system including the use of specialist trauma centres and critical care facilities rather than purely clinical interventions undertaken in the pre-hospital setting. The assumptions linked to patient survival benefit from CCP interventions are

shown in Figure 5. In the absence of empirical evidence to show significant positive patient survival benefit from CCP interventions, a number of comparators from previous studies can be used to give an estimate of likely patient outcomes. It is not assumed that CCPs can replace HEMS doctors but the positive patient survival rates give some indication of the direction that an advanced skills set together with higher clinical judgements may have on outcomes. In this model of care, doctors play an important role in providing medical oversight and clinical supervision. Table 5 shows the CCP comparators from different studies and the associated patient outcomes.

Study	CCP Comparator	Patient outcomes	Patient Condition
Bernard, et al. (2010)	MICA paramedics Intervention – rapid sequence induction and intubation (randomised controlled trial)	Improved neurological survival at 6 months	Severe head trauma
Woodall, McCarthy et al. (2007)	Intensive care paramedics (ICPs) in Queensland	+2.04% higher survival rate than non-ICPs	Cardiac arrest
Gold & Eisenberg (2009)	Paramedic experience	+2.0% survival rate per year of experience	Cardiac arrest
Frankema, Ringburgh et al. (2004)	HEMS medical team	+2.2 times better chance of survival	Multiple trauma
Baxt & Moody (1987)	HEMS doctor	+35% survival rate	Trauma
Younge, Coats et al. (1997)	HEMS medical team	+2-6% survival rate	Blunt injury
Davis, Peay et al. (2005)	Endotracheal intubation	Odds ratio = 1.4 of survival	Traumatic brain injury
MacDonald & Farquhar (2005)	CCP Tansfer of intra-aortic balloon pump (IABP) – dependent patients	Successfully managed all complications and no deaths of patients	Intra-aortic baloon pump

Table 6: CCP Comparators and patient outcomes

The pre-hospital environment represents a small element of the patient pathway. The only measures are the changes in patient condition at the start and end of the patient journey with the ambulance service. It is difficult to relate this journey directly to the discharge and readmission of patients. So many variables come into play in terms of hospital interventions that can affect these outcomes. This does not stop statisticians providing outcome measures and controlling for hospital variables. In the field, one CCP equated saving lives to the provision of the best skills leading to the best chances of survival:

"No, I think what I can say hand on heart is that for the incidents I have been to, that person has had a world class service, without question, and if they're going to have a chance, they have chance with us. I think that again personally the incidents that I've been to, if you're going to a 95-year-old lady in a nursing home whose had no CPR for five minutes before you arrived, her chances are pretty remote you're not going to be able to do a great deal. But certainly that person if they are going to have a chance, they have a good chance with us."

Mortality rates and avoidable deaths at SECAmb

The Trauma Audit & Research Network (TARN) collects information from hospitals (1989-present) to help improve the effectiveness of trauma care in the UK. Its database is an important source of epidemiological data and can help individual hospitals in their clinical audits especially when a patient's outcome was 'unexpected'. As shown in Figure 5, the national mortality rates have remained relatively unchanged over 15 years and mortality rate in the South East Coast (SEC) region is generally lower than the national rate.

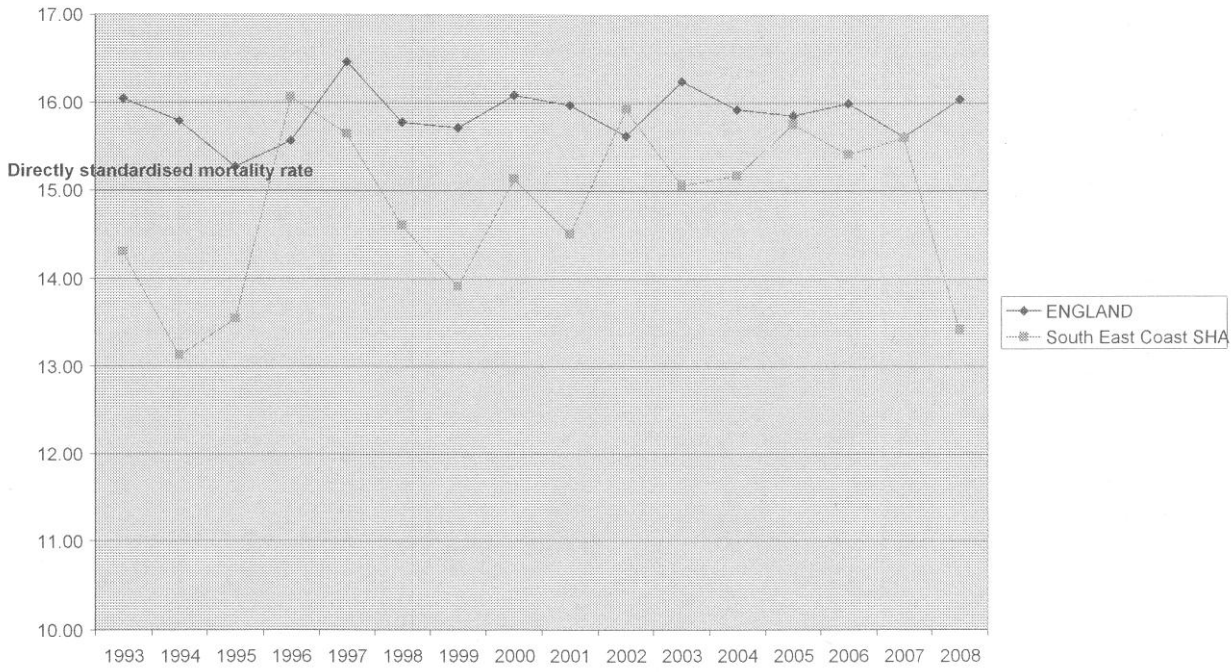


Figure 6: Changes in age standardised mortality from accidents in the SEC region - all ages 1993-2008 (Kammerling 2010)

However, if one considers the mortality rates for the 15-24 age group which is prone to higher mortality rates, the SEC region rates are broadly similar to national rates. One of the difficulties with TARN data is that only 60% of hospitals submit data to TARN. For example, in the SEC region there are five hospitals for which TARN has no data. Despite these limitations, one can estimate that there are around 2604 patients expected at hospital in the SEC region each year. Out of these patients, 710 patients are expected to have

severe injury with an injury severity score (ISS) > 15. ISS is an anatomical scoring system that correlates linearly to mortality, morbidity and length of stay in hospital.

Mortality rates are 20% lower in the US and this has been attributed to the trauma systems adopted. Royal London Hospital has found that it can match the US rates (19.3%) by reorganising its trauma systems. Addenbrooke Hospital has achieved the highest rates nationally (28% reduction) for treating severely injured patients. Kammerling (2010) analysed the TARN data and found that there are 185 deaths expected each year in the SEC region based on current trauma systems. If the trauma systems in the SEC region were improved to the standards of Royal London Hospital, there would be an extra 36 avoided deaths each year. If the SEC region became best in class following Addenbrooke's example, there would be 56 avoidable deaths each year.

Current evidence on survival rates is limited as shown in Figure 5. There is likely to be 2% improvement in survival rates for cardiac patients using CCPs. In addition, there is likely to be 2% improvement in preventable deaths from trauma and non-trauma related deaths. Evidence shows that there is an annual improvement in survival rates for each year of CCP experience. There is also an increased odds of survival (1.4) of patient with CCP advanced airway management skills. These assumptions do not take into account the lack of current evidence in non-trauma related deaths associated with severe asthma, chest pains, myocardial infarction, left ventricular failure, acute heart failure and paediatric emergencies. The analysis has assumed that there will be an additional 1% improvement in preventable deaths from medical supervision and online support via telemedicine when CCP knowledge and skills are insufficient in the field. An improvement of 4-6% in survival rates using CCPs and doctors appears reasonable and fair based on current literature as shown in Table 6. This proportion of improvement in prehospital care appears in accordance with the 20% improvements in survival rates in the US using advanced paramedics.

Improvements from preventable death interventions	**CCP interventions**	**Doctor interventions**
Cardiac arrest	2%	2%
Trauma and non-trauma	2%	3%
Medical supervision	1%	1%
Total	4-5%	6%

Table 7: Preventable death assumptions using CCPs and doctors in prehospital care

For the purposes of a cost benefit analysis, the following conservative assumptions will be adopted about the introduction of enhanced CCP capabilities into the trauma system in the SEC region (Table 8):

CCP or Doctor Teams in Prehospital Care	Average number of additional lives saved annually	Improvement in expected deaths in the SEC region annually (185 deaths currently each year)
Partial scope: CCP Enhanced Care Team 24/7 with minimal clinical supervision and support (6 CCPs) using 8 teams	8	4.3%
Full scope: CCP Enhanced Care Team 24/7 with full clinical supervision and support (6 CCPs) using 8 teams	10	5.4%
Alternative scope: Doctor Enhanced Care Team 24/7 with full clinical supervision and support (6 doctors) using 8 teams	12	6.5%
Alternative scope: Doctor Enhanced Care Team 24/7 with full clinical supervision and support (6 doctors) using 2 teams	3	1.6%

Table 8: Assumptions of lives saved from enhanced CCP and doctor skills in pre-hospital care in the SEC region

These assumptions adopted are in line with evidence showing the increased survival rates from the use of specialist paramedics (Woodall, McCarthy et al. 2007; Gold and Eisenberg 2009) and doctors (Younge, Coats et al. 1997) in prehospital care.

If SECAmb adopted two doctors enhanced care teams in each Strategic Health Authority, the assumption is that they would save 3 additional lives (12lives/4). This is based primarily on the fact that doctors and CCPs have a radius of action as shown by the isochromes in Figure 7. Only doctors associated with HEMS helicopters would have a greater reach over the SECAMB region. However, they would principally assist in cases of major trauma rather than cardiac arrest. If one factors in such logistics, HEMS doctors are likely to reach 80% of trauma patients and 10% of cardiac arrest patients.

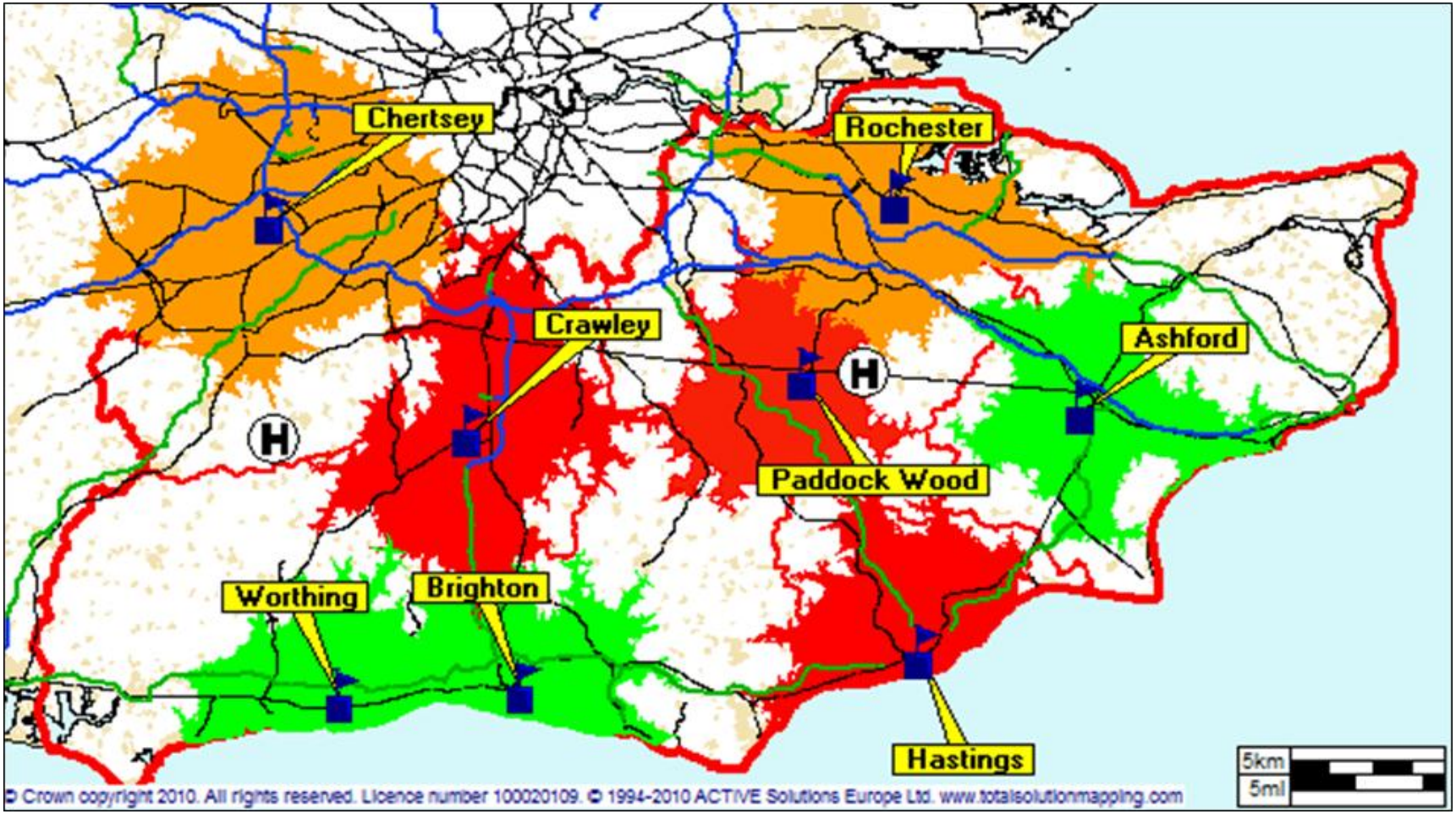


Figure 7: 20 Minute isochromes of SECAmb region showing radius of action of CCP and doctor teams

Cost benefit analysis of CCP development

Cost benefit analysis is a branch of welfare economics which assumes that utility, such as lives saved in our analysis, is cardinal and measurable by observation or judgement. The welfare of the individual is represented by such a utility. This assumption needs to be questioned as different cohort studies of survival rates and mortality may not be applicable universally. Instead, the region's geography and trauma systems adopted may be more germane to lives saved. In welfare economics, utility is routinely measured in monetary value. These utilities act as the exclusive basis for welfare judgements. One could argue that it is meaningless to put a monetary value on lives saved using this approach. However, policy makers adopt cost-benefit analyses in order to make decisions about resource allocation. Such analyses can help answer whether the monetary benefits of a health care programme are higher than using the same resources in another sector of the economy such as transportation. For example, do CCPs save more lives for the same resource base than traffic calming measures in a village? Such an analysis also uncovers whether the benefits of a certain programme are greater than its costs. Tensions may arise between the maximisation of social welfare rather than health outcomes as the basis on which decisions are made.

In line with Ken Wright's (1984) analysis of extended training of ambulance staff and the positive patient outcomes likely to be accrued from CCP interventions, a cost benefit analysis was conducted to explore value of life saved using various levels of CCPs and doctors in pre-hospital care (see Table 9).

Option 1: Current CCP model with CCP team in 4 PCTs – level of service is at an interim (developing) operating capability

A fully equipped CCP team requires six CCPs and six other paramedics/technicians to support an ambulance for a year. If we assume that CCPs will provide 10 years of service, the additional costs of training for four PCTs (see Table 3):

Additional CCP training costs for four PCTs = £5676.56 x 24 = £136237.44

Total clinical costs for SECAmb = £136,237.44

Please note that the total SECAmb medical support costs were managed by no additional costs to the NHS. The salary uplift costs of CCPs from Band 5 to Band 6 were managed by filling vacancies within the Trust's Band 6 funding allocation. The education and training was funded from SECAmb's existing MPET and NMET budget allocations.

Total potential lives saved at SECAmb (see Table 8) = 4 lives

Value of life saved = £45,412

Option 2: Developing CCP model – CCP teams in all 8 PCTs

This is the same as Option 1 but includes the development of CCP teams in all eight PCTs in the SEC region. A fully equipped CCP team requires six CCPs and six other paramedics/technicians to support an ambulance for a year. If we assume that CCPs will provide 10 years of service, the additional costs of training for eight PCTs (see Table 3).

Additional CCP training costs per ambulance = £5676.56 x 48 = £272,474.88

Total clinical costs for SECAmb = £272,474.88

Please note that the total SECAmb medical support costs will be managed with no additional costs to the NHS. The salary uplift costs of CCPs from Band 5 to Band 6 will be managed by filling vacancies within the Trust's Band 6 funding allocation. The education and training will be funded from SECAmb's existing MPET and NMET budget allocations.

Total potential lives saved at SECAmb (see Table 8) = 8 lives

Value of life saved = £272,474.88/8 **= £34,059**

Option 3: Fully developed CCP model with additional clinical support – CCP teams in all eight PCTs with medical supervision and support from 2 No. FTE Consultants

This is the same as Option 2 but includes the provision for enhanced medical supervision, online advice via telemedicine, intermittent in field supervision and coaching, generation of procedures, research and clinical audit functions. The two FTE equivalent Consultant positions would be equivalent to one for each Strategic Health Authority. The same assumptions hold for CCPs that they will provide 10 years of service, the additional costs of training for the eight PCTS (see Table 3).

Additional CCP training costs per ambulance = £5676.56 x 48 = £272,474.88

Consultant salary costs (Threshold 5 – four years completed as a consultant) = £83,829 (2010/2011 NHS pay scales)

Clinical excellence awards (Level 5) = £14,785

Airway radio/on-going technological advances = £1,000 (estimate)

Total clinical costs for SECAmb =

£272,474.88 + 2x (£83,829 + £14,785 + £1000) = £471,702.88

Total potential lives saved at SECAmb (see Table 8) = 10 lives
Value of life saved = £471,702.88/10 **= £47,170**

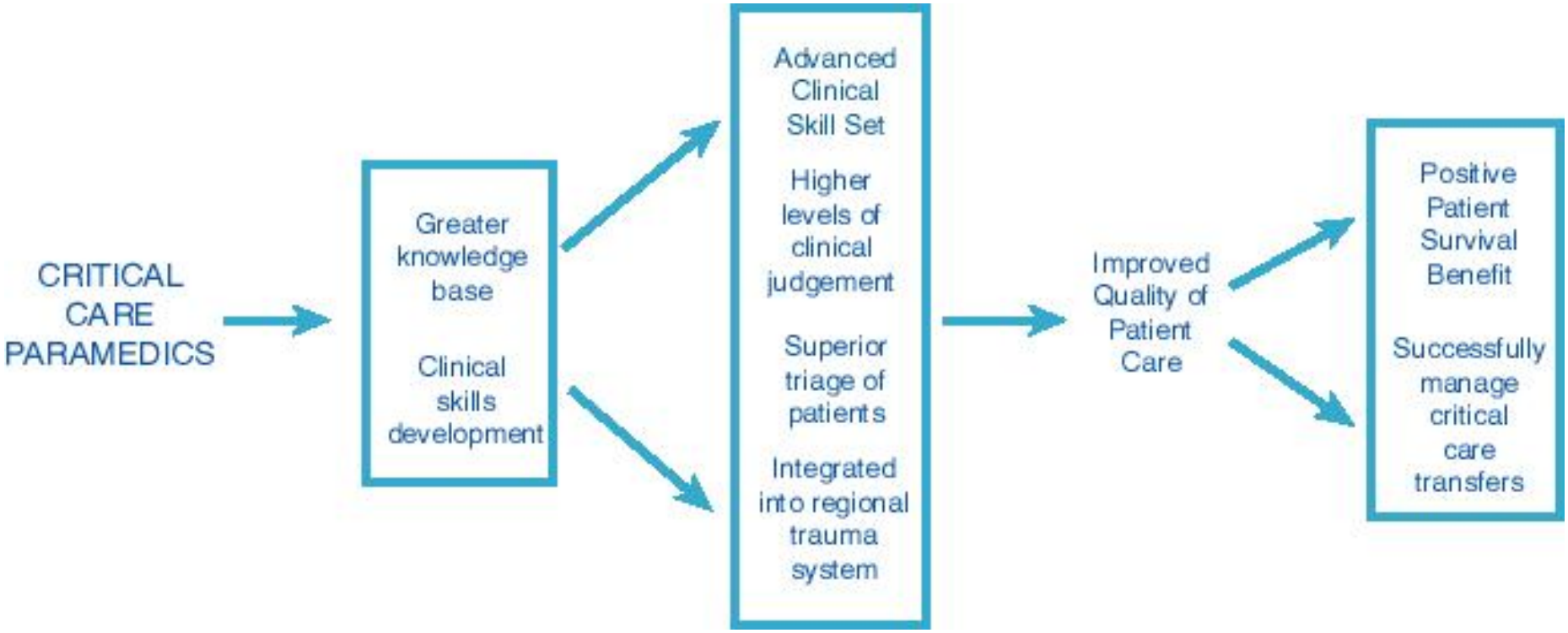


Figure 8: Assumptions linked to CCP interventions and positive patient benefits

Financial appraisal of greater use of doctors in pre-hospital care

It is clear from the Baxt and Moody (1987) study that doctors have the potential to increase the survival rate of patients by 35%. However, it is interesting that no future studies have verified this effect from doctor intervention. The evidence is mixed. Some studies show that there is no difference in survival rates from doctor interventions whereas others suggest improvements between 2-6%. We have assumed that an ambulance team manned by doctors 24/7 would save an additional six lives a year, equivalent to an improvement of 3.2% lives saved. Even though doctors are more prevalent in ambulances in France and Germany, a number of British national reports have highlighted the need for doctors in pre-hospital care. The report "Better Care for the Severely Injured" (2000) recommended that advanced airway management such as rapid sequence intubation (RSI) should be carried out only by doctors (p.36). The Bradley Report (2005) suggested that the use of doctors to respond to Category A calls should be better supported. In addition, the NCEPOD report "Trauma Who Cares" (2007) advised that pre-hospital intubation needs to be part of a pre-hospital doctor based care system (p.44). This is to address the high incidence of failed intubations in pre-hospital care. Improved resuscitation care and trauma interventions have been tackled by CCPs and it is unlikely that junior doctors will show any difference in survival rates with respect to their pre-hospital intervention capabilities. Instead, increased survival rates are more likely to accrue from senior consultant level medical interventions and their diagnostic expertise. Two additional options have been provided for SECAMB to use doctors in ground based pre-hospital care.

Option 4: One Doctor Team 24/7 in each Strategic Health Authority (two teams in total in SEC region) with medical supervision and support from 1 No. FTE Consultant

We assume that six speciality doctors and 1 No. FTE Consultant are needed to provide 24/7 cover.

Consultant salary costs (Threshold 5 – four years completed as a Consultant) = £83,829 (2010/2011 NHS pay scales)

Clinical excellence awards (Level 5) = £14,785

Airway radio/on-going technological advances = £1,000 (estimate)

Specialist Doctor salary costs (Scale 7) = £58,983 (2010/2011 NHS pay scales)

Total medical team salary costs = £83,829 + £14,785 + £1000 + 6 x £58,983 = £ 453,512 per SHA

Total clinical costs for SECAmb = £907,024

Total potential lives saved at SECAmb (see Table 8) = 3 lives

Value of life saved = £907,024/3 **= £302,341**

Option 5: One Doctor Team 24/7 in each PCT (eight teams in total in SEC region) with medical supervision and support from 2 No. FTE Consultant

We assume that six speciality doctors per PCT and 2 No. FTE Consultant are needed to provide 24/7 cover.

Consultant salary costs (Threshold 5 – four years completed as a Consultant) = £83,829 (2010/2011 NHS pay scales)

Clinical excellence awards (Level 5) = £14,785

Airway radio/on-going technological advances = £1,000 (estimate)

Specialist Doctor salary costs (Scale 7) = £58,983 (2010/2011 NHS pay scales)

Total medical team salary costs = 2 x (£83,829 + £14,785 + £1000) + 8 x (6 x £58,983) = £ 3,030,412

Total clinical costs for SECAmb = £3,030,412

Total potential lives saved at SECAmb (see Table 8) = 12 lives

Value of life saved = £3,030,412/12 = **£252,543**

Options	Model	Role and number of doctors	Role and number of CCPs	Total Medical Support Cost per year	New costs to NHS	Total Potential Lives Saved	Value of Life Saved	International Comparator
1	CCP Enhanced Care Teams in 4 PCTs - interim operating capability (developing)	Medical Director provides offline mentoring, teaching and audit (n= <1FTE)	CCPs 24/7- primary retrieval and 4% transfers n=24 in 4 ground units	£136,237	£0	16	£8,515 (£0.00)	Move towards US, Australia, Canada, South Africa, New Zealand
2	Developing CCP model – CCP Enhanced Care Teams in all 8 PCTs	Medical Director provides offline mentoring, teaching and audit (n= <1FTE)	CCPs 24/7 - primary retrieval and 4% transfers n=48 in 8 ground units	£272,475	£0	32	£8,515 (£0.00)	Move towards US, Australia, Canada, South Africa, New Zealand
3	Fully developed model - CCP Enhanced Care Teams (ground) with additional clinical supervision	Enhanced medical supervision, online medical advice/support via telemedicine, intermittent in field supervision and coaching, generation of procedures, research and audit (n=2 FTE Consultant level)	CCPs 24/7 - primary retrieval and 30% transfers n=48 in 8 ground units (1 per PCT)	£471,703	£199,228	40	£11,793 (£4981)[1]	US, Australia, Canada, South Africa, New Zealand, Netherlands, Israel
4	One Doctor Enhanced Care Team 24/7 in each Strategic Health Authority (2 teams)	Primary retrieval of severely ill and injured patients and critical care transfers in each SHA (n=12) + 1 Consultant FTE oversight	Secondary role to assist doctor if available	£907,024	£907,024	12	£75,585	France, Germany, Russia, Argentina
5	One Doctor Enhanced Care Team 24/7 in each PCT (8 teams)	Primary retrieval of severely ill and injured patients and critical care transfers in each PCT (n=48) + 2 No. Consultants FTE oversight	Secondary role to assist doctor if available	£3,030,412	£3,030,412	48	£63,134	France, Germany, Russia, Argentina

Table 9: Cost benefit analysis: Improving the quality of care at SECAmb using CCP and doctor enhanced care teams

Research themes

Critical Care Paramedics: Hybrid Paramedics or advanced Paramedics?

In the UK, the Health Professions Council (HPC) is the main registration body to regulate the training, professional skills and behaviour of paramedics. The term ‘paramedic’ is a protected title and paramedics who meet the requirements can gain a licence to practice in the UK upon payment of an annual fee to the HPC. There are just over 15,000 paramedics registered in the UK. The key role of the HPC is to act as a regulator and to protect the public. Paramedics can be struck off the register if they do not meet HPC standards.

The Nurse & Midwifery Council (NWC), the regulation body for nurses in the UK, annotates the registration of a nurse with their qualifications and level of working. This may include working as a specialist nurse such as in intensive care. However, the HPC are not interested in any annotation or title for a ‘critical care paramedic’ and cannot see any legal basis for it. The College of Paramedics, the paramedic professional body in the UK, has lobbied the HPC for such an annotation based on their curriculum guidance and competence framework (College of Paramedics 2008). The ‘critical care paramedic’ would be in line with the role of a ‘specialist paramedic’ as envisaged in their career framework shown in Figure 6. The HPC suggested that the College of Paramedics could hold a voluntary register of specialist paramedics. The College was dissuaded from creating a voluntary register as it would have no statutory basis and would need a significant investment of its limited resources.

As a young professional body that was established in 2000, the College of Paramedics has a relatively small membership of 4,000 out of the 15,000 registered paramedics and relatively low influence among ambulance employers. Traditionally, employers have been resistant to any competence or career frameworks set by external bodies, preferring to develop their own. Currently, they do not recognise the right of professional bodies to set standards of education and training. There has been relatively little collaboration between ambulance services and, hence, little standardisation in approach particularly in terms of professional development. The consequence is an uneasy tension between ambulance services and their professional body. The paramedic professional qualification lacks quedos and isn’t seen as a pre-requisite to paramedic job applications.

Figure 9: College of Paramedics Career Framework (2008, p.17)

There are arguments that in a cost constrained NHS service CCPs are not needed. In most ambulance services, 40-60% of staff are paramedics even though only 10% of the 999 workload requires paramedic skills. In addition, evidence from US studies (add citation) show that your chances of survival from major trauma are vastly improved if you're taken by taxi or police car directly to hospital; that survival rates are linked more to diesel and surgery. Further evidence (add citation) shows that advanced life support interventions can have a detrimental effect of increasing mortality rates. As one independent paramedic expert noted:

"I'm always concerned that we give people more skills and more expertise and tell them they're experts, and they have a tendency to stay on scene with trauma patients for far too long."

SECAmb would argue that they are developing their paramedic workforce to a much higher level without any additional burden on NHS funding (see Table 5). This development of critical care paramedics has taken on two roles; one of primary retrieval of seriously ill and injured patients and the other of transporting critically ill patients between hospitals. The driving vision of CCPs was to be involved with critical care transfers. An early taskforce on critical care transport, involving Professor Andy Newton and Dr Chris Carney (Chief Executive of East of England Ambulance Service), recognised that there was considerable potential in developing paramedics to take on the role of specialist nurses in critical care transfers. Critical care transfers traditionally had a doctor, an ITU nurse and a paramedic transporting the critically ill patient. If paramedics were developed with ITU nurse competencies required during patient transport, there would be a considerable saving in ITU nurse time. Similar discussions were conducted at the University of Hertfordshire especially with the Dean, Professor Barry Hunt, on the future direction of the paramedic profession to meet changing patient demands. It was recognised that there was considerable benefit to short staffed hospitals in this approach from avoiding key medical staff being sent for three hours on a transfer. A consequence of these conversations was a successful bid with the NHS Challenge Fund to develop curriculum for CCPs with Dr Mark Block, an anaethetist, at Imperial College.

The NHS paid for CCP curriculum to be developed at the University of Hertfordshire. One team member, Linda Simpson, moved to Warwick and a mutation of the CCP curriculum has been adopted at University of Warwick. This is only open to air ambulance paramedics and paid for by a charity. The CCP development programme is aimed at enhancing the quality of air ambulance paramedics and based on primary retrieval rather than transfers. CCPs are trained at Cobham and the University of Warwick. It is believed that an alternative CCP programme has been developed for paramedics flying with the Great Western Ambulance Service. This may be based on the Masters programme in Specialist Practice at the University of West of England.

The initial operating capability at SECAmb will be met by 2013. This is to have a system of eight critical care paramedic units operating on the ground linked

to a network of trauma centres, hospitals for transporting critically ill patients and regional helicopter systems. The current conception of CCPs at SECAmb could be viewed as 'hybrid paramedics' (as shown in Figure 7) possessing a mixture of high level ITU and primary retrieval clinical skills and judgement. As shown in Table 1, the primary driver of CCP competence development is the growth of ITU skills need for critical care transfer. Some of these competencies are equally relevant in the primary retrieval arena. In contrast, the Warwick CCP programme is more oriented towards an 'advanced paramedic' model of CCPs primarily focused on higher level clinical retrieval skills (see Figure 7).

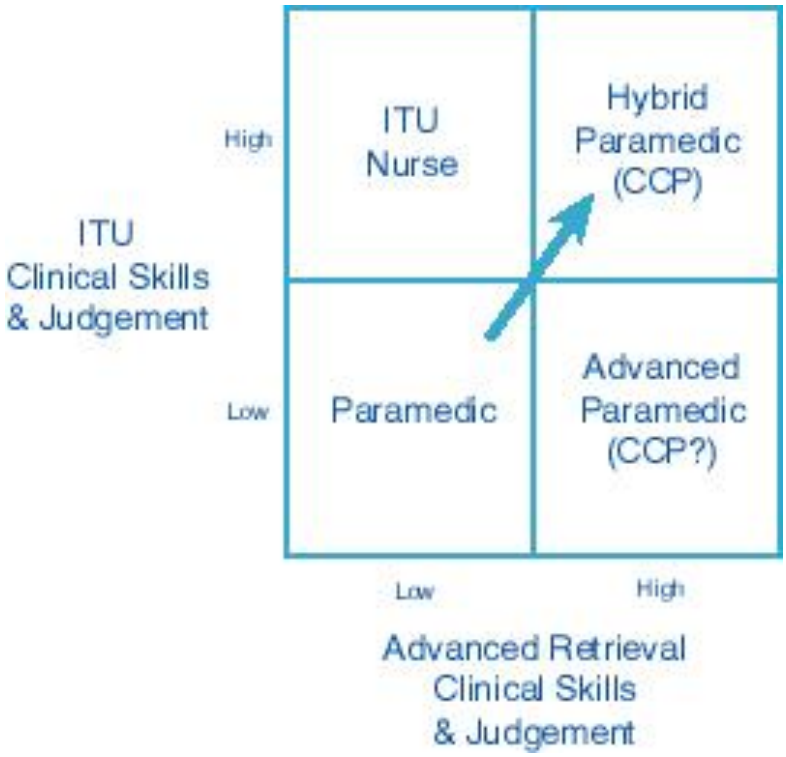


Figure 10: CCP - Hybrid or advanced paramedic?

Some tensions have emerged among CCPs between the curriculum design of the CCP programme and what CCPs actually do in practice. Critical care inter-facility transfers have averaged around 4% of CCP workload and some CCPs have done no transfers at all. There are no transfers occurring in Surrey, one of the three counties in the SECAmb region. CCPs have questioned some of the assumptions behind critical care transfers. In their experience, they found that a critical care nurse has often accompanied the doctor on transfers. Hence, there are limited savings in hospital resource as envisaged. In some cases, CCPs reported that the hospital culture was hostile to using CCPs:

"I've said a few times on my transfers. 'Do you want to leave your nurse here?' or 'Do you want to leave you doctor here?' I'm happy to convey this and it doesn't seem to be getting much of a response as far as 'Well no, the receiving hospital does seem to want a nurse and a doctor there as opposed to a paramedic"

"…we were told quite plainly that if an anaesthetist has a choice, he or she has a choice to take an experienced critical care nurse or an experienced ODP with them, she will choose one of them. They are not going to choose us."

There appears to be a role for greater liaison between SECAmb and hospitals in their region to gain greater commitment from senior managers and ITU consultants to use CCPs as a replacement for ITU nurses in critical care transfers. Without this commitment, the clinical need for using CCPs in transfers is likely to be low and subsequent benefits in saving ITU nurse time will be affected.

The SECAmb CCP programme follows the Australian MICA paramedic model which is also based on a 'hybrid paramedic' model. MICA paramedics are involved in primary retrieval and inter-facility transfers. Transfers can be ground or air based as noted by one MICA paramedic:

"As a slot paramedic, probably 40% of my work is inter-hospital transfers, generally from regional hospitals; anywhere up to well 250 to 300 kilometres from Melbourne. That's on the helicopter. On the planes, we have fixed wing aircraft as well and we'll do up to 300 to 400 kilometres from… no actually,

sometimes 500 kilometres from Melbourne, we'll do transfers in the fixed wing aircraft back to major Melbourne hospitals. So, for the most part - about 80% of those transfers and this includes ventilator transfers and patients with pacemakers and inotropes."

There is normally a medical doctor accompanying the patient on these transfers but not an ITU nurse.

There is a strong argument for replacing CCPs with doctors if the primary aim is to improve the quality of care of high acuity patients; similar to the Franco-German model. They are established and can easily provide the high levels of clinical skills and judgement that are needed for this role. However, a medical model would be prohibitively expensive (as shown in Table 5) costing at least four to 10 times more than CCP equivalents and the evidence is mixed whether they would be more effective. In Germany, they are reducing the numbers of doctors in the field as research has shown they are economically unviable. Added to this, the low volume of patients requiring this high level of care would make the use of doctors unjustified. Rather than being involved in a flying squad of care, doctors have an important role to play in clinical leadership and supervision of critical care, offering teaching and promoting reflective practice, and conducting research and evaluation of services. Doctors currently accompany paramedics in air ambulance and provide medical direction for ambulance services. As the Medical Director at SECAmb has pointed out, there are other roles for doctors in ambulance services rather than acting purely in the field in ground based services:

"There are quite a lot of initial roles for doctors. None of which add up to a doctor. But if you take all of them together they start adding up to doctors. We need to have some enhanced clinical supervision. You know there is a small clinical component absolutely. That's quite an expensive bit. There's also the long stop for clinical decisions and at the moment, I do that, just in my spare time at home. But the CCPs have been ringing me up and they'll ask me about difficult cases, whether it's to stop a resuscitation, even though it's outside their protocol for stopping; or maybe it's about using drugs slightly outside their brief, but they can give it under my say so. So I can provide a certain degree of clinical support and because of their training, I can have that professional conversation with them, in a way that you can't do with a paramedic who hasn't got that understanding. So that's a bit of a doctor. There's also the need for providing some back up for the clinical desk and that's our telephone service. And that's becoming, more so particularly with the increasing demand on it and the inappropriateness of some of our cases having a vehicle based response. But if you don't have a telephone based clinical support that has to have some back up, it can't be an isolated thing. So we need that. We've also got our urban search and rescue team for HART, who need to have access to senior clinical input. And all of those things coming together, start to look like a need for some more doctors to be employed somewhere in the system. So yes, I can see it happening, and I think … as an interim model, that would actually work quite well."

The introduction of the new role of ‘Critical Care Paramedics’ has had its fair share of resistance from other paramedics. CCPs have been nicknamed ‘Comfy Chair Paramedics’ or ‘Can’t Carry Patients’ in line with their perceived low volume, high acuity workload. Many paramedics feel that they have the necessary clinical skills to deal with high acuity patients; no different to their skills prior to the existence of this role. Many argue that they have considerable years of experience with high acuity patients, which is more valuable than CCP training. The counter-argument provided by one CCP was:

“A lot of these guys that say they’ve got 20 years’ experience, don't have 20 experience, They've got five years’ experience four times, because they go out to the same thing day after day, doing the same thing, and whilst you can’t completely discount the experience I don't give it the credence a lot of people do.”

As pioneers of a new role, many CCPs recognise the short-term pain involved compared with the long term benefits for the profession. There has been movement in changing perceptions among paramedics. Much of this comes from CCP assistance requests from paramedics to give them a hand with a patient. Such requests are acting to break down barriers of an ‘us and them’ attitude towards one that is ‘we’re in this together’. Previous CCP reputation as good paramedics has also helped curb some of the resistance. There have been pockets of resistance with the worst occurring around Worthing. Worthing is a high influential and vocal ambulance station. This was the first station to have a pilot CCP team based purely on clinical patient need. CCPs found themselves isolated among other paramedics at the station and physically moved their base to Arundel. As described by one CCP, there was mixed reaction to them at Worthing:

“It was just so derogatory and kind of ‘get out of my way, we don’t need you, we don’t want you, get lost.” Whereas sometimes it like, “I’m really pleased you are here, can you help me out here?”

A CCP profile

Allan McHenry – Critical Care Paramedics Coordinator

I've worked in healthcare in one capacity or another all my working life. I joined the Army aged 16 and trained as a Combat Medical Technician. Having worked in this role in a number of theatres I wanted to be able to do more for the patients I came into contact with.

Early on in my career an opportunity to train as a Registered Nurse arose and during this training I began to developing a keen interest in critical care. After qualifying I worked in a variety of critical care areas including Intensive Care and A&E.

I decided to join the ambulance service as I enjoyed working autonomously and felt that the pre-hospital environment would be more challenging professionally than working in a hospital. I entered the service as an Ambulance Technician in 1998 and qualified as a Paramedic in 2001.

The idea of the Critical Care Paramedic (CCP) was developing in 2006 and I jumped at the opportunity to participate in this exciting development to paramedic practice. I was seconded to Kent Surrey Sussex Air Ambulance Trust and worked as a Flight Paramedic alongside a doctor, gaining exposure to a high volume of high-acuity patients.

The university element of the CCP programme was one of my most positive educational experiences to date, with the theory translating well into practice.

I am currently completing an MSc in Paramedic Science – Critical Care. In my current role I am involved in pushing the boundaries of paramedic practice in areas such as autonomous use of pre-hospital ultrasound and increased surgical intervention by CCPs such as thoracostomy and surgical airways

My focus is firmly set on continuing to developing the programme to match other more developed systems, driving paramedic practice and providing the best care for our patients which in their time of need, they deserve.

Research Themes

Critical Care Paramedics: Capabilities and Clinical Outcomes

Following the training and development programme, CCPs have reported a number of capabilities that have improved significantly compared to their former roles as paramedics. A contributing factor may be that they are also tasked to calls from high acuity patients and are continuously learning from managing seriously ill and injured patients. Improved capabilities of CCPs are shown in Table 8.

Enhanced CCP Capabilities
Airway management
Enhanced patient assessment skills
Improved diagnostic ability
Greater clinical decision making skills
Wider knowledge of drugs
Greater ability to handle complex situations
Acting more confidently and calmly
Clinical leadership

Table 10: Enhanced CCP Capabilities

Airway management

Securing, protecting and maintaining an airway requires considerable skill especially in an unconscious patient. The training and development programme has given CCPs greater confidence in managing difficult airways and failed intubations. One CCP described this confidence as:

"Whereas in the past I'd look and think 'this is a difficult intubation and therefore I won't attempt it', I now think 'this is a difficult intubation but can be achieved without any great effort, it's achievable'. So I think personally it's a confidence boost and my confidence of airway management is much, much better than it was."

Some CCPs are more mindful of things going wrong and more likely to spend time thinking through the potential options and consequences. A CCP describes his experience of managing a cardiac arrest with three other paramedics looking on:

"I ended up doing the airway and felt that they were looking at me and thinking

'what the hell is that guy doing?' Because I spent a minute or so actually assessing the airway. Still ventilating the patient, but actually assessing the airway more thoroughly before just having a go and putting a tube down. And when we debriefed afterwards I said, 'Did you feel I took a long while to intubate?' and they said 'No not to intubate but actually to get ready for an intubation - you did seem to take quite a long while'. And I explained that the patient had a small mouth with very little movement of the jaw and a bull neck and a large head, and these are the things that I was looking for prior to even putting a laryngoscope in. They were aware of most of that process, of my thought processes. So yeah, I think my airway management, personally, is very, very different."

As part of their skills development, CCPs have learnt to use a gum elastic Bougie for difficult intubations. This is particularly important in the pre-hospital setting where CCPs may work in bad weather and poor light conditions. There is some debate whether all paramedics should have skills in using a Bougie. London Ambulance Service has supported this approach. The CCP training has given CCPs a systematic stepwise approach to intubation and more acute sensitivity to airway control. One CCP describes his renewed ability to use a Bougie without any light using the knowledge and skills developed on the CCP course:

"As a paramedic you're supposed to intubate under direct vision and I've intubated people when there's no vision at all and I've had to use a Bougie - that's as a paramedic I wouldn't have done it because I can't see what I'm doing whereas now, as a CCP, with having that extra confidence and knowledge and skill I can use a Bougie and know that what I've done is correct and I've achieved the goal of intubating the patient."

CCPs have learnt to provide non-invasive ventilatory support using CPAP (continuous positive airway pressure) using a small piece of equipment powered by an oxygen generator. While CPAP does not replace intubation, it does provide a less invasive means of respiratory support. A number of ambulance trusts have introduced CPAP with their paramedics even though SECAmb have currently introduced CPAP through their CCPs.

Enhanced patient assessment skills

The patient assessment module at the University of Hertfordshire has been particularly beneficial among CCPs in improving their medical clerking. Some believe that medical clerking should be part of the formalised clinical governance process with clear 'protected time' allocated to it. One CCP recognised the medical clerking of the patient assessment module:

"I can document more effectively what I have done in my assessment. Seeing what I have done that makes my impressions more likely when I handover. I can show physically the record of my assessment. The nursing staff are more likely to go along with my impressions and hand me straight over to a doctor or follow my lead.

Some of the enhanced patient assessment skills are attributed to the more 'medicalised' module of learning patient assessment. As suggested by one CCP, patient assessment is much more clinical and structured:

"I think they're better structured and I think my whole thought process is much more clinical. I think more about what could and can go wrong throughout my assessment. So rather than just thinking it's belly ache I'm thinking much more broader."

Improved diagnostic ability

Some CCPs recognise that their diagnostic abilities are more systematic and organised compared to their abilities as paramedics. The increased diagnostic abilities are also attributed to greater exposure to high acuity patients. Reflecting on their approach as a paramedic, one CCP acknowledges that they look at diagnostics in more detail:

"Mechanisms of injury, secondary injury brain injury for example. Managing shock, looking at the current literature on things like a lot of the stuff coming out of Afghanistan and Iraq. That's all really relevant to what we do now. What we haven't not done yet, we are looking at doing a lot more scenario work, looking at why we do what we do, what was your clinical decision making process? Why did you do that as opposed to doing this? Really challenging you to justify your rationale for what you've done, which we don't get as paramedics generally. I mean and again to use ATLs as an example it will be why did you do that because page 64 quite clearly says that that's what I do. I feel that we want CCPs to be thinking machines not protocol driven."

There is much greater knowledge involved in patient diagnosis by a CCP than a paramedic. One aspect of this diagnosis is some CCPs getting involved in mentoring their team on why they adopted certain interventions and questioning the underlying knowledge base and processes:

"I think, again, just the underlying knowledge and the underlying processes that we use as far as, again, I did a very long cardiac arrest with my crew mate and another two technicians and the way I form it or we, me and my crew mate, not me personally, I'm not God. But how we formulated that plan and how we went through our Hs and Ts very methodically and how I quite like to do some teaching as well while I'm treating my patients particularly with other staff and my crew mate. I'm sort of telling him, teaching him as well I like to feel. And the feedback I get from that is like 'oh we learnt so much on that even though the outcome wasn't particularly good this time. We learnt stuff for next time' and how you formulate or how I formulate things does seem to be different to your bog standard paramedic."

Greater clinical decision making skills

Paramedics tend to think within a box and the part of the learning on the CCP programme has been to teach them to think outside the box. It has been teaching them to use their knowledge and skills base to decide on the optimal

intervention in any given pre-hospital situation. It is moving beyond the fear of protocols ingrained in ambulance services and giving CCPs the ability to take and justify their clinical decisions based on their advanced skills and knowledge base. CCPs have enhanced their abilities to vary from protocols and have the ability to back up their decision making with their increased knowledge. The differences between paramedic and CCP decision making have been described by one CCP as:

"At the end of day you would still treat the condition. How you treat that condition may be slightly different to a paramedic. A paramedic will classically come in for argument's sake and start giving the patient oxygen until they get their stats up to a hundred per cent. Whereas a CCP will realise the value of the fact that there should also be carbon dioxide on board and we will try not to flush out. So there are subtle, slight changes that we would probably look at the individual patient's illness as well as their other co-morbidities and then we'll actually say, start giving this drug, I'm actually going to create this problem, whereas a paramedic will probably go by the book or by the training. For argument's sake, LVF now, we hold back on Salbutemol because we believe it's not the right drug to give, the paramedic by way of being taught will naturally say, well it's one of the routes that you can go down. We tend to look at things slightly differently because we realise the effects of the outcome. You know, it's an antagonism, it can increase heart rate and everything else, which is what we're trying to reverse, if that makes sense."

Wider knowledge of drugs

CCPs have developed a much wider knowledge of drugs and their use on their taught module as well as the administration of drugs on their placements. Their knowledge of drugs goes beyond analgesia primarily understood by paramedics:

" I would suggest that a CCP will have greater knowledge of anaesthetics as studied on our anaesthetics module within the university and also its abuse within theatre on our placement. I think we're aware of the other drugs to use in the sense of illness and injury and the effect of those drugs and why certain drugs should be used over other ones, whereas a routine paramedic will not generally deal with anaesthetics. Their skill mix will clearly be for an analgesic type base and nothing more, whereas we can take much more than that."

Greater ability to handle complex situations

CCPs are more likely to foresee problems and understand alternative pathways when things go wrong. This was the verdict of one of the preceptor supervisors:

"Yes, and they'll be a better person to work with in a complex situation because they'll much more quickly understand what doctors and other people who have different skills, are talking about, rather than a paramedic who'll say, I can intubate with an endoscope and do that, that's where I stop. Well a CCP can say, that's where I start. It's the other bits that I can assist with and understand and can help bail out and know what's going to happen next and foresee problems and that sort of thing."

CCPs are more likely to have the necessary skills and knowledge base when things go wrong. They have more of an understanding of what doctors are looking for in seriously ill and injured patients. They have an appreciation of the bigger picture and the ongoing decision making processes as the condition of the patient changes. They are also more likely to question everything and evaluate their decisions using the latest research and guidelines. In terms of airway management, one CCP describes the differences in their approach compared to a paramedic:

"I also think that because we look at it in a more sophisticated way, we are better able to anticipate the potential problems that we'll come across, so we are less likely to have an airway that fails. And I think we are also a bit more robust when it comes to checking tube placement, a bit more protective of that tube once it's in place, because it's not something that we take for granted."

Acting more confidently and calmly

One of the differences between CCPs and paramedics has been described that paramedics are less interested in why they do what they do. A protocol may ask them to put needle A in point B. With their increased knowledge and training, CCPs are more likely to question the protocol than their paramedic colleagues. From their placements, they have developed much greater confidence in dealing with difficult and failed intubations. The effect of managing a high volume of high acuity cases also increases CCP confidence:

"The confidence as a CCP to go to cardiac arrest after cardiac arrest, you pick it up, quite a few jobs; the confidence side of things and being confident in yourself, not just in what you're doing but the fact that people are looking to

you to be the calming influence, maybe to be able to challenge what's going on or maybe help with airways or canulating, those sort of things, just through your normal clinical skills you've got anyway but you've practiced them more often because you've been tasked as a CCP when that happens."

CCP confidence derives from knowing their skills and knowledge base are up to date and regularly demonstrating them to other teams of paramedics. This confidence has a result in managing difficult and stressful situations calmly without undue panic:

"Confidence I think is a key factor and also if you're in a position where you can perhaps maintain an airway and carry out basic life support without having to gain any further intervention; and you realise that the intervention that you're carrying out at the moment in time is adequate enough for the resussee, particularly with a neo-natal. You're also dealing with the parents and bystanders as well. I think from that calmness that leads to reassurance of the parents who will know - I would imagine that they probably realise that there's not a lot that can be done but you tend to look at things in a different light. It's confidence, skill and knowledge I think."

Clinical leadership

CCPs have been developed to provide clinical leadership in the field for seriously ill and injured patients. They possess enhanced medical assessment skills linked to multiple pathologies and multiple illnesses and are able to identify more easily the patient issues and the most appropriate treatment. They have the skills for better diagnosis and the right treatment first time even

in complex patients. They are equally comfortable in medical and trauma settings. To acknowledge this new role, the new organisational structure at SECAmb has been adapted to ensure that all CCPs are made Clinical Team Leaders (CTLs) in the future. Some CCPs are naturally born leaders whereas others do struggle with the role:

"One of the things that I have actually struggled against personally and possibly the most because my character is not a forceful one and insisting my will upon others, particularly others I don't know well is not something that comes naturally to me. It feels very uncomfortable for me and that's something I had to work on and make a conscious effort with."

Naturally born leaders recognise that there are situational skills with each incident depending on the nature of the patient and the paramedic team attending:

"Sometimes it's saying the 'I'm here now, out of the way, the experts are here' approach is definitely the wrong approach and I hate that side of things when I see it from whatever qualification. But in some cases, I like to try and feed my information through the person that was there. If I arrive second I say okay shall we try and get them to start thinking about how they're dealing with the patient and inevitably sometimes you have to say 'right can I just have a look at this' and have a listen to some heart sounds or 'can I just do this, do you mind?' And sometimes that leads to becoming the lead of that scene or that case and sometimes it's 'thanks very much, this is what I heard do you want to have a listen?' 'Okay, thanks for that, crack on, you're doing a great job' sort of thing so yes it can be, sometimes it's very much not wanted."

Unless you're a naturally born leader, there is currently no training provided at SECAmb on taking on the clinical leadership role, dealing with difficult colleagues, developing situational skills, mentoring, providing clinical governance and development of colleagues.

Impact of CCP capabilities on clinical outcomes

If each clinical outcome is taken on its own, airway management is the only clinical outcome where the CCP clinical skills and judgement surpass those of the paramedic. However, if we look at the combined CCP capabilities from enhanced thought processes and improved actions, there are major synergies among the capabilities that cannot be considered in isolation (see Figure 8). Each capability enhances each other. Hence, it could be argued that the clinical approach to cardiac arrest, paediatric and obstetric support will be broader and capable of dealing with complex situations.

In terms of cardiac arrest, most CCPs agree that there is little difference between their clinical skills and those of paramedics given that some paramedics have also done advanced cardiac care courses. One of the preceptorship supervisors concurs that there is little difference in cardiac arrest between the two roles:

"I don't think there is actually to be quite honest. I think the thing that is very topical at the moment is whether somebody who's having a heart attack should be bypassed Hospital to go to a cardiac centre and I think probably the paramedics can make those decisions. So at the moment I think they've got enough skills to do that, so I'm not sure the CCP's are adding any more to that."

As part of their training CCPs are sent to the European Paediatric life support and Neonatal life support. They increase their knowledge of what can go wrong with critically ill and injured children. There is limited CCP exposure to paediatrics and obstetrics due to the small number of emergencies in this area. Hence, there is no new skills development in paediatrics or obstetrics. There were no hospital attachments to paediatric intensive care units or neo-natal units. CCPs are sent to the labour ward for short periods on some placements.

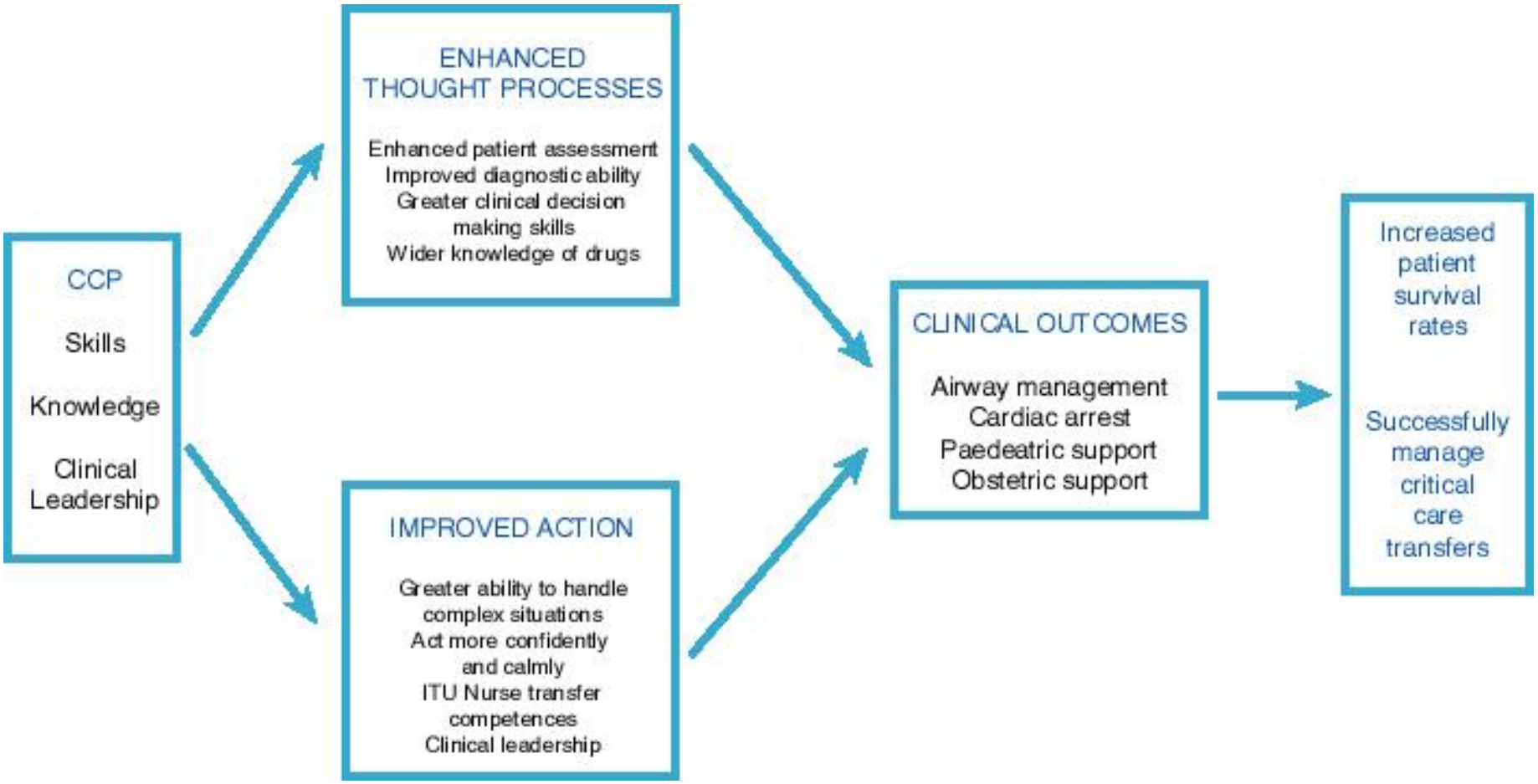


Figure 11: Impact of CCP capabilities on clinical outcomes

A CCP profile

Emma Relf – Critical Care Paramedic

I am SECAmb's first female CCP. I joined Sussex Ambulance Service as a call taker based in Lewes in 1999. Whilst developing my career in control to dispatcher level, I also carried out a number of third manning shifts before entering the direct entry programme for trainee ambulance technicians and paramedics.

I began my clinical career in the Crawley area before transferring to Eastbourne for seven years completing the IHCD Paramedic qualification in 2004 and becoming a Clinical Team Leader in 2008. I then applied for CCP training because of a desire to progress into a specialist academic role.

Throughout my career I have particularly been interested in educating children in first aid and accident prevention through participation in public events, school visits and 999 displays. I enjoy working for a forward-thinking ambulance service with the opportunity to undertake additional training and skills other trusts do not offer.

The CCP is course is demanding but I would recommend the additional skills and training to my colleagues as my practice and knowledge base has really improved. As a CCP I have the theory to back up my day-to-day application of paramedic skills to a benefit a variety of patients, therefore improving patient care and outcomes. I am lucky to have the fantastic opportunity to progress with my MSc which I am currently undertaking, along with several of the other previous CCP cohorts.

Research themes

Critical Care Paramedics: Training & Development

University of Hertfordshire: Taught CCP Programme

The learning and teaching element of CCP development at the University of Hertfordshire was delivered to a high quality standard. The course was challenging especially for CCPs from a non-academic background. These students struggled initially but felt a tremendous sense of achievement on course completion. The University provided a 'critical thinking module' to help CCPs with their mental reasoning and academic writing skills. For some, academia provided a new language and skill set. Even though this introductory module was aimed at CCPs without higher education backgrounds, almost all CCPs went through this introductory module. One CCP described his experience of course challenges:

"Well purely in respect of me, I grew up on a council estate and left school with four CSEs, so to then go to university after twenty odd years after leaving school, you're obviously not as fresh as you were and then to write at level two, three and Masters level, was like climbing K2 for me. However, I've done it. There were some - a couple of guys that had already done some university type based work and found it slightly easier. So, in the introduction of the university they allowed us all to take what they called the 'ramp course' and that was purely learning how to write in university style, as a reflective practice and so that raised my game instantly."

Rather than academic skills, the recruitment criteria for CCPs was more focused on practical paramedic skills with at least three years post experience and leadership potential. CCPs recruited onto the programme were highly motivated and self-disciplined in their learning. They demonstrated tremendous commitment having to juggle family and work pressures as well as course demands for over nine months. The paramedic profession is moving towards all paramedics having a first degree but this requirement hasn't filtered through to many senior and experienced paramedics. In this respect the considerable experience of recruited paramedics was seen as equivalent to an undergraduate degree; a form of accredited prior experiential learning. It is clear that CCPs supported each other on the course as expressed here:

"There were people there who had a lot more practical experience than me, or life experience than me and I had a lot more academic experience than them so by the time we all pooled heads there was a real sense of camaraderie. We managed to get through."

There were some re-sits of modules among the CCPs but none of them failed or dropped out of the course. All CCPs gained a Postgraduate Certificate in Paramedic Science. Some have used the PG certificate to continue their

learning towards a Master's programme. This has been self-financed by CCPs. One member of the course team recognised the need for further development of CCPs in line with the College of Paramedics career framework:

"Well I think it is part of their development if you see it as an overall picture. A short course is never going to meet all the needs of either primary retrieval or inter hospital transfer and certainly not both in my opinion. It's what they are doing at the moment. They are doing 60 credits worth of study and the whole vision with this is very much a foundation to working as a critical care paramedic and then there will always be a need for people to specialise in other areas."

Many CCPs who have continued their development on the Masters programme have indicated that all CCPs could have benefitted from the trauma module. Some have even gone further to say that it is more relevant to their everyday work than than the critical care transport module. On this module, students learn what doctors are doing and why they're doing something especially with airway management, the use of drugs and the decision making processes. There were some tensions between the weightings of the pre-hospital care and the critical care transport aspects of the course design. CCPs tended to want greater levels of input on pre-hospital care in line with majority of their workloads in practice. The omission of the trauma module as part of CCP development was mentioned by a number of CCPs:

"At the time, I would say, there was no formal trauma application on the course and I would have said that's a huge oversight on the grounds that trauma is one of the things we are officially meant to be doing and it is the thing which by far is most advertised in terms of what we do. It's what crews who do call us are going to call us for. Therefore our call work is going to be weighted towards that. The fact that we didn't have any formal trauma element to the course, I thought, was a massive oversight."

The course team recognised differences in curriculum design between the current course more focused on critical care transport and one focused on primary retrieval of seriously ill and injured patients. This was acknowledged by one course team member:

"And I think if SECAmb want their guys to be enhanced so they can look after patients generally, we're not failing them as part of the course. There's a patient assessment module, there are foundations in critical care, a resuscitation module. So those both give them the foundation and groundwork for better patient care and even some of the stuff we're talking about, some of the skills options stuff would help those that work on helicopters and interacting with positions on the helicopter. So none of the stuff is wasted but obviously we haven't sat down and told them how to manage a sick respiratory patient. We've told them how they would transfer a ventilated respiratory. So some of the stuff they take away from us is good, but if they

wanted something to help with the 96% of other patients, we have never tried to sell the course to do that."

Patient assessment module

The CCP patient assessment module is very similar to the one taught at Level 3 undergraduate programme. A major difference is that the undergraduate students would not have the significant CCP experience levels. CCPs bring refined patient assessment skills to the course and have strong clinical decision making skills. This course was shared with paramedic practitioners (PPs). CCPs found that the course content was directly relevant to what they do in practice. One CCP questioned whether the extent of the course was necessary for CCPs and rather more pertinent to PPs:

"Again invaluable but the only problem, it seems to me, do we need to do things as in-depth because we are critical care paramedics? If we are going to a patient not in an extreme condition, there is time to do a more formal airway, chest examination or abdominal assessment. That falls into the PP's role. Maybe we shouldn't be doing all that?

Foundations of Critical Care module

Many CCPs found that this module was pitched at the right level. One CCP felt it could have been pitched higher given the experience base of most CCPs. However, the overwhelming sentiment of this module was summarised by one CCP as:

"Foundations in critical care was again a very good module, I enjoyed it. It certainly made me raise my game as far as my understandings of anatomy and physiology are concerned particularly with physiology. A lot of the medical physics had never even occurred to me, I had to work quite hard at that to get my head round it. But again it's one of these things that when you actually understand it, it alters how you think about things, which I suppose was the whole point in doing it really. "

Advanced Airway Management, Ventilation and Resuscitation module

In the advanced airway module, CCPs made a formal assessment of an airway and its perceived difficulties and problems. They were taught about ventilation from the use of ventilators in the pre-hospital setting up to more sophisticated ones used in hospital. Students learnt about chest drains and managing chest injuries. They were given an understanding of decision making processes of doctors involved with critical care transfers. All CCPs concurred that they found the knowledge on this module invaluable especially combined with the practical application of difficult airways in their hospital placements. One CCP remarked on how it has enhanced his thought processes linked to airways:

"I thought it was fantastic, the hands-on part. Having the exposure of having a consultant anaesthetist there sharing his knowledge with us, being able to ask questions, going and finding the answers to the questions and then transposing that on to our practice when we went into theatres was fantastic. I was on a better playing field when I went this time than I first went when I was on my paramedic course. I think that the advanced airway module was really good."

Critical Care Transport module

Many CCPs questioned the value of this module given that transfers currently represent a very low part of their workloads. They would prefer more on aspects linked to the majority of their workloads such as trauma, cardiac arrest and pharmacology. The course content was considered good and challenging but its application was queried by one CCP:

"Critical care transport module. Again a lot more physiology. A lot of looking at ventilators and a bit more physiology. It was useful but because we're not in that environment there's not a great deal of it that transfers directly to what I'm doing now. So it's difficult. I enjoyed it and at the time, given the role that I perceived I would be doing, I thought it was very good. However, it hasn't translated to the reality."

There was no leadership training provided for CCPs to take on their clinical leadership roles. CCPs were able to gain access to online materials at the University and access to the library especially for journal articles.

Preceptorship Programme

All CCPs reported that their preceptorship programme was excellent and the experience they gained was invaluable. This aspect of CCP development was about developing and evidencing the competences shown in Table 1 and getting the competences signed off by a Consultant Anaethetist. One of the preceptorship supervisors described the development process:

"They get two weeks which they spend down in Accident and Emergency with one of our A & E Consultant Supervisors and that's very much about diagnosing, seeing lots of patients, a more diagnostic side of things. Then they spend two weeks in our operating theatre and that's a lot of practical airway stuff, learning about rapid sequence inductions, failed intubation drills, they'll also see things like putting fluids up, putting blood up, and that side of things. And then four weeks in Intensive Care which is basically looking after the critically ill patients and all the things we do here; monitoring, sedation and drugs. The idea of the course was that they would then be involved in transfers of critically ill patients, so every time we have a patient who is transferred to CT or in the Hospital, they go with them as well, so they get a lot of experience of that. That's really how their training goes and then

obviously I try and do some mannequin training with them as well so that we have some sort of classroom teaching too, although they're very keen not to have too much of that because they have covered that in their University course but sometimes it's easier to assess them on their airway skills, in emergencies on mannequins rather than the real life environment, because we don't have the emergencies, we hope, in the theatre environment."

The preceptorship supervisors played a pivotal role in helping CCPs get clinical exposure to different situations and respect in different departments. The anaethetists were enthusiastic and keen to teach and the staff in ITU units were generally supportive. In some cases, they were puzzled about what CCPs were doing and why they were placed in ITU units. In most cases, CCPs made a positive contribution in ITU units as illustrated by one CCP:

"I worked with the same chap up there and he was very welcoming to start off with, we got on very well, but as he saw what we actually did really, his jaw almost hit the deck when I said I'm just nipping off with Doctor XY&Z. I came back and said I've intubated, ventilated, reset the ventilator, came up so he could check my drug calculations because I was doing the drugs, so he could draw those up and check them, and he said 'you've done all that'?, and I said, 'yes', and then when he saw me doing some of the patient assessments skills, chatting to the F2s, he asked 'how do you know that'? I said, 'well that's our time in A & E', and he was quite impressed with the overall rounded knowledge."

CCPs weren't shy of getting their hands dirty during their placements and were often treated like a junior nurse in an ITU environment with distant supervision. ITU nurses enjoyed teaching CCPs and recognised that they were a valuable resource as they were often short staffed. CCPs were accepted and made to feel part of the ITU team. The knowledge and skills development was aptly described by one CCP:

"I would say a large thing is even though you already knew how the systems of the body could fail, when you see it, it was quite an eye opener of how you can tinker with the human body with drugs we had never come across before, how fine measures could change outcomes drastically and quickly and just seeing how you could play with the pharmacology side of things to affect the human body. I was so ignorant before with just a Parapak in the back of the ambulance, looking at a patient that's ventilated and just never left, always a nurse or a doctor looking over them and who's tinkering with a ventilator to get the best outcome, that side of things, let alone the mechanisms behind it, trying to figure out… I mean almost the pre-hospital side it's a crash quiz, whereas on ITU you can look, tinker, think, suggest, tinker about, 'yes that works', 'no that doesn't', it's like an extended puzzle, except with more tools and I think that was a huge, a huge learning curve. The doctor who is the Consultant Intense'ivist up there, loved teaching, loved telling us and had time for us and throw a few ideas about, ended up trusting us as much as SHOs, took us down the ward, yeah we're going to knock this lady out, SHOs you can do a central line, you can do an arterial line, J's you can intubate, what are we going to do with ventilate once we've done that, there are the blood gasses, how are you going to change that, yeah, the whole works and I think looking back now perhaps that's the confidence part of being put under pressure, of being able to work under a very highly respected man and still have credibility at the end of it, for him to say, we did well."

One of the consequences of the preceptorship programme has been the development of social capital between CCPs, doctors and ITU nurses. Numerous connections have been made where CCPs are recognised for their skills and there is a danger that these cohesive relationships may be lost due to the low transfer workload. CCPs have had placements in neo-natal and paediatric units. The experience was more observational rather than hands on. One of the preceptorship supervisors wasn't convinced that CCPs had learnt much about paediatrics. Each CCP had two weeks in the theatre where they practiced advanced airways and learnt important patient assessment skills. This complemented what they had learnt at the University of Hertfordshire.

Clinical supervision

There are strong parallels between the CCP preceptorship programme and similar development of MICA paramedics. Each MICA paramedic has a clinical instructor providing clinical supervision for six months during the preceptorship phase. The instructor provides considerable on-the-job training including questioning, reflection and external study. Once the MICA paramedic has passed their panel exams (post preceptorship phase), they are appointed a mentor. The mentor works regularly with the MICA paramedic and provides operational and clinical advice. They will audit and review at least two cases each month. The mentoring process lasts for one year. There is currently no formal system of feedback, mentoring and on-going training of CCPs at SECAmb. Much of the mentoring role currently falls directly on the Medical Director. This may be a short term measure but a more

robust system needs to be in place. CCPs need the opportunity to debrief about their seriously ill and injured patients and to discuss their diagnoses, clinical decision making processes and their clinical judgement. This could be done by employing doctors in the pre-hospital setting to take on this clinical governance role or training experienced CCPs to provide mentoring guidance. CCPs employed on HEMS air ambulance can practise advanced procedures as they are under the guidance and supervision of a doctor. SECAmb did employ a mentor advisor to take on this role but the effectiveness of this position hasn't worked out as expected.

The nature of CCP workload is low volume, high acuity patients. In terms of clinical supervision, SECAmb could learn from the fire service of regularly conducting fire drills to cover every eventuality that could ever happen at an incident. The equivalent for CCPs would be 'moulage' (training from mock or previous injuries). CCPs could pick up previous jobs of critically ill or injured patients, go through the paperwork, review and question all aspects of the job: the response times, the management and clinical judgement. CCPs could review the dosages of drugs provided and the rationale, justifications and appropriateness of the treatments provided. A robust system of clinical supervision and support needs to be in place if CCPs are expected to work to a high level of practice in novel ways

Problem of skills fade

The problem of knowledge and skills fade is a real issue for CCPs as critical care transfers only account on average for 4% of their workload. One preceptorship supervisor portrayed the problem in the following manner:

"I think the skill fade on remembering about the drugs and the procedure and the complications and the opt out clause and 'what's my next line if this doesn't work'?, would go quickly, very quickly, and I think that's a huge problem with the CCP's, and it's something we've been discussing with SECAmb I think the skill fade will be huge, which is why I was very keen on the programme. It was envisaged that the CCP's would be embedded within their Critical Care Emergency Department at some point during the normal working practice, not just their training, in which case I thought the skill fade would be prevented by people continuing to work in the role that we just trained them up to within a hospital environment to maintain the skills."

The issue of skills fade is recognised equally by CCPs and doctors. For example, CCPs are only likely to manage a paediatric emergency every five or six years. There is a need for CCPs to refresh their skills regularly. The difficulty is finding the optimal solution for overcoming it. One option is to have CCPs based in hospitals for at least one month in every six months. They could be integrated as part of a paid works programme and act in some capacity as an ITU nurse. Funding could be sought from Commissioners to this effect especially with the shortage of ITU nurses in many hospitals and the increasing demands of an ageing population. An essential part of the retraining would be to teach CCPs about back up plans especially when things go wrong. One preceptorship supervisor suggests that CCPs need a

minimum of one day in hospital every 6 months to maintain high level airway and intubation skills:

"I suspect three days is probably all you need for your airway and intubation skills, to keep yourself really right at the top of the curve, but I think it's four monthly or six monthly, but certainly not less than that. I don't think even the CCP paramedics are doing that many intubations out there. Talk to those guys when they come back here admittedly after only a year and I think the number of intubations they've done, it's a handful really, it's an infrequent thing out on the road."

In general, CCPs have been keen to maintain their skills through post training placements. Even though the appropriate mechanism is unclear, there is consensus among CCPs to have regular exposure to ITU units and operating theatres to prevent skills fade. Closer linkages with hospitals were seen as an essential part of on-going development by one CCP:

"Yeah, sort of like a continual link with the hospital and even have the facility to say, I think I'll pop up to ITU because I feel I'm getting rusty, or maybe pop down to theatres for half a day to practise down there. I think we've got allies there which we don't want to lose and the potential of continuing our clinical development, because if you look at what happens in ITU with the tracheas and that side of things, once the doctors start knowing we're not just there for a four week placement, but we are actually in and out, that could really be beneficial, let alone the drugs, the kit and that side of things. I think it's a skill we've spent a long time on the course learning and we're just in danger of losing the connections and our own clinical judgement."

Knowledge sharing

There is little sharing of knowledge or experience among CCPs. Informally CCPs may have a discussion at crew change over, a bonnet conference. Otherwise, emails are the main form of communication. This tends to be more for operational matters rather than sharing knowledge and experiences of a patient. There is considerable clinical discussion that occurs among MICA paramedics analysing case sheets on what was done, why it was done and could it be done differently. This does not appear to be happening with CCP currently at SECAmb.

There are no discussion forums for CCP interaction on the SECAmb website and none of the CCPs are engaged in clinical discussions on their professional institution's electronic discussion forums. MICA paramedics have developed strong informal networks with other ambulance branches and play a role in reviewing their case load:

"Within the branches the MICA guys will often go out and visit the branches around them, so you'll go out too. A MICA unit might basically look after about four or five ambulance branches and in your downtime you'll often go out to the branches and chew the fat with the guys at the branch and share experiences. So you know that's quite satisfying when people will do that, but that actually does occur a lot but it's certainly an informal thing, it's not a formal thing necessarily."

A CCP Profile

Mark Durham, Critical Care Paramedic

I have been working as a CCP in the Brighton area since the unit became active there earlier this year. I began my training at the University of Hertfordshire in 2000. The university's paramedic course is twinned with the London Ambulance Service and so my placements were spent in areas including Brixton, Willesden, Tottenham, and Camden. As one of the first cohorts of paramedics to be trained full time at university, I was often met with suspicion by the other crews, as is sadly so often the case with any new way of doing something.

However, with time, colleagues started to get more used to the idea of working with university-trained colleagues. In total I spent eight years working all over London as bank staff. This allowed me to get as much experience as possible in working in different and often challenging areas.

When the time came for me to move on from London I returned home to Sevenoaks, and spent a wonderful year working there. I had started to want to take my career a step further by that stage though, and while at Sevenoaks I learned about the fledgling CCP programme.

After deciding to apply I was lucky enough to get onto the second CCP cohort. Six months later I was back at the same university I'd worked so hard to graduate from in the first place.

I don't mind admitting that I found the CCP course hard. It was probably the most intense course I've ever been on. The faculty were great though, and the placements excellent. I came out feeling I had learned a lot and realise now that I tend to approach things in a very different, much more systematic way.

Personally I like to think that the areas where CCPs can offer the best help is best summed up in two words: 'life support'. Immediately this brings to mind the standard ALS (and protocol C) and also includes trauma life support.

I've been exposed to some major trauma in my short time as a CCP, including lorry crashes, roof collapses, and railway incidents. Finally of course, 'life support' encompasses things like respiratory, cardiac, and neurological life support, allowing us not only to do the ITU/HDU transfers we trained for, but also be of service in the primary treatment of these patients on the road.

Research themes

Critical Care networks & transfers

All critical care transfers are monitored by three critical care networks in the SECAmb region. The critical care networks coordinate, manage, commission and lead the whole spectrum of rehabilitation pathways from non-invasive ventilation in the community to chronic care provision. They collect a lot of data in the form of transfer audit reports which gives them a good indication of critical care services required in the populations they serve. Critical care transfers may occur as patients require specialist investigation or treatment at another hospital, or may arise from the lack of ICU beds or repatriation of a patient to a hospital closer to home. Critical care transfers can be particularly hazardous and result in removing a doctor and ITU nurse from hospital for several hours. Transfers may occur via ground ambulance or by air ambulance particularly where long distances need to be covered or in the presence of difficult terrain. The doctor accompanying the patient is normally trained in intensive care medicine and skilled in airway support (tracheal intubation), ventilation, cardiovascular support and resuscitation. A second escort is likely to be an ITU nurse experienced in resuscitation, cardiopulmonary support and the use of drugs. Sometimes an Operating Department Practitioner (ODP) is used instead as a second escort.

The development of CCPs to take on the role of a second escort has generated some debate among critical care networks. Kent and Sussex have been supportive of the initiative while Surrey hasn't been persuaded by the new role and remit of CCPs to be able to commission them. They have a different view about the nature of the problem and the potential solutions. They question whether an elite group of paramedics is required or whether up-skilling all paramedics would be more suitable:

If CCPs were used in transfers, each critical care network would be commissioning a hybrid paramedic (see Figure 7) with high level ITU skills and clinical judgement. This is reinforced by their everyday primary retrieval skills of successfully managing seriously ill and injured patients. They have developed enhanced competences in airway management, ventilation, drugs and cardiopulmonary support; the very competences provided by an ITU nurse or an ODP during a critical care transfer. The advantage of using a CCP is that they would replace the ITU nurse or ODP and save any disruption from an ITU nurse being taken out of an ITU unit. This is a creative use of CCPs moving them beyond a pure transportation role and offering an additional medical resource especially when shortages of ITU nurses often occur in hospitals. Almost 40% of the workload of MICA paramedics in Australia is inter-hospital transfers. Most of these transfers include ventilator support, cardiopulmonory support including the use of inotropic agents. They act as the second escort accompanied by a doctor. The doctor provides the advanced clinical supervision, guidance and skills as required. This is similar to CCPs working on air ambulance and aiding doctors with high acuity patients. The

reality of many critical care transfers is that pretty junior doctors are sent with potentially less exposure and experience of critically ill patients than CCPs. A counterargument of patient familiarity by ITU nurses was expressed in one critical care network.

The familiarity argument can be addressed by focusing on the skills and competences required by a second escort during a critical care transfer, be they CCP or ITU nurse. CCPs have been trained in the necessary skills through their hospital placements but there are real problems of skills fade due to the low volume of critical care transfers in their current workload, around 4% at present. This needs to be tackled through closer engagement of CCPs with hospitals to maintain their high level clinical skills by working regularly in ITU units, operating theatres and A&E departments. Despite the clear financial benefits of CCPs taking on this role, there are some reservations expressed about their payment by some hospitals:

"... and the NHS will say, "Well actually yes, they're really useful and helpful, but we don't want them that week," because they don't want to pay for them."

The issue of payment for CCP services for critical care transfers would need to be negotiated between commissioners in the SECAmb region. There are clear benefits for both sides. Hospitals would be saving several hours of ITU nurse time for every critical care transfer and SECAmb would be gaining from the regular updating of CCP skills in intensive care. Honorary contracts were established for CCPs when they were conducting their placements in hospitals. Any such arrangement would provide the necessary reassurance to critical care networks that patient quality and safety of critical care transfers was maintained. The importance of retraining was reiterated by an ITU Consultant:

"Well at the moment I said we're not losing anything, if we have a transfer it'll still be a Doctor, a Nurse and a CCP because they haven't got sufficient skills because they're not being retrained all the time to take on that role, so I haven't allowed that at the moment. I think if they had sufficient retraining and kept things up to date and they worked with us regularly then I personally think there would be a role for a Senior Doctor and a CCP to transfer a patient without an ITU Nurse and it would stop taking the Intensive Care Nurse out of the Unit. The things against that is of course the ITU Nurse knows the patient very well and the handover may not be quite as good at the other end and also it will mean the ITU Nurses will lose that skill of transferring patients, but the problem is I think we've got to face the fact in the future, we are going to have less ITU Nurses because we're short of them as it is, with the ageing population there won't be as many around, so we have to be a bit creative, think outside the box, as to how we are going to sort those problems out. So that's the way I would see it, but we're a long way off that as well and that's because of this skills fade, and we're not seeing them enough. They're great guys, they do really well with us, they've worked really hard, I'll be delighted if we could use them more, I think they would as well."

The use of CCPs to act as secondary escorts in critical care transfers does raise political issues about the potential eroding role of ITU nurses in their professional capacity. Even if CCPs possess the necessary skills and competences, anaethetists and other ITU doctors may be less willing to have CCPs as their second escort on transfers. They may prefer the everyday familiarity of ITU nurses rather than the unknown skills of an extended paramedic professional. To overcome such resistance in hospitals, it will require the leadership of ITU and A&E Consultants to champion the use of CCPs in critical care transfers. This can only be done with the regular engagement of CCPs in ITU units and A&E departments. In essence, CCPs would act as a bridge between hospitals and ambulance services. The exact details of the new role and relationships would need to be worked out locally to meet the needs of both services.

The critical care networks can provide regional leadership by commissioning CCPs in this new role and evaluating their effectiveness in terms of value for money for critical care transfers. There are clearly cost savings from sending only a CCP and a doctor on a transfer rather than including an ITU nurse. Over a year, this could be a sizeable saving for any critical care network. If clinical ITU skills could be maintained, CCPs could make a significant difference to the delivery of critical care transfers as well as provide significant financial benefits for critical care networks. Already, CCPs are involved with 'Tricky Trips' training programme organised by the Critical Care Network in Surrey for transferring critically ill patients. The training programme is delivered with A&E staff, coronary care staff, intensive care staff, junior medical staff as well as CCPs. Such training supplements on-the-job training CCPs receive in ITU units, theatre and A&E departments. In addition, knowledge sharing and exchange could occur more smoothly from the greater involvement of CCPs in clinical forums organised by Critical Care Networks to discuss protocols and improvements in the delivery of critical care transfers. As highlighted by an international paramedic expert, CCPs could provide a useful role in breaking down some of the silo mentality in the NHS:

"This is a problem in the NHS, that it still works in silos and clearly if CCPs agreed inter-professionally that there is a role for CCPs and a that it is a useful role, then they need to be working inside critical care settings in hospitals, both to enhance their skills, maintain their skills, but also to build confidence and team-working with the other healthcare professionals. They are going to be relying on their skills."

Research themes

Critical Care Paramedics: Appropriate tasking

Appropriate tasking of CCPs has provided some operational challenges. The continual pressure of performance among ambulance services being measured by response times rather than clinical need has added to the difficulties. This has generated a certain tension within SECAmb as its development of CCPs is based more on improving clinical outcomes rather than response times. The experience of many CCPs is that they are still being tasked on the basis of their proximity to a job rather than clinical need. They have suggested that some duty dispatch managers can be more interested in their 'response time' yardstick of performance rather than clinical outcomes, especially as these are much harder to measure. The effectiveness of CCP tasking has varied across the SECAmb region. For instance, the utilisation of CCPs in the Folkestone team has been higher than the Worthing team. However, the appropriateness of jobs has been better in the Worthing team.

Two mindsets have emerged, one of dispatch wanting to meet their eight minute and 19 minute targets and the other of CCPs wanting to be tasked primarily to high acuity Category A calls. This has raised high levels of CCP frustrations when they are tasked inappropriately. The perceptions of tasking in SECAmb are that the focus of is one of quantity rather than quality. It is not about getting the right person to the right place at the right time. Clinical care and efficiency are not mutually exclusive. Computer modeling may help get the right balance between these two indicators based on the density of calls and the density of resources at any one time. For instance, they have developed a two tier dispatch system for MICA paramedics in Australia. It is about the optimal use of resources. If the wrong resource is sent to a call due to its close proximity, there may be a need for back up resulting in two resources being utilised rather than one. The new circumstances require a more sophisticated approach to tasking if the improved clinical outcomes are to be realised. The nature of the problem is portrayed by the Medical Director:

"If you have someone who requires anticonvulsants by IV and you send a technician who can't do it, or the patient might need fluids, or a whole host of other paramedic drugs, the patient might well come to harm because you've delayed that. Because in the worst case scenario, by the time the technician gets there realises they need the backup, the paramedics have gone down the road to somewhere else and are not available and the next nearest paramedic is five miles away. By the time they arrive, the patient's come to harm. So by not sending the right resource first time you may well be affecting patient outcomes. But you may also by using up more than one resource on a single incident, this may affect response times as well. "

There is a cultural perception that the dispatch centre hasn't challenged the basic assumption that the quickest response is the best response regardless of quality. Many CCPs complain that they answer every type of call rather than being focused primarily on high acuity calls. The Operations Director recognises this need for a shift in thinking between dispatch and frontline crews:

"We've agreed what they should do so if it's assistance, a full assistance requires getting a CCP on scene to do that. They can help the patient but if the patient then requires conveyance to the hospital, if the CCPs skills aren't required then they should be calling for back-up. Culturally, that's a very different model for the organisation and for frontline crews who are saying 'Well why are we going to get a low acuity patient when you've got your best clinicians there anyway?' So culturally that's quite a challenge."

There are some excellent dispatchers and Dispatch Duty Managers (DDMs) who understand the nature of CCPs and how to task them effectively. This isn't the norm and CCPs notice a clear difference in the quality of dispatch teams when they are working. Even though all the Emergency Dispatch Centres (EDCs) work under a single management team, it would appear that implementation of CCP tasking guidelines varies between centres. The tasking guidelines have been developed by CCPs and are quite clear as described by one dispatcher:

"CCPs must be tasked to all cases where the CCPs can offer specialist skills, such as chest pain, to backup crews that are not paramedics, or they can go as a first response because for a patient with a major MI, that would be suitable. For breathing difficulties where crews are requesting to have backup, cardiac arrest which is our highest priority as a first response, but always as a backup if they're available. Suspected aortic aneurysm is a first response or backup.

Fitting calls as a first response or backup - if the patient's still fitting they obviously need a paramedic and the crew might not have a paramedic on it. For paediatric cases such as babies not being alert, fitting, high temperature, first response also backup crews, particularly if there's no paramedic on that crew, not just for the paramedic skills but because it's specialist as well. Then there are obstetric cases, high risk complications in delivery. I haven't sent them to one of those myself yet. Then there's RTCs or trauma, sort of large falls, it says, RTCs or traumas where the mechanism of injury suggests a probable severe injury or a multiple vehicle response is required, falls above 20 foot, any incident involving a train or aircraft, associated fatality, ejection, penetrating wounds, amputation above the wrist or ankles."

In line with high acuity calls taken by HEMS, there is an argument for CCPs having a dedicated desk at the EDC. This isn't likely to be a panacea for resolving CCP tasking issues. Experience shows that there are around three calls to EDC each day where CCPs can make a difference. The question it raises is what do CCPs do for the rest of the time. There will still be pressures

on CCPs to take Category B or C calls when no other vehicle is available. Another option is self-tasking of CCPs. This has been tried in West Sussex where CCPs supplement the skills of dispatchers in EDC. CCPs assess the calls to see if they can contribute additional clinical skills and make a difference. This can provide its own challenges as CCPs are stuck in front of computer screens all day waiting for the occasional high acuity calls. A warning sound for high risk patients such as those with breathing difficulties or chest pains would assist the long hours in front of a screen. The police have used audible signals to alert them to high risk calls and found they worked well. The management problem of CCPs self-tasking has been that CCPs in some instances have ended up taking very few calls on their shift. This adds pressure to the ambulance service in reaching response time targets when some CCP ambulances are unavailable to respond to calls other than Category A calls. One CCP suggests that the situation could be improved by the use of specialist dispatchers in EDC rather than self-tasking:

"I think there is a model out there where you can have a laptop and see everything, they were looking at that as a sort of a tablet form computer for us to try. Again it's money - it's expensive and it's not having vehicles on the road and having only, I think the latest figure was only 70 of us in the three counties to incorporate a rota within the A & E, within the EDC - it's difficult. I like the idea that there's a small unit that are very good at what they do. That's what doctors are doing, that's what nurses are doing. The umbrella term paramedic and everyone does the same thing is probably a little outdated now and we've developed these specialisms in PP courses and CCP courses and it seems a bit of a waste to have those skills and have that knowledge and have that expertise but not really use it to the full extent. Again there could be another small group of specialists that are clinically dispatching people."

Even with specialist dispatchers, there is the difficult and sophisticated problem of judging and weighing up patient need against the ambulance services available. It is also about balancing clinical need against travel time. Phone backs from CCPs to EDC can be useful to gather more information on the patient and determine whether their skills would be appropriate. One CCP argues that the specialist dispatcher could be a well informed paramedic rather than relying on the small number of CCPs:

I think if you've got some clinical knowledge as a paramedic does or I know a lot of the technicians do, you really need to have an understanding of whether it needs to be a CCP. I think a paramedic with knowledge of what a CCP does would be okay. The gold standard would obviously be somebody who knows the job intricately that does the job and works in there but we understand the limitations in numbers and rotas etc."

Appropriate tasking depends on the accuracy of information received. There are threshold points at which ambulance crews, CCP or HEMS teams are sent to an incident. The accuracy of information improves through learning and feedback loops at different in the process as shown in Figure 12. One lesson from Australia is that MICA paramedics perform 40% of their shifts in

the control room and have the necessary information systems to see all the cases coming through the dispatch system. They can open up cases and interrogate them. They can read the comments on the cases and decide unilaterally whether to upgrade or downgrade the rating of a case. This is a clinical support role on top of their clinical role as 'hybrid paramedics' involved in primary retrieval and transfer of seriously ill and injured patients.

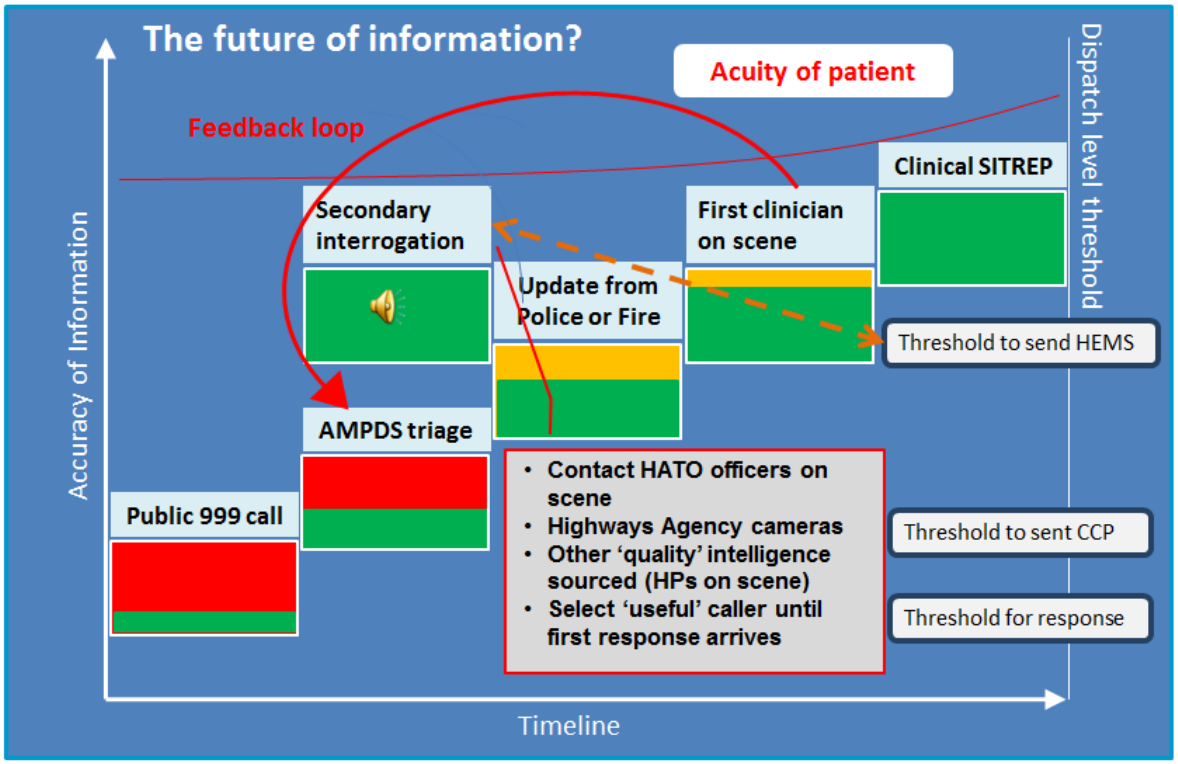


Figure 12: Tasking thresholds and information accuracy

Tasking has improved at SECAmb and data obtained from AMPDS codes (the diagnosis category from the original call) has shown a definite bias towards high acuity conditions by CCP crews when compared to normal ambulance crews. Figure 13 shows the case profile for standard crews in Worthing and Figure 14 shows the case profiles for CCP units in the same area. For the standard crews, falls, breathing problems and 'sick person' feature most heavily. In comparison, among CCP crews there is a greater incidence of high acuity patients with higher incidence of traffic/transportation incidents, increased activity in cardiac presentations including cardiac arrests and chest pains as well as convulsions. CCPs still undergo some lower acuity activity to maximise the utilisation of their resource which is focussed on high acuity but low volumes of patients. This can create conflicts in tasking at times when CCPs are tasked to low acuity patients due to their geographic proximity rather than high acuity patients who may be more distant and are served by less experienced crews.

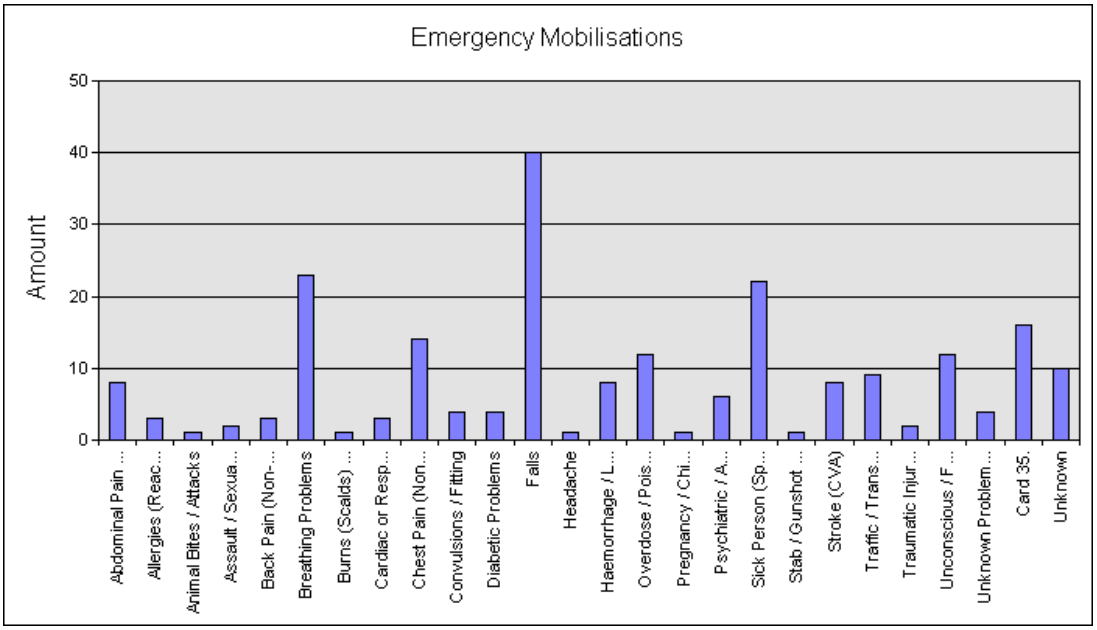


Figure 13: Case profiles for 'standard' crews in Worthing (Jan-Feb 2009)

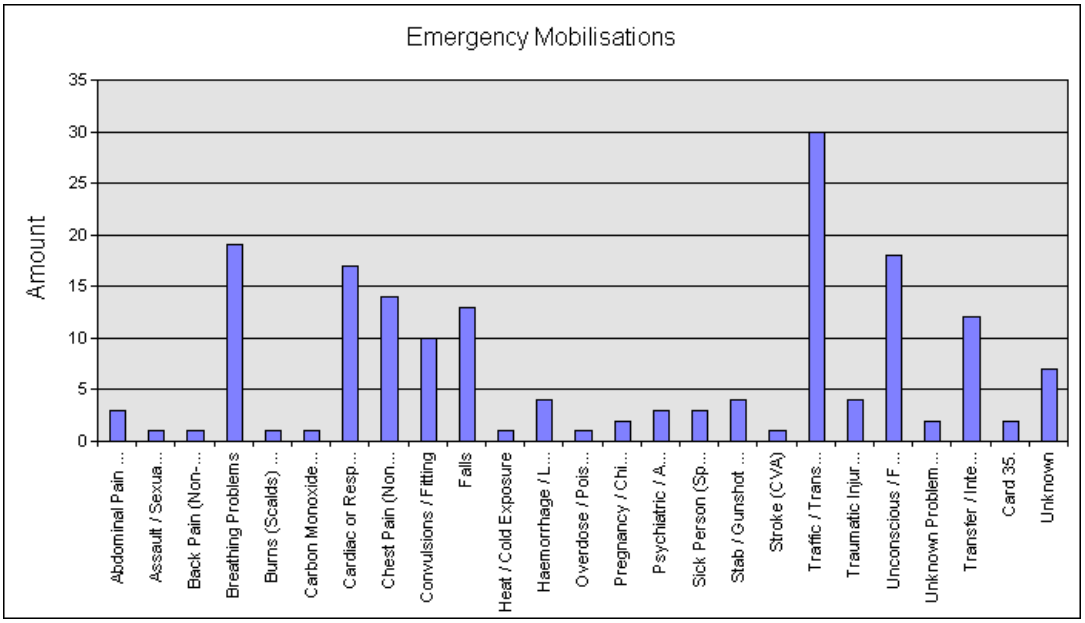


Figure 14: Case profiles for CCP units in Worthing (Jan-Feb 2009)

Conclusions

There is clarity among national reports concerning trauma and the care of seriously ill and injured patients that the general quality of care is substandard (National Confidential Enquiry into Patient Outcome and Death 2007) and estimates predict that between 450 and 770 lives could be saved in England from trauma alone each year (Royal College of Surgeons of England and British Orthopaedic Association 2000; National Audit Office 2010). In order to meet this challenge, SECAmb has proactively developed a specialist group of critical care paramedics (CCPs) to address this suboptimal care. This has been in line with its vision as an innovative, high performing Trust that meets or exceeds international excellence. Strategically, it has adopted a resource based view of the firm (Barney 1991) and chosen to improve its effectiveness through careful management of its tangible and intangible assets. In this instance, SECAmb has developed enhanced capabilities of CCPs to provide clinical leadership in the field and a highly developed clinical skill set in primary retrieval and inter-facility transfers. They have recognised the core competences and collective learning achieved over 30 years by advanced MICA paramedics in Australia and modelled CCP development based on this experience.

SECAmb has been highly ambitious in this venture driven by high ‘stretch’ aspirations on a low resource base (Hamel and Prahalad 1993). This innovative enterprise has been funded creatively through managing existing Trust funding allocations without any additional recourse to the public purse. The assumption is that the new CCP clinical knowledge and skills measured as medical capabilities will play an important role in improving the quality of care in trauma networks and result in lower mortality rates. In line with the recent report by the National Audit Office (2010), SECAmb recognises that hospital mortality is most likely to be reduced by implementing trauma systems. As shown in Figure 13, SECAmb considers the enhanced CCP capabilities will play a major role in increasing survival rates in trauma networks.

The role of MICA paramedics was introduced in Australia to address the same issues of preventable deaths from road traffic accidents and heart attacks. SECAmb adopted this model of care for seriously ill and injured patients based on the premise that specialist paramedics in critical care exposed continually to high acuity patients were more likely to be effective than paramedics who occasionally managed such patients. In line with MICA paramedics, SECAmb has designed the new role to encompass primary retrieval of seriously ill and injured patients, transfer of critically ill patients between hospitals and specialist tasking of CCPs at the dispatch centre. To underpin the new capabilities, CCPs have studied part-time for nine months at the University of Hertfordshire and undergone hospital placements as part of their preceptorship programme to develop various ITU related competences.

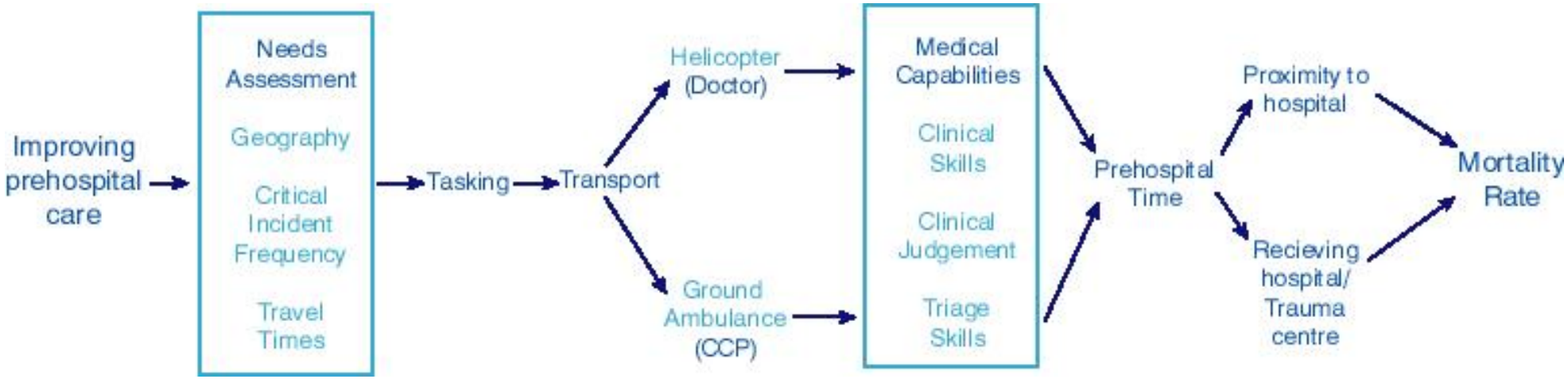


Figure 15: Improving trauma systems through CCP capabilities

One option available to SECAmb to improve mortality rates in their trauma network is to employ doctors instead of CCPs. The argument for this option is that a doctor's clinical skills, judgement and triage skills are far greater than a CCP. Hence, the doctor would be far more effective as they have recourse to a far greater range of medical procedures. However, the evidence of whether the presence of a doctor on HEMS makes a difference to mortality rates compared to a ground based ambulance team is mixed (Butler, Anwar et al. 2010). Some studies showed that there was no benefit of having a doctor in the HEMS team (Cameron 1999; Biewener, Aschenbrenner et al. 2004; Ringburg, Spanjersberg et al. 2007) whereas others showed a significant improvement in mortality rates from the use of doctors (Baxt and Moody 1987; Garner, Rashford et al. 1999; Frankema, Ringburgh et al. 2004). If one adds the increased financial costs of replacing CCPs by doctors to this open debate, it is clear that the costs would be prohibitive in the current economic climate.

Even though there are economic criticisms of cost-benefit analysis, this branch of welfare economics is used by policy makers to make decisions on resource allocations. Some of the criticisms are around how one can measure a utility such as a life saved in monetary terms. A cost benefit analysis was conducted using a variety of options available to SECAmb using doctors to provide oversight or clinical interventions in the field. A summary of the analysis is shown below:

Strategic options	Potential lives saved	Improvement in preventable deaths	Total Clinical cost at SECAmb per year	Value of life saved
Current CCP model (CCP teams in 4 PCTs)	4	2.2%	£136,237	£34,059
Developing CCP model (CCP teams in all 8 PCTs)	8	4.3%	£272,475	£34,059
Fully developed CCP model (CCP teams in all 8 PCTs with clinical and medical oversight)	10	5.4%	£471,703	£47,170
One Doctor team 24/7 in each Strategic Health Authority (2 teams)	3	1.6%	£907,024	£302,341
One Doctor team 24/7 in each PCT (8 teams)	12	6.5%	£3,030,412	£252,543

Table 11: Cost benefit analysis of using CCPs and doctors at SECAmb

The analysis shows that replacing CCPs by doctors would cost ten times more than using CCPs and the value of life saved would increase seven-fold as well. There are strong arguments for employing doctors in clinical governance and supervision roles. Doctors could provide medical supervision of CCPs through mentoring, coaching, teaching and observation as well as conduct a clinical audit and research function.

The current conception of CCPs is as 'hybrid paramedics' with high level clinical skills and advanced retrieval skills. They are 'specialist paramedics' engaged in high acuity environments as described by the College of Paramedics (professional body for paramedics) career framework. This has created tensions among CCPs as only 4% of their current workload is involved with transfers. There hasn't been the large volume of inter-hospital transfers experienced by their Australian MICA counterparts. As expected in any organisational change programme, there has been some resistance to the new role by other paramedics nicknaming CCPs as "Comfy Chair Paramedics" due to their low volume high acuity workload. The change process is on-going and has been managed well by senior managers.

CCPs have developed advanced airway management skills as recommended in a number of national reports (Royal College of Surgeons of England and British Orthopaedic Association 2000, p.36; National Confidential Enquiry into Patient Outcome and Death 2007, p.44). They have learnt to manage difficult airways and failed intubations. In addition, they have learnt to provide non-invasive ventilatory support using CPAP. One debate that continues is whether CCPs should develop skills in RSI (rapid sequence intubation). They are provided with theoretical knowledge of RSI on their hospital placements but not the clinical skills. This is still seen as the realm of the specialist doctor or anaethetist in the UK. In Australia, MICA paramedics are given the skills to perform RSI and have an on-going training programme combined with theoretical assessments and competence evidence through practical scenarios. However, all the current evidence from systematic reviews shows that there is no benefit to the patient of using a RSI intervention in the pre-hospital setting. The risks can outweigh the benefits as it may be difficult to intubate and ventilate patients after RSI. If the evidence changes in the future, it would be advisable for CCPs to gain a Certificate of Anaesthetic Competency from working regularly in theatres as well as having on-going training.

CCP capabilities have improved significantly from enhanced thought processes and improved action. They have gained a wider knowledge of drugs, improved diagnostic abilities, and better decision making skills. To this they have developed the ability to act calmly and confidently especially in complex situations. The new role has demanded clinical leadership in the field but leadership training has been an oversight in this programme.

The theoretical training on four modules at University of Hertfordshire has been exceptional particularly in the ability of the teaching staff to manage and cope with CCPs from wide range of educational backgrounds. The

preceptorship programme was also of a high standard enhanced greatly by the enthusiasm and commitment of the Consultant Anaethetists acting as preceptorship supervisors. What was lacking was the clinical supervision of CCPs once they had finished their formal development programme. There was no one to observe, mentor and provide feedback to the new CCPs as found embedded in the MICA development programme. There is also no on-going 'moulage' to train and think about every eventuality that a CCP may come across in critically ill and injured patients. It is thinking through the potential unknowns and the most appropriate interventions.

The low volume of inter-facility transfers has raised the real problem of ITU related skills fade among CCPs. This can only be addressed through post-training placements and closer linkages between SECAmb and hospitals. There is a potential win: win scenario for both sides as CCPs aid hospitals in transfers without the need for an ITU nurse or ODP as a second escort. Some mechanism needs to be found through dialogue between SECAmb, the critical care networks and the hospitals operating in the region. Part of this dialogue is communicating and marketing the new role of CCPs and part of it is exploring how the new role could assist all parties. The intention is to increase the volume of inter-hospital transfers managed by CCPs.

One of the major frustrations among CCPs has been inappropriate tasking to low priority calls. Tasking has improved with the production of clear CCP tasking guidelines but variations do exist in different parts of the region. CCPs have worked at the Emergency Dispatch Centre to improve the quality of tasking as well as self-tasking to varying degrees of success. There is a tension for dispatchers between managing time related performance targets

and the limited resources (including CCPs) on a shift. Even if specialist dispatchers were employed just for CCPs, they would still need to balance clinical need against travel time.

The development of CCPs at SECAmb is the first UK initiative to tackle substandard pre-hospital care and high mortality rates among seriously ill and injured patients. The programme is insightful and far reaching in its attempt to reduce mortality rates in trauma networks by providing CCPs with advanced medical skills and capabilities. SECAmb has succeeded in developing this programme of 'hybrid paramedics' without any additional funding. There have been various teething problem as one would expect with any new venture. Ambulance trusts around the UK can learn valuable lessons from this initiative for improving the quality of pre-hospital care of high acuity patients. A future population based study comparing HEMS and CCP units would be welcome. This would help further inform on-going debate of the effectiveness of doctors and CCPs in reducing mortality rates. Many doctors will be pleasantly surprised by the advanced clinical capabilities CCPs have developed in airway management and circulatory support (Mackenzie, Steel et al. 2009). The burning question is whether the cheaper CCPs can provide the necessary levels of pre-hospital care as doctors and achieve similar mortality rates.

Recommendations

1. The current coalition government has no appetite for increased public spending but any NHS initiative that increases the quality of pre-hospital patient care and reduces mortality rates would need serious consideration. SECAmb has provided organisational reform and increased medical capabilities of trauma systems with its development of CCPs. This clinical innovation has been driven through prudent financial management of existing budgets with no additional burden on the public purse. It is recommended that other ambulance trusts take SECAmb's lead and develop their own 'hybrid' or 'advanced' paramedics to address national concerns around substandard levels of care in the pre-hospital environment.

2. The mortality rate in the US is 20% lower than the UK. The US emergency medical system is based on using paramedics and specially trained advanced paramedics in the field rather than doctors. The evidence is mixed whether doctors outperform paramedics in the pre-hospital environment. Even though the nature of the trauma system will be a determining factor, the enhanced medical capabilities and increased exposure of a doctor or CCP on-scene will play an important role in determining clinical outcomes. From our analysis, the use of CCPs provides a more economical solution compared to doctors to PCTs interested in enhancing the quality of their pre-hospital care and reducing mortality rates in their area. The cost of using doctors in the same role as CCPs would increase ten-fold and be difficult to justify. Doctors can play an important role in the pre-hospital environment providing medical supervision, teaching, coaching, mentoring, audit and research.

3. It is recommended that commissioners from PCTs support the investment of two full time equivalent (FTE) Consultant level positions at SECAmb to provide the necessary medical governance and supervision of CCPs. Currently, this is conducted offline by the Medical Director. There is a need for on-going feedback, mentoring and training of CCPs in the field. This could be provided in the field by Consultants or via telemedicine using digital NHS radio. CCPs would be able to debrief their experiences on high acuity calls, discuss their diagnoses, their medical interventions and their clinical judgement. The additional cost of around £200K (including administrative support) would bring the CCP programme in line with international best practice where clinical supervision and oversight are provided for a year after advanced paramedics have completed their training programmes. The role could be extended to encompass the different aspects of medical governance at SECAmb.

4. SECAmb needs to work very closely with hospitals and critical care networks if it is to succeed with its notion of CCPs as 'hybrid paramedics' involved in inter-facility transfers and primary retrieval

activities. Currently, only 4% of CCP workload is involved with transfers leading to skills fade among these professionals. Dialogue needs to occur at the highest levels between SECAmb, PCTs, critical care networks and hospitals. If there is no expressed need for CCPs to act as secondary escorts on transfers, the role of CCPs needs to be reconsidered as one of primary retrieval. If there is an expressed need especially in saving the time of highly skilled ITU nurses, there needs to be a firm commitment from critical care networks, A&E departments and ITU units to use CCPs as secondary escorts on a critical care transfer. This is likely to require a major education and communications programme focussed on doctors and nurses making transfer decisions. The aim would be to increase CCP transfer workload to 30-40% over the next five years.

5. CCP clinical skills need to be updated regularly to prevent skills fade particularly in critical care transfers. Some form of post training placements needs to be adopted where CCPs gain regular exposure to ITU units and operating theatres to maintain high level ITU clinical skills and airway management skills. It is recommended that this occurs every three months and not less than every six months for CCPs to retain their highly developed clinical capabilities. CCPs could play an active role in ITU units for two weeks on a rota basis every three months. In this period a full complement of six CCP staff in an ambulance unit would update their skills. There is potentially a win:win situation for hospitals as they would gain the equivalent of one full-time ITU assistant each year. The added value is the potential for much greater collaboration between the ambulance service and hospitals for improving the quality of the trauma network.

6. The College of Paramedics can play an important role in the future development of critical care paramedics in the UK. The professional body needs to pool the learning from ambulance trusts such as SECAmb, West Midlands, West of England as well as international best practice. In light of the experiences, the College can update its curriculum framework document and provide guidance on the training and development of specialist and advanced paramedics. The College needs to explore the real distinctions in competence between a specialist and advanced paramedic apart from the requirement of a postgraduate qualification.

7. CCPs have highly developed clinical capabilities and can play a major role in teaching and mentoring technicians and other paramedics. This clinical leadership role needs to be further developed at SECAmb so that CCPs can provide continuous on-the-job learning at their ambulance base. This may be reviewing previous cases with other colleagues and learning from past clinical errors and mistakes. Or CCPs may introduce latest best practice in pre-hospital care from online journal papers. SECAmb could consider an innovation from the fire service in the use of ‘drills’ to cover every eventuality that may occur on the road. CCPs could take a lead in devising numerous

practical scenarios from past experiences of seriously ill and injured patients. Some CCP leadership training would be advisable.

8. There is little knowledge sharing among CCPs and, hence, the wealth of clinical experience is isolated and dissipated. There needs to be greater interaction and communication between CCPs. This can occur through developing informal networks using regular half-day development days and providing time for CCPs to talk in small groups about difficult situations they have managed and how they may do things differently. A number of online solutions can be used to supplement these informal networks: online CCP discussion forums, development of wikis for seriously ill and injured patients, CCP blogs and the use of social network sites such as Facebook. CCPs are more likely to share their knowledge with others they can trust.

9. A special action group chaired by a SECAmb Director needs to be set up to examine some of the underlying causes of poor CCP tasking and potential solutions including different forms of specialist tasking. The action group needs to include CCPs, HEMS, dispatch duty managers and dispatchers from across the SECAmb region. Improvements in the quality of tasking are likely to have a marked impact on the effectiveness of CCPs.

10. SECAmb needs to consider extending the role of CCPs as they gain greater experience and maturity. Some CCPs can play an important role in the classroom and hospital in the training and development of future CCPs, paramedics and technicians. They can also play an essential role in medical governance and clinical supervision of newly qualified CCPs in the future.

11. There is a pressing need for a future population based study to examine the effectiveness of CCPs in reducing mortality rates. It would be useful to include HEMS in the study to provide UK based evidence to inform the debate on the effectiveness of doctors and paramedics in pre-hospital care. A comparable ambulance service would need to act as a control that didn't have specialist paramedics tasked to high acuity incidents and had a similar size, geography and trauma systems. Confounding variables would need to be controlled. Such research would be ground breaking and provide considerable impact for any funding body and represent a valuable use of its resources.

12. CCPs are developing considerable clinical skills in pre-hospital care from their continuous exposure to high acuity patients. SECAmb has a unique opportunity to capture and share these experiences using corporate online video sharing applications similar to YouTube. The videos could include presentations from developmental activities and best practices from other ambulance services. Each video could be indexed and retrieved by any member of staff at SECAmb. This would enhance the on-going training and development of all staff.

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Appendix 1:
Comparison of CCP and MICA paramedic drug administration

Table shows the comparison:

Drug	CCP	MICA
Activated Charcoal	Not endorsed by JRCALC	Not able to administer
Adrenaline 1:1000	Able to administer	Able to administer
Adrenaline 1:10000	Able to administer	Able to administer
Amiodarone	Able to administer	Able to administer
Aspirin	Able to administer	Able to administer
Atropine	Able to administer	Not able to administer
Benzylpenicillin	Able to administer	Not able to administer alternative available: Ceftriaxone
Ceftriaxone IV/IM	Not able to administer alternative available: Benzylpenicillin	Able to administer
Chlorphenamine (Pirton) Injection	Able to administer	Not able to administer
Diazepam IV	Able to administer	Able to administer
Diazepam PR	Able to administer	Able to administer
Entonox	Able to administer	Not able to administer alternative available: Methoxyflurane
Dexamethasone	Not able to administer	Able to administer
Dextrose 5%	Not able to administer	Able to administer
Fentanyl	Not able to administer	Able to administer IV & IM

Drug	CCP	MICA
Fursemide	Subject to clinical evaluation	Able to administer
Glyceryl Trinitrate	Able to administer	Able to administer
Glucagon	Able to administer	Able to administer
Glucose 10%	Able to administer	Able to administer
Heparin	Able to administer	Not able to administer
Hypostop (oral dextrose gel)	Able to administer	Able to administer
Ibuprofen	Able to administer	Not able to administer
Ipratropium Bromide (Atrovent)	Able to administer	Able to administer
Ketamine IV	Pending introduction*	Able to administer - trial
Lidocaine	Not able to administer	Able to administer
Lidocaine (local anaesthesia) SC	Not able to administer	Able to administer
Lidocaine (IO for anaesthesia)	Able to administer	Not able to administer
Midazolam IV	Pending Introduction*	Able to administer IV & IM
Midazolam Buccal	Pending introduction	Not able to administer
Metaraminol Bitartrate	Not able to administer	Able to administer
Methoxyflurane (Penthrane)	Not available in UK. Alternative available is Entonox	Able to administer
Metoclopramide IV	Able to administer	Able to administer
Morphine Sulphate IV	Able to administer	Able to administer

Drug	CCP	MICA
Morphine Sulphate (Oramorph)	Able to administer	Not able to administer
Naloxone hydrochloride	Able to administer	Able to administer
Oxygen	Able to administer	Able to administer
Pancuronium Bromide	Able to administer	Able to administer
Paracetamol IV solution	Able to administer	Not able to administer
Paracetamol tablets	Pending Introduction	Not able to administer
Pralidoxime Mesylate injection	Able to administer	Not able to administer
Prochlorperazine (Stemetil) IM	Not able to administer	Able to administer
Salbutamol nebulised	Able to administer	Able to administer
Salbutamol IV	Not able to administer	Able to administer
Sodium Bicarbonate 8.4% IV	Not able to administer	Able to administer
Sodium Chloride 0.9% 500 mls	Able to administer	Able to administer
Sodium Chloride 0.9% flush	Able to administer	Able to administer
Sodium Lactate (Hartmanns Solution) 500 mls	Able to administer	Able to administer
Suxamethonium Chloride	Not able to administer	Able to administer
Syntometrine	Able to administer	Not able to administer
Tetracaine (ametop) Gel	Subject to clinical evaluation	Not able to administer
Thrombolytics	Able to administer	Able to administer - trial
Verapamil Hydrochloride	Not able to administer	Able to administer

*Awaiting changes to Home Office legislation regarding possession of ketamines by paramedics

Appendix 2:
Comparison of CCP and MICA paramedic course outcomes

		PAR4302 - Management of emergency cardiac conditions
		PAR4301 - Theoretical foundations of MICA paramedic practice
		PAR4303 - Management of emergency trauma and environmental conditions
		PAR4305 - Management of paediatric and obstetric patients

CCP	MICA
3AHP0074 – Foundations of Critical Care: Adult and Child	
Be able to correctly identify and differentiate the aetiology, physiology, pathophysiology of key body systems for critical care management.	Describe the structure and function of the heart through the application of their knowledge of normal cardiac anatomy and physiology. Describe the natural history of ischemic heart disease and cardiovascular pathology related to acute myocardial infarction. Interpret common electrocardiographic (ECG) rhythms and waveforms. Discuss the epidemiology of cardiac disease. Discuss the anatomical and physiological basis of common emergency medical conditions. Relate the pathophysiology of common emergency medical conditions to their management. Relate the pathophysiology of common paediatric conditions to the identification of those with the potential to result in an emergency presentation Discuss the psychological and physiological responses of children to illness and injury; Identify the common patterns of paediatric and obstetric injury and related emergency management.
Be able to evaluate key applied pharmacological concepts to include kinetics,	Recall the pharmacology of relevant drugs used in the emergency management of adult medical

dynamics, autonomic pharmacology, anaesthesia/analgesia, fluid and endocrinal management utilising evidence-supported practice. Be able to demonstrate effective care through recognition and application of appropriate pharmacological interventions.	emergency conditions. Discuss the importance of mica paramedic practice being evidence based. Implement evidence-based practice to the management of emergency cardiac conditions. Relate the pathophysiology of common traumatic and environmental injuries to their management. Recall the pharmacology of relevant drugs used in the emergency management of trauma and environmental conditions Recall the pharmacology of relevant drugs used in the emergency management of adult medical emergency conditions. Implement evidence-base practice to management of emergency medical conditions. Recall the pharmacology of relevant drugs used in the emergency management of paediatric and obstetric conditions. Describe the ongoing management of patients with emergency obstetric or paediatric conditions; Implement evidence-base practice to the management of emergency paediatric and obstetric conditions.
Be able to examine the decision-making processes in critical care management and the impact of technical and non-technical interventions upon these in out-of-hospital environments.	Integrate the theoretical knowledge and clinical skills to the management of the adult patient with an emergency medical condition in 'real time' work simulation using a clinical problem solving and clinical decision making model.
MAHP0137 – Advanced Airway Management, Ventilation and Resuscitation: Adult and Child	
Demonstrate application of their knowledge and understanding of physiology, anatomy and pharmacology to the appropriate management of the emergency airway.	Demonstrate advanced trauma life support clinical skills. Recall the pharmacology of relevant drugs used in the emergency management of cardiac conditions.

Demonstrate critical appraisal of airway management and ventilation in the acutely ill/injured patient	
Critically evaluate the risks and benefits of different therapeutic options with regard to emergency airway management.	
Demonstrate a critical understanding of the differing clinical presentations of airway problems in the emergency setting.	Integrate the theoretical knowledge and clinical skills to the management of cardiac emergencies in 'real time' work simulation using a clinical problem solving and clinical decision making model.
Demonstrate effective skills in maintaining the safety of the patient during the care process, including preparation of drugs and equipment, seeking help where necessary and using risk management strategies when appropriate. Critically assess patients' needs, initiate appropriate management and therapeutic processes. Demonstrate excellent clinical decision making and leadership skills in airway emergency situations. Analyse and reflect on leadership skills concepts and practice in order to improve and reinforce ALS skills in out-of-hospital environments.	
MAHP0136 – Critical Care Transport: Adult and Child	
Demonstrate a high level of understanding of the pathophysiology, presentation, treatment and management options for a range of common adult and paediatric conditions that often require time-sensitive	Demonstrate the skills and knowledge to manage obstetric emergencies and care for the pregnant patient who has experienced physical trauma or is suffering from a medical emergency. Relate the pathophysiology of common paediatric conditions to the identification of those with the potential to result in an emergency presentation.

transfer.	Recall the pharmacology of relevant drugs used in the emergency management of the paediatric and obstetric conditions. Describe the structure of trauma systems and define the related trauma triage criteria. Demonstrate the required clinical skills to be able to manage the adult medical emergencies and recognise, assess and manage patients with abnormal behaviour.
Demonstrate a critical understanding of patient preparation, assessment and optimisation prior to packaging and departure, including transportation, communication and documentation.	Describe the benefits of pre-hospital advanced trauma life support and the related role of community emergency health practitioners.
Demonstrate a critical understanding of academic literature and policy governing current UK transfer services for both adult and paediatric patients.	Discuss the process by which the MICA paramedic practice and Clinical Practice Guidelines are developed. Discuss the ethical and professional frameworks within which MICA paramedics practice. Describe the required knowledge base and scope of practice of a MICA paramedic. Identify the legislative and supportive frameworks that support the role of the MICA paramedic.
Demonstrate expertise in a range of clinical techniques vital to the safe and effective management of patients during critical care transfers. Demonstrate the ability to communicate appropriately with other healthcare professionals and emergency services in a professional manner. Be able to clearly articulate a critical understanding of various clinical and management strategies to effectively deal with common	Describe the benefits of pre-hospital advanced cardiac life support and the related role of the MICA paramedic. Demonstrate advanced trauma life support clinical skills. Integrate the theoretical knowledge and clinical skills to the management of trauma and environmental emergencies in 'real time' work simulation using a clinical problem solving and clinical decision making model. Discuss how community emergency health practitioners might relate to and coordinate with hospital critical care units.

complications encountered with and during transfers. Demonstrate effective skills to work flexibly in any critical care environment including out-of-hospital settings, ICU, theatres, and A&E.	Demonstrate the characteristics of an interactional professional within the context of managing patients with trauma emergencies; and implement evidence-base practice to management of emergency trauma and environmental conditions. Describe the ongoing management of patients with trauma in hospital critical care units within the framework of a trauma system. Integrate the theoretical knowledge and clinical skills to the management of the adult Patient with an emergency medical condition in 'real time' work simulation using a clinical problem solving and clinical decision making model. Describe the role of coronary care units in the management of patients with emergency cardiac conditions. Discuss how community emergency health practitioners might relate to and coordinate with hospital coronary care units. Demonstrate the characteristics of an interactional professional within the context of managing patients with cardiac emergencies. Discuss how community emergency health practitioners might relate to and coordinate with hospital emergency departments. Demonstrate the characteristics of an interactional professional within the context of managing patients with emergency medical conditions. Demonstrate the skills and knowledge to manage obstetric emergencies and care for the pregnant patient who has experienced physical trauma or is suffering from a medical emergency. Demonstrate the clinical skills required to manage paediatric emergencies. Integrate the theoretical knowledge and clinical skills to the management of paediatric and neonatal trauma and medical emergencies in 'real time' work simulation using a clinical problem solving and clinical decision making model.

	Discuss how community emergency health practitioners might relate to and coordinate with hospital paediatric critical care units and maternity departments. Demonstrate the characteristics of an interactional professional within the context of managing patients with paediatric and obstetric emergencies.
Outcomes not matched	
	Relate the desired personal and professional attributes of a graduate of Monash University and a MICA paramedic to their own professional practice.
	Describe the social significance of health and illness within society.
	Identify the reactions of patients and family to acute illness and injury within a range of cultural contexts.
	Discuss the historical evolution of the MICA paramedic within the integrated emergency medical services environment.
	Discuss the epidemiology of trauma and environmental injury.
	Describe the benefits of pre-hospital adult medical emergency life support and the related role of community emergency health practitioners.
	Discuss the epidemiology of emergency medical conditions.
	Describe the ongoing management of patients with common emergency medical conditions in hospital emergency departments.
	Discuss the epidemiology of paediatric and obstetric conditions.

Appendix 3: CCP Locations: actual and planned

Existing Units	Planned Units
1. Worthing	A. Crawley
2. Brighton	B. Medway
3. Chertsey	C. Hastings
4. Folkestone	D. Paddock Wood

Price: £20